CRANE CREEK M-1 CANAL FLOW RESTORATION

BIDDING AND CONSTRUCTION SPECIFICATIONS

FOR DRAWING VOLUMES 1 AND 2

Project No. 19750-066-01

Owner:

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
4049 Reid Street
Palatka, Florida 32178-1429

Engineer:

JONES EDMUNDS & ASSOCIATES, INC.
3910 S. Washington Avenue
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Certificate of Authorization #1841

November 2022

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DIVISION 1

GENERAL REQUIREMENTS

SECTION 01000
PROJECT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Contract Documents – The Agreement between the St. Johns River Water Management District and the Contractor to/for Crane Creek M-1 Canal Flow Restoration, including all attachments; the document entitled *Bidding and Construction Specifications* produced by Jones Edmunds & Associates, Inc. and dated November 2022; and related drawings.

B. Contract Price – Total Compensation for the performance of the Work, as described in the Agreement Between the St. Johns River Water Management District and the Contractor to/for Crane Creek M-1 Canal Flow Restoration.

C. Engineer – Jones Edmunds & Associates, Inc.

D. Owner – St. Johns River Water Management District.

E. Specifications – Refers to all sections within Divisions 1 through 16 of the document entitled *Bidding and Construction Specifications* produced by Jones Edmunds & Associates, Inc. and dated November 2022.

1.02 SCOPE OF WORK

A. The Work to be done consists of the furnishing of all labor, materials, and equipment and the performance of all Work included in this Contract. The summary of the Work is presented in Section 01100, Summary of Work.

B. Work Included

1. The Contractor shall furnish all labor, superintendence, materials, plant power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion of the Work. The Contractor shall obtain and pay for all necessary local building 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 Owner 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. He 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 Project 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 plant, tools, and equipment as may be necessary, in the opinion of the Owner, 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 Owner 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 Owner, 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.

    a. 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 his own investigations to inform himself fully of the character, condition, and extent of all such installations and structures as may be encountered and as may affect the construction operations.
    b. 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 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 shall be repaired by the Contractor, at his expense. No separate payment shall be made for such protection or repairs to public utility installations or structures.
    c. Public utility installations or structures owned or controlled by the Owner 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 therefor.

d. Where public utility installations of structures owned or controlled by the Owner or other governmental body are encountered during the Work and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Owner, 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 Owner, 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.

e. At all times in performance of the Work the Contractor shall employ acceptable 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 cooperate fully with the owners thereof to that end.

f. The Contractor shall field locate by hand-digging to verify existing utility location, size, material, depth, elevation, etc., within 10 feet of both sides of the utility to be constructed, including at all crossing and connection points, before shop drawing preparation and submittal, and also during execution of proposed utility installations. The Contractor shall include consideration of such existing utilities in planning and before execution of work and include field measurements of existing and proposed utilities in the shop drawing submittal.

g. The Contractor shall provide shoring or other means necessary to avoid encroachment of work outside prescribed limits, easements, rights-of-way, or onto unauthorized private property, unless authorized by said property owner in advance. All effort to secure permissions and to restore private properties shall be by the Contractor and at the Contractor’s expense.

h. The Contractor shall give written notice to the Owner and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations at least 48 hours in advance of breaking ground in any area or on any unit of the Work.

i. 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.

1.03 DRAWINGS AND SPECIFICATIONS

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. Supplementary Drawings

1. When, in the opinion of the Owner, it becomes necessary to explain more fully the Work to be done or to illustrate the Work further or to show any changes that may be required, the Owner will prepare drawings known as Supplementary Drawings, with specifications pertaining to such Drawings, and the Contractor will be furnished one complete set of reproducible black-line prints (22 inches by 34 inches) and one reproducible copy of the specifications, or alternatively may be provided electronic files in PDF format, at the Contractor's option.
2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Contract Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of Work, credit to the Owner or compensation therefor to the Contractor shall be subject to the terms of the Agreement.

C. 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 Owner, and shall notify the Owner 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 therefrom, nor from rectifying such conditions at his own expense. He will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Owner should such errors or omissions be discovered.
2. All schedules are given for the convenience of the Owner and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for making estimates of the size, kind, and quantity of materials and equipment included in the Work to be done under the Contract.

D. Specifications: The Specifications include General Requirements sections in Division 1, and Technical Specifications in Divisions 2 through 16. The Technical Specification sections each consist of three parts: General, Products, and Execution. The General part contains General Requirements that govern the Work. The Products and Execution parts modify and supplement the General Requirements by detailed requirements for the Work and shall always govern whenever there appears to be a conflict.

E. Intent

1. All Work called for in the Specifications applicable to this project, 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. The interpretation of these Specifications shall be made upon that basis.

1.04 EXISTING GEOTECHNICAL REPORTS

A. Two geotechnical reports have been prepared for this Project and are provided for information only in Appendix A. The opinions expressed in these reports are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. The Owner will not be responsible for interpretations or conclusions drawn from these data. The geotechnical reports are not part of the Contract Documents.

1. The geotechnical reports are titled:

a. Subsurface Soil Exploration and Geotechnical Engineering Evaluation Crane Creek / M-1 Canal Flow Restoration Project, Brevard County, Florida, prepared by Ardaman & Associates, Inc., and dated May 3, 2019.
b. Subsurface Soil Exploration and Geotechnical Engineering Evaluation M-1 Discharge System Project, West Melbourne, Florida, prepared by Ardaman & Associates, Inc., and dated March 17, 2022.

2. The Contractor shall make additional test borings and conduct other exploratory operations necessary for performance of the work at no additional cost to the Owner.

1.05 SUBSURFACE UTILITY TEST HOLE REPORT

A. Subsurface utility test hole data reports have been prepared for this Project and are provided for information only in Appendix B. The Contractor shall verify and protect all existing utilities as outlined elsewhere in this Section and throughout the Contract Documents. The Owner will not be responsible for interpretations or conclusions drawn from these reports. The test hole reports are not part of the Contract Documents.

1. The test hole reports are titled and summarized as follows:

a. Subsurface Utility Engineering Test Hole Report prepared by Southeastern Surveying and Mapping Corp. (SSMC) for test holes 1 through 10. These are labeled as "VVH" in the drawing set prepared by Hanson Professional Services, Inc. that are part of the Contract Documents covering the 24-inch force main from the east pump station at Coastal Lane, east across I-95 and Columbia Lane.

b. Test Hole Data Report prepared by ECHO, Inc. for test holes labeled as "TH" in the Volume 2 drawing set prepared by Jones Edmunds covering the west pump station at the STA and the 24-inch force main running south along the west side of St. Johns Heritage Parkway and west along the north side of US-192 to the discharge site.

1.06 MATERIALS AND EQUIPMENT

A. Manufacturer

1. All transactions with the manufacturers or subcontractors shall be through the Contractor unless the Contractor shall request and at the Owner's option that the manufacturer or subcontractor deal directly with the Owner. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
2. 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

1. The Contractor shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the Work to complete the Work within the allotted time.
2. The Contractor shall also coordinate deliveries to avoid delay in or impediment of the progress of the work of any related Contractor.

C. Tools and Accessories

1. Unless otherwise stated in the Contract Documents, the Contractor shall furnish each type, kind, or size of equipment one complete set of suitably marked high-grade special tools and appliances that may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be furnished in approved painted-steel cases, properly labeled, and equipped with good-grade cylinder locks and duplicate keys.
2. Spare parts shall be furnished as specified herein and as recommended by the manufacturer necessary for the operation of the equipment, not including materials required for routine maintenance.
3. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight, and principal rate data.

D. 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 help the Contractor, when required, 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 Contractor, the manufacturer's engineer or superintendent shall make all adjustments and tests required by the Owner to prove that the equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.07 INSPECTION AND TESTING

A. General

1. For tests specified to be made by the Contractor, 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. Reports shall be submitted and authoritative certification thereof must be furnished to the Owner as a prerequisite for the acceptance of any material or equipment.

2. If, in the making of any test of any material or equipment, the Owner ascertains that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof and he 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 Owner.
3. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with the recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
4. The Contractor shall be fully responsible for the proper operation of equipment during testing and instruction periods and shall neither have nor make any claim for damage that may occur to the equipment before the time when the Owner formally takes over the operation thereof.

B. Costs

1. The Contractor shall provide all inspection and testing of materials furnished under this Contract, unless otherwise expressly specified.
2. The Contractor shall bear the cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents, and such costs shall be deemed to be included in the Contract Price.
3. The Owner may test materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment that are rejected for non-compliance.

C. Certificate of Manufacture

1. The Contractor shall furnish the Owner with authoritative evidence in the form of a 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.

D. Shop Tests

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified

shall be tested in the shop of the maker in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.

2. Manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and/or independent laboratory, shall be submitted to the Owner for approval.
3. The Contractor shall bear the cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment.

E. Start-up Tests

1. As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make start-up tests of equipment.
2. If the start-up tests disclose any equipment furnished under this Contract that does not comply with the requirements of the Contract Documents, the Contractor shall, before demonstration tests, make all changes, adjustments, and replacements required. The furnishing Contractor shall assist in the start-up tests as applicable.

F. Demonstration Tests

1. Before the Contractor's request for a Substantial Completion inspection, all equipment and piping installed under this Contract shall be subjected to demonstration tests as specified or required to prove compliance with the Contract Documents.
2. The Contractor shall furnish labor, fuel, energy, water, and all other materials, equipment, and instruments necessary for all demonstration tests at no additional cost to the Owner. The Contractor shall assist in the demonstration tests as applicable.

1.08 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 Owner. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
2. The Contractor will establish benchmarks and coordination points using Surveys where provided in the Contract Drawings. Where not provided in the Contract Drawings, the benchmarks and coordination points will be established by the Contractor at no additional cost to the Owner. Reference marks for lines and grades as the Work progresses will be

located by the Contractor to cause as little inconvenience to the prosecution of the Work as possible. The Contractor shall place excavation and other materials so as to cause no inconvenience in the use of the reference marks provided. He shall remove any obstructions he places contrary to this provision.

B. Surveys

1. At his own expense, the Contractor shall furnish and maintain 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 Owner's attention to any inaccuracies.
3. At his own expense, the Contractor shall establish all working or construction lines and grades as required from the reference marks set by the Contractor and shall be solely responsible for the accuracy of these lines and grades. He shall, however, be subject to check and review by the Owner.

C. Safeguarding Marks

1. The Contractor shall safeguard all points, stakes, grade marks, monuments, and benchmarks made or established on the Work; bear the cost of re-establishing them if disturbed; and bear the entire expense of rectifying Work improperly installed due to not maintaining or protecting or 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 shall bear the cost of re-establishing them if they are disturbed or destroyed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01100
SUMMARY OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

Unless otherwise expressly provided in the Contract Documents, the Work must be performed in accordance with best modern practice, with materials and workmanship of the highest quality to the satisfaction of the Owner.

A. The Project title is *Crane Creek M-1 Canal Flow Restoration*.

B. These Specifications support Volumes 1 and 2 of the Drawings titled *Crane Creek M-1 Canal Flow Restoration*.

C. These Specifications have been updated since an original bidding set was released in August 2020. The updates to these Specifications capture new work added with the creation of the Volume 2 Drawings.

D. The Work of this Project consists of the construction of six primary project elements:

1. An operable control structure within the M-1 Canal east of Evans Road, including pneumatic crest gates (weirs), concrete hardened flow channel, flow channel center dividing wall, flow attenuation blocks, foundations, rip rap, mechanical equipment, power supply and equipment, concrete slabs, instrumentation and controls, paving, grading, and other incidental work.
2. A stormwater pumping station east of I-95 adjacent to the M-1 Canal along Coastal Lane. Work includes intake structure and screens, intake piping and manholes, concrete wetwells, pumps, discharge piping, valves, pipe supports, power supply and equipment, concrete slabs and pavement, instrumentation and controls, paving, grading, and other incidental work.
3. A stormwater pumping station west of the St. Johns Heritage Parkway. Work includes intake structure and screens, intake piping and manholes, concrete wetwell, pumps, discharge piping, valves, pipe supports, power supply and equipment, concrete slabs and pavement, instrumentation and controls, paving, grading, and other incidental work.
4. A section of 24-inch-diameter underground high-density polyethylene (HDPE) stormwater force main from the east pump station to the stormwater treatment area (STA). Installation by horizontal directional drilling and open-cut trenching, valves, fittings, surface restoration,

plantings to restore temporary construction easements and other project areas, a precast outfall structure into the STA, and other incidental work.

5. A section of 24-inch-diameter underground HDPE stormwater force main from the west pump station. Installation by horizontal directional drilling and open-cut trenching, valves, fittings, surface restoration, plantings to restore temporary construction easements and other project areas, an outfall structure north of US Highway 192 (US-192), and other incidental work.
6. An STA west of the St. Johns Heritage Parkway. The STA will include earthwork for regrading slopes of an existing borrow pit, an access road, and other incidental work.

E. The Specification divisions and Drawings are an integrated part of the Contract Documents and, as such, will not stand alone if used independently as individual sections, divisions, or drawing sheets. The Drawings and Specifications establish minimum standards of quality for this project. They do not purport to cover all details, labor, materials, and equipment needed for construction of the Project.

1.02 REFERENCE STANDARDS

Reference standards and recommended practices referred to herein shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Association of State Highway and Transportation Officials (AASHTO) Formerly (AASHO)
B. American Concrete Institute (ACI)
C. American Institute of Steel Construction (AISC)
D. American Iron and Steel Institute (AISI)
E. American National Standards Institute (ANSI)
F. American Standards Association (ASA)
G. American Society of Mechanical Engineers (ASME)
H. American Society of Testing and Material (ASTM)
I. American Water Works Association (AWWA)
J. American Welding Society (AWS)
K. Anti-Friction Bearing Manufacturer's Association (AFBMA)
L. Building Officials and Code Administrators International, Inc. (BOCA)
M. Construction Specifications Institute (CSI)
N. Federal Specification (FS)
O. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, Latest English Edition (Standard Specifications)
P. FDOT Roadway and Traffic Design Standards Latest English Edition (FDOT Index)
Q. Geosynthetics Institute (GSI)

R. National Bureau of Standards (NBS)
S. National Electrical Manufacturer's Association (NEMA)
T. National Fire Protection Association (NFPA)
U. Portland Cement Association (PCA)
V. Occupational Safety and Health Act (Public Law 91-596), U.S. Department of Labor (OSHA)
W. Steel Structures Painting Council (SSPC)
X. Southern Standard Building Code (SSBC)
Y. Underwriters' Laboratories, Inc. (UL)
Z. United States of America Standards Institute (USASI)
AA. Regulations of Florida Industrial Commission Regarding Safety
BB. All local, state, county, or municipal building codes requirements of the Owner's Insurance

1.03 GENERAL REQUIREMENTS

A. Unless otherwise specified on the Construction Drawings or Specifications, all work and the quality of materials shall conform to the referenced sections of the 2022 Florida Department of Transportation (FDOT) *Standard Specifications for Road and Bridge Construction, Supplementary Specifications*, and *Roadway and Traffic Design Standards*. The Contractor shall retain on the job site copies of these standard FDOT documents. The basis of payment shall conform to Section 01200, Measurement and Payment, of the General Requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers methods of measurement and payment for items of work under this Contract.

B. The total Contract Price shall cover all work required by the Contract Documents. All cost in connection with the proper and successful completion of the work, including furnishing all materials, equipment, and tools and performing all necessary labor and supervision to fully complete the work, shall be included in the unit price and lump-sum Bid prices. All work not specifically set forth as a pay item in the Bid Form or Bid Schedule shall be considered a subsidiary/ ancillary obligation of the Contractor and all costs in connection with these subsidiary/ancillary obligations shall be included in the Bid(s) to provide a complete and functional Project.

1.02 LUMP SUM

A. For lump-sum items, payments shall be made to the Contractor in accordance with an accepted Progress Schedule of Values on the basis of actual work completed and accepted by the Owner at the final completion of the Project.

1.03 UNIT PRICE (NOT USED)

1.04 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

A. When alterations in the quantities of unit price work not requiring a Change Order(s), as herein provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract unit price multiplied by the actual quantities of work constructed and accepted by the Owner at the completion of the project.

B. The actual percentage of each lump sum bid item completed by the Contractor and accepted by the Owner at the final completion of the Project will be paid to the Contractor.

1.05 DELETED ITEMS

A. Should any items contained in the Bid Schedule(s) be found unnecessary for the proper completion of the work contracted, the Owner may eliminate such items from the Contract. This action shall in no way invalidate the Contract and no financial allowance or compensating payment for anticipated profit, overhead, etc., will be made for items so eliminated in making final payment to the Contractor.

1.06 PARTIAL PAYMENTS

A. Partial payments shall be made monthly as the work progresses. Partial payment shall be made to the Contractor based on an Owner-approved Schedule of Values indicating percentages of work items completed, submitted with Contractor's application for payment and approved by the Owner.

1.07 PAYMENT FOR STORED MATERIAL DELIVERED TO THE PROJECT

A. When requested by the Contractor and at the discretion of the Owner, payment may be made for all or part of the value of acceptable materials and equipment to be incorporated into bid items, which have not been used, and which have been delivered to the construction site or placed in storage places acceptable to the Owner. The Contractor shall provide receipts for all stored material items requested for reimbursement which clearly identify the stored material item, where it is to be constructed, the unit cost of the item, as well as the total cost of the delivered item(s), the quantity of the item, the brand name of the item, and the supplier. Note that there are additional documentation requirements and storage requirements within the Contract Documents that must also be met before the Contractor can be reimbursed for these stored materials.

B. No payment shall be made for fuels, supplies, installation or connection hardware, lumber, false work, or other similar materials or on temporary structures or other work (items) of any kind which are not a permanent part of the Contract. Items having a value of less than $2,500 shall not be compensated for as a stored material item.

1.08 SCHEDULE OF VALUES

A. A schedule of values for the lump-sum bid items and some of the unit price bid items as required by the Owner shall be submitted and accepted before the first pay request is approved by the Owner. The schedule of values shall be based on the prices bid in the Bid Schedule(s). Prices bid in the Bid Schedule(s) cannot be changed in the schedule of values; they can only be broken down into more detail

so that the Owner can more accurately review and approve the Contractor's pay application for the completed work.

1.09 MISCELLANEOUS CONSTRUCTION ITEMS

A. The Contractor shall take all precautions necessary to protect existing utilities, roadways, structures, signs, equipment, fencing, trees, surfaces, and other items from damage during construction.

B. The Contractor shall repair, relocate, or replace existing utilities, roadways, structures, signs, equipment, fencing, trees, surfaces, and other items to pre-construction conditions.

C. All repairs, relocations, and replacements necessary are considered incidental to the work and will be at the Contractor's cost, with no cost to the Owner.

PART 2 PAY ITEM DESCRIPTIONS

2.01 BID – LUMP SUM

The descriptions provided in the following Paragraphs are to be used by the Bidder in preparing the Lump Sum Bid Schedule(s). They generally indicate how the major workscope items and their respective costs are to be separated into the line items listed in the Bid Schedule(s). These descriptions are not fully representative nor all-inclusive of the work required to complete the project in accordance with the Contract Documents. It is the Bidder's responsibility to include all required costs within the most appropriate line item(s).

Lump Sum Bid Items shall include costs for Miscellaneous Work Items such as Health and Safety Requirements, Environmental Protection, Mobilization/Demobilization, Maintenance of Traffic, Construction Surveying, and Utility Relocations as follows:

A. Health and Safety Requirements shall include all costs for establishing, maintaining, and monitoring a complete and comprehensive site health and safety program during the execution of the Construction Contract that complies with all local, state, and federal safety guidelines and laws. This activity is solely the responsibility of the Contractor. The Engineer will only be responsible for the safety of the Engineer's personnel and facilities.

B. Environmental Protection includes all costs for providing a comprehensive environmental protection program for the project site and other areas as may be affected by the construction. This includes providing labor and materials necessary to prevent environmental damage to the ground, water, and air in conformance with all local, state, and federal laws. Examples include control of stormwater, erodible soils, noise, dust, pollutants, trash, waste, pumping

discharge, and any other substance or activity that may adversely impact the environment.

C. Mobilization/Demobilization includes and covers the costs for performing preparatory construction and overhead operations, including but not limited to movement of personnel and equipment to and from the site, sanitary facilities, project administration and management, insurance, bonds, Owner and Engineer indemnification, temporary utilities, permits related to construction, materials testing, Contractor health and safety, progress meetings, and all other similar activities and facilities necessary for execution of this project.

D. Maintenance of Traffic (MOT) shall include all costs for labor, signage, barricades, and other equipment necessary to provide traffic control in accordance with FDOT Standard Specifications for all phases of work and preparing and obtaining approval of an MOT plan as may be required by local, county, or state agencies.

E. Construction Surveying includes all costs for providing the service of a Professional Land Surveyor to perform pre-construction stakeout and as-built drawings in accordance with the Contract Documents and to the satisfaction of the Owner.

F. Utility Relocations include costs for coordinating utility relocations with individual utility owners. This includes verifying which utility owners will relocate their own utilities and which will supervise relocations by the Contractor. The Contractor shall include all costs for providing equipment that may be required by utility owners to perform relocation and costs for performing utility relocations by the Contractor.

BID ITEM 1. OPERABLE CONTROL STRUCTURE (WEIR)

The Contractor shall furnish all labor, materials, equipment, and services for constructing and placing into operation the operable control structure (weir) improvements and related access improvements at Monopole Park as shown on the Drawings, including but not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, pneumatic crest gates (weirs), concrete hardened flow channel, flow channel center dividing wall, flow attenuation blocks, foundations, rip rap, weir mechanical equipment, power supply and equipment, coordinating new service with Florida Power & Light (FP&L), concrete slabs, instrumentation and controls, utility coordination and protection, paving, grading, driveway restoration, seeding, sodding, concrete, pavement striping and markings, a new portable cofferdam system for long-term Owner maintenance, and related work in accordance with the Contract Documents to the satisfaction of the Owner. The Contractor will be paid by lump sum for the Work installed complete.

BID ITEM 2. EAST STORMWATER PUMP STATION

The Contractor shall furnish all labor, materials, equipment, and services for constructing and placing into operation the stormwater pump station east of I-95 adjacent to the M-1 Canal along Coastal Lane as shown on the Drawings, including but not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, canal intake structure and screen, intake piping and manholes, concrete wetwell, pumps, discharge piping, valves, pipe supports, power supply and equipment, coordinating new service with FP&L, concrete slabs and pavement, instrumentation and controls, paving, grading, restoration, seeding, sodding, concrete, pavement striping and markings, utility coordination and protection, and related work in accordance with the Contract Documents, to the satisfaction of the Owner. Existing soils may not be exported from this site. The Contractor will be paid by lump sum for the Work installed complete. This bid item includes the construction of a 24-inch-diameter high-density polyethylene (HDPE) stormwater force main from the pump station discharge to the fence-line of the District-owned East Pump Station property.

BID ITEM 3. WEST STORMWATER PUMP STATION

The Contractor shall furnish all labor, materials, equipment, and services for constructing a new West Stormwater Pump Station just west of St. Johns Heritage Parkway (SJHP), the stormwater treatment area (STA) site, as shown on the Drawings, including but not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, precast pump station intake structure, slope hardening, piping, concrete wetwell, pumps, discharge piping to the SJHP right-of-way line, valves, pipe supports, power supply and equipment, coordinating new service with FP&L, concrete slabs and pavement, bollards, instrumentation and controls, utility coordination and protection, and related work in accordance with the Contract Documents, to the satisfaction of the Owner. The Contractor will be paid by lump sum for the Work installed complete.

BID ITEM 4. EAST STORMWATER FORCE MAIN AND OUTFALL

The Contractor shall furnish all labor, materials, equipment, and services for constructing and placing into operation a 24-inch-diameter underground HDPE stormwater force main from the new stormwater pump station at Coastal Lane to the new STA; crossing under I-95, existing utility easements, and the SJHP; and discharging at a District-owned STA, including STA pond inflow structure (outfall) and slope hardening, as shown on the Drawings. This work includes but is not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, horizontal directional drilling, entry/exit pits, piping, valves, fittings, surface restoration, concrete, utility coordination and protection, and related work in accordance with the Contract Documents to the satisfaction of the Owner. The Contractor will be paid by lump sum for the Work installed complete. This Bid Item includes a 24-inch-diameter stormwater force main installation from the fence-line of the District-owned East Stormwater Pump Station property to the interface with the precast pond inflow structure at the STA.

BID ITEM 5. WEST STORMWATER FORCE MAIN AND OUTFALL

The Contractor shall furnish all labor, materials, equipment, and services for constructing and placing into operation a 24-inch-diameter underground HDPE stormwater force main from the new West Stormwater Pump Station at the STA, south along SJHP, then west along US Highway 192 (US-192) to a District-owned discharge site as shown on the Drawings. This work includes but is not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, horizontal directional drilling, entry/exit pits, piping, valves, fittings, utility coordination and protection, traffic signal pole and utility pole protection, signage protection, sidewalk replacement, surface restoration, concrete, precast discharge structures, slope hardening, grading, access driveway, pavement striping and markings, new signage, seeding, sodding, fencing, gates, and related work in accordance with the Contract Documents to the satisfaction of the Owner. The Contractor will be paid by lump sum for the Work installed complete. This bid item includes a 24-inch-diameter stormwater force main installation from the SJHP right-of-way line to the discharge structures at the discharge area north of US-192.

BID ITEM 6. STORMWATER TREATMENT AREA

The Contractor shall furnish all labor, materials, equipment, and services for constructing and placing into operation the STA using existing borrow pits on the District-owned floodplain mitigation site just west of SJHP as shown on the Drawings, including but not limited to mobilization, demobilization, MOT, silt fence, excavation, dewatering, temporary excavation shoring and bracing, backfilling, compaction, utility coordination and protection, grading, access drives, seeding, sodding, landscaping, and related work in accordance with the Contract Documents, to the satisfaction of the Owner. In addition to the proposed grading changes shown on the Drawings, this Bid Item shall include a total of 50,000 square feet of grading repairs on the existing side slopes of the stormwater treatment pond in up to five separate locations at the STA to be directed by the District. The grading repairs will include work from the top-of-bank down to elevation 11.5 feet North American Vertical Datum of 1988 (NAVD 88), applying staked sod to repaired side slopes above and below the water line, and hydroseeding tops of banks and all other areas disturbed by the repair work. The Contractor will be paid by lump sum for the Work installed complete.

END OF SECTION

SECTION 01290
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. To the Owner, a proposed Schedule of Values allocated to the various portions of the Work, in accordance with Section 01000, Project Requirements, and Section 01200, Measurement and Payment.

B. Upon request of the Owner, supporting data that will substantiate the values' correctness.

C. The accepted Schedule of Values shall be used as the basis for the Contractor's Applications for Payment.

D. An update and resubmittal of the Schedule of Values when Change Orders affect the listing or when the actual performance of the Work involves necessary changes of substance to values previously listed and approved.

E. Schedule of Values

1. Submit typed schedule on EJCDC 1910-8-E forms or another format as may be approved by the Owner.
2. Submit Schedule of Values in PDF format via Owner-approved electronic transmittal method or on CD, or as duplicate hardcopies, within 10 days after the date of Owner-Contractor Agreement.
3. Format – Use the schedule of prices in the Bid Proposal. Show the cost breakdown for each lump-sum item. The lump-sum breakdown shall, at a minimum, use the Table of Contents of this manual outline. Identify each line item with the number and title of the major Specification Section. Identify site mobilization and demobilization, bonds and insurance, Record Drawings, photographs, and operations and maintenance manuals, etc.
4. Revise the schedule to list approved Change Orders with each Application for Payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300
CONTRACT ADMINISTRATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section sets forth some of the general project requirements.

1.02 SUBMITTALS

A. The Contractor shall furnish the Owner with revised progress schedules with each Application for Payment in addition to the number required by the Owner.

B. The Contractor shall furnish the Owner with required photographs to accompany each Application for Payment.

C. The Contractor shall furnish the Owner with five copies of the Application for Payment.

D. At Contract closeout, the Contractor shall transmit Record Documents and samples with cover letter to the Owner listing the following:

1. Date.
2. Project title and number.
3. Contractor's name, address, and telephone number.
4. Number and title of each Record Document.
5. Signature of Contractor or authorized representative.

1.03 FORMAT

A. The Contractor shall prepare schedules as a time scale logic diagram and bar chart unless otherwise approved by the Owner. Each major and minor portion of work or operation shall be clearly identified and tied by logical sequence to the shop drawing schedule and schedule of values. All schedules shall be prepared and submitted in 11-inch-by-17-inch PDF format or hardcopies.

1.04 SCHEDULE CONTENT

A. The Contractor shall show the complete sequence of construction by activity, with dates for beginning and completion of each element of construction and provide sub-schedules to define critical portions of the entire schedule. Schedules shall

also show accumulated percentage of completion of each item and total percentage of work completed as of the first day of each month.

1.05 REVISIONS TO SCHEDULES

A. The Contractor shall indicate the progress of each activity to the date of submittal and the projected completion date of each activity. Revised schedules shall identify activities modified since previous submittal, major changes in scope, and other identifiable changes. The Contractor shall also provide a narrative report to define problem areas, anticipated delays, and impact on schedule. The Contractor shall also report corrective action taken or proposed and its effect, including the effect of schedule changes on other contractors.

1.06 PROGRESS MEETINGS

A. The Contractor will conduct regularly scheduled progress meetings at least once every 2 weeks to discuss the progress of the Work. The Contractor and any subcontractors the Contractor deems necessary shall attend these meetings. At the Owner's discretion, the frequency of the meetings may be increased if the progress of the Work is not satisfactory or if coordination problems should arise.

B. The agenda for the meeting shall include the status of items from previous meetings, with said previous items and status notes dated, for easy tracking. The Contractor may use their own format for the agenda, but the agenda shall include at a minimum the topics listed below, unless approved otherwise by the Owner:

1. Attendees/Sign-In.

2. Schedule/Progress Report:

    a. Work Completed Previous Week.
    b. Work Planned for This Week.
    c. Work Completed This Week.
    d. Work Planned for Next Week.
    e. Safety.
    f. Security.

3. Contract Time Summary:

    a. Notice to Proceed Date.
    b. Substantial Completion Date.
    c. Final Completion Date.
    d. Number of Days Added/Deleted (via Change Order).
    e. Revised Substantial Completion Date.

f. Revised Final Completion Date.
g. Percent Complete.

4. Contract Price Summary:

a. Original Contract Amount.
b. Amount Added/Delete (via Change Order).
c. Revised Contract Amount.
d. Amount Requested through Last Pay Application.
e. Balance Remaining.
f. Percent Complete.

5. Applications For Payment.

6. Requests For Information (RFI).

7. Proposed Contract Modifications (PCM).

8. Construction Field Orders (CFO).

9. Change Orders (CO).

10. Submittals/Shop Drawing Status.

11. Other Concerns and Issues.

12. Next Progress Meeting.

C. The Contractor shall revise the agenda and include additional information as needed or as directed by the Owner to clearly document the status of Work, ongoing issues, action items, responsible parties, etc.

D. The Contractor shall issue meeting minutes to the Owner within 2 business days after the meeting and shall make corrections and revisions requested by the Owner. The Contractor may use the meeting agenda with annotations to serve as the meeting minutes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01325
CONSTRUCTION PHOTOS AND VIDEOS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall have digital photos and videos made of the Work from views and at such times as directed by the Owner. The photos and videos shall represent a visual history of the Project, from Contract Award through Contract Completion.

B. The requirements of this Section constitute a minimum requirement, but the Owner may request additional photos or videos at their discretion for complete documentation of the work performed.

C. The Contractor shall also use additional digital photography as necessary to record and facilitate resolution of on-site issues through the transmission of photos by e-mail or other electronic submittal forum from the site to the Owner's offices.

D. Digital photos and videos shall be taken at all project areas. Project areas correspond to the work areas covered under each Bid Item in Section 01200, Measurement and Payment.

E. Digital photos and videos shall be provided before or with applications for payment, and at frequencies specified in this Section.

1.02 SUBMITTALS

A. Aerial Photo and Video Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DIGITAL PHOTO REQUIREMENTS

A. Digital photos shall be in color. Provide one copy of each digital photo via electronic submittal to the Owner.

B. Provide photos taken of each of the major items at all project areas during construction.

C. View and Quantities Required: A minimum of 20 photos per project area per month clearly showing project status and key elements of construction.

D. Deliver digital photos to the Owner with every pay request, whichever is more frequent.

E. Photos shall be from locations to adequately illustrate the condition of construction and the state of progress.

F. The Contractor shall provide before and after photos of each site or portion of each site. The below-ground facilities shall include before, during, and after photos of all equipment, walls, floor, piping, utility crossings, and supports. At major locations, photos shall include before, during, and after photos all submitted electronically in ascending date order to show the Work as it progresses.

3.02 DIGITAL VIDEO RECORDING REQUIREMENTS

A. The Contractor shall provide to the Owner color digital video of each project area, and structures and facilities adjacent to the construction before construction starts, during construction, and when construction has been completed. Videos shall include all project areas in their entirety and areas of adjacent properties within 100 feet of the limit of the Work. Show the existing improvements and features affected by the work.

B. On a monthly basis, submit a minimum of 5 minutes of digital video for each project area to the Owner showing Work completed, Work in progress, Work started, and problems that occurred since the last digital video was made.

C. Where needed during video recording, the Contractor shall narrate the video, explaining what is being shown, problems that have occurred, and what is being done.

3.03 AERIAL PHOTOS AND VIDEOS

A. The Contractor shall obtain digital, true-color, aerial photos and aerial videos using aerial drones or other approved means of the entire project site before construction begins, quarterly (approximately every 3 months) during construction at times approved in advance by the Owner, and at final completion showing the entire completed construction project.

B. The Contractor is required to secure all permits and approvals from authorities having jurisdiction before any aerial or drone flights and shall have licensed pilots/drone pilots performing the flights in accordance with applicable regulations.

C. From each flight, provide a minimum of five aerial digital photos for each project area (project areas correspond to Bid Items) for a total of 30 aerial digital photos or more photos as needed to cover the project areas completely.

D. Aerial videos shall be a minimum of 5 minutes in length for each project area (project areas correspond to Bid Items) or longer durations if needed to show the projects from all sides with slow panning, tilting, and/or translating views of the work sites.

E. Provide a digitally collected orthophoto mosaic supplied in Geotiff format via digital submittal of pre-construction and post-construction conditions covering all project areas. The final color-balanced, true-color orthophoto mosaic will be projected in North American Datum of 1927 (NAD 27), state plane west, and all vertical reference shall be North American Vertical Datum of 1988 (NAVD 88), US feet, and shall meet a final accuracy of plus or minus 5 feet.

F. The Contractor shall submit an aerial photo and video plan to the Owner for approval before conducting the work. The plan shall include a description of the proposed views, lengths of each scene, equipment to be used, schedule, and other relevant information to ensure the Owner's needs are met.

3.04 PHOTO AND VIDEO INFORMATION

A. Each digital photo and video file shall be digitally tagged with the following data or the file name shall be referenced from a log that contains the following information for each photo and video:

1. Digital photo or video digital file name/number.
2. Project name.
3. Contract number.
4. Name of Contractor.
5. Date photo or video was taken.
6. Photographer name.
7. Description of location, view, and construction items the photo displays.

B. All photos and videos shall be clear, unobstructed, sharply focused, and free of distortion.

C. Photos and videos shall be submitted to the Owner within 10 working days after recording unless specified otherwise.

D. All videos shall be delivered to the Owner before Final Completion.

END OF SECTION

SECTION 01330
SUBMITTALS AND ACCEPTANCE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall submit documentation that describes the Work to be performed under the Contract as required in this Section. This documentation will be for the Owner's review and use. The documentation furnished by the Contractor must enable the Owner to verify the Contractor's performance and compliance with Contract requirements. The documentation shall cover all services and deliverables required and secured by the Contract Documents.

1.02 SUBMITTALS

A. General—The Contractor shall submit the following:

1. Project documentation: For the Owner's internal use and shall include all information that will be essential for the facility's operations, maintenance, training, and repair of equipment and facilities supplied by the Contractor. The Contractor shall submit all documentation necessary to ascertain compliance with technical/contractual provisions.
2. Shop drawings: Drawings, schedules, diagrams, warrant, and other data prepared specifically for this Contract by the Contractor or through the Contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower-tier contractor to illustrate a portion of the Work.
3. Product data: Preprinted materials such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the Work, but not prepared exclusively for this Contract.
4. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portions of the Work, illustrating portions of work, or establishing standards for evaluating appearance of finished work or both.
5. Installation Lists: All manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Owner with the required Shop Drawings. The installation list shall include all installations where identical equipment has been installed and has been operating for at least 1 year.
6. Administrative submittals: Data presented for reviews and acceptance to ensure that administrative requirements of the project are adequately met

but not to ensure directly that work is in accordance with the design concept and in compliance with Contract Documents.

B. Coordination

1. Submittals and schedules shall be checked and coordinated with the Work of all trades involved before they are submitted and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.

C. Start of Work

1. Within 30 calendar days after the notice to proceed for the project, the Contractor shall submit to the Owner a Contract Data Requirements List that defines all data to be submitted under this Contract. Included in this list shall be the names of all proposed manufacturers furnishing specified items to the extent known. Review of this list by the Owner shall in no way relieve the Contractor from providing materials, equipment, systems, and structures fully in accordance with the Specifications.

D. General Requirements

1. The Contractor shall prepare, assemble, and submit all documents as described herein. The Contractor shall submit certification that the documents prepared conform to the Contract requirements and will result in a complete and operable project. The Owner shall review the Contractor’s documents for conformance to the Contract requirements and may comment on the documents.
2. The Contractor shall approve and certify all project documents. The Contractor’s failure to certify the documents or failure to provide documents that demonstrate conformance to the Contract requirements are grounds for rejection. The Contractor shall be responsible for and bear all costs for proceeding with any part of the Work that fails to meet the Contract requirements.
3. Submittal of documents for the Owner’s review shall in no way relieve the Contractor of full responsibility for providing a complete, safe, reliable, operating, and coordinated Work (system/equipment/facilities) that is in compliance with these Contract documents.

E. Requests for Substitution

1. All requests for substitution shall clearly and specifically indicate any and all differences or omissions between the products specified as basis of

design and the product proposed for substitution. Data shall include but not be limited to differences as follows for both the specified and substituted products:

a. Principle of operation.
b. Materials of construction or finishes.
c. Thickness or gauge of materials.
d. Weight of item.
e. Deleted features or items.
f. Added features or items.
g. Changes in other work caused by the substitution.
h. If the substitution contains differences or omissions not specifically called to the attention of the Owner, the Owner reserves the right to require equal or similar features to be added to the substituted product at the Contractor's expense.

F. Submittal Requirements and Procedures

1. Drawing Formats and Requirements

a. Drawings—All Drawings and Shop Drawings shall be prepared in 11-x-17-inch or larger format and shall have a blank area of 3 x 4 inches in the lower right hand corner above the title block. Each Drawing shall indicate the following information in the title block:

(1) Title and Drawing Number.
(2) Date of Drawing or Revision.
(3) Name of Building or Facility.
(4) Name of Contractor or subcontractor.
(5) Drawing contents and locations.
(6) Specification Section and Subsection Numbers.

b. All drawings shall be submitted via electronic transmittal in PDF format or other formats as may be required by the Owner for review.

2. Product Data

a. Requirements—Product data shall include all catalog cuts, performance surveys, test reports, equipment lists, material lists, diagrams, pictures, and descriptive material. All product data shall be submitted in either 8.5-x-11-inch or 11-x-17-inch size formats. The submittal information shall show the standard and optional

product features, as well as all performance data and specifications. The manufacturer’s recommendation for special tools shall be supplied.

b. All product data shall be submitted via electronic transmittal in PDF format or other formats as may be required by the Owner for review.

3. Samples—The Contractor shall furnish samples required by the Contract Documents, for review by the Owner. Samples shall be delivered to the Owner as specified or directed.

   a. All samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product, with integrally related parts and attachment devices. The samples shall show the full range of color, texture, and pattern.
   b. The Contractor shall submit a minimum of four samples of items submitted. All samples shall be marked with required submittal information, as specified above.

4. Color, Texture, and Pattern Charts

   a. The Contractor shall submit color, texture, or pattern charts of all required finishes.
   b. A minimum of four charts of each item shall be submitted.

5. Submittal Information Requirements

   a. When used in the Contract Documents, the term "Submittal Information" shall be considered to mean the following information at a minimum:

      (1) Contract Name.
      (2) Contract Number.
      (3) Location within Facility.
      (4) Date Submitted.

   b. Drawings—The Contractor shall mark submittal information on all Drawings in the left half of the 4-x-3-inch block as described above.

   c. Product Data and Manufacturer's Literature—The Contractor shall mark all product data and manufacturer's literature with submittal information and note which item is being furnished. The Contractor shall mark the option and supplies to be furnished with

the item. Do not submit the manufacturer's general catalog: submit only items being installed or delivered. When manuals are being submitted, the Contractor shall mark submittal information on both the cover and title page. If manuals being submitted contain more than just one item, each item must be marked, and only Contract name and number is to be marked on the cover and title page.

6. Training, Operation and Maintenance Manuals

a. The Contractor shall submit to the Owner for review and acceptance of manufacturer's installation, operations, lubrication, maintenance, and training manuals for all equipment installed or delivered under this Contract. All manuals shall have submittal information marked on the front cover, title page, and three places inside the manual. If the manual being submitted is for different components, mark the front cover and title page only. Each component section must be marked with the Specification Section and subsection numbers.

b. Operations and Maintenance Manual shall conform to requirements defined in Section 01830, Operations and Maintenance Manuals.

G. Required Submittals

1. Structural Submittals

a. This Section specifies general procedural requirements for contractual submittals for the following structural schedules, product data, samples, and manufacturer's certificates.

(1) Product Data—The Contractor shall provide product data for all architectural and structural items, options, and other data and provide supplemental manufacturer's standard data for information unique to the Work and installation. The submittals shall reflect all items delivered or installed under this Contract.

(2) Samples—The Contractor shall provide all samples required under this Specification including color charts and product samples.

(3) Material, equipment, and installation and demolition Specifications.

2. Mechanical System Submittals

a. This Section specifies general procedural requirements for mechanical schedules, performance data, control diagrams, and other submittal data.

b. The Contractor shall submit the following:

(1) Performance Data.

(2) Finished Data—Complete surface preparation and finished data for all mechanical and electrical unit/subsystems shall be provided, including a complete list of cleaning instructions.

(3) Factory Testing—Detailed description of factory testing procedures, reporting procedures and criteria for test passing or failing shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with the General Requirements and Technical Requirements Sections.

(4) Site (Field) Testing and Acceptance—Detailed description of site testing and acceptance tests including descriptions of procedures, testing equipment, reporting procedures, and criteria for passing or failing tests shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with General Requirements and Technical Requirements.

(5) Factory Test Report—After fabrication and testing, the Contractor shall submit the results of tests. No shipment of any mechanical and electrical unit/subsystem shall be allowed without the written certification from the Contractor that the equipment conforms to the Contract requirements.

(6) Site Test and Acceptance Report—Site test and acceptance reports shall be submitted to the Owner.

(7) Operations and Maintenance Manuals—The Contractor shall furnish manuals for all mechanical and electrical

equipment specified under this Contract. Each manual shall include the following at a minimum:

(a) Description of equipment.
(b) Record shop drawing.
(c) Operation and maintenance instructions.
(d) Part lists.
(e) Equipment ratings.
(f) Valve list.
(g) Lubrication instructions.

H. Submittal Review

1. The Owner's review of the Contractor's documents shall not relieve the Contractor of the responsibility for meeting all of the requirements of the Contract nor of the responsibility for correcting the documents furnished. The Contractor shall have no claim for additional cost or extension in time because of delays due to revisions of the documents that may be necessary for ensuring compliance with the Contract.

2. The Owner will review a submittal or re-submittal once, after which the cost of review shall be borne by the Contractor. The cost of Engineering shall be equal to the Engineer's full cost.

3. No partial submittals will be reviewed. A submittal or re-submittal not complete will be returned to the Contractor for completing and re-submittal.

4. Documents submitted by the Contractor for approval by the Owner will be returned bearing a project-specific stamp bearing the dated signature of the reviewer and one of four boxes checked:

   a. NO EXCEPTIONS NOTED—This indicates that the submittal appears to comply with the requirements of the performance specifications and that the Work may proceed.
   b. MAKE CORRECTIONS NOTED—This indicates that the reviewer has added a minor correction to the submission and that the Work (modified in accordance with the correction comment) may proceed. The Contractor shall accept the responsibility of the modified document and resulting Work with no additional compensation.
   c. AMEND AND RESUBMIT—This indicates that the submittal will require Contractor modifications based on the reviewer's comments that accompanied the returned submittal. The Contractor will be cautioned that work may not proceed under this review status.

d. REJECTED—This indicates that the submittal is not in conformance with the requirements of the performance Specifications and cannot be modified to gain compliance. A new submittal will be required in the instance of a "reject" status and the Contractor will be cautioned that work may not proceed under this condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL PROCEDURES

A. Before submitting documents for the Owner's review, the Contractor shall review the documentation for conformance to the Contract requirements. Submittals shall be complete and comprise a logical division of the Contract Work.

B. All documentation submitted by the Contractor to the Owner shall be accompanied by a letter of transmittal and shall be submitted in a sequence that allows the Owner to have all of the information necessary for checking and accepting a particular document at the time of submittal.

C. Each document shall be identified by a document number, Contract number, Contract name, location, Specification Section, subsection numbers, and submittal date. Where a manual/drawing is revised to reflect a change in design or a change for any other reason, each such revision shall be shown by a revision number, date, and subject in a revision block. Indication of official approval by the Contractor's Project Manager shall also be included. To permit rapid location of the revision, additional notation shall be made in the manual opposite the line or area where the change was made and identified by the corresponding revision number.

3.02 DOCUMENTATION CONTROL AND SUBMITTAL SEQUENCING

A. The Contract Data Requirements List shall be updated and resubmitted to the Owner monthly, throughout the duration of the Contract. This list shall identify the Contractor's submittal number, proposed and actual submittal date, Contract Specification Section Number, Paragraph, Item of the Work, and type of document.

B. The Contractor shall work with the Owner to provide a regulated flow of submittals that allows the Owner to review the submittals in the defined time frame without undue delays. Monthly the Contractor shall provide the Owner a schedule of the approximate quantities and delivery dates for all submittals due for the next 120 days.

3.03 FINAL RECORD DRAWINGS

A. The Contractor shall submit the Final Record Drawing Package to the Owner for review at Substantial Completion. The Contractor shall be provided with CADD files of the Contract Drawings in AutoCAD, version specified by the Owner. Final Record Drawings shall be prepared in AutoCAD with the same version used for the Contract Drawings and shall be provided electronically in AutoCAD. The Contractor may request to use a different version, but it must be approved by the Owner.

B. Final Record Drawings shall also be provided in hardcopy format, three copies, printed at the full size of the original Contract Drawings.

C. Record Drawings shall be in accordance with Section 01785, Record Documents.

3.04 REQUIREMENTS FOR SUBMITTAL

A. Additional documents, drawings, interface data, and other pertinent project submittal data are listed in specific sections of this Contract.

3.05 RECORD PRINTS

A. The Contractor shall submit one set of all record prints before final completion. The record print or project records shall include submittals, catalog cuts, drawings, calculations, test reports, manufacturer's data, maintenance manuals, installation instructions, and operating manuals. All "record prints" shall be delivered to the Owner in three-ring binders with dividers and shall be placed in order by Specification Section.

END OF SECTION

SECTION 01350
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work covered by this Section consists of furnishing all labor, materials, and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations during and as the result of construction operations under this Contract. In this Section *environmental pollution* is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires considering air, water, and land and involves managing noise and solid waste as well as other pollutants.

C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the Work. The Contractor shall provide erosion-control measures such as diversion channels, sedimentation or filtration systems, berms, staked silt fence, seeding, mulching or other special surface treatments that are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion-control measures shall be in place in an area before any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 02370, Erosion and Sedimentation Control.

D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the laws of the State of Florida and the Project Environmental Resource Permit.

1.02 SUBMITTALS

A. Contractor shall prepare a Stormwater Pollution and Prevention Plan (SWPPP) and a sedimentation and erosion-control drawing meeting the FDEP and SJRWMD requirements. The drawing shall clearly indicate the construction

entrance, delivery and storage area, in-stream turbidity controls and proposed locations for soil stockpiles. The Contractor shall furnish two copies to the Engineer, and two copies to the Owner.

B. The Contractor shall provide the Engineer with two copies of documentation that the Contractor filed with FDEP a "NOTICE OF INTENT TO USE GENERIC PERMIT FOR STORMWATER DISCHARGE FROM LARGE AND SMALL CONSTRUCTION ACTIVITIES" in accordance with Rule 62-621.300(4), FAC.

C. The Contractor shall submit two copies of approved Spill Prevention Control and Countermeasures (SPCC) plans to the Owner and the Engineer.

D. If the Contractor proposes to construct temporary roads or embankments and excavations for work areas, the Contractor shall submit the following to the Owner for approval at least 10 days before the scheduled start of such temporary work:

1. A layout of all temporary roads, excavations, embankments, and drainage to be constructed within the work area.
2. Details of temporary road construction.
3. Drawings and cross-sections of proposed embankments and their foundations, including a description of proposed materials.
4. Drawings showing the proposed restoration of the area. The proposed removal of any trees and shrubs must be indicated. The Contractor is responsible for obtaining necessary tree clearing permits with the local municipalities.
5. Locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged.
6. The drawings shall provide for the obliteration of construction scars as such and shall provide for a natural appearing and functioning final condition of the area.
7. Modification of the Contractor's approved drawings shall be made only with the written approval of the Owner. No unauthorized road construction, excavation, or embankment construction including disposal areas will be permitted.
8. The Contractor shall mark/flag the proposed temporary work in the filed for review by the Owner prior to beginning such work.

1.03 WORK SEQUENCE

A. Before beginning the Work, the Contractor shall meet with the Owner to establish agreed-upon compliance with these provisions and administration of the environmental pollution control program.

B. The Contractor shall remove temporary environmental control features when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

1.04 REFERENCE STANDARDS

A. Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

B. The Contractor shall comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EROSION CONTROL

A. The Contractor shall provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion-control measures, such as temporary vegetation, siltation basins, mulch check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Surface water shall be prevented from flowing into excavated areas. At the completion of the Work, erosion and sedimentation controls shall be removed and the ground surface restored to its original condition.

3.02 PROTECTION OF STREAMS AND SURFACE WATERS

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

B. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the FDEP. The Contractor shall submit two copies of approved contingency plans to the Engineer.

3.03 PROTECTION OF LAND RESOURCES

A. After completion of construction, the Contractor shall restore land resources within the project boundaries and outside the limits of permanent work to a condition that will appear to be natural and not detract from the appearance of the project. All construction activities shall be confined to areas shown on the Drawings.

B. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, the Contractor shall first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. The Contractor shall protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping, or other operations by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.

D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Owner will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.

1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and, in the opinion of the Owner, are beyond saving shall be immediately removed and replaced.

E. The Contractor’s storage and other construction buildings required temporarily in the performance of the work shall be located in cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Owner and shall not be within wetlands or floodplains. Preserving the landscape shall be required in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for the Owner’s approval.

F. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling, and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation the roadway areas. The disturbed areas shall be prepared and seeded as approved by the Owner.

G. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.04 PROTECTION OF AIR QUALITY

A. Burning—Burning will not be permitted at the project site for the disposal of refuse and debris.

B. Dust Control—The Contractor shall maintain all excavations, embankment, stockpiles, access roads, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides is prohibited.

D. To be approved, sprinkling must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the Work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Owner.

3.05 NOISE CONTROL

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

3.06 MAINTENANCE OF POLLUTION-CONTROL FACILITIES DURING CONSTRUCTION

A. During the life of this Contract, the Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular

pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.07 PERMIT COMPLIANCE REQUIREMENTS

A. The Contractor shall comply with all conditions of permits and crossing agreements obtained by the Owner or required to be obtained by the Contractor, including but not limited to:

1. City of West Melbourne.
2. City of Melbourne.
3. Brevard County.
4. Florida Department of Environmental Protection.
5. US Army Corps of Engineers.
6. Florida Department of Transportation.
7. Florida Gas Transmission.
8. Florida Power and Light.

END OF SECTION

SECTION 01355
SPECIAL PROVISIONS

PART 1 GENERAL

1.01 SPARE PARTS

A. Where spare parts are specified in the Specification Sections, the Contractor shall furnish all spare parts recommended by the manufacturer or system supplier for 1 year of service. In addition, the Contractor shall furnish all spare parts itemized in each Section.

B. The Contractor shall collect and store all spare parts in an area to be designated by the Owner and shall furnish the Owner with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.

C. Spare parts shall be packed in cartons properly labeled with indelible markings with complete descriptive information, including manufacturer, part number, part name, and equipment for which the part is to be used and shall be properly treated for 1 year of storage.

D. Portable Dam System: The Contractor shall supply a new and complete portable dam system as specified in Section 11280, Pneumatic Control Gate, Article 2.08, Portable Cofferdam System, for the Owner's use in maintenance. The portable dam system shall be supplied to the Owner at Substantial Completion and shall be delivered to the St. Johns River Water Management District (SJRWMD) Palm Bay Service Center in Palm Bay, Florida.

1.02 HURRICANE PREPAREDNESS PLAN

A. Within 30 calendar days of the date of Notice to Proceed, the Contractor shall submit a Hurricane Preparedness Plan to the Owner for approval. The Plan shall describe in detail the necessary measures that the Contractor will perform, at no additional costs to the Owner, in case of a hurricane warning. The Contractor shall revise the Plan as required by the Owner.

1.03 WEATHER PROTECTION

A. In the event of inclement weather, the Contractor shall protect the Work and materials from damage or injury from the weather. If, in the opinion of the Owner, any portion of the Work or materials has been damaged by reason of

failure on the part of the Contractor to protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the Owner.

B. The Contractor shall provide a controlled and stabilized path for the flow of the M-1 Canal through the site at all times.

1.04 PROVISIONS FOR CONTROL OF EROSION

A. The Contractor shall take sufficient precautions during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride, or other polluting materials harmful to humans, fish, or other life, into the wetlands and surface waters of the State. Control measures must be adequate to ensure that turbidity in the receiving water will not be increased more than 10 nephelometric turbidity units (NTU), or as otherwise required by the State or other controlling body, in water used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity must not exceed 25 NTU unless otherwise permitted. Special precautions shall be taken in the use of construction equipment to prevent operations that promote erosion.

1.05 PROVISIONS FOR THE CONTROL OF DUST AND LITTER

A. The Contractor shall take sufficient precautions during construction to minimize the amount of dust created. Wetting down the Site may be required or as directed by the Owner to prevent dust as a result of vehicular traffic. Control of blowing litter caused by any regrading by the Contractor shall be the responsibility of the Contractor.

1.06 ON-SITE STORAGE

A. The Contractor should note that there may be special storage requirements and possible charges for noncompliance of on-site storage requirements for materials and equipment as specified in Section 01600, Materials and Equipment.

1.07 ELECTRICAL POWER AND TESTING EQUIPMENT

A. The Contractor shall furnish electric power and all equipment and tools required for testing equipment. The cost of this electric power, equipment, and tools shall be included in the prices quoted in the Bid Form.

1.08 DAMAGE DUE TO HIGH WATER

A. The Contractor will be responsible for all damage done to his work by heavy rains or floods and he shall take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off stormwater as the nature of the work may require.

1.09 EMERGENCY PHONE NUMBERS AND ACCIDENT REPORTS

A. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and the phone's location be made known to all.

B. Accidents shall be reported immediately to the Owner by phone.

C. The Contractor shall document all accidents and shall submit to the Owner a fully detailed written report about the accident after each accident.

1.10 ITEMS SPECIFIED ON DRAWINGS

A. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. The Contractor shall provide such items in accordance with the Specification on the Drawings.

1.11 SALVAGE

A. Any existing equipment or material, including but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction under this project may be designated as salvage by the Owner and, if so, shall be excavated, if necessary, and shall be cleaned and stored on or adjacent to the Site in a protected place specified by the Owner or loaded onto trucks provided by the Owner. Any equipment or material not worthy of salvaging, as directed by the Owner, shall be disposed of by the Contractor at a suitable location at the Contractor's expense.

1.12 WORKMANSHIP, MATERIAL, AND EQUIPMENT

A. When a particular product or products are specified or called for, it is intended and shall be understood that the proposal tendered by the Contractor include those products in his bid. Should the Contractor desire to substitute a product or products equal to those specified, the Contractor shall furnish information on the substitution as needed for Owner review and approval. The alternate product or products submitted by the Contractor shall meet the requirements of the Specifications and shall, in all respects, be equal to the product or products specified by name in the Specifications.

B. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Work shall be the new and unused standard products of recognized reputable manufacturers.

1.13 RESPONSIBILITY OF CONTRACTOR

A. The Contractor shall be responsible for the entire Work determined by the Contract Documents from the date of the starting of the Work until it is accepted as complete by the Owner. The Contractor shall be responsible for removals, renewals, and replacements due to action of the elements and all other causes except as otherwise provided in the Specifications. The Contractor shall keep the Contract under his own control and it shall be his responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the work personally or shall have a competent English-speaking superintendent or representative, who shall be on the site of the project at all working hours and who shall be empowered with full authority by the Contractor to direct the performance of the Work and make arrangement for all necessary materials, equipment, and labor without delay.

B. Renewals or repairs required because of defective materials or workmanship or due to the action of the elements or other natural causes, including fire and flood, before the acceptance as determined by the Owner, shall be done in accordance with the Contract Documents at the expense of the Contractor.

1.14 CONSTRUCTION CONDITIONS AND SUBSURFACE INVESTIGATION

A. The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) or agency(ies) having jurisdiction over the Work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.

B. The Contractor shall be responsible for having determined to his satisfaction, before submitting his bid, the nature and location of the Work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the groundwater conditions, the character of equipment and facilities needed before and during the execution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under this Contract. The prices established for the work to be done will reflect all costs pertaining to the Work. Any claims for extras based on substrata, groundwater table, and other such conditions will not be allowed.

1.15 SUSPENSION OF WORK DUE TO WEATHER

A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the Owner as to suspensions shall be final and binding. The ability to issue such an order shall not be interpreted as a requirement to do so. During suspension of the work from any cause, the Work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise, and if the Owner shall so direct, the rubbish and surplus materials shall be removed.

1.16 PERMITS

A. Upon notice of award, the Contractor shall immediately apply for all applicable permits, including building permits, NPDES permits, dewatering permits, and any other required permits not previously obtained by the Owner to do the Work from the appropriate governmental agency or agencies. No work shall begin until all applicable permits have been obtained and copies delivered to the Owner. The Contractor shall bear all costs for obtaining all permits.

1.17 PUMPING

A. The Contractor with his own equipment shall do all pumping necessary to prevent flotation of any part of the structures during construction operations.

B. For the duration of the Contract and with his own equipment, the Contractor shall pump out water and wastewater which may seep or leak into the excavations or structures.

1.18 CLAIMS FOR PROPERTY DAMAGE

A. Upon notification by the Owner, the Contractor shall investigate each claim for property damage and shall file, within 10 days of such notification, a statement with the Owner setting forth all facts and details relative to the claim.

1.19 DAILY REPORTS

A. The Contractor shall submit daily reports of construction activities, including non-workdays. The report shall include the following:

1. Manpower, number of workers by craft.
2. Equipment on the project.
3. Major deliveries.
4. Activities work with reference to the CPM schedule activity numbers.

5. New problems.
6. Other pertinent information.

B. A similar report shall be submitted for/by each subcontractor.

C. The reports shall be submitted to the Owner within 2 days of the respective report date. Each report shall be signed by the Contractor's Superintendent or Project Manager.

1.20 CONNECTIONS TO EXISTING SYSTEMS

A. The Contractor shall perform all work necessary to locate, excavate, and prepare for connections to the terminus of the existing systems all as shown on the Drawings or where directed by the Owner. The cost of this work and for the actual connection of the existing mains shall be included in the bid for the Project and shall not result in any additional cost to the Owner.

1.21 COORDINATION OF WORK

A. The Contractor shall afford other contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with such other work. The Contractor shall coordinate his Work with the Owner and other contractors to store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the Work so that it will not unduly interfere with the progress of the Work or the work of any other contractors.

B. If the execution or result of any part of the Work depends on any work of the Owner or of any separate contractor, the Contractor shall, before proceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any separate contractor that render it unsuitable for the proper execution or result of any part of the Work.

C. Failure of the Contractor to inspect and report any deficiencies shall constitute an acceptance of the Owner's or separate contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or separate contractor's work after completion of the Work and which the Contractor could not have discovered by his inspection before the Work was completed.

D. If the Contractor damages the work or property of the Owner or of any separate contractor on the Project or other work on the Site, or delays or interferes with the Owner's work on ongoing operations or facilities or adjacent facilities or the separate contractor's work, the Contractor shall be liable for damage caused, and, in the case of another contractor, the Contractor shall attempt to settle the claim

with the other contractor before the other contractor institutes litigation or other proceedings against the Contractor.

E. If a separate contractor sues the Owner on account of any damage, delay, or interference caused or alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner in such proceedings at the Contractor's expense. If any judgment or award is entered against the Owner, the Contractor shall satisfy the same and shall reimburse the Owner for all damages, expenses, attorneys' fees, and other costs which the Owner incurs as a result of the judgment or award.

F. If a separate contractor causes damage to the Work or to the property of the Contractor or causes delay or interference with the Contractor's performance of the Work, the Contractor shall present directly to the separate contractor any claims it may have as a result of such damage, delay, or interference (with an information copy to the Owner) and shall attempt to settle its claim against the separate contractor before instituting litigation or other proceedings against the separate contractor.

G. In no event shall the Contractor seek to recover from the Owner or the Engineer, and the Contractor hereby represents to the Owner and the Engineer that he will not seek to recover from them, or either of them, any costs, expenses, (including, but not limited to, attorneys' fees) or losses of profit incurred by the Contractor as a result of any damage to the Work or property of the Contractor or any delay or interference caused or allegedly caused by any separate contractor.

H. The Owner shall determine and adjust any difference or conflict which may arise between the Contractor and other contractors who may be performing work on behalf of the Owner or between the Contractor and workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of any acts of omissions of any other contractor of the Owner, the Contractor shall on that account have no claim against the Owner other than for an extension of time.

1.22 FINAL GUARANTEE

A. The Contractor shall guarantee all work for 1 year from the date of Substantial Completion of the Work by the Owner.

B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Owner, are rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall

do the following promptly upon receipt of notice from the Owner and without expense to the Owner:

1. Place in satisfactory condition in every way all such guaranteed work and correct all defects in the guaranteed work.
2. Make good all damage to the building or site, or equipment or piping, or their contents, which, in the opinion of the Owner, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract.
3. Make good any work or material or the equipment and contents of the building, structure, or site disturbed in fulfilling any such guarantee.

C. If the Contractor, after notice, fails to proceed to comply with the terms of this guarantee within 10 days, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expenses incurred provided. However, that in case of an emergency where, in the opinion of the Owner, delay would cause loss or damage, repairs may be started without notice being given to the Contractor and the Contractor shall pay the cost of such repairs.

D. All special guarantees or warranties applicable to specific parts of the Work as may be stipulated in the Contract Specifications or other papers forming a part of this Contract shall be subject to the terms of this Paragraph during the first year of life of each such guarantee. The Contractor shall assemble all special guarantees and manufacturers' warranties, along with a summary list of the special guarantees and warranties, and deliver these to the Owner before the Work is accepted.

1.23 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK

A. With the approval of the Owner, the Contractor may use on the project such stone, gravel, sand, or other material determined suitable by the Owner as may be found in the excavation. The Contractor shall replace at his own expense, with other acceptable material, all of that portion of the excavation materials so removed and used which were needed for use in the embankments, backfills, approaches, or otherwise. No charge for the materials used will be made against the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01450
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor will pay for the costs of all laboratory tests required to determine soil density, concrete compressive strength, and other testing to determine compliance with the Contract Documents. All required testing shall be coordinated and scheduled by the Contractor.

1. The Contractor shall cooperate with the laboratory to facilitate the execution of required services.
2. The Owner shall approve the selection of the testing laboratory.
3. Employment of a testing laboratory shall in no way relieve the Contractor of the obligation to perform work in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK

A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities.

B. Respective Sections:

1. Certification of products.
2. Laboratory tests required and standards for testing.

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

B. Submit to the Engineer for review a list and schedule of all tests to be conducted.

C. Describe test procedures along with the duration of tests.

D. After each inspection and test, the Laboratory shall promptly submit two copies of the laboratory report to the Engineer, one copy to the Contractor, and one copy to the Owner.

E. Include the following:

1. Date issued.
2. Project title and number.
3. Name of field testing technician or inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specifications Section.
6. Location in the Project.
7. Type of inspection or test.
8. Date of test.
9. Results of test.
10. Conformance with Contract Documents.

F. When requested by the Engineer, provide interpretation of test results.

1.04 REFERENCE STANDARDS

A. Reference standards and recommended practices shall be the latest revision of any such document in effect at the bid time.

1.05 QUALITY ASSURANCE

A. The Laboratory is not authorized to do any of the following:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of the Work.
3. Perform any duties of the Engineer of Record or the Engineer.

B. The Contractor shall be responsible for the following:

1. Cooperating with laboratory personnel, providing access to work and to manufacturer's operations.

2. Securing and delivering to the laboratory adequate quantities of representative samples of materials proposed to be used and that require testing.

3. Providing to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes that require control by the testing laboratory.

4. Furnishing incidental labor and facilities:

a. To provide access to Work to be tested.

b. To obtain and handle samples at the project site or at the source of the product to be tested.
c. To facilitate inspections and tests.
d. To store and cure test samples.

5. Notifying the Engineer and laboratory sufficiently in advance of operations to allow the laboratory time to assign personnel and schedule tests.

6. Employing and paying for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling, and testing required for the Equipment Supplier or Contractor's (as applicable) convenience.

C. Materials and equipment used in the performance of Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard requirements for quality and workmanship are indicated in the Contract Documents. The Engineer may require the equipment supplier or Contractor (as applicable) to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.

D. If the test and any subsequent retest results indicate that the materials or equipment fail to meet the requirements of the Contract Documents, the equipment supplier or Contractor (as applicable) shall pay for the laboratory costs.

1.06 QUALIFICATIONS

A. Laboratory: Licensed to operate in Florida.

B. Laboratory Staff: Maintain a full-time Florida-registered Professional Engineer on staff to review the services performed under this project.

C. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards (NBS) or accepted values of natural physical constants.

D. Provide qualified personnel at the site. Cooperate with the Engineer and Contractor in performing services.

E. Perform specified inspection, sampling, and testing of products in accordance with specified standards.

F. Ascertain compliance of materials and mixes with requirements of Contract Documents.

G. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or Products.

H. Perform additional inspections and tests required by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01520
FIELD OFFICES

PART 1 GENERAL

A. Within 2 weeks after starting work, the Contractor shall provide a minimum of one field office trailer including space for use of the Owner and Owner's representatives. The Contractor shall maintain the field office until the completion of the work to be done under this Contract.

1. The field office shall be a minimum 8 feet by 28 feet. The Owner's space within the field office shall be a minimum of 8 feet by 8 feet, unless otherwise approved by Owner.
2. Installation of the field office shall meet all local codes and ordinances. At a minimum, the Contractor shall install the structure on a level, well-drained area and secure it against wind in accordance with applicable requirements of the Florida Building Code and ASCE-7.
3. The field office shall be provided with structurally sound and safe steps and landings for each door. The doors shall have secure locks.
4. The field office shall be designated as a "No Smoking Area."
5. The windows shall be arranged for cross ventilation with screens.
6. The Contractor shall provide air conditioning and heating systems with thermostat control.
7. The Contractor shall provide electric power for the duration of the Project.
8. On completion of the Project, the Contractor shall remove the field office and all such temporary facilities from the site at a time discussed and agreed to with the Owner. The Contractor shall remove foundations and debris, remove any temporary pavement, compacted ground or base materials (such as limerock or stabilized soils created by the Contractor for construction parking or storage), grade the site to required elevations, sod all disturbed areas, and clean and remove all trash and debris. Ensure the soil permeability for stormwater drainage is equivalent to preconstruction conditions or as required by the Contract Documents.

B. In general, at a minimum the Contractor shall provide the following:

1. Electric lights (50-foot candles at desktop height) and power supply outlets (minimum of four).
2. High-speed Internet access with Wi-Fi router for wireless access and a Wi-Fi password made available to the Owner.
3. Complete toilet facilities within the field office acceptable to the Owner that meet all local and State health codes and regulations including appropriate restroom signage.

4. Fire extinguisher (Halon type, minimum 4-pound capacity).
5. Water coolers, bottled water, and paper cups for the duration of the Project.
6. Table for viewing the Project Drawings.
7. Office furnishings, as described in Article 1.05 below.
8. File cabinets, storage, bookcases, as described in Article 1.05 below.
9. Standard office supplies.
10. Miscellaneous field supplies, as described in Article 1.05 below.
11. Weekly janitorial services.

1.02 REFERENCE STANDARDS

A. Comply with all Federal, State and local codes including the National Electric Code, OSHA, FLOSHA, Florida Building Code, and ASCE-7.

B. Comply with all General Industrial standards and regulations, including but not limited to AWWA, ANSI, NEMA, IEEE, ASHRAE, UL, etc.

1.03 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.05 SPECIFIC REQUIREMENTS

Unless otherwise noted, the quantity shall be sufficient for the duration of the Project.

A. Office Furnishings/Equipment: The following furnishings and equipment shall be delivered and placed subject to Owner approval:

1. Owner's Space: One office desk and chair with two guest chairs. Chairs shall be adjustable height and on rollers with arm rests.
2. Chairs in common space: Eight desk-type chairs, adjustable heights, on rollers, with armrests.
3. Drawing Table: One plywood or standard drawing tables, 3 feet by 6 feet, with all required appurtenances.
4. Printer/Copier: One color copier capable of copying, scanning, and printing pages up to and including 11-inch-x-17-inch paper size. All warranties, maintenance, and servicing for the duration of the Work.

Sufficient appropriate ink/toner cartridges and paper for the Owner or the Owner's Representatives to print thirty 11-inch-x-17-inch or sixty 8-1/2-inch-x-11-inch color prints per week for the duration of the Work in addition to the Contractor's printing needs.

5. One each: 4.0-cubic-foot or larger refrigerator, microwave, coffee machine, and toaster oven.
6. Other furnishings, storage, or equipment deemed necessary by the Contractor.

B. Miscellaneous Field Supplies

1. One minimum/maximum digital thermometer with batteries for the duration of the Work.
2. Broom, dustpan, and brush.
3. One rain gauge.
4. One 36-inch-x-72-inch table and eight folding chairs.
5. Large wastebasket.
6. Wall clock.

1.06 ELECTRICITY, LIGHTING

A. The Contractor shall obtain and pay for utilities including electrical facilities and water and sanitary facilities. Connections to existing facilities will not be allowed unless properly metered and protected.

1.07 SANITARY FACILITIES

A. The Contractor shall provide suitable and adequate toilet facilities for all employees subject to the approval of the Owner as to the type, size, and location.

B. The facilities shall be maintained in a sanitary condition, frequently cleaned and disinfected, and promptly removed from the site when directed by the Owner.

1.08 FIRST AID

A. The Contractor shall provide a completely equipped first-aid kit that shall be maintained in a clean and orderly condition in the field office.

B. Telephone numbers for summoning aid from the Police Department, Fire Department, physicians, ambulances, inhalator, and rescue squads from outside sources shall be conspicuously posted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

This Section includes the minimum requirements for the furnished materials and equipment for this project. The more stringent requirements in the Technical Specification sections shall take precedence over these requirements for any conflicts.

A. Materials and equipment furnished by the Contractor shall be new and shall not have been in service at any other installation unless otherwise approved. They shall conform to applicable specifications approved in writing by the Owner.

B. Unless restricted to a specific type by the Contract Documents or the Owner, the Contractor may perform the work using equipment, tools, machinery, etc., of his own choosing.

C. The Contractor shall provide a unique alphanumeric identification number on all equipment (other than small tools) used on the project. This number shall be a minimum of 2 inches high and appear on both sides of the equipment. Place the number in such a manner so as to contrast sharply in color with the background on which it is placed. Ensure that the number, which may be painted or otherwise permanently affixed to the equipment, is clearly legible at all times.

D. If the Contractor's equipment or procedures during construction damage any part of the facility, the Contractor shall replace or repair it as directed by the Owner at no expense to the Owner.

E. Manufactured and fabricated products shall be designed, fabricated, and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gauges so as to be interchangeable.

F. Use only factory-recommended exhaust mufflers on internal combustion engines. Remove from the job, alter, or repair equipment disapproved by the Owner. Ensure that the number of units, the sizes, etc., of the equipment on hand are adequate to complete the work within the Contract Time.

G. Provide adequate equipment maintenance procedures to promote continuous satisfactory working condition and minimize noise pollution caused by construction equipment. Screen all stationary equipment such as pumps,

compressors, generators, etc., from noise sensitive receivers if that equipment is to operate beyond normal working hours. If it is feasible, screen this equipment during normal working hours to reduce noise impacts.

H. Quantities of items that are identical shall be by the same manufacturer, regardless of the Design Package breakdown.

I. Equipment sizes, capacities, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

J. Materials and equipment shall not be used for any purpose other than that for which they are designed or specified.

K. Where materials or equipment are specifically shown or specified to be reused in the Work, special care shall be used in removing, handling, storing, and reinstalling to ensure their proper function in the completed Work.

L. Material and equipment incorporated into the Work:

1. Shall conform to applicable specifications and standards.

2. Shall comply with size, make, type, and quality specified or as specifically approved in writing by the Owner.

3. Manufactured and fabricated products:

a. Rotating machinery shall be designed and fabricated to provide satisfactory operation without excessive wear and without excessive maintenance during its operating life. Rotating parts shall be statically and dynamically balanced and shall operate without excessive vibration.

1.02 ACCEPTANCE OF MATERIAL AND EQUIPMENT

A. Only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Owner. No material shall be delivered to the site that does not meet the Contract Specifications.

B. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporating in the work. Any delay of acceptance resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against the Owner.

C. The materials and equipment used in the Work shall correspond to the approved samples or other data.

D. If requested, the Contractor shall be required to submit to the Owner ample evidence that each and every part of the materials, machinery, and equipment to be furnished is of a reliable make and of a type that has been in successful operation within the continental United States. No equipment will be considered unless the manufacturer has designed and manufactured equipment of a comparable type and size for at least 3 years. The Owner will not allow any experimental or untried type of material or machinery to be installed.

E. The equipment specified shall be carefully designed and installed to ensure that it adequately performs all required functions within the specified degree of precision. Each unit shall operate with each of the other parts of the equipment to provide a completely integrated system that shall operate to the satisfaction of the Owner.

F. All equipment, machinery, parts, and assemblies of equipment, machinery, or parts entering into the Work shall be tested as specified. Unless waived in writing by the Owner, all field and operating tests shall be made in the presence of the Owner or the Owner's authorized representative. When such a waiver is issued, the Contractor or manufacturer shall furnish sworn statements in duplicate of the tests conducted and the results of the tests to the Owner.

G. The Contractor shall submit copies of welding procedures for all welding. Welders and welding operators shall be selected in accordance with the qualification requirements of the AWS Code. Welders and welding operators for stainless steel shall pass qualification tests using stainless steel filler metal and procedures developed for stainless steel. Procedures, welder, and operator qualifications shall be certified by an independent testing laboratory retained and paid by the Contractor.

H. The Contractor shall not start fabrication of the Work until the Contractor receives written acceptance of the proof of welding procedures from the Owner for each type of weld.

I. The Contractor shall submit copies of mill certificate for each type of rolled steel and as required in the Specifications. The Contractor shall not start fabrication of the work until the Contractor receives written acceptance of all mill certificates from the Owner.

1.03 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

A. The equipment installation details shall suit the existing and furnished equipment and are subject to acceptance by the Owner.

B. Any changes or revisions made necessary by the type and dimensions of the equipment furnished shall be made at the expense of the Contractor who shall furnish detailed drawings showing such changes or revision for the acceptance of the Owner.

C. The installation of all work shall comply with the manufacturer's printed instructions. The Contractor shall obtain and distribute copies of such instructions to parties involved in the installation, including six copies to the Owner for distribution. One complete set of instructions shall be maintained at the job site during installation and until the Project is complete.

D. All products and equipment shall be handled, installed, connected, cleaned, conditioned, and adjusted in accordance with the manufacturer's instructions and specified requirements. Should job conditions or specified requirements conflict with the manufacturer's instructions, such conflicts shall be called to the Owner's attention for resolution and revised instructions.

E. The Contractor shall perform work according to the manufacturer's instructions and not omit any preparatory step or installation procedure unless the instructions are specifically modified or the step or procedure exempted by the Contract Documents.

1.04 INSTALLATION OF EQUIPMENT

A. General: The Contractor shall install the equipment in accordance with the manufacturer's instructions and recommendations and approved submittals at the locations shown on the Drawings. If the equipment locations shown on the Drawings are in conflict with the manufacturer's recommendations or will interfere with the installation or operation of any other item indicated in the Contract Documents, the Contractor shall relocate this equipment and provide the necessary appurtenances to install the equipment in accordance with the manufacturer's recommendations at no additional cost to the Owner. The Contractor shall not install any equipment at locations not in accordance with the Contract Documents or approved submittals.

B. The Contractor shall take special care to ensure proper alignment of all equipment including water control gates, pumping stations, water control structures, and appurtenances. The units shall be carefully aligned on their foundations by qualified millwrights after the units' sole plates have been shimmed to true

alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the Manufacturer's Representative has approved the foundation alignments, the bedplates or wing feet of the equipment shall be securely bolted in place. The Contractor shall further check the alignment of the equipment after it is secured to the foundations and, after all alignments are confirmed, shall finally grout the sole plates in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping and under no circumstances will "pipe springing" be allowed.

C. The Contractor shall install equipment, slabs, walls level and plumb, parallel, and perpendicular to other building and components in exposed interior spaces, unless otherwise shown on the Drawings.

D. The Contractor shall apply an anti-seize compound to threaded fasteners of equipment components that require removal, replacement, or adjustment as part of any maintenance or inspection procedure.

E. The Contractor shall furnish and install the required oil and grease for initial operation in accordance with the manufacturer's recommendations.

F. The Contractor shall provide means of oil lubrication for bearings and other metallic parts in sliding contact. Use alemite industrial-type fittings except where otherwise specified. The Contractor shall also perform the following work:

1. Locate lubrication points on equipment readily accessible without the necessity of removing covers, plates, housings, or guards, or without creating safety hazards at installed equipment elevations.
2. Exhaust pressure-lubricated units to the atmosphere to prevent excessive greasing.
3. Extend grease fittings to locations that are readily accessible to the Owner. The Contractor shall coordinate the location of these grease fittings with the Owner before their installation.

G. The Contractor shall furnish and apply touch-up paint to any equipment's factory painting finish that is chipped or damaged during installation. All factory-finish touch-up paint shall be mutually compatible with the factory finish on the equipment and shall be furnished by the manufacturer of the equipment to be touched up in the field.

H. If equipment mounting heights are not shown on the Drawings, the Contractor shall install that piece of equipment to provide the maximum amount of headroom (defined as the distance from the bottom of the structure to the top of finished floor or grade) as possible. In such an instance, the Contractor shall obtain the

Owner's approval for this mounting location before installing that piece of equipment in the field.

I. The Contractor shall furnish and install all mechanical equipment to facilitate service, maintenance, and repair or replacement of the equipment components. The Contractor shall connect equipment for ease of disconnecting, with minimum interference to other installations

J. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before Substantial Completion.

K. The Contractor shall furnish the service of competent manufacturers' representatives for Contractor- or Owner-furnished equipment when evident malfunction or over-heating makes such services necessary or as determined by the Owner. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

L. The Contractor shall furnish all wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level, and secure an apparatus in place. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper alignment after erection shall be done at the expense of the Contractor.

M. The Contractor shall furnish the necessary materials and construct suitable concrete foundations or pads for all equipment installed by the Contractor, even though such foundations or pads may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting.

1.05 SPECIAL TOOLS

A. Manufacturers of equipment and machinery shall furnish two sets of any special tools (including grease guns or other lubricating devices) required for normal adjustment, operations and maintenance, and disassembly, together with instructions for their use. The Contractor shall preserve and deliver to the Owner these tools and instructions in good order before completing the Contract. Tools shall be high-grade, smooth, forged, alloy tool steel. Grease guns shall be lever-type.

B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

C. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Owner.

D. Tools shall be delivered in heavy steel tool-boxes complete with lock and duplicate keys.

1.06 TESTS AND TEST REPORTS

A. When used in the Contract Documents, "Factory/Fabricating Shop Performance, Evaluation, Certification, and/or Acceptance Tests and Test Reports" shall be considered to mean the corresponding manufacturer's, fabricator's, and/or other builder's official test and tests reports. Included in these test reports shall be appropriate substantiating documentation/data ascertaining the correct and complete manufacture, fabrication, and "shop performance" (to the greatest extent normally practicable) of the particular material, equipment, system, and/or facilities proposed for eventual delivery. These are subdivided into three significant tests and test report types: 1) Certification Tests and Test Reports, 2) Factory Tests and Test Reports, and 3) Shop Performance/Evaluation Tests and Test Reports. Minimal requirements are described below.

B. Certification Tests and Test Reports

1. Standard specifications, code references, etc. for minimum quality and workmanship levels are indicated in the Contract Documents and Construction Documents. Statements, certificates, and other substantiating reporting data, called "Certification Test Reports" in this Section, of tests conducted on previously manufactured materials or equipment identical to that proposed for use shall be compiled by the Contractor.
2. At a minimum all Certification Test Reports shall contain an official analysis of sufficient material composition or show evidence of meeting or exceeding the specified material standard(s) referenced, e.g., ASTM, ASME, or other designations. All reports shall also indicate from whom the material was/will be purchased.
3. The Contractor shall pay all costs of certification tests and test reports.

C. Factory Tests and Test Reports

1. Additional tests and reports performed on material or equipment by the manufacturer or fabricator to ascertain quality or workmanship are referred to here as "Factory Tests and Test Reports."
2. Before the delivery of any Factory Test Report, the Contractor shall first submit for review and approval a detailed description of the proposed testing, including reporting procedure and criteria. Such descriptions shall

also be delivered to the Owner for review as part of the first submission of the technical submittal.

3. Materials and equipment used in the performance of the Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. If Work to be accomplished away from the construction site is to be inspected on behalf of the Owner during its fabrication or manufacture, the Contractor shall give prior notice to the Owner of the place and time where such fabrication or manufacture is to be done. Such notice shall be in writing and delivered to the Owner not less than 30 days before the Work is to be done so that the necessary arrangements for the particular factory inspection tests can be made.
4. Upon completion of the factory inspection tests and immediately following manufacture or fabrication, the Contractor shall compile a complete Factory Test Report following the approved format above. All such reports shall be delivered to the Owner for review as part of the technical submittal corresponding to such tested material or equipment.

D. Shop Performance/Evaluation Tests and Tests Reports

1. Material and equipment used in the performance of the Work of this Contract are also subject to evaluation and testing after the complete full-scale assembly into major equipment and/or systems. Shop Performance/Evaluation Tests, i.e., tests of simulated startup, steady-state, variable loading, and other normal operating conditions, for such assembled equipment/systems shall be accomplished in strict accordance with the standard testing practices specified or otherwise accepted by the Owner.
2. Before the delivery of any Shop Performance/Evaluation Test Report, the Contractor shall submit for review a detailed description of the proposed performance/evaluation tests, including anticipated reporting procedures, data reduction, and criteria used. Where appropriate, such descriptions shall also be delivered to the Owner for review as part of a first or subsequent submission of the technical submittal.
3. Should such performance/evaluation tests be accomplished away from the construction site, the Contractor shall give prior notice to the Owner of the places and times where such tests will be accomplished. Such prior notice shall be in writing and delivered not less than 30 days before such events so that necessary arrangements for the particular tests can be made.
4. The requirements above pertaining to Factory Tests and Test Reports shall be incorporated for shop Performance/Evaluation Tests and Test Reports. Unless factory tests are coincident with shop performance tests and vice versa for the same material or equipment, a minimum of 15 days shall be scheduled between such multiple equipment tests where extended travel is required.

E. Cost of Performance Shop Tests

1. The Contractor shall conduct shop performance full-scale tests at its expense on all equipment as specified. Each piece of equipment shall be tested completely assembled and the shop tests performed by the equipment manufacturer until successful tests are achieved.
2. If the performance tests are conducted outside the continental United States, the Contractor shall pay all transportation expenses incurred by the Owner's representatives in witnessing the tests at no additional cost to the Owner.

1.07 FIELD TESTING

A. Field-testing shall be conducted when called for in the Technical Specification Sections and on all completed systems in general. The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally consist of performing the pre-startup and startup tests as specified in the Division 11 Specifications. The Contract Documents may require the Contractor to perform factory testing on equipment items before the Owner approves their use for this project. The Contractor shall refer to the Division 11 Specifications regarding equipment shop testing requirements.

B. After completing the installation, the Contractor shall test the system in the presence of the Owner and under actual operating conditions. Tests shall be performed according to the manufacturer's recommendations.

C. The Contractor shall include with its bid the services of the equipment manufacturer's field service technician for a period necessary to complete the Work to the satisfaction of the Owner.

D. This service shall be for the purposes of checkout, initial start-up, certification, and instruction of facilities personnel.

E. A written report covering the technician's findings and installation approval shall be submitted to the Owner covering all inspections and outlining in detail any deficiencies noted.

1.08 ACCEPTANCE OF INSTALLATION

A. The Owner may accept an equipment system installation as ready for Substantial Completion when:

1. The Owner has accepted all factory tests and all other component testing.
2. The Owner has accepted all performance shop tests.
3. All components of the system are installed and tested, including without limitation hydrostatic tests, leak tests, continuity tests, insulation resistance tests, phase rotation tests, bump tests, stroke testing, calibration, adjustment for proper operation, and all other component tests as appropriate.
4. Field start-up activities have been completed and approved by the Owner.
5. The appropriate certificates have been submitted.
6. All equipment has met the performance requirements.
7. The Owner has accepted integrated system tests and adjustments performed by the Contractor to demonstrate that the system as a whole functions reliably and meets the performance requirements, in manual and automatic modes, without failure, fault, or defect of any component or of the system as a whole.
8. The Owner has accepted integrated facilities tests performed by the Contractor to demonstrate that the entire Construction functions together reliably as an integrated facility and meets the performance requirements, in manual and automatic modes, without failure, fault, or defect of any component.
9. The Owner has accepted facilities performance tests which demonstrate that the design criteria and performance criteria are met.
10. The Owner has accepted the O&M Manuals.
11. All required Owner personnel have been trained.
12. All other Contract requirements for Substantial Completion have been satisfied.

1.09 GREASE, OIL, AND FUEL

A. The Contractor shall furnish all grease, oil, and fuel required for start-up and testing of equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.

B. All grease, oil, and fuel required for start-up and testing of equipment shall be furnished with the respective equipment.

C. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of mechanical equipment no greater than 30 days after initial break-in of the equipment.

1.10 ELECTRICAL EQUIPMENT ENCLOSURES

A. All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the appropriate electrical sections of the Specifications. Enclosures for electrical equipment, such as switches and starters, shall conform to the requirements specified under the appropriate electrical sections of the Specifications.

1.11 EQUIPMENT DRIVE GUARDS

A. Screens, guards, or cages shall be provided for all exposed rotating or moving parts in accordance with accepted practices of applicable governmental agencies. Unless specified otherwise in the Technical Specifications sections, guards shall be constructed of galvanized sheet steel or galvanized woven wires or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps that will permit easy removal for servicing the equipment.

1.12 PROTECTION AGAINST ELECTROLYSIS

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

1.13 CONCRETE INSERTS

A. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized.

1.14 SLEEVES AND OPENINGS

A. The Contractor shall provide all openings, channels, chases, etc., in new construction and furnish and install anchor bolts and other items to be embedded in concrete, as required to complete the Work under this Contract. The Contractor

shall perform all cutting, coring, and rough and finish patching required in existing construction for the work of all trades.

B. Subcontractors shall furnish all sleeves, inserts, hangers, anchor bolts, etc., required for the execution of their work. Before the work of the Contractor begins, the subcontractors shall be responsible for furnishing the Contractor with the above items and with templates, drawings, or written information covering chases, openings, etc., which they require and to follow up the work of the Contractor as it progresses, making sure that their drawings and written instructions are carried out. If the subcontractors fail to do this, they shall be responsible for the cost of any corrective measures that may be required to provide necessary openings, etc. If the Contractor fails to carry out the directions given him, covering details and locations of openings, etc., he/she shall be responsible for any cutting and refinishing required to make the necessary corrections. In no case shall beams, lintels, or other structural members be cut without the approval of the Owner.

C. Unless otherwise indicated on the Drawings or specified, openings for the passage of pipes through floors and walls shall be formed of sleeves of standard-weight, galvanized-steel pipe. Each sleeve shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be of sufficient length to be flush at the walls and the bottom of the slabs and to project 2 inches above the finished floor surface. Threaded nipples shall not be used as sleeves.

D. Sleeves in exterior walls below ground or in walls to have liquids on one or both sides shall have a 2-inch annular fin of 1/4-inch plate welded with a continuous weld completely around the sleeve at about mid-length. Sleeves shall be galvanized after the fins are attached.

E. All sleeves shall be set accurately before the concrete is placed or shall be built-in accurately as the masonry is being built.

1.15 SERVICES OF MANUFACTURERS' FIELD SERVICE TECHNICIAN

A. Bid prices of equipment furnished shall include the cost of a competent field service technician of the manufacturers of all equipment to supervise the installation, adjustment, and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. The approved manufacturer's operation and maintenance data as specified in Section 01830, Operations and Maintenance Manuals, shall be delivered to the Owner before instructing the Owner's personnel. This supervision may be divided into two or more periods as required by the installation program or as directed by the Owner.

B. After the equipment has been installed and the equipment is presumably ready for operation, but before it is operated by others, the manufacturers' field service technician shall inspect, operate, test, and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without cracked or otherwise damaged parts).
2. Completeness in all details, as specified and required.
3. Correctness of setting, alignment, and relative arrangement of various parts.
4. Adequacy and correctness of packing, sealing, and lubricants.
5. Calibration and adjustment of all related instrumentation and controls.
6. Energize equipment.
7. Deficiency correction.
8. Demonstration of compliance with application performance specification.

C. The operation, testing, and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

D. Upon completion of this operation, testing, and adjustment, the manufacturers' field service technician shall submit to the Owner, in triplicate, a complete, signed report of the results of the inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance.

E. Each equipment manufacturer shall provide instruction to the Owner's operating personnel. Training shall not be performed until the requirements of Paragraphs B, C, and D above have been fully satisfied and any specified performance testing completed. Training shall be provided for the number of days specified in each Equipment Section of these Specifications. Training shall be provided on an 8-hour-per-day basis. Partial days (less than 8 full working hours) shall not be credited toward the specified durations. Training shall not be concurrent with on-going testing, debugging, or installation activities but shall be a separate activity devoted exclusively to the instruction of the Owner's personnel in the operation and maintenance of the manufacturers' equipment. Training shall be performed by qualified representatives of each equipment manufacturer specifically skilled in providing instruction to operation personnel. Training shall provide an overview of operations and maintenance requirements and shall include but not be limited to the following:

1. Description of unit and component parts.
2. Operating capabilities and performance criteria.
3. Operating procedures.

4. Maintenance procedures.
5. Servicing and lubrication schedules.
6. Troubleshooting.

F. A certificate from the manufacturer stating that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested and is ready for operation; and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before start-up and acceptance by the Owner. The certificate shall indicate date and time the instruction was given and names of the operating personnel in attendance.

G. See the detailed Specifications for additional requirements for furnishing the services of the manufacturers' field service technician.

H. For equipment furnished, the Contractor, unless otherwise specified, shall furnish the services of accredited field service technicians of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01650
DELIVERY, STORAGE, AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

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

1.02 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in this Section for storing and protecting the items.

B. The Contractor shall do the following:

1. Materials and equipment shall be loaded and unloaded by methods affording adequate protection against damage. Every precaution shall be taken to prevent injury to the material or equipment during transportation and handling. Suitable power equipment shall be used and the material or equipment shall be under control at all times. Under no condition shall the material or equipment be dropped, bumped, or dragged. When a crane is used, a suitable hook or lift sling shall be used. The crane shall be so placed that all lifting is done in a vertical plane. Materials or equipment skid loaded, palletized, or handled on skidways shall not be skidded or rolled against material or equipment already unloaded.

2. Material and equipment shall be delivered to the job site by means that will adequately support it and not subject it to undue stresses. Material and equipment damaged or injured in the process of transportation unloading or handling shall be rejected and immediately removed from the site.

3. The Contractor shall coordinate the delivery of all materials, including those furnished by the Owner. The Contractor shall be responsible for the proper transport, handling, and storing of all materials, and materials shall be protected to ensure their expected performance. Delivery schedules shall be coordinated by the Contractor, in advance, so that the Work will be done in a timely manner.

4. The Contractor shall coordinate deliveries of products with construction schedules to avoid conflict with work and conditions at the site. The Contractor shall also do the following:

    a. Deliver products in undamaged condition, in the manufacturer's original containers or packaging, with identifying labels intact and legible.
    b. Immediately on delivery, inspect shipments to ensure compliance with requirements of the Contract Documents and approved submittals and to ensure that the products are properly protected and undamaged.

5. The Contractor shall provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

6. All materials and equipment shall be stored on-site in complete compliance with the manufacturer’s recommendations.

7. Store products subject to damage by the elements in weather-tight enclosures.

8. Maintain temperature and humidity within the ranges required by the manufacturer's instructions.

9. Store fabricated products above the ground, on blocking or skids to prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings, and provide adequate ventilation to avoid condensation.

10. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during, and after shipment in a manner that will prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind to the material or equipment.

11. All materials which, in the opinion of the Owner, 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 the Contractor shall receive no compensation for the damaged material or its removal.

12. The Contractor shall arrange storage in a manner to provide easy access for inspection and make periodic inspections of stored products to ensure that products are maintained under specified conditions, free from damage or deterioration.

13. The Contractor shall provide substantial coverings as necessary to protect installed products from traffic damage and subsequent construction operations and shall remove these coverings when they are no longer needed.

14. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract, within 7 days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in the previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may include expenditures for labor, equipment use, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

15. Schedule delivery to reduce long-term onsite storage before installation and/or operation. Under no circumstances shall equipment be delivered to the site more than 1 month before installation without written authorization from the Owner.

16. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.

17. Deliver products to the site in the manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.

18. Unload and place all items delivered to the site in a manner which will not hamper normal construction operation nor that of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

19. Provide necessary equipment and personnel to unload all items delivered to the site.

20. The Contractor shall store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Follow storage instructions, review them with the Owner, and keep a written record of this. Arrange storage to permit access for inspection.

21. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

22. Store cement and lime under a roof and off the ground and keep it completely dry at all times. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking. Handle and store brick, block, and similar masonry products in a manner to keep breaking, cracking, and spilling to a minimum.

23. Store all mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) in a weathertight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner. The building shall be provided with adequate ventilation to prevent condensation. The Contractor shall ensure that temperature and humidity are maintained within the range required by the manufacturer.

    a. All equipment shall be stored fully lubricated with oil, grease, and other lubricants unless otherwise instructed by the manufacturer.
    b. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor shall start the equipment, at least at half load, once weekly for an adequate period to ensure that the equipment does not deteriorate from lack of use.
    c. Lubricants shall be changed when installation is complete and as frequently as required thereafter during the period between installation and acceptance. The Contractor shall put new lubricants into the equipment at the time of acceptance.
    d. Before accepting equipment that has been stored for some time, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01780
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

A. Compile specified warranties and bonds.
B. Co-execute submittals when so specified.
C. Review submittals to verify compliance with Contract Documents.
D. Submit submittals to the Owner for review.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Assemble warranties, bonds, and service and maintenance contracts executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Number of original signed copies required: two each.

C. Table of Contents: Neatly typed, in sequence of the Specifications. Provide completion information for each item as follows:

1. Product or work item.

2. Firm, address, telephone and fax numbers, and name and email of principal.

3. Scope.

4. Date of beginning of warranty, bond, or service and maintenance contract.

5. Duration of warranty, bond, or service and maintenance contract.

6. Provide information for Owner's personnel:

a. Proper procedure in case of failure.
b. Instances that might affect the validity of warranty or bond.

7. Contractor, with address, telephone and fax numbers, and the name and email of responsible principal.

D. Submittal of warranties, bonds, and service and maintenance contracts shall be included in submittals for review and before Final Completion with actual dates included.

E. The Contractor's obligation to correct defective or nonconforming Work shall run for 1 year (or such longer period may otherwise be specified in the Contract Documents) beginning from the date Substantial Completion is achieved.

1.03 WARRANTIES

A. All mechanical and electrical equipment together with devices of whatever nature and all components which are furnished and/or installed by the Contractor shall be guaranteed.

B. The guarantee shall be against the manufacturing and/or design inadequacies, materials, and workmanship not in conformity, improper assembly, hidden damage, failure of devices and/or components, excessive leakage, or other circumstances which would cause the equipment to fail under normal design and/or specific operating conditions for 1 year or such longer period as may be shown and/or specified from and after the date of Substantial Completion.

C. The Contractor shall replace and install each piece of equipment, device, or component which shall fail within the term specified above of the guarantee with reasonable promptness without increase in the Contract Price. If the Contractor fails to provide timely repairs as specified in this Section, the Owner shall issue a claim against the Contractor's Bond. In some instances, if approved by the Owner, the Contractor may be allowed to repair the equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01785
RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section details the minimum requirements for the Contractor for maintenance and recording of Record Documents, and Record Drawings

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance, and record documents as specified below:

A. The Contractor shall institute a computerized record control program.

B. The Contractor shall make documents and samples available at all times for inspection by the Owner.

C. At Contract closeout, the Contractor shall transmit Record Documents including Record Drawings, and samples with cover letter to the Owner, listing the following:

1. Date.
2. Project Title and Number.
3. Contractor's Name and Addresses.
4. Number and Title of each Record Document.
5. Signature of Contractor or its Authorized Representative.
6. Contract Section and Subsection numbers.
7. Location.

D. Before assembling and submitting records, the Contractor shall review for completeness the records maintained by its subcontractors.

E. Tracings of all Construction Documents and Shop Drawings made by the Contractor, subcontractors, and suppliers of materials or equipment shall be corrected to show the Work as actually completed or installed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROJECT RECORD

A. The Contractor shall label and file Record Documents and samples in accordance with the corresponding Specification Section number. Each document shall be labeled “PROJECT RECORD” in neat, large, printed letters. Record Documents shall be maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes.

3.02 RECORDING

The Contractor shall record construction information as follows (refer to the Record Drawing Checklist at the end of this Section for additional requirements):

A. Record and update daily Record information from field notes on a set of opaque Contract Drawings and to the satisfaction of the Owner.

B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.

C. Record information concurrently (daily) with construction progress. Work shall not be concealed until required information is recorded.

D. Record Drawings shall be a special revision of the construction drawings and shall reflect the following:

1. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
3. Field changes of dimension and detail.
4. Changes made by modifications.
5. Top-of-wall elevations, northing and easting coordinates, and slab elevations of all new and modified structures.
6. For underground piping, northing and easting coordinates of valves elbows, tees, and invert elevations.
7. Details not on original construction drawings.
8. At locations where a top-of-pipe elevation or centerline is required for pipeline, a top-of-ground or top-of-pavement elevation shall also be measured and noted on the Drawings.
9. On Record Drawings, at locations where the horizontal or vertical dimensions of constructed pipelines, structures, equipment, and other improvements deviate from the horizontal positions that were shown on

the construction Drawings, the actual positions of the pipelines or structures shall be measured and redrawn in CADD to depict their actual positions on the Record Drawings, and their original design positions shall be cross-hatched out, screened back to a lighter shade, or other notations to indicate the change between design and as-built.

10. Record information shall include a thorough description of the improvements that have been installed, including types of material, size, class, diameter, diameter ratio, deviations from the design, and other basic information.
11. For new valves, the manufacturer type (e.g., gate, plug, ball), size (pipe nominal diameter), and make (manufacturer) of each valve shall be noted on the Record Drawings.
12. The drawings scales used in the Record Drawings shall be the same as were used in the Contract Drawings, and the sheet number of each Record Drawing sheet shall be the same as the sheet numbers that were used on the Contract Drawings from which the Record Drawings originate.
13. Record Drawings shall accurately depict all existing improvements lying within the immediate vicinity of the constructed facilities. Existing improvements shall include but not be limited to sidewalks, fences, road surfaces, buildings, and other utilities. Immediate vicinity includes areas within utility easements, right-of-way corridors, and also includes areas within 15 feet of new potable water mains, force mains, gravity sewer mains, storm pipes, power and communications lines, gas piping, and other utilities. Immediate vicinity also includes areas within 10 feet of potable water meters, backflow preventers, and fire hydrants. Rights-of-way, easements, and property corners shall be shown and shall be of sufficient detail as to confirm that constructed facilities are within appropriate property boundaries, easements, or rights-of-way. A reference to the recording document (O.R. Book or Plat Book and Page) shall be included with any depiction of a right-of-way, easement, or property boundary.
14. Each roadway depicted on the Drawings shall have the correct roadway name noted on it.
15. Horizontal locations required for valves, fittings, services, and other utility structures shall be to the center of each installation. Top-of-ground or pavement elevations required along pipelines shall be reported to the nearest 0.1 foot. Top-of-pipe elevations shall be reported to the nearest 0.1 foot. Elevations of manhole rims and manhole pipe inverts shall be reported to the nearest 0.1 foot. Top-of-wall elevations shall be reported to the nearest 0.02 foot. Weir and gate elevations shall be reported to the nearest 0.02 foot.
16. All sheets that were used to depict locations and elevations of utility structures in the Construction Drawings shall be included in the Record Drawings set.

17. Record information shall be presented in a clear and comprehensible form.
18. Abandoned-in-place water main pipe shall be shown in their actual positions.

E. The Contractor shall present the field logbook containing swing tie information and red-lined as-built drawings at each monthly construction meeting for review by the Owner. Failure to produce adequate as-built information will be grounds for withholding appropriate funds from the monthly payment applications.

F. CAD Requirements for Record Drawings: The Contractor shall, upon completion of the work, provide the Owner with a complete set of Record Drawings that includes as-built information updated in AutoCAD on the original Contract Drawings. The Record Drawings shall include every drawing that is in the Contract Drawing set, plus any supplemental drawings necessary to convey the as-built information. Supplemental drawings shall use the same title block as the other Record Drawings with supplemental unique page numbers. No additional compensation will be allowed for the Contractor to provide the Record Drawings. The Contractor shall use the AutoCAD drawings furnished by the Owner for this purpose. Record Drawings must be submitted in the AutoCAD format of the Contract Drawings. No other CAD software or format will be accepted. The Contractor is solely responsibility for ensuring that the Record Drawings conform to the following CAD requirements:

1. Two sets of hard copy drawings shall be submitted to the Owner as well as digital AutoCAD drawings submitted via electronic transmittal. Each electronic transmittal shall be clearly labeled with the appropriate project number, client name, date, and file names included on each CD. If files are compressed, a description of the compression software must be included along with a copy of the appropriate uncompressing software.
2. All changes to drawings must be done in accordance with the same scale of the drawing revised and shall be delineated by placing a "cloud" around the areas revised and adding a revision triangle indicating the appropriate revision number.
3. Each drawing must have the revision block completed to indicate the revision number, date, and initials of the person revising the drawing. The description of the revision must say "Record Drawing." This procedure must be followed for every drawing even when no changes are made to the drawing.
4. All revisions to drawings must be put on separate layers with the layer names prefixed Record followed by the appropriate existing layer name. The colors and line types of the appropriate existing layers shall be adhered to when creating new layers.
5. The Contractor shall supply one full set of Record Drawings on reproducible black line prints and five full sets of opaque copies.

G. The Contractor shall have the Licensed Land Surveyor certify the Record Drawings as being true, correct, and complete, and data were collected in the field by the surveyor or by a representative under the direct supervision of the surveyor. All visible record features, including sewer and drainage inverts, must be measured and located by the surveyor or by personnel under his or her direct supervision. The certifying surveyor shall be fully responsible for the accuracy of the record locations and elevations shown on the Record Drawings.

1. The Contractor's surveyor shall resurvey all visible surface structures as part of the Record Drawings submittal, including, but not limited to, valve boxes, hydrants, relocated or new water meter boxes, automatic blow-off assemblies, walls, gates, and weirs.
2. Horizontal locations shall be tied to Geodetic Datum (NAD) 83.
3. Elevations shall be tied to North American Vertical Datum (NAVD) 88. Elevations tied to National Geodetic Vertical Datum (NGVD) 29 shall be converted to NAVD 88.

END OF SECTION

SECTION 01830
OPERATIONS AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

A. Compile product data and related information appropriate for the Owner's maintenance and operation of products furnished under the Contract.

1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of the Specifications. The data presented in the O&M Manuals shall be specifically related to this Contract and application.
2. Incorporate maintenance and operation data furnished by the Owner, if any.

B. Furnish all labor, equipment, materials, and all other items to supply and deliver to the Owner O&M Manuals for the Work in accordance with the requirements of this Section.

C. Provide O&M Manuals for all equipment, including instrumentation, electrical, and process control system equipment and software for the entire Facility.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Manuals which, in general, shall have two levels: a facilities-wide systems level and an individual-component level.

1. The facilities-wide systems level shall do the following:

a. Describe the facilities-wide systems, including diagrams.
b. Explain start-up, shutdown, normal operations, and malfunctions of the facilities-wide systems.
c. Tabulate a lubrication schedule for the facilities-wide systems.
d. Describe preventive maintenance checking procedures for the facilities-wide systems.
e. Include a cross-reference to all individual component manuals.

2. The individual-component level shall contain the following:

    a. Storage requirements.
    b. Installation instructions.
    c. Alignment instructions and tolerances.
    d. Operating instructions.
    e. Troubleshooting instructions.
    f. Lubrication requirements.
    g. Maintenance instructions.
    h. Parts list.
    i. Recommended spare parts list and how to obtain same.

B. Format:

1. Electronic file format: PDF.

2. Size: 8 1/2-x-11-inch format for narrative and figures. Larger standard sizes are acceptable for drawings.

3. Text: Manufacturer's printed data or neatly word-processed.

4. Provide a new page for each separate product or each piece of operation equipment.

    a. Provide a word-processed description of the product and major component parts of equipment.
    b. Provide indexed tabs.

5. Cover: Identify each volume with the typed title, "OPERATION AND MAINTENANCE INSTRUCTIONS," listing the following:

    a. Title of Project.
    b. Identity of separate structure as applicable.
    c. Identity of general subject matter covered in the manual.

6. All word processing must be done using the latest version of Microsoft Word.

7. Arrange the data into related consistent groupings and cover all with a table of contents and index with page numbering of all sheets.

C. The Contractor shall submit the following:

1. Equipment Manuals—O&M Instruction Manual for each piece of equipment shall be submitted to the Owner with delivery of the equipment.
2. Systems O&M Manuals—Systems O&M Manuals, indexed and submitted to the Owner no later than 14 days before the Facility's start-up. Systems O&M Manuals will be complete except for field results and refinements added as result of demonstrations.
3. Final O&M Manuals—Final Equipment and Systems O&M Manuals, indexed and submitted to the Owner before the Substantial Completion under this Contract.
4. The cost of these Manuals shall be included in the total Contract Price.

D. Any modifications required after final O&M submission shall be made to the manuals by issuance of complete replacement O&M manuals. Addenda with pages for insertion into manuals previously provided are not allowed. The updated manuals shall be accompanied by a written description of the changes made to the manual.

1.03 QUALITY ASSURANCE

A. Data shall be prepared by personnel:

1. Trained and experienced in maintaining and operating the described products.
2. Familiar with requirements of this Section.
3. Skilled as a technical writer to the extent required to communicate essential data.
4. Skilled as a person competent to prepare required drawings.

1.04 CONTENTS, EACH VOLUME

A. Neatly word-processed table of contents for each volume, arranged in systematic order, to include the following:

1. Contractor, name of responsible principal, address, fax number, and telephone number.

2. A list of each product required to be included, indexed to content of the volume.

3. A list with each product, name, address, fax number, and telephone number of the following:

    a. Subcontractor or installer.
    b. A list of each product to be included, indexed to content of the volume.
    c. Identify area of responsibility of each subcontractor or installer, if more than one.
    d. Local source of supply for parts and replacement.
    e. Manufacturer.

4. Identify each product by product name and other identifying symbols as set forth in the Contract Documents.

B. Product Data

1. Include only those sheets that are pertinent to the specific product.

2. Annotate each sheet to achieve the following:

    a. Clearly identify the specific product or part installed.
    b. Clearly identify data applicable information.
    c. Delete references to inapplicable information.

C. Drawings

1. Supplement product data with drawings as necessary to illustrate the following clearly:

    a. Relations of component parts of equipment and systems.
    b. Control and flow diagrams.
    c. Owner Tag Numbers.

2. Coordinate drawings with information in Record Documents to ensure correct illustration of completed installation.

3. Do not use Record Documents as maintenance drawings.

D. Written text as required to supplement product data for the particular installation:

1. Organize in consistent format under separate headings for different procedures.
2. Provide a logical sequence of instructions for each procedure.
3. Describe how the complete system is to operate.

E. Copy of pertinent information related to warranty, bond, and service Contract issued.

1. Provide information sheet for Owner's personnel with the following information:

a. Proper procedures in event of failure.
b. Instances that might affect the validity of warranties or bonds.

F. Training manuals used in training courses will become part of this Manual.

1.05 MANUAL FOR MATERIALS AND FINISHES

A. Content, for architectural products, applied materials, and finishes:

1. Manufacturer’s data, giving full information on products:

a. Catalog number, size, composition.
b. Color and texture designations.
c. Information required for re-ordering special-manufactured products.

2. Instructions for care and maintenance:

a. Manufacturer’s recommendation for types of cleaning agents and methods.
b. Cautions against cleaning agents and methods that are detrimental to product.
c. Recommended schedule for cleaning and maintenance.

B. Content, for moisture-protected and weather-exposed products:

1. Manufacturer’s data, giving full information on products:

a. Applicable standards.
b. Chemical composition.
c. Details of installation.

2. Instructions for inspection, maintenance, and repair.

C. Additional requirements for maintenance data as required by other sections of the Specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Content, for each electrical, mechanical, instrumentation, and communication system, as appropriate:

1. A table identifying each piece of equipment, each associated control or instrument, the location of the control or instrument, and the function of the control or instrument.

2. A description of the system and its component parts:

   a. Function, normal operating characteristics, and limiting conditions for the system, the sub-system, and the component parts.
   b. Performance curves, engineering data, and tests.
   c. Complete nomenclature and commercial numbers of replaceable parts.

3. Circuit directories of panel board:

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

4. As-installed color-coded wiring diagrams.

5. Instrument loop diagrams showing the path that a control or instrumentation signal takes from its origin to the action it takes.

   a. An electrical schematic for each item.
   b. A chart listing the controls/instruments in a loop identifying the equipment's abbreviated symbol, a description of the symbol, design criteria, process flow, quantity supplied, and manufacturer's model and serial number.

6. Operating procedures:

   a. Routine and normal operating instructions.
   b. Sequences required.
   c. Special operating instructions.

7. Maintenance procedures:

   a. Routine operations.
   b. Guide to "trouble-shooting."

c. Disassembly, repair, and re-assembly.
d. Alignment, adjustment, and checking.

8. The manufacturer's printed operating and maintenance instructions.

9. A list of the original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

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

11. Abnormal and emergency operations:

a. Potential overloads.
b. Procedures for equipment breakdown.
c. Action to be taken in a power outage.
d. Identity of alarms by equipment location and action to correct.
e. Equipment safety features, requirements, and potential hazards.

12. Programming manuals for programmable devices including list of standard programming.

B. Content, for each unit of equipment and system, as appropriate:

1. Description of unit and component parts:

a. Function, normal operating characteristics, and limiting conditions.
b. Performance curves, engineering data, and tests.
c. Complete nomenclature and commercial number of replaceable parts.
d. Model number and name plate data for each piece of equipment.
e. Assembly drawings.
f. List of all special tools required to service equipment and/or systems including where the tools are stored.

2. Operating procedures:

a. Start-up, break-in, routine, and normal operating instructions.
b. Regulation, control, stopping, shut-down, and emergency instructions.
c. Summer and winter operating instructions.
d. Special operating instructions.
e. Control settings and ranges.

3. Maintenance procedures:

    a. Type and frequency of preventive maintenance activities required for each piece of equipment.
    b. Guide to "trouble-shooting."
    c. Disassembly, repair, and re-assembly.
    d. Alignment, adjusting, and checking.

4. Servicing and lubrication schedule:

    a. List of lubricants required.
    b. Period between lubrications.

5. Manufacturer's printed operating and maintenance instructions. (This is not to be a generalized catalog of the entire product line.)

6. Description of sequence of operation.

7. The original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance:

    a. Predicted life of parts subject to wear.
    b. Items recommended to be stocked as spare parts.

8. As-installed control diagrams.

9. Each Contractor's coordination drawings.

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

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

12. Charts of equipment, instrument, and valve tag numbers with location and function:

    a. Reference drawing which shows equipment, instrument, or valve location.
    b. Manufacturer's model and serial number.
    c. Valve actuator type (manual, hydraulic, electric, or pneumatic).

13. Local services (process water and air, drains, HVAC, natural gas and steam).

C. The Contractor shall prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.

D. Additional requirements for O&M data required by other sections of the Specifications.

PART 2 PRODUCTS

2.01 O&M MANUALS

A. Electronic Version: O&M Manuals shall be provided electronically. The manual files must be in PDF format capable of being read, annotated, and printed with Adobe Standard, Adobe Pro, or BlueBeam, unless other software and file format is approved by the Owner, at the time of the transmittal of documents. AutoCAD files for drawings shall be provided separately from PDF versions included in the manual.

PART 3 EXECUTION (NOT USED)

END OF SECTION

DIVISION 2

SITE CONSTRUCTION

SECTION 02000
REFERENCED FDOT SPECIFICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the work necessary to provide for the construction where indicated on the Drawings.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Product data for reinforced concrete pipe, along with gaskets, is required to indicate performance in accordance with the specifications.

B. Shop drawings for drainage structures including curb inlets, ditch bottom inlets, manholes, and mitered end sections is required to indicate performance in accordance with the specifications. Include shop drawings for frames, covers, and grates with each drainage structure.

C. Submit maintenance of traffic plan(s) for each phase of construction.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time, unless otherwise noted. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. The January 2022 edition of the *FDOT Standard Specifications for Road and Bridge Construction* (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section. The referenced FDOT Standard Specifications that apply to this project include the following sections along with the sections referenced within these sections:

- 104, Prevention, Control, and Abatement of Erosion and Water Pollution.
- 110, Clearing and Grubbing.
- 120, Excavation and Embankment.
- 285, Optional Base Course.

- 515, Metal Pedestrian/Bicycle Railings, Guiderails, and Handrails.
- 520, Concrete Gutter, Curb Elements, and Traffic Separator.
- 522, Concrete Sidewalk and Driveways.
- 530, Revetment Systems.
- 550, Fencing.
- 570, Performance Turf.
- 911, Base and Stabilized Base Materials.

1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to “the Owner” by this contract.

2. Payment for this project is in accordance with Section 01200, Measurement and Payment.

3. Additional requirements superseding the applicable portions of the above FDOT Standard Specifications are provided in the subsequent sections of these Technical Specifications.

1.04 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

PART 2 PRODUCTS

2.01 GENERAL

A. The January 2022 edition of the *FDOT Standard Specifications for Road and Bridge Construction* (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section. The referenced FDOT Standard Specifications that apply to this project include the following sections along with the sections referenced within these sections:

- 104, Prevention, Control, and Abatement of Erosion and Water Pollution.
- 110, Clearing and Grubbing.
- 120, Excavation and Embankment.
- 515, Metal Pedestrian/Bicycle Railings, Guiderails, and Handrails.
- 520, Concrete Gutter, Curb Elements, and Traffic Separator.

- 522, Concrete Sidewalk and Driveways.
- 530, Revetment Systems.
- 550, Fencing.

1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to “the Owner ” by this contract.

2. Payment for this project is in accordance with Section 01200, Measurement and Payment.

3. Additional requirements superseding the applicable portions of the above FDOT Standard Specifications are provided in the subsequent sections of these Technical Specifications.

PART 3 EXECUTION

3.01 GENERAL

A. The January 2022 edition of the *FDOT Standard Specifications for Road and Bridge Construction* (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section. The referenced FDOT Standard Specifications that apply to this project include the following sections along with the sections referenced within these sections:

- 104, Prevention, Control, and Abatement of Erosion and Water Pollution.
- 110, Clearing and Grubbing.
- 120, Excavation and Embankment.
- 515, Metal Pedestrian/Bicycle Railings, Guiderails, and Handrails.
- 520, Concrete Gutter, Curb Elements, and Traffic Separator.
- 522, Concrete Sidewalk and Driveways.
- 530, Revetment Systems.
- 550, Fencing.

1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to “the Owner” by this contract.

2. Payment for this project is in accordance with Section 01200, Measurement and Payment.

3. Additional requirements superseding the applicable portions of the above FDOT Standard Specifications are provided in the subsequent sections of these Technical Specifications.

END OF SECTION

SECTION 02078
GEOGRID REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install geogrid reinforcement as needed to bridge unsuitable soils.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Pre-construction Submittals: Submit the following within 10 days of Notice to Proceed and 30 days before proposed product shipment:

1. Manufacturer's Information:

a. Manufacturer's name, address, and primary contact.

b. Manufacturing plant name and the address where the geogrid for this project will be produced.

c. Manufacturer's qualifications including:

(1) Evidence of production of at least 2 million square feet of geogrid that meets the specifications of Article 2.01.
(2) Certification that the Manufacturer has sufficient capacity to provide the required material in the given timeframe.
(3) A list of at least 10 projects for which the Manufacturer has supplied geogrid reinforcement, three of which shall have been for projects of similar size and purpose.

d. Manufacturer's quality control (MQC) plan and certificates, including name and address of the quality control testing laboratory, laboratory certification, examples of re-testing notification, and documentation. Testing must be done in accordance with the quality control plan and in accordance with Article 2.01.

e. Manufacturer's product name, description, and material properties sheet (product sheets) of proposed product documenting that it will meet or exceed the specified requirements in Article 2.01.

f. Product sample 4 inches by 7 inches or larger.

g. Written instructions for delivering, storing, handling installing, seaming/joining, and repairing the proposed geosynthetic, including recommendations for loading, unloading, and handling equipment (model number or load capacity).

h. Structural connection product information and Manufacturer's certificate of connection strength values for geogrid connection.

i. Sample product warranty.

2. Installer's Information:

a. Installer's name, address, and primary contact.

b. Installer's qualifications, including but not limited to a list of at least three previous projects of similar size and scope to this project including project name, location, size, and date of installation.

c. Construction Quality Control (CQC) plan, including but not limited to the following:

(1) Description of seaming/joining equipment and techniques.
(2) Description of methods for repairing geogrid.
(3) Description of method for removing rejected materials.
(4) Proposed staffing.
(5) Proposed equipment.
(6) Complete set of forms to be used for recording installation quality control data, including but not limited to daily record documents.

d. Installer's written procedures manual, including proposed construction equipment and structural connections.

B. Manufacturer's Quality Control (MQC)

1. MQC Certification reports shall be submitted at least 21 days before shipment of product.

2. MQC Sampling shall be in accordance with the specific test method listed in Table 1 of Article 2.01. If no sampling protocol is stipulated in the test method, then samples shall be taken evenly spaced across the entire roll width.
3. The number and frequency of the tests shall be in accordance with Table 1 in Article 2.01.
4. The Owner will reject rolls for which MQC requirements are not met.

C. Construction Quality Control (CQC)

1. During construction the Contractor shall submit the following CQC documentation weekly:

   a. Material delivery report.
   b. MQC testing reports and certifications.
   c. Rejected material removal report.
   d. Records of daily installation including roll numbers placed.
   e. Records of daily personnel activity.
   f. Meeting reports.
   g. Updated record drawing.

2. The Contractor shall submit the Geotechnical Testing Agency Qualifications according to ASTM E329 to conduct testing.

3. The Contractor will bear the cost of all of the Manufacturer's certification testing, including shipping samples to the CQA Consultant.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at bid time. The following documents are a part of this Specification. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D4354—Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing.
2. ASTM D4873/D4873M—Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
3. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
4. ASTM D5262—Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.

5. ASTM D5818—Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.
6. ASTM D6575/D6575M—Standard Test Method for Determining Stiffness of Geosynthetics Used as Turf Reinforcement Mats (TRMs).
7. ASTM D6637/D6637M—Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
8. ASTM D6706—Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.

B. Geosynthetic Research Institute (GRI)

1. GRI-GG2—Standard Test Method for Geogrid Junction Strength GRI-GRI-GG4(a)—Determination of the Long-Term Design Strength of Stiff Geogrids.
2. GRI-GG4(b)—Determination of Long-Term Design Strength of Flexible Geogrids.

C. US Army Corps of Engineers (USCOE)

1. Draft Specification for Grid Aperture Stability by In-Plane Rotation.
2. CW-02215 Determination of Percent Open Area.

1.04 QUALITY ASSURANCE

A. The Contractor will engage and pay for the services of an engineer and a testing agency to perform Construction Quality Assurance (CQA) testing in addition to the Construction Quality Control (CQC) performed by the Contractor.

1. Manufacturer, Installer, and Contractor must help the Owner and the Engineer with product sampling for CQA testing by providing samples, personnel, and equipment as necessary.

2. CQA tests will be the basis of acceptance of product and installation. The Contractor will be responsible for the cost of retesting should the CQA tests fail. The retests will be paid by the Owner and reimbursed by the Contractor.

3. After review of the Manufacturer's Materials Properties Sheets the Owner may visit the manufacturing plant and/or select product rolls to be sampled by the Manufacturer. The Manufacturer will ship one 3-foot-long by the width-of-roll-wide sample of product to the CQA Laboratory for CQA testing. The sample package should include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production

run from which the sample was taken. Five copies of the cover letter shall be submitted to the Owner.

4. Among other tasks, the Owner will observe and document the following:

   a. Delivery and storing material.
   b. Subsurface preparation.
   c. Placement and seaming/joining.
   d. Repairs.
   e. Quantities used.

B. The Owner will reject product for which quality control requirements are not met.

C. MQC and CQC are the responsibility of the Contractor who must document that the material and installation are in accordance with this Specification.

D. The Contractor's CQC representative will be responsible for construction quality control in accordance with the submitted CQC Plan, which is independent of Construction Quality Assurance (CQA).

1.05 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

B. The geogrid Manufacturer shall warrant, in writing, the geogrid material for a minimum of 5 years on a pro-rated basis. The warranty shall apply to normal use, service, environment, and exposures which can be anticipated from the intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. Material delivery, storage, and handling shall be in accordance with the documents as required in Paragraph 1.02A.1.g.

C. Labeling, shipment, and storage shall follow ASTM D4873/D4873M.

D. Product labels shall clearly show the project name, manufacturer or supplier name, product name, roll number, and lot number.

E. Identify and separate damaged rolls from undamaged rolls and store damaged rolls at locations designated by the Owner. Rolls without proper labeling that identify roll number and dimensions will be considered damaged. Damaged material will be repaired or rejected at the discretion of the Owner. Cost of repair or replacement will be borne by the Contractor.

F. Store product in a location designated by the Owner. In the absence of a specific location, product must not be stored in areas that will impair the operations of the facility or harm the materials.

G. Store geogrid to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

H. Store geogrid on a prepared surface. Prevent water from accumulating beneath the rolls.

I. Follow the Manufacturer's recommendations regarding protection from exposure to sunlight. Geosynthetic materials should not be left directly exposed to sunlight for a period longer than the period recommended by the manufacturer. A temporary enclosure should be constructed or the product should be moved inside an enclosed facility for storage periods exceeding manufacturer recommendations.

J. Use appropriate handling equipment to unload and store geosynthetic rolls. Appropriate equipment includes cloth chokers and spreader bars. The equipment must be of sufficient size and capacity to safely and efficiently handle geosynthetic materials without damage to the materials or injury to personnel.

K. Do not drag geogrid on the ground.

1.07 QUALIFICATIONS

A. Provide the Manufacturer's and the Installers qualifications in accordance with Paragraph 1.03A.1 and 2.

1.08 RECORD DRAWINGS

A. Record Drawings shall be prepared, maintained, and submitted showing the geogrid reinforcement installation in accordance with the requirements of the Contract Documents. Record Drawings shall indicate panel location, seam locations, and roll numbers for each panel. Record Drawings shall be updated throughout the project and are subject to field review by the Owner any time upon request. Record Drawings shall also meet all requirements of Section 01785, Record Documents.

1.09 DEFINITIONS

A. *Geogrid Subsurface*: The soil or geosynthetic surface on which the geogrid lies.

B. *Geogrid:* A biaxial or triaxial polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth to function primarily as reinforcement.

C. *Multi-Layer Geogrid:* A geogrid product consisting of multiple layers of grid which are not integrally connected throughout.

D. *Woven Geogrid:* A geogrid product formed by weaving discrete strips of polymer into a network. These geogrids usually require a protective coating to protect the polymer from pre-mature degradation.

E. *Welded Strip Geogrid:* A geogrid product formed by heat bonding (welding) discrete strips of polymer into a regular network.

F. *Bridging*: The condition when geosynthetic becomes suspended over its subgrade due to contraction of the material or poor installation.

G. *Installer:* The party responsible for field handling, transporting, storing, deploying, seaming/joining, and protection of the material.

H. *Lot:* A group of consecutively numbered rolls from the same manufacturing line.

I. *Manufacturer*: The party responsible for the production and quality of geotextile.

J. *Minimum Average Roll Value (MARV):* Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. 97.7 percent of any individual samples will have values greater than the MARV for any given property. Value based on testing and determined in accordance with ASTM D4759-92.

K. *True Initial Modulus in Use:* The ratio of tensile strength to corresponding zero strain. The tensile strength is measured via ASTM D6637/D6637M at a strain rate of 10 percent per minute. Values shown are MARVs. For multi-layer geogrid products, rib tensile testing shall be performed on the multi-layer configurations, as prescribed by ASTM D6637/D6637M.

L. *Junction Strength:* Breaking tensile strength of junctions when tested in accordance with GRI-GG2 as modified by AASHTO Standard Specification for

Highway Bridges, 1997 Interim, using a single rib having the greater of 3 junctions or 8 inches and tested at a strain rate of 10 percent per minute based on this gauge length. Values shown are minimum average roll values. For multi-layer geogrid products, junction strength testing shall be performed across junctions from each layer of grid individually, and results shall not be assumed as additive from single layers to multiple layers.

M. *Flexural Stiffness (aka Flexural Rigidity):* Resistance to bending force measured via ASTM 6575, using specimen dimensions of 864 millimeters in length by 1 aperture in width. Values shown are MARVs. For multi-layer geogrid products, flexural stiffness testing shall be performed directly on the multi-layer configuration without using any connecting elements other than those used continuously throughout the actual product, and results shall not be assumed as additive from testing performed on a single layer of the multi-layer product.

N. *Aperture Stability Modulus (aka Torsional Rigidity or Torsional Stiffness):* Resistance to in-plane rotational movement measured by applying a 20 kg-cm (2.0 m-N) moment to the central junction of a 9-inch by 9-inch specimen restrained at its perimeter. Values shown are MARVs. For multi-layer geogrid products, torsional stiffness testing shall be performed on each layer of grid individually, and results shall not be assumed as additive from single layers to multiple layers.

O. *Subgrade Improvement:* Placement of a geogrid immediately over a soft subgrade soil in order to improve the bearing capacity and mitigate deformation of the subgrade soil. The goal of this application may be to reduce undercut requirements, improve construction efficiency, reduce the amount of subbase/base material required, provide a stiff working platform for construction, or combination of these.

PART 2 PRODUCTS

2.01 STRUCTURAL GEOGRID

A. The geogrid shall be integrally formed and deployed as a single layer having the following characteristics:

Test	ASTM Test Designation	Minimum MQC Test Frequency	Conformance QA Test Frequency	Required Test Values (MARV)
				MD
1. Ultimate Tensile Strength (MD and XD)*	D6637/D6637M	1/project	1/project	2000 lb/ft
2. Tensile Strength at 5% Strain (MD and XD)*	D6637/D6637M	1/project	1/project	900 lb/ft

PART 3 EXECUTION (INSTALLER)

3.01 EXAMINATION

A. The Contractor shall check the geogrid upon delivery to verify that the proper material has been received. The geogrid shall be inspected by the Contractor to be free of flaws or damage occurring during manufacturing, shipping, or handling.

3.02 PROTECTION

A. When placing Fill over the geogrid ensure the following:

1. No damage to geogrid.
2. No slippage of geogrid on underlying layers.
3. No excessive tensile stresses are applied to geogrid.

B. Do not damage the geogrid when handling, with equipment traffic, due to leakage of hydrocarbons, or by any other means.

C. Do not allow any vehicular traffic directly on the geogrid without approval from the Owner.

3.03 PREPARATION

A. The Installer shall verify in writing to the CQA Consultant that the surface on which the geogrid will be installed is acceptable.

B. The Installer shall verify that no particles project from the underlying surface that could puncture the geosynthetic.

C. Underlying components must be completed and accepted by the CQA Consultant.

D. At a minimum, the subgrade shall be proof rolled prior to geogrid placement.

E. Geogrids shall not be placed in standing water.

3.04 DEPLOYMENT

To ensure proper deployment, the Installer shall do the following:

A. Follow the Manufacturer's recommendations, standards, and guidelines.

B. The geogrid shall be laid at the proper elevation and orientation as shown on the construction drawings or as directed by the Owner. Correct orientation of the geosynthetic shall be verified by the Contractor.

C. The geogrid shall be laid smooth without wrinkles or folds on the prepared subgrade.

D. On curves, the geogrid may be overlapped and cut to conform to the curves. The overlap shall be in the direction of construction and held in place.

E. Adjacent rolls shall be overlapped and joined in accordance with the Manufacturer's requirements and these specifications. Overlaps shall be in the direction of construction.

F. Weight geogrid with sandbags or equivalent as ballast during deployment that will not damage geogrid. Leave ballast in place until the geogrid is about to be covered. Remove ballast before placing overlying soil.

G. Cut geogrid using approved cutter only.

H. Do not entrap excessive dust, stones, or moisture in the geogrid that could hamper subsequent joining.

I. Examine the geogrid over the entire completed surface to ensure that no potentially harmful foreign objects are present. Remove any foreign objects.

J. Do not drag the geogrid across rough or textured surfaces to avoid damage.

K. After being rolled out, the geogrid shall be tensioned until taut, free of wrinkles, and lying flat.

L. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material as needed to avoid bridging.

M. Before covering geogrid, Contractor shall certify in writing to the Owner that the geogrid has not been damaged during installation. Damaged geogrids shall be repaired immediately. Cover the damaged area with a geogrid patch extending beyond damaged area.

3.05 FILL PLACEMENT OVER GEOGRID

A. Fill material shall be placed by end dumping on to the geogrid from the edge or over previously placed fill. Fill shall be placed in lifts and compacted as directed

under Section 02300, Earthwork for Structures. Fill material shall be placed, spread, and compacted in such a manner that minimizes the development of wrinkles in the geogrid and/or movement of the geogrid.

B. Tracked vehicles shall not be operated directly on geogrid. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid. When underlying substrate is trafficable with minimal rutting, rubber-tired equipment may pass over the geogrid at slow speeds (less than 10 mph) and in straight paths. When woven, multi-layer or welded-strip geogrids are used, rubber-tired equipment shall not be allowed to pass directly on the geogrid. Sudden braking and sharp turning movements shall be avoided.

C. If placement of the backfill material causes damage to the geogrid, the damaged area shall be repaired as described above. The placement procedure shall then be modified to eliminate further damage from taking place.

3.06 SEAMING AND OVERLAPPING

A. Adjacent geogrid rolls shall be joined in the machine direction with bodkin joint or according to manufacturer's recommendation.

B. Joints should be minimized in the primary strength direction.

C. Joints occurring in adjacent panels should be staggered a minimum of 15 feet.

D. Adjacent geogrid rolls shall be overlapped per manufacturer's specifications

E. Adjacent geogrid rolls shall be joined in the cross-machine direction with plastic ties.

3.07 REPAIRING

A. Any roll of geogrid damaged before, during and after installation shall be replaced by the Contractor at no additional cost to the Owner.

B. Proper replacement shall consist of replacing the affected area, adding 3 feet of geogrid to either side of the affected area. Join repaired geogrid with bodkin joint or according to Manufacturer's recommendations.

3.08 ACCEPTANCE

A. The Contractor retains all Ownership and responsibility for geogrid until acceptance by Owner.

B. The Owner accepts geogrid when:

1. The installation is complete.
2. CQA tests verify product requirements have been received and accepted.
3. All required documentation from the Manufacturer, Installer, and Contractor has been received and accepted.
4. Verification of the adequacy of all seams/joints and repairs, including associated testing, is complete.
5. The Owner has completed Final Inspection and any noted defects have been repaired.

END OF SECTION

SECTION 02230
SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, and equipment required and perform all site preparation, complete as shown on the Drawings and as specified in this Section.

B. The Contractor shall obtain all permits required for site preparation before proceeding with the work, including clearing and tree removal.

C. The areas to be cleared, grubbed, and stripped within public rights-of-way and utility easements shall be minimized to the extent possible for the scope of pipeline work and in consideration of the actual means and methods of construction used. No unnecessary site preparation shall be performed within these areas.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

A. Submit to the Owner copies of all permits required before clearing, grubbing, and stripping work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

A. The Contractor shall cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.

B. The Contractor shall preserve and protect trees and other vegetation designated on the Drawings or directed by the Owner to remain as specified below.

3.02 GRUBBING

A. The Contractor shall grub and remove all stumps, roots in excess of 1-1/2 inches in diameter, matted roots, brush, timber, logs, concrete rubble, and other debris encountered to a depth of 18 inches below original grade or 18 inches beneath the bottom of foundations, whichever is deeper.

B. The Contractor shall refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface in accordance with Sections 02300, Earthwork for Structures, Sections 02301, Earthwork for the Stormwater Treatment Area, and Section 02305, Earthwork for Utilities.

3.03 STRIPPING

A. The Contractor shall strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.

B. Topsoil shall be free from brush, trash, large stones, and other extraneous material. Avoid mixing topsoil with subsoil.

C. The Contractor shall stockpile and protect topsoil until it is used in landscaping, loaming, and seeding operations and dispose of surplus topsoil after all work is completed.

3.04 DISPOSAL

A. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved off-site disposal area. No rubbish or debris of any kind shall be buried on the site.

B. Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

3.05 PROTECTION

A. Trees and other vegetation designated on the Drawings or directed by the Owner to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards, and enclosures or by other approved means. The Contractor shall conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed. The Contractor shall provide for the safety of employees and others.

B. The Contractor shall maintain protection until all work in the vicinity of the work being protected has been completed.

C. The Contractor shall not operate heavy equipment or stockpile materials within the branch spread of existing trees.

D. The Contractor shall immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.

E. When work is completed the Contractor shall remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over 1 inch in diameter shall be treated with an acceptable tree wound paint.

F. The Contractor shall restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the Owner. Adjacent properties and improvements on these properties, public or private, which become damaged by construction operations shall be promptly restored to their original condition to the full satisfaction of the property owner.

G. The Contractor shall remove trees damaged beyond saving, through no fault of the Contractor, as directed by the Owner.

END OF SECTION

SECTION 02240
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the work necessary to complete the dewatering activities. All work in this Section shall be done in accordance with the requirements of the Environmental Resource Permit and Water Use Permit (if required) as issued by the St. Johns River Water Management District (SJRWMD).

B. In addition to the requirements listed in this Section, the Contractor shall obtain, if required, and comply with all requirements of the Generic Permit for the Discharge of Ground Water From Any Non-Contaminated Site Activity as described in FAC 62-621-300.

C. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control groundwater flow into excavations and permit construction to proceed on dry, stable subgrades.

1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Remove dewatering system if no longer needed.

D. The Contractor shall dewater so as to prevent damage to existing work. The Contractor shall repair or replace damage resulting from the dewatering activities promptly, remedy environmental damage as approved by the Owner, and pay any and all fines levied to Contractor at no additional cost or time to the Owner.

E. The Dewatering Plan shall be signed and sealed by the licensed professional engineer responsible for its preparation.

F. The Contractor shall design the dewatering system. The Contractor shall be responsible for obtaining whatever investigations are necessary, before bidding, to design the dewatering system.

1.02 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

A. Before construction, the Contractor shall obtain a dewatering permit from the Florida Department of Environmental Protection as required. At a minimum, the dewatering plan submitted with the dewatering application shall include the following:

1. Duration of dewatering for each area.
2. Number and size of pumps.
3. Method of dewatering each area.
4. Methods for routing/containing the discharge.
5. Methods of isolating dewatering areas.
6. Time dewatering structure will be in place.
7. Proposed discharge points.

Five copies of the plan shall be submitted to the Owner for record purposes only.

B. The Contractor shall be responsible for determining if a Water Use Permit will be required. If a Water Use Permit is required, it is the Contractor's responsibility to obtain the required information from the Owner to complete the Water Use Permit application to submit with the Dewatering Plan. If a Water Use Permit is required, the Contractor shall submit five copies of the application to the Owner for submittal purposes only.

C. The Contractor shall be responsible for obtaining a Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity as set forth in FDEP Rule 62-621.300(2), FAC. The Contractor shall obtain the required permit Form 62-621.300(2) and the required information from the Owner to complete the Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity application to submit with the Dewatering Plan. The Contractor shall submit five copies of the application to the Owner for submittal purposes only.

D. Provide photographs or videotape, sufficiently detailed, of existing conditions of adjoining properties, facilities, and other construction and site improvements that might be later misconstrued as damage caused by dewatering operations.

E. Submit Record Drawings at Project closeout identifying and locating utilities and other subsurface structural, electrical, or mechanical items encountered during dewatering.

1. Note locations and capping depth of wells and well points.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. Florida Administrative Code (FAC)

1. Rule 62-621.300, FAC – Permits.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

B. Pre-installation Conference: Conduct conference at the Project site to present and discuss dewatering means, methods, and monitoring program.

C. Identify a person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the dewatering system being installed for this Project, the referenced standards, environmental and permit requirements, the requirements of this Work, and who shall direct all work performed under this Section.

D. It shall be the responsibility of the Contractor to determine the water levels before and during the dewatering work.

1.05 QUALIFICATIONS

A. The Contractor shall provide at least one person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the dewatering system being installed, the referenced standards, the requirements of this Work, and who shall direct all work performed under this Section.

B. The Contractor shall be responsible for determining the water level before beginning excavation and construction.

1.06 PRE-BID INSPECTION AND TESTING

A. The Contractor is advised that site soil borings may indicate groundwater levels below the levels which may occur in response to normal, seasonal, extreme, or prolonged rainfall. The Contractor is further advised that site soil borings may not necessarily represent soil conditions to be encountered elsewhere on the job site, other than at the specific boring locations.

B. Before bidding, the Contractor shall perform a detailed site inspection and, if desired, obtain the Owner's permission to perform site-specific testing as he deems necessary to obtain all required information relative to project dewatering requirements.

C. The Contractor shall include as part of his Bid the total cost of all surface and subsurface dewatering as required to construct the Project in complete compliance with the Drawings and these Specifications.

1.07 PROJECT CONDITIONS

A. The Contractor shall not interrupt utilities serving facilities occupied by Owner or others unless approved by the Owner and then only after arranging to provide temporary utility services according to requirements indicated.

B. Survey adjacent structures and improvements, employing a professional land surveyor licensed in Florida to establish exact elevations at fixed points to monitor settlement. Clearly identify monitoring points and reference vertical datum, and benchmarks. Monitor and record existing initial elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Owner if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction and existing structures.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DEWATERING SYSTEM

A. The dewatering system shall be adequate to drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of 2 feet below the bottom of the excavation, side slopes of excavations, or bottom

of the footings at all times, or as otherwise required to obtain the specified compaction and installation conditions. Pipeline trenches must be dewatered at least 1 foot below the trench bottom.

B. If layered soils are encountered, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.

C. Unless otherwise noted and before any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously and then shall be operated continuously 24 hours a day, 7 days a week, throughout the excavation to maintain and protect all work until the work has been completed to the satisfaction of the Owner.

D. Where used, well points shall be installed in an Owner-approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed so that traffic on public thoroughfares and site access roads will not be impeded.

E. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the specified work. The dewatering system shall stay in full operation until not less than 90% of the total building load is applied, as will be determined by the Owner, or until excavations and trenches have been backfilled and compacted.

F. To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.

G. Wellpoint or surface water pump discharge shall be controlled to prevent erosion, undermining, and all other damage and be piped to approved locations.

H. With the Owner's assistance, the Contractor is responsible for determining what approvals and permits are required to comply with any and all applicable regulations and permitting requirements relating to dewatering activities. With the Owner's assistance the Contractor shall obtain all necessary approvals and permits and comply with any and all applicable regulations and permitting requirements concerning all dewatering activities, including pumpage and discharge. The Contractor is solely responsible for all costs associated with the proper implementation of dewatering activities.

I. The Contractor shall perform all dewatering work in strict compliance with Section 01350, Environmental Protection Procedures, and the Contract Drawings.

J. Excavations shall be kept free from water during the placing of concrete and for 36 hours after or until concrete forms are removed.

K. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, ponding on prepared subgrades, or flooding the site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

L. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

M. Install sufficient dewatering equipment to drain water-bearing strata above and below the bottom of foundations. If excavating through layered soils, relieve any potential groundwater hydrostatic head in the zones below to prevent uplift.

1. Open-sump pumping which leads to loss of fines, subgrade softening, and slope instability shall not be permitted.

N. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids flooding or accumulation on private property. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

3.02 OBSERVATION WELLS

A. The Contractor shall install observation wells as may be required to record accurate water levels.

B. The Contractor shall be responsible for maintaining all observation wells and observing and recording the elevation of the piezometric water levels daily.

C. Wells damaged or destroyed shall be replaced at no additional cost to the Owner.

3.03 CLEANUP

A. Upon completing dewatering elsewhere on the Project, the Contractor shall remove all equipment and leave the project site in a neat, clean, and acceptable condition satisfactory to the Owner. Wellpoint holes and excavations shall be adequately backfilled and compacted to prevent settlement.

END OF SECTION

SECTION 02260
STEEL SHEET PILING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor and materials required and install metal sheet piling complete as shown on the Drawings and as specified in this Section.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

1. Installer Qualifications: Conformity to Article 1.05 of this Section.
2. Metal Sheet Piling: Product data, section properties, storage requirements, and conformity to ASTM standards.
3. Design calculations signed and sealed by a Florida-licensed Professional Engineer.
4. Coatings: Product data and conformity to ASTM standards.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect on the date the Drawings were signed and sealed. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Welding Society (AWS)

1. AWS D1.1/D1.1M—Structural Welding Code – Steel.

B. American Society for Testing and Materials (ASTM)

1. ASTM A123/A123M—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A328/A328M—Standard Specification for Steel Sheet Piling.
3. ASTM A572/A572M—Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
4. ASTM A780/A780M—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion, or damage to the interlocks or coatings.

1.05 QUALIFICATIONS

A. Installer Qualifications: Submit information showing that the sheet piling installer has had, as a minimum, three successful past installations of sheet piling of comparable overall heights, sections, and comparable penetration into soils similar to those found on the project.

PART 2 PRODUCTS

2.01 GENERAL

A. Sheet piling shall be full-length sections.
B. Like items of materials shall be the end products of one manufacturer.

2.02 MATERIALS

A. Steel Sheet Piling: "Z" Profile, hot-rolled sections conforming to ASTM A328/A328M or ASTM A572/A572M, Grade 60 that have free-sliding interlocks that maintain continuous interlocking when installed and the following section properties:

1. Steel Sheet Pile

a. Minimum Elastic Section Modulus: 25.65 inches^3/foot.
b. Minimum Thickness: Design thickness plus 0.10 inch for expected 50-year corrosion and no less than 0.375 inch.
c. Depth: 14 inches.

B. Sheet Pile Caps: Not part of this design.

C. Coatings: All sheet piles shall be fully coated on both sides with Sherwin Williams Zinc Clad II (85) Inorganic Zinc Rich Coating or approved equal in accordance with the manufacturer's recommendations. In addition to the Zinc Rich Coating, the dividing sheet pile wall at the weir site detailed in Section 6 on Drawing S5-2 shall also be fully coated with two coats of Sherwin Williams Dura-Plate 235 Multi-Purpose Epoxy or approved equal in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not begin sheet pile installation until the earthwork on the retained soil side in the area where the piles are to be installed has been completed to the extent that the grade elevation is at no more than 12 inches above or below the top of the piling elevation as indicated on the Drawings.

B. Any fill along the alignment of the sheet pile on the retained soil side must be in place to sub-grade elevations and compacted prior to installing the sheet pile.

C. Fill material (except riprap, boulders, bedding, concrete and grout) is not to be placed on the retained soil side of the sheet pile after the sheet pile is in place.

3.02 INSTALLATION

A. All welding or gas cutting shall be in accordance with AWS D1.1/D1.1M.

B. The Contractor shall brace and/or provide soil grading as necessary during construction operations to provide lateral stability for the sheet pile wall. The sheet pile wall shall be designed for the soil grades of the final configuration denoted on the Drawings and a water height on one side of the sheet pile of 14 feet. Other temporary configurations during the construction period are the responsibility of the Contractor.

C. Placing

1. Pilings shall be located as shown on the Drawings. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line. Place the pile so the face will not be more than 6 inches from vertical alignment at any point.
2. Top of pile at elevation of cut-off shall be within 2 inches horizontally and 1 inch vertically of the location indicated. Manipulation of piles to force them into position will not be permitted.
3. Check all piles for heave. Re-install all heaved piles to the required tip elevation.
4. Remove and replace piling damaged during construction at the Contractor’s expense.
5. Contractor shall ensure that the pilings are placed and installed to the correct alignment. Use a system of structural framing sufficiently rigid to resist lateral and installation forces and to adequately support the sheet piling until design tip elevation is achieved.

D. Installation

1. Use installation method that protects existing structures or utilities from damage. The Contractor shall document conditions before and after installation and monitor during installation.
2. Remove and replace pilings damaged during installation or installed out of interlock at the Contractor's expense.
3. Pilings across the middle of the weir shall be driven at least 25 feet below existing grades and have the top of wall elevations as indicated on the Drawings. Piling may be installed to deeper depths than those indicated on the Drawings at the option of the Contractor. End pilings for scour protection shall be driven at least 5.5 feet below the bottom of the perimeter-thickened edge of the weir slab and have the top of the pilings 6 inches below the top of the weir slab. Pilings may be installed to deeper depths than those indicated on the Drawings at the option of the Contractor.
4. Pilings shall not be driven within 100 feet of concrete less than 28 days old.
5. Jetting will not be permitted.
6. Pre-augering or spudding of piles will not be permitted.

END OF SECTION

SECTION 02300
EARTHWORK FOR STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, equipment, tools, appliances, and materials and perform all operations necessary for the following:

1. Preparing subgrades for slab-on-grade, walks, pavements, and lawns and grasses.
2. Excavating and backfilling for buildings and structures.
3. Laying the subbase course for concrete sidewalks and pavements.

1.02 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. The Contractor shall submit the name, address, company name, and license number for the Florida-licensed professional geotechnical engineer to be retained by the Contractor for overseeing the testing, observation, and other geotechnical support required for the project.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each onsite and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 for each onsite and borrow soil material proposed for fill and backfill.

The Contractor shall submit records before the start of this work. The Contractor shall verify that the existing conditions are correct as shown on the plans and mentioned in these Specifications. The Contractor shall note any discrepancies found immediately and notify the Owner. The records shall include the following:

1. The location of all underground utilities, structures, etc. surrounding the areas to be excavated that may be impacted by the work.
2. The location of test excavations.
3. The location of inspections.

C. The Contractor shall submit written verification from the Contractor's geotechnical engineer related to subgrade suitability as described under Quality Assurance.

D. Testing Agency Invoices indicating if the invoice is for an initial test or a re-test of the Contractor's work.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
2. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
3. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
4. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
5. ASTM D2167—Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
8. ASTM D2940/D2940M—Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
9. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
10. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
11. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Occupational Safety and Health Administration (OSHA)

1. OSHA 2226—Trenching and Excavation Safety.

1.04 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and definition testing, as documented according to ASTM D3740.

B. The Contractor shall do the following:

1. Ensure that excavations provide adequate working space and clearance for the work to be performed and for installing piping and buried utilities. In no case shall excavation faces be undercut.
2. Ensure that foundation surfaces are clean and free of loose material of any kind when pipelines and buried utilities are placed on them.
3. Excavate, trench, and backfill in compliance with applicable requirements of governing authorities having jurisdiction.
4. Ensure that shoring and sheeting for excavations are designed by a Florida-registered Professional Engineer and are in accordance with OSHA 2226.
5. Before beginning any excavation or grading, ensure the accuracy of all survey data indicated on the Contract Drawings and in the Specifications and/or as provided. If the Contractor discovers any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Owner so that proper adjustments can be anticipated or ordered. If the Contractor begins any excavation or grading, this shall be considered an acceptance of the survey data by the Contractor, after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.
6. Ensure that tolerances for excavation are plus or minus 0.10 foot to the required line and to the required grade. Tolerance for compaction of in-place material shall be plus or minus 0.10 foot to the required grade, unless otherwise noted.
7. Remove unsuitable materials including muck, silts, peat, and other loose and very loose compressible soils from excavations before placing pipe foundation, bedding, and buried utilities.
8. Ensure that the Contractor's Florida-licensed professional geotechnical engineer observes all foundation and slab-on-grade bearing surfaces before the placement of form work or reinforcing steel. The geotechnical engineer shall verify in writing that the actual exposed subgrade is in accordance with the site-specific borings, test pits, and testing and data reports included in Appendix A.

1.05 PROJECT CONDITIONS

A. Existing Utilities: The Contractor shall not interrupt utilities serving facilities occupied by the Owner or others unless permitted to do so in writing by the Owner and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify the Owner not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Owner's written permission.
3. Contact a utility-locator service and obtain utility locations for the Project area before excavating.

B. The Contractor shall demolish and completely remove from the site underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.06 DEFINITIONS

A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.

1. *Initial Backfill*: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. *Final Backfill*: Backfill placed over initial backfill to fill a trench.

B. *Base Course*: The course placed between the subbase course and hot-mix asphalt paving.

C. *Bedding Course*: The course placed over the excavated subgrade in a trench before laying pipe.

D. *Borrow Soil*: Suitable soil imported from off site for use as fill or backfill.

E. *Drainage Course*: The course supporting the slab-on-grade that also minimizes the upward capillary flow of pore water.

F. *Excavation*: Removing material encountered above subgrade elevations and to lines and dimensions indicated.

1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Owner.

Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Owner. Unauthorized excavation as well as remedial work directed by the Owner shall be without additional compensation.

G. *Fill*: Soil materials used to raise existing grades.

H. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. *Subgrade*: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. *Utilities*: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: The Contractor shall provide borrow soil materials when sufficient suitable soil materials are not available from excavations.

B. Suitable Soils: ASTM D2487 Soil Classification Groups SW and SP or a combination of these groups, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsuitable Soils: Soil Classification Groups GW, GP, GM, GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

1. Unsuitable soils also include suitable soils not maintained within 2% of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95% passing a 1-1/2-inch sieve and not more than 8% passing a No. 200 sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90% passing a 1-1/2-inch sieve and not more than 12% passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100% passing a 1-inch sieve and not more than 8% passing a No. 200 sieve.

G. Sand: ASTM C33/C33M; fine aggregate, natural, or manufactured sand.

H. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 EXECUTION

3.01 PREPARATION

A. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. The Contractor shall prepare subgrade for earthwork operations including removing vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface as specified in Section 02230, Site Preparation.

C. The Contractor shall protect and maintain erosion and sedimentation controls, which are specified in Section 01350, Environmental Protection Procedures.

3.02 DEWATERING

A. The Contractor shall prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding the Project site and surrounding area.

B. The Contractor shall protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system**,** specified in Section 02240, Dewatering, to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: The Contractor shall excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsuitable soil materials, replace with suitable soil materials.

3.05 EXCAVATION FOR STRUCTURES

A. The Contractor shall excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb the bottom of the excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb the bottom of excavations intended as bearing surfaces.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. The Contractor shall excavate surfaces under walks and pavements to indicated lines, cross-sections, elevations, and subgrades.

3.07 SUBGRADE INSPECTION

A. The Contractor shall notify the Owner when excavations have reached the required subgrade.

B. If the Owner determines that unsuitable soil is present, the Contractor shall continue excavation and replace with compacted backfill or fill material as directed.

C. The Contractor shall proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll the subgrade in one direction**,** repeating proof-rolling in the direction perpendicular to the first direction. Limit vehicle speed to 3 miles per hour (mph).
2. Excavate soft spots, unsuitable soils, and areas of excessive pumping or rutting, as determined by the Owner, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices or additional work.

E. As directed by the Owner, the Contractor shall reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities without additional compensation.

3.08 UNAUTHORIZED EXCAVATION

A. The Contractor shall fill unauthorized excavation under foundations or wall footings by extending the bottom elevation of concrete foundation or footing to the excavation bottom without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2,500 psi, may be used when approved by the Owner.

1. Fill unauthorized excavations under other construction or utility pipe as directed by the Owner.

3.09 STORAGE OF SOIL MATERIALS

A. The Contractor shall stockpile excavated suitable soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water.

1. Stockpile soil materials away from edge of excavations. Do not store within the drip line of remaining trees.

3.10 BACKFILL

A. The Contractor shall place and compact backfill in excavations promptly, but not before completing the following:

1. Constructing below finish grade, including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. The Contractor shall place backfill on subgrades free of mud.

3.11 SOIL FILL

A. The Contractor shall plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. The Contractor shall place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use suitable soil material.
2. Under walks and pavements, use suitable soil material.
3. Under building slabs, use engineered fill.
4. Under footings and foundations, use engineered fill.

C. The Contractor shall place soil fill on subgrades free of mud.

3.12 SOIL MOISTURE CONTROL

A. The Contractor shall uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compacting to within 2% of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy.
2. Remove and replace or scarify and air dry otherwise suitable soil material that exceeds optimum moisture content by 2% and is too wet to compact to the specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. The Contractor shall place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. The Contractor shall place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. The Contractor shall compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact the top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98%.
2. Under walkways, scarify and recompact the top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98%.
3. Under lawn or unpaved areas, scarify and recompact the top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98%.

3.14 GRADING

A. General: The Contractor shall uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross-sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.15 FIELD QUALITY CONTROL

A. The number and location of the tests shall be as specified in these Specifications and as directed by the Owner during construction.

B. The Contractor shall coordinate activity with the Owner and the testing agency to permit testing as directed in the presence of the Owner.

C. The cost of all testing to achieve specified requirements shall be borne by the Contractor. The Contractor shall be reimbursed by the Owner for passing field tests.

D. The costs of any and all retests due to failure to achieve specified requirements shall be solely borne by the Contractor and are not reimbursable under this Contract.

E. All materials proposed for use shall be tested as follows:

Material	Required Test	Minimum Number of Tests
Suitable Soil Materials	Soil Classification using ASTM D2487 (including all tests contained therein)	One per source of materials to determine conformance with materials specified in this Specification; additional test whenever there is any apparent change.
	Soil moisture-density relationship using Modified Proctor ASTM D1557	One per source of material or apparent change in material.

F. The Contractor shall allow the testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after the test results for previously completed work comply with requirements.

G. Footing Subgrade: At footing subgrades, the testing agency will perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner.

H. The testing agency will test compaction of soils in place according to ASTM D1556/D1556M, ASTM D2167, ASTM D2937, and ASTM D6938 as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,000 square feet or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 400 feet or less of trench length but no fewer than two tests.

I. When the testing agency reports that subgrades, fills, or backfills have not achieved the degree of compaction specified, the Contractor shall scarify and moisten or aerate or remove and replace soil to the depth required and recompact and retest until specified compaction is obtained.

J. The approved testing agency shall transmit copies of field testing results as follows:

1. Two copies to the Owner.
2. Two copies to the Contractor.

The field test reports shall include, at a minimum, project title; project location; location of sample(s) tested; time of testing; date of testing; testing person's full name; testing agency name, address, and telephone number; and test results.

K. No soil material shall be used until (1) the Owner has reviewed and approved test reports and (2) the Contractor submits certification that the soil material proposed for construction is clean and meets gradation and other parameters specified in this Specification.

L. At no cost to the Owner, the Contractor shall remove and replace or correct all materials and work which tests indicate do not conform, in the opinion of the Owner, to the requirements of these Specifications.

M. The results of in-place density tests shall be considered satisfactory if the density in each instance is equal to or greater than the specified density. Soil moisture content at the time of testing shall conform to requirements of these Specifications.

N. Where unsatisfactory compaction is revealed by the tests, the Contractor shall re-excavate, backfill, recompact, and/or rework the backfill as required to obtain the required degree of compaction over the entire depth of the excavation.

O. The testing agency shall transmit to the Owner copies of all testing agency invoices submitted to the Contractor for payment. Invoices shall clearly indicate specific services and date and time services are rendered and shall indicate if the invoiced testing cost is an initial test of the Contractor's work or is a re-test required due to the Contractor's failure to initially achieve the specified requirements.

3.16 PROTECTION

A. Protecting Graded Areas: The Contractor shall protect newly graded areas from traffic and erosion and keep them free of trash and debris.

B. The Contractor shall repair and reestablish grades to the specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Owner and reshape and recompact.

C. Where settling occurs before the Project Correction Period elapses, The Contractor shall remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: The Contractor shall transport surplus suitable soil to designated storage areas on the Owner's property and stockpile and spread this soil as directed by the Owner.

1. Remove waste material, including unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 02301
EARTHWORK FOR THE STORMWATER TREATMENT AREA

PART 1 GENERAL

1.01 SCOPE OF WORK

This Section covers the work necessary to excavate and construct embankments as required for the stormwater treatment area – ponds and wetlands, berms, and maintenance access embankment.

A. The Contractor shall examine the site before submitting a bid, taking into consideration all conditions that may affect the work.

B. The Contractor shall coordinate all additional subsurface investigations and testing included in this work with the Engineer before performing the excavation and foundation preparation work. In general, if the Contractor finds different soil conditions during the work, the Contractor shall notify the Engineer and the Owner immediately.

1.02 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Material Source Certification Test Reports: The Contractor shall submit from a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D3282 of each onsite and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 for each onsite and borrow soil material proposed for fill and backfill.

B. The Contractor shall submit records before the start of this work. The Contractor shall verify that the existing conditions are correct as shown on the plans and mentioned in these Specifications. The Contractor shall note any discrepancies found immediately and notify the Owner and Engineer. The records shall include the following:

1. Location of all existing underground utilities, structures, etc. surrounding the areas to be excavated that may be impacted by the work.

2. Location of test excavations.
3. Location of inspections.

C. The Contractor shall submit in writing the Geotechnical Testing Agency Qualifications Certification according to ASTM E329 and ASTM D3740.

D. Construction Quality Control (CQC) Test Reports: During construction, the Contractor shall submit CQC test reports from a qualified independent testing agency verifying the soil materials, field density, moisture content, and bearing value for the subgrade, fill, backfill, subbase, base, bedding, and drainage course in accordance with the requirements of these Specifications.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply:

A. The January 2022 FDOT Standard Specifications for Road and Bridge Construction (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section.

1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to “the Owner and/or Engineer” by this Contract.
2. The Contractor shall retain an independent testing agency, as approved by the Engineer, to perform all tests, including tests referenced to be performed by the Engineer.
3. Payment for this project shall be in accordance with Section 01200, Measurement and Payment.

B. American Society for Testing and Materials (ASTM)

1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
2. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m)).
4. ASTM D2167—Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

6. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
7. ASTM D2940/D2940M—Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
8. ASTM D3282—Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
9. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
10. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
11. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

C. Florida Statutes (FS)

1. Florida Trench Safety Act (90-96, Laws of Florida).

D. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1926, Subpart P—Safety and Health Regulations for Construction, Excavations.
2. OSHA 2226—Trenching and Excavation Safety.

1.04 QUALITY ASSURANCE

A. The Contractor will engage and pay for the services of an Engineer and a testing agency to perform Construction Quality Assurance (CQA) testing in addition to the CQC performed by the Contractor.

B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and definition testing, as documented according to ASTM D3740.

C. The Contractor shall perform field-density tests along the centerline of construction or as directed by the Engineer and in accordance with FDOT's *Standard Specifications for Road and Bridge Construction*, January 2022.

D. The Engineer may require additional testing as deemed necessary. The Engineer shall interpret test results and the Contractor shall perform remedial work as directed by the Engineer. The Contractor shall provide labor to the Engineer for help in performing tests and/or checking line and grade at no additional cost to the Owner.

E. Laboratory maximum dry density of soil mixtures at optimum moisture shall be determined by ASTM D1557 for subgrade, fill, backfill, stabilized subgrade, recycled concrete, and limerock base course.

F. Field density of stabilized subgrade and soils or soil mixtures in fill or backfill shall be determined by ASTM D2167, ASTM D1556/D1556M, or ASTM D6938, or ASTM D1556/D1556M or ASTM D6938 for limerock base course.

G. Bearing value of stabilized subgrade shall be determined by the methods required for determining limerock bearing ratio (LBR) according to the FDOT, Standard Specification FM 5-515.

H. Field density of stabilized subbase shall be 95% or greater of the modified proctor maximum dry density, ASTM D1557.

I. The Engineer shall have sole responsibility for interpreting all test results. The Construction Management at Risk (CMAR) shall bear the cost of all retests due to failure to achieve specified requirements.

1.05 PROJECT CONDITIONS

A. Existing Utilities: The Contractor shall not interrupt utilities serving facilities occupied by the Owner or others unless permitted to do so in writing by the Engineer and then only after arranging to provide temporary utility services according to the requirements indicated.

1. Notify the Engineer not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Engineer’s written permission.
3. Contact the utility-locator service and obtain utility locations for the Project Area before excavating.

B. The Contractor shall demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.06 DEFINITIONS

A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.

1. *Initial Backfill*: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. *Final Backfill*: Backfill placed over initial backfill to fill a trench.

B. *Base Course*: The course placed between the subbase course and hot-mix asphalt paving.

C. *Bedding Course*: The course placed over the excavated subgrade in a trench before laying pipe.

D. *Borrow Soil*: Suitable soil imported from off-site for use as fill or backfill.

E. *Drainage Course*: The course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. *Excavation*: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Engineer. Authorized additional excavation and replacement material will be paid for according to the Contract provisions for unit prices.
2. *Bulk Excavation*: Excavation more than 10 feet in width and more than 30 feet in length.
3. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be without additional compensation.

G. *Fill*: Soil materials used to raise existing grades.

H. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. *Subgrade*: The surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. *Utilities*: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.07 TESTING REQUIREMENTS

A. The Contractor shall furnish a soil survey for suitable material and samples of materials.

B. Testing for source material, for classification, and for prequalification of material (on or off site) shall be performed by an independent testing agency retained by the Contractor and approved by the Engineer.

C. Testing for in-place compacted fill shall be performed by the same independent testing agency as approved by the Engineer and retained by the Contractor.

D. The number and location of the tests shall be as specified in these Specifications and as directed by the Engineer during construction.

E. The Contractor shall coordinate activity with the Engineer and the testing agency to permit testing as directed in the presence of the Engineer.

F. The cost of all testing to achieve specified requirements shall be borne by the Contractor. The Contractor shall be reimbursed by the Owner for passing field tests.

G. The costs of any and all retests due to failure to achieve specified requirements shall be solely borne by the Contractor and are not reimbursable under this contract.

H. All materials proposed for use shall be tested as follows:

Material	Required Test	Minimum Number of Tests
Suitable Soil Materials	Soil Classification using ASTM D2487 (including all tests contained therein)	One per source of materials to determine conformance with materials specified in these Specifications; additional tests whenever there is any apparent change.
	Soil moisture-density relationship using Modified Proctor ASTM D1557	One per source of material or apparent change in material.

I. Soil materials shall be tested during construction as follows:

Material	Required Test	Minimum Number of Tests
Suitable Soil Material in-place after compaction	Field Density ASTM D1556/D1556M – Sand Cone Method, or ASTM D6938 – Nuclear Density Method, or ASTM D2937 – Drive Cylinder Method	For each layer of trench bottom subgrade before addition of soil materials, refill, bedding, and backfill, and for each 400 lineal feet of trench or fraction thereof, whichever is greater; two tests for each drainage, manhole, or wet well structure; additional test whenever there is any change in native soil, groundwater, or soil moisture conditions.

J. The approved testing agency shall transmit copies of required laboratory test results as follows:

1. One copy to the Owner.
2. Two copies to the Engineer.
3. Two copies to the Contractor.

The laboratory test reports shall include, at a minimum, project title; project location; location of sample; source, time, and date of testing; testing agency's name, address, and telephone number; and test results. Each test report shall be signed and sealed by the Professional Engineer representing the testing agency as specified in these Specifications.

K. The approved testing agency shall transmit copies of field testing results as follows:

1. One copy to the Owner.
2. Two copies to the Engineer.
3. Two copies to the Contractor.

The field test reports shall include, at a minimum, project title; project location; location of sample(s) tested; time of testing; date of testing; testing person's full name; testing agency name, address, and telephone number; and test results.

L. No soil material shall be used until 1) the Engineer has reviewed and approved test reports, and 2) the Contractor submits certification that the soil material proposed for construction is clean and meets gradation and other parameters specified in these Specifications.

M. At no cost to the Owner, the Contractor shall remove and replace or correct all materials and work that tests indicate do not conform, in the opinion of the Engineer, to the requirements of these Specifications.

N. The results of in-place density tests shall be considered satisfactory if the density in each instance is equal to or greater than the specified density. Soil moisture content at the time of testing shall conform to requirements of these Specifications.

O. Where the tests reveal unsatisfactory compaction, the Contractor shall re-excavate, backfill, recompact, and/or rework the backfill as required to obtain the required degree of compaction over the entire depth of the excavation.

P. The testing agency shall transmit to the Engineer copies of all testing agency invoices submitted to the Contractor for payment. Invoices shall clearly indicate specific services and date and time services are rendered and shall indicate if the invoiced testing cost is an initial test of the Contractor's work or is a re-test required due to the Contractor's failure to initially achieve the specified requirements.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. General: The Contractor shall provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D3282 Soil Classification Groups A-1 and A-3 and or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsuitable Soils: Soil Classification Groups A-2, A-4, A-5, A-6, A-7, and A-8 according to ASTM D3282, or a combination of these groups.

1. Unsuitable backfill soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95% passing a 1-1/2-inch sieve and not more than 8% passing a No. 200 sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90% passing a 1-1/2-inch sieve and not more than 12% passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100% passing a 1-inch sieve and not more than 8% passing a No. 200 sieve.

G. Sand: ASTM C33/C33M; fine aggregate, natural, or manufactured sand.

H. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

I. Subgrade: Satisfactory soil in-place and proof-rolled to relative specified density and moisture content to lines and grade as shown in the Contract Drawings.

2.02 EXCAVATION

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-2, Classifications of Excavation.

2.03 EMBANKMENT-BERMS AND MAINTAINENCE ACCESS ROADS

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-7, Materials for Embankment.

B. Exceptions

1. Section 120-7.2, General Requirements for Embankment Materials: Constructing embankment of reclaimed asphalt pavement (RAP), reclaimed concrete aggregate (RCA), and portland cement concrete rubble shall not apply.

C. Additional Requirements

1. The Contractor shall excavate soil to the lines, grades, and elevations shown on the Drawings as needed to construct the subgrade. Excavate unsuitable material to 2 feet vertically and 3 feet horizontally from lines and grades shown on the Drawings. If organic material is encountered, excavate at least 2 feet below the organics. If organic layer is greater than 2 feet deep, place a layer of geogrid (meeting the requirements of Section 02078, Geogrid Reinforcement) at the bottom of the excavation. Backfill excavated unsuitable subgrade soil with backfill.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The Contractor shall verify that any existing vegetation or trees designated to remain are tagged or identified by the Owner. Protect vegetation and any featured designated to remain.

B. The Contractor shall prepare subgrade for earthwork operations, including removing vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface as specified in Section 02230, Site Preparation.

C. The Contractor shall protect and maintain erosion and sedimentation controls, which are specified in Section 01350, Environmental Protection Procedures.

3.02 DEWATERING

A. The Contractor shall prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding the Project site and surrounding area.

B. The Contractor shall protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system**,** specified in Section 02240, Dewatering, to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.

3.03 EXCAVATION

A. The following sections of the Standard Specifications shall apply. Final soil disposal areas must be approved by the Owner:

1. Section 120-1, Description.
2. Section 120-2, Classifications of Excavation.
3. Section 120-3, Preliminary Soils Investigation.
4. Section 120-4, Removal of Unsuitable Materials and Existing Roads.
5. Section 120-5, Disposal of Surplus and Unsuitable Material.
6. Section 120-10, Acceptance Program.

7. Section 120- 11, Maintenance and Protection of Work.
8. Section 120-12, Construction.

B. Exceptions

1. Section 120-4.1, Subsoil Excavation: The Contractor shall excavate soil to the lines, grades, and elevations shown on the Drawings as needed to construct the subgrade. Excavate unsuitable material to 3 feet vertically from lines and grades shown on the Drawings. Backfill excavated unsuitable subgrade soil with Backfill.
2. Section 120-5.2, Disposal of Muck on Side Slopes: Disposing of muck on side slopes will not be allowed on this project.
3. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1-foot above or below the plan cross-section will be allowed.

3.04 EMBANKMENT-BERMS AND ROADS

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-3, Preliminary Soils Investigation.
3. Section 120-5, Disposal of Surplus and Unsuitable Material.
4. Section 120-6.1, Materials for Borrow.
5. Section 120-7, Materials for Embankment.
6. Section 120-8, Embankment Construction.
7. Section 120-9, Compaction Requirements.
8. Section 120-10, Acceptance Program.
9. Section 120- 11, Maintenance and Protection of Work.
10. Section 120-12, Construction.

B. Exceptions

1. Section 120-5.2: Disposing of muck on side slopes will not be allowed on this project.
2. Section 120-8.2.4, Placing Outside Standard Minimum Slope: Placing unsuitable material in the embankment will not be allowed on this project.
3. Section 120-8.3, Hydraulic Method: Use of the Hydraulic Method will not be allowed on this project.
4. Section 120-8.4, Reclaimed Asphalt Pavement (RAP) Method: The use of RAP will not be allowed on this project.
5. Section 120-9.1, Moisture Content and 120-9.2.1, General: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D1557. Field densities shall be determined by ASTM D2167, ASTM D1556/D1556M or ASTM D6938. All embankments shall be

compacted to not less than 95% of the maximum dry density at a moisture content within 3% of optimum as determined by ASTM D1557.

6. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1-foot above or below the plan cross-section will be allowed.

C. Additional Requirements

1. The Contractor shall excavate soil to the lines, grades, and elevations shown on the Drawings as needed to construct the subgrade. Excavate unsuitable material to 3 feet vertically from lines and grades shown on the Drawings. If unsuitable layer is greater than 3 feet deep, place a layer of geogrid (meeting the requirements of Section 02078, Geogrid Reinforcement) at the bottom of the excavation. Backfill excavated unsuitable subgrade soil with suitable material.

3.05 EMBANKMENT – WETLAND CELLS

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-3, Preliminary Soils Investigation.
3. Section 120-5, Disposal of Surplus and Unsuitable Material.
4. Section 120-6.1, Materials for Borrow.
5. Section 120-7, Materials for Embankment.
6. Section 120-8, Embankment Construction.
7. Section 120-9, Compaction Requirements.
8. Section 120-10, Acceptance Program.
9. Section 120- 11, Maintenance and Protection of Work.
10. Section 120-12, Construction.

B. Exceptions

1. Section 120-5.2, Disposal of Paving Materials: Disposing of muck on side slopes will not be allowed on this project.
2. Section 120-8.3, Hydraulic Method: Use of the Hydraulic Method will not be allowed on this project.
3. Section 120-8.4, Reclaimed Asphalt Pavement (RAP) Method: The use of RAP will not be allowed on this project.
4. Section 120-9.1, Moisture Content and 120-9.2.1, General: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D1557. Field densities shall be determined by ASTM D2167, ASTM D1556/D1556M, or ASTM D6938. All embankments shall be compacted to not less than 95% of the maximum dry density at a moisture content within 3% of optimum as determined by ASTM D1557.

5. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1-foot above or below the plan cross-section will be allowed on this project.

3.06 PROTECTION OF PERSONS AND PROPERTY

A. The Contractor shall do the following:

1. Barricade and post excavations with warning signs for the safety of persons. Provide warning lights during hours of darkness.
2. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations against damage including loading, settlement, lateral movement, undermining, and washout.

B. Conduct topsoil removal operations to ensure the safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

3.07 SHEETING AND BRACING

A. Where sheeting and bracing are required to support the side walls of the excavation, the Contractor shall retain a Professional Engineer, registered in Florida, to design sheeting and bracing. The design shall establish requirements for sheeting and bracing and shall comply with all applicable codes; authorities having jurisdiction; and federal, state, and local regulations.

B. The sole responsibility for the design, methods of installation, and adequacy of sheeting and bracing shall be and shall remain that of the Contractor and the Contractor's Professional Engineer. The Contractor shall provide all necessary sheeting and bracing or other procedures as required to ensure safe working conditions and to protect the excavations.

C. Sheeting and bracing shall consist of braced steel sheet piling, trench box, braced wood lagging, and soldier beams or other approved methods.

D. The Contractor shall immediately fill and compact voids formed outside the sheeting. Where soil cannot be properly compacted to fill the void, the Contractor shall use Class B concrete as backfill at no additional cost to the Owner.

E. The Contractor shall install sheeting outside the required clearances and dimensions. Sheeting shall be plumb, securely braced, and tied in position. Sheeting shall be adequate to withstand all pressure to which it may be subjected. The Contractor shall correct any movement or bulging at no expense to the Owner to provide the necessary clearances and dimensions.

F. The Contractor shall maintain sheeting and bracing in excavations and trenches for the entire time excavations will be open.

G. The Contractor shall not brace sheeting against pipe being laid. Sheeting shall be braced so that no concentrated load of horizontal thrust is transmitted to the pipe.

H. Sheeting shall not be withdrawn if driven below the spring line of any pipe. The Contractor shall cut off tops as indicated on the Contract Drawings and leave bottoms permanently in place.

3.08 DEWATERING, WATER REMOVAL, AND DRAINAGE MAINTENANCE

A. Water shall not be permitted to accumulate in excavations. The Contractor shall provide dewatering systems to convey water away from excavations so that softening of foundations bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be as specified in Section 02240, Dewatering, and as approved by the Engineer before being installed by the Contractor. Groundwater levels shall be maintained a minimum of 2 feet below bottom of trenches or excavations.

B. Dewatering systems and equipment shall be in place as required to eliminate water during the excavation period until the work is completed. The Contractor shall provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation. This includes the use of sand or gravel as required to maintain adequate flow during the pipe laying or installation of other items of work within the excavation.

C. Water pumped or drained shall be disposed of in a suitable manner without damage to adjacent property, to other work under construction, or to roads. Water shall not be discharged onto surface improvements without adequate protection of the surface at the point of discharge. All gutter, drains, culverts, sewers, and inlets shall be kept clean and open for surface drainage. Water shall not be directed across or over pavements except through approved pipes or properly constructed troughs. The Contractor shall obtain permission from the Owner of any property involved before constructing water courses or installing discharge pipe or hose for removal of water and provide for disposal of the water without ponding or creating a public nuisance.

D. All pumps used for dewatering shall have noise-reduction features and shall be able to run continuously with minimal attendance. If required by the Owner or Engineer, the pumps shall be enclosed on all sides with a plywood enclosure, with padded material suitable for outdoor conditions on the inside of the enclosure, to

further reduce pump engine noise to an acceptable level. All applicable ordinances and codes for noise abatement shall be followed. The Contractor shall maintain pumps at all times, as necessary. When pumps are no longer required, the Contractor shall remove the pumps, wellpoints, pipes, and other apparatus from the area.

E. It is essential that the discharge of the trench dewatering pumps be conducted to natural drainage channels, drains, or storm sewers.

F. Trenches shall be constructed on the upstream side of the traffic way across roadways, driveways, or other traffic ways adjacent to drainage ditches or water to prevent impounding water after the pipe has been laid. The Contractor shall construct and maintain bridges and other temporary structures required to maintain traffic across such unfilled trenches. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. After backfilling is completed, the Contractor shall immediately remove all material deposited in roadway ditches or other water courses crossed by the line of trench and restore the original section, grades, and contours of ditches or water courses. Surface drainage shall not be obstructed longer than necessary.

G. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1%, the Contractor shall install ditch checks. Unless otherwise indicated on the Contract Drawings, ditch checks shall be concrete or as otherwise approved by the Engineer. Ditch checks shall extend not less than 2 feet below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

3.09 BACKFILLING AND COMPACTION

A. The Contractor shall not backfill trenches until required tests are performed.

B. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.

C. The Contractor shall perform the following steps to ensure compaction at the bottom of the trench or excavation before bedding:

1. Remove disturbed native soil material and/or any soils not meeting the requirement of suitable soil material as indicated on the Contract Drawings.
2. Compact the bottom of the trench excavation (undisturbed native subsurface soil) to no less than 98% of the Modified Proctor maximum dry

density in accordance with ASTM D1557, before placement of foundation, bedding, piping, and backfill.

D. To backfill below and around pipe to the spring line of the pipe, the Contractor shall do the following:

1. Construct foundation and bedding as indicated on the Contract Drawings before placement of pipe.
2. Install each pipe at proper grade, alignment, and final position.
3. Deposit suitable soil material uniformly and simultaneously on each side of pipe in completed course layers to prevent lateral displacement.
4. Compact under pipe haunches and on each side of pipe to the pipe spring line as shown on the Contract Drawings to hold the pipe in the proper position during subsequent pipe backfilling and compaction operations.
5. Construct haunching as indicated on the Contract Drawings.

E. To trench backfill above pipe spring line to finished grade, the Contractor shall do the following:

1. Deposit suitable soil material around and above pipe in uniform layers as shown on the Contract Drawings.
2. Backfill and compact trenches from the spring line of the pipe to the top of the trench in completed course layers as shown on the Contract Drawings.
3. Use material previously defined in these Specifications as suitable soil material.
4. Compact by hand or mechanical tampers.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Excess soils from the STA site are the property of Brevard County and shall be hauled to their designated storage facility.

B. The Contractor shall remove and legally dispose of waste materials, including excavated material classified as unsuitable soil material, trash, and debris from the property at no additional cost to the Owner.

END OF SECTION

SECTION 02305
EARTHWORK FOR UTILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all materials, equipment, labor, and work necessary to completely construct the project in accordance with the Contract Documents. This work includes but is not limited to the following:

1. Backfilling trenches at the end of each working day.
2. Preparing trench foundations.
3. Providing satisfactory material for all trenches as specified and as required.
4. Obtaining, storing, maintaining, and disposing of materials.
5. Dewatering, shoring, and sheeting.
6. Placing, compacting, testing, final grading, and demolishing subgrade.
7. Performing all other work required by the Contract Documents.

B. The Contractor is responsible for performing all work so as not to damage existing roadways, facilities, utilities, structures, etc. and shall repair and replace such damage to equal or better than its original undamaged condition without cost to the Owner.

C. The Contractor shall examine the site before submitting a bid, taking into consideration all conditions that may affect the work.

D. The Contractor shall coordinate all additional subsurface investigations and testing included with this work with the Owner before performing the excavation and foundation preparation work. In general, if the Contractor finds different and unsuitable/unsuitable soil conditions during the work, the Contractor shall notify the Owner immediately.

1.02 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each onsite and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 for each onsite and borrow soil material proposed for fill and backfill.

B. The Contractor shall submit records before the start of this work. The Contractor shall verify that the existing conditions are correct as shown on the plans and mentioned in these Specifications. The Contractor shall note any discrepancies found immediately and notify the Owner. The records shall include the following:

1. Location of all existing underground utilities, structures, etc. surrounding the areas to be excavated that may be impacted by the work.
2. Location of test excavations.
3. Location of inspections.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply:

A. American Society for Testing and Materials (ASTM)

1. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
3. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
5. ASTM D3282—Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

6. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
7. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
8. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Florida Statutes (FS)

1. Florida Trench Safety Act (90-96, Laws of Florida).

C. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1926, Subpart P—Safety and Health Regulations for Construction, Excavations.
2. OSHA 2226—Trenching and Excavation Safety.

1.04 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and definition testing, as documented according to ASTM D3740.

B. The Contractor shall do the following:

1. Ensure that excavations provide adequate working space and clearance for the work to be performed and for installing piping and buried utilities. In no case shall excavation faces be undercut.
2. Ensure that foundation surfaces are clean and free of loose material of any kind when pipelines and buried utilities are placed on them.
3. Excavate, trench, and backfill in compliance with applicable requirements of governing authorities having jurisdiction.
4. Ensure that shoring and sheeting for excavations are designed by a Florida-registered Professional Engineer and are in accordance with OSHA 2226.
5. Before beginning any excavation or grading, ensure the accuracy of all survey data indicated on the Contract Drawings and in these Specifications and/or as provided. If the Contractor discovers any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Owner so that proper adjustments can be anticipated or ordered. If the Contractor begins any excavation or grading, this shall be considered an acceptance of the survey data by the Contractor, after which time the

Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.

6. Ensure that tolerances for excavation are ±0.10 foot to the required line and to the required grade. Tolerance for compaction of in-place material shall be ±0.10 foot to the required grade.
7. Ensure that all trench materials derived from the project site and imported to this site are examined, tested, and classified by an Engineer-approved soils testing laboratory.
8. Remove unsuitable materials including muck, silts, peat, and other loose and very loose compressible soils from excavations before placing pipe foundation, bedding, and buried utilities.

1.05 PROJECT CONDITIONS

A. Existing Utilities: The Contractor shall not interrupt utilities serving facilities occupied by the Owner or others unless permitted to do so in writing by the Owner and then only after arranging to provide temporary utility services according to the requirements indicated.

1. Notify the Owner not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Owner's written permission.
3. Contact the utility-locator service and obtain utility locations for the Project Area before excavating.

B. The Contractor shall demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.06 DEFINITIONS

A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.

1. *Initial Backfill*: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. *Final Backfill*: Backfill placed over initial backfill to fill a trench.

B. *Base Course*: The course placed between the subbase course and hot-mix asphalt paving.

C. *Bedding Course*: The course placed over the excavated subgrade in a trench before laying pipe.

D. *Borrow Soil*: Suitable soil imported from off-site for use as fill or backfill.

E. *Drainage Course*: The course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. *Excavation*: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Owner. Authorized additional excavation and replacement material will be paid for according to the Contract provisions for unit prices.
2. *Bulk Excavation*: Excavation more than 10 feet in width and more than 30 feet in length.
3. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Owner. Unauthorized excavation, as well as remedial work directed by the Owner, shall be without additional compensation.

G. *Fill*: Soil materials used to raise existing grades.

H. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. *Subgrade*: The surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. *Utilities*: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.07 TESTING REQUIREMENTS

A. The Contractor shall furnish a soil survey for suitable material and samples of materials.

B. Testing for source material, for classification, and for prequalification of material (on or off site) shall be performed by an independent testing agency retained and paid for by the Contractor and approved by the Owner.

C. Testing for in-place compacted fill shall be performed by the same independent testing agency as approved by the Owner and retained by the Contractor.

D. The number and location of the tests shall be as specified in these Specifications and as directed by the Owner during construction.

E. The Contractor shall coordinate activity with the Owner and the testing agency to permit testing as directed in the presence of the Owner.

F. The cost of all testing to achieve specified requirements shall be borne by the Contractor.

G. The costs of any and all retests due to failure to achieve specified requirements shall be solely borne by the Contractor and are not reimbursable under this contract.

H. All materials proposed for use shall be tested as follows:

Material	Required Test	Minimum Number of Tests
Suitable Soil Materials	Soil Classification using ASTM D2487 (including all tests contained therein)	One per source of materials to determine conformance with materials specified in these Specifications; additional tests whenever there is any apparent change.
	Soil moisture-density relationship using Modified Proctor ASTM D1557	One per source of material or apparent change in material.

I. Soil materials shall be tested during construction as follows:

Material	Required Test	Minimum Number of Tests
Suitable Soil Material in-place after compaction	Field Density ASTM D1556/D1556M – Sand Cone Method, or ASTM D6938 – Nuclear Density Method, or ASTM D2937 – Drive Cylinder Method	For each layer of trench bottom subgrade before addition of soil materials, refill, bedding, and backfill, and for each 400 lineal feet of trench or fraction thereof, whichever is greater; two tests for each drainage, manhole, or wet well structure; additional test whenever there is any change in native soil, groundwater, or soil moisture conditions.

J. The approved testing agency shall transmit copies of required laboratory test results as follows:

1. Two copies to the Owner.
2. Two copies to the Contractor.

The laboratory test reports shall include, at a minimum, project title; project location; location of sample; source, time, and date of testing; testing agency's

name, address, and telephone number; and test results. Each test report shall be signed and sealed by the Professional Engineer representing the testing agency as specified in these Specifications.

K. The approved testing agency shall transmit copies of field testing results as follows:

1. Two copies to the Owner.
2. Two copies to the Contractor.

The field test reports shall include, at a minimum, project title; project location; location of sample(s) tested; time of testing; date of testing; testing person's full name; testing agency name, address, and telephone number; and test results.

L. No soil material shall be used until 1) the Owner has reviewed and approved test reports, and 2) the Contractor submits certification that the soil material proposed for construction is clean and meets gradation and other parameters specified in these Specifications.

M. At no cost to the Owner, the Contractor shall remove and replace or correct all materials and work that tests indicate do not conform, in the opinion of the Owner, to the requirements of these Specifications.

N. The results of in-place density tests shall be considered satisfactory if the density in each instance is equal to or greater than the specified density. Soil moisture content at the time of testing shall conform to requirements of these Specifications.

O. Where the tests reveal unsatisfactory compaction, the Contractor shall re-excavate, backfill, recompact, and/or rework the backfill as required to obtain the required degree of compaction over the entire depth of the excavation.

P. The testing agency shall transmit to the Owner copies of all testing agency invoices submitted to the Contractor for payment. Invoices shall clearly indicate specific services and date and time services are rendered and shall indicate if the invoiced testing cost is an initial test of the Contractor's work or is a re-test required due to the Contractor's failure to initially achieve the specified requirements.

PART 2 PRODUCTS

2.01 STRUCTURAL MATERIALS

A. Materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, shall be in good serviceable condition. Any timber used shall be sound and free from large or loose knots.

B. Pressure-treated timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place.

2.02 TRENCH SOIL MATERIALS

A. Materials used for trench construction shall be free of clumps of clay, rock or gravel, debris, waste, frozen materials, and other deleterious matter as determined by the Owner and shall be suitable soil materials as follows:

Area Classification	Soil Materials
In excavations and trenches	Excavated and borrow material that has been sampled, tested, and approved as "Suitable Soil Material."

B. Suitable Soil Materials

1. Soil Classification Groups: Suitable soil materials for each trench shall be as follows:

Suitable Soil Material (ASTM D3282, Soil Classification Groups)		
In-situ Foundation	Bedding, Haunching, and Initial Backfill	Final Backfill
SW SP	SW SP	SW SP

2. Maximum Particle Size Limitations for Suitable Soil Materials: The maximum allowable particle size for suitable soil materials within each trench for each type of utility shall be as follows:

Conduit	Maximum Allowable Particle Size		
	In-situ Foundation	Bedding, Haunching, and Initial Backfill	Final Backfill
Plastic Pipe (PVC, CPVC, HDPE, etc.) less than 6-inch-diameter	See Note 1	1/2 inch	3 inches
Plastic Pipe (PVC, CPVC, HDPE, etc.) 6-inch-diameter and Larger	See Note 1	3/4 inch	3 inches
Concrete Pipe			
Steel Pipe			
Ductile Iron Pipe			

Conduit	Maximum Allowable Particle Size		
	In-situ Foundation	Bedding, Haunching, and Initial Backfill	Final Backfill
Fiberglass Pipe	See Note 1	3/4 inch or three times the wall thickness, whichever is less	3 inches
Other Conduit Materials	See Note 2	See Note 2	See Note 2

(1) There is no requirement when suitable undisturbed native soil material is used. Disturbed portions of the foundation and/or unsuitable native soil material shall be replaced with suitable soil materials meeting all the requirements for Bedding.
(2) The maximum allowable particle size shall be in accordance with the manufacturer's written recommendation.

3. Additional Requirements of Suitable Materials: Suitable soil materials shall be free of debris, waste, frozen materials, vegetation, or other deleterious matter. Soils within 4 inches of the exterior surface of the pipe shall be free of gravel, stones, or other materials that may abrade the pipe surface.

C. Unsuitable Materials: Unsuitable soil material shall mean ASTM D2487, Soil Classification Groups GW, GP, GM, GC, SC, CL, ML, OL, CH, MH, OH, PT, and other highly organic soils and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

The Contractor shall do the following:

A. Carefully verify by hand methods the location of all surrounding underground utilities before performing utility excavations and trenches.

B. Protect utilities to be left in place from damage.

C. Do not interrupt existing utilities serving facilities occupied and used by the Owner, except when permitted in writing by the Owner.

D. Protect benchmarks, survey points, and existing structures, roads, sidewalks, monitoring wells, paving, curbs, etc. against damage from equipment, vehicular or foot traffic, settlement, lateral movement, undermining, washout, and all construction-related activities.

E. Repair and replace damage to existing facilities to equal or better than their original undamaged condition without cost to the Owner and to the approval of the Owner.

F. Excavate and trench in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.

G. Protect excavations and trenching by shoring, bracing, sheet piling, underpinning, or other methods as required to prevent cave-ins or loose dirt from falling into excavations and trenches.

H. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for depositing or compacting backfill material.

I. Compact the backfill material placed next to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.

J. Excavate, fill, backfill, and grade to elevations required by the Contract Documents.

K. Pile excavated materials suitable for backfill in an orderly manner a sufficient distance from excavations to prevent overloading, slides, and cave-ins.

L. Do not obstruct access ways, roadways, and plant facilities.

M. Dewater excavations and trenches in accordance with Section 02240, Dewatering.

N. Refer to the Contract Drawings for additional requirements related to earthwork and protection of existing features.

3.02 TRENCH EXCAVATION

A. Before excavating the trench, the Contractor shall prepare the surface including clearing and grubbing as specified in Section 02230, Site Preparation.

B. The Contractor shall be required to fully comply with all applicable OSHA Excavation Safety Standards and to abide by them as covered by the most current version of the Florida Trench Safety Act (90-96, Laws of Florida).

C. The Contractor shall ensure that mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be so operated that conduit/utility, when accurately laid to specified alignment, will be centered in the

trench with adequate clearance between the conduit/utility and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

D. The Contractor shall not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, other existing property, utilities, structures, etc. above or below ground. In all such locations, the Contractor shall use hand-excavating methods.

E. The Contractor shall not use blasting.

F. The Contractor shall cut trenches sufficiently wide to enable proper installation of services and to allow for testing and inspection. The Contractor shall also trim and shape trench bottoms and leave them free of irregularities, lumps, and projections. Trench width shall be excavated as specified on the Contract Drawings.

G. The Contractor shall construct trench walls to avoid side wall collapse or sloughing. Trenches shall be either braced or open construction in accordance with the Contract Documents. No separate payment will be made for any special procedure used in connection with the excavation.

H. Where sheeting and bracing are not required, the Contractor shall construct trench walls in the bottom of the excavation as vertical as possible to the maximum height allowable by OSHA. Trench walls above this height shall be sloped to guard against side wall collapse or sloughing as specified on the Contract Drawings.

I. Where sheeting and bracing are required, the sheeting and bracing system shall meet the requirements in these Specifications.

J. Excavations shall be to the design elevations shown on the Contract Drawings or as specified, unless unsuitable foundation materials are encountered in the bottom of the excavation. Where unsuitable foundation materials are encountered, this material shall be undercut and removed as indicated on the Contract Drawings and replaced with suitable soil material meeting all the requirements for Bedding. The lift thicknesses and compaction requirements for the replacement soil shall also meet the requirements for Bedding.

K. The Contractor shall be careful not to overexcavate except where necessary to remove unsuitable materials, irregularities, lumps, rock, and projections. Unnecessary overexcavation shall be replaced as specified in these Specifications at the Contractor's sole expense.

L. The Contractor shall accurately grade bedding soil materials at the bottoms of the trenches to provide uniform bearing and support for each section of conduit/utility

at every point along its entire length except where it is necessary to excavate the bedding for conduit/utility bells (e.g., pipe bells), etc. or for proper sealing of conduit/utility joints. Abrupt changes in grade of the trench bottom shall be avoided.

M. The Contractor shall dig bell holes and depressions after the bedding has been graded to ensure that the conduit/utility rests on the prepared bedding for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint.

N. The Contractor shall do the following:

1. Pile all excavated material in a manner that will not endanger the work or erode the stormwater management facilities or water courses.
2. Avoid obstructing sidewalks, driveways, and plant facilities.
3. Leave hydrants, valve pit covers, valve boxes, or other utility controls unobstructed and accessible.
4. Keep gutters, drainage inlets, natural water courses, and miscellaneous drainage structures clear or make other satisfactory provisions for their proper operation.

O. The Contractor shall keep all suitable materials that are suitable for use/reuse in the trench construction separated from unsuitable materials.

P. Except where otherwise authorized, indicated, or specified, the Contractor shall replace, at the Contractor's own expense, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations with concrete or flowable fill, as directed by the Owner.

Q. The Contractor shall adhere to these Additional Excavation Requirements for piping:

1. Excavate trenches so that the piping can be laid to the lines, grades, and elevations indicated on the Contract Drawings.

2. For piping designated to be laid to a minimum cover requirement, grade trenches to avoid high and low points to the extent practical. Record Drawings of such pipes shall present top-of-pipe and grade elevations at all high and low points along each pipe segment, at the end points of each pipe segments, and at intervals not to exceed 100 feet along each pipe segment. If, in the opinion of the Owner, additional air release and/or vacuum relief valves are required, the Contractor shall install the additional items as directed by the Owner.

3. Except at locations specifically indicated otherwise on the Contract Drawings, the required minimum cover over the top of the pipe from finished grade for various pipe diameters shall be as follows:

	Pipe Diameter			
	48-inch or less	66-inch	72-inch	96-inch
Minimum Cover	3 feet	4 feet	4.5 feet	5 feet

Continue dewatering operations along each pipe segment until the required minimum cover is provided. During the dewatering operations, the ground water level in the trench shall remain at all times a minimum of 1 foot below bottom of trench excavations.

R. The Contractor shall adhere to these Additional Excavation Requirements for Electrical Utilities:

1. Avoid abrupt changes in grade of the trench bottom.

2. The required minimum cover over the top of electrical conduits from finished grade shall be as follows:

	Electrical Conduits (Lines less than 5 kV)	Electrical Conduits (Lines 5 kV and up)
Minimum Cover	2 feet	3 feet

3. The required minimum clearance from the bottom of mat foundations and/or footings shall be 2 feet. Provide additional cover where necessary to satisfy the minimum clearance requirement.

4. Provide additional cover depth if necessary, to avoid interference of other cables, ducts, piping, structures, and other utilities.

S. The Contractor shall adhere to this Additional Excavation Requirement for Appurtenances:

1. Ensure that excavations for valves and similar appurtenances shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls.

3.03 PROTECTION OF PERSONS AND PROPERTY

A. The Contractor shall do the following:

1. Barricade and post excavations with warning signs for the safety of persons. Provide warning lights during hours of darkness.
2. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations against damage including loading, settlement, lateral movement, undermining, and washout.

B. Conduct topsoil removal operations to ensure the safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

3.04 SHEETING AND BRACING

A. Where sheeting and bracing are required to support the side walls of the excavation, the Contractor shall retain a Professional Engineer, registered in Florida, to design sheeting and bracing. The design shall establish requirements for sheeting and bracing and shall comply with all applicable codes; authorities having jurisdiction; and federal, state, and local regulations.

B. The sole responsibility for the design, methods of installation, and adequacy of sheeting and bracing shall be and shall remain that of the Contractor and the Contractor's Professional Engineer. The Contractor shall provide all necessary sheeting and bracing or other procedures as required to ensure safe working conditions and to protect the excavations.

C. Sheeting and bracing shall consist of braced steel sheet piling, trench box, braced wood lagging, and soldier beams or other approved methods.

D. The Contractor shall immediately fill and compact voids formed outside the sheeting. Where soil cannot be properly compacted to fill the void, the Contractor shall use Class B concrete as backfill at no additional cost to the Owner.

E. The Contractor shall install sheeting outside the required clearances and dimensions. Sheeting shall be plumb, securely braced, and tied in position. Sheeting shall be adequate to withstand all pressure to which it may be subjected. The Contractor shall correct any movement or bulging at no expense to the Owner to provide the necessary clearances and dimensions.

F. The Contractor shall maintain sheeting and bracing in excavations and trenches for the entire time excavations will be open.

G. The Contractor shall not brace sheeting against pipe being laid. Sheeting shall be braced so that no concentrated load of horizontal thrust is transmitted to the pipe.

H. Sheeting shall not be withdrawn if driven below the spring line of any pipe. The Contractor shall cut off tops as indicated on the Contract Drawings and leave bottoms permanently in place.

3.05 DEWATERING, WATER REMOVAL, AND DRAINAGE MAINTENANCE

A. Water shall not be permitted to accumulate in excavations. The Contractor shall provide dewatering systems to convey water away from excavations so that softening of foundations bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be as specified in Section 02240, Dewatering, and as approved by the Owner before being installed by the Contractor. Groundwater levels shall be maintained a minimum of 2 feet below bottom of trenches or excavations.

B. Dewatering systems and equipment shall be in place as required to eliminate water during the excavation period until the work is completed. The Contractor shall provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation. This includes the use of sand or gravel as required to maintain adequate flow during the pipe laying or installation of other items of work within the excavation.

C. Water pumped or drained shall be disposed of in a suitable manner without damage to adjacent property, to other work under construction, or to roads. Water shall not be discharged onto surface improvements without adequate protection of the surface at the point of discharge. All gutter, drains, culverts, sewers, and inlets shall be kept clean and open for surface drainage. Water shall not be directed across or over pavements except through approved pipes or properly constructed troughs. The Contractor shall obtain permission from the Owner of any property involved before constructing water courses or installing discharge pipe or hose for removal of water and provide for disposal of the water without ponding or creating a public nuisance.

D. All pumps used for dewatering shall have noise-reduction features and shall be able to run continuously with minimal attendance. If required by the Owner, the pumps shall be enclosed on all sides with a plywood enclosure, with padded material suitable for outdoor conditions on the inside of the enclosure, to further reduce pump engine noise to an acceptable level. All applicable ordinances and codes for noise abatement shall be followed. The Contractor shall maintain pumps at all times, as necessary. When pumps are no longer required, the Contractor shall remove the pumps, wellpoints, pipes, and other apparatus from the area.

E. It is essential that the discharge of the trench dewatering pumps be conducted to natural drainage channels, drains, or storm sewers.

F. Trenches shall be constructed on the upstream side of the traffic way across roadways, driveways, or other traffic ways adjacent to drainage ditches or water to prevent impounding water after the pipe has been laid. The Contractor shall construct and maintain bridges and other temporary structures required to maintain traffic across such unfilled trenches. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. After backfilling is completed, the Contractor shall immediately remove all material deposited in roadway ditches or other water courses crossed by the line of trench and restore the original section, grades, and contours of ditches or water courses. Surface drainage shall not be obstructed longer than necessary.

G. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1%, the Contractor shall install ditch checks. Unless otherwise indicated on the Contract Drawings, ditch checks shall be concrete or as otherwise approved by the Owner. Ditch checks shall extend not less than 2 feet below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

3.06 BACKFILLING AND COMPACTION

A. The Contractor shall not backfill trenches until required tests are performed.

B. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.

C. The Contractor shall perform the following steps to ensure compaction at the bottom of the trench or excavation before bedding:

1. Remove disturbed native soil material and/or any soils not meeting the requirement of suitable soil material as indicated on the Contract Drawings.
2. Compact the bottom of the trench excavation (undisturbed native subsurface soil) to no less than 98% of the Modified Proctor maximum dry density in accordance with ASTM D1557, before placement of foundation, bedding, piping, and backfill.

D. To backfill below and around pipe to the spring line of the pipe, the Contractor shall do the following:

1. Construct foundation and bedding as indicated on the Contract Drawings before placement of pipe.
2. Install each pipe at proper grade, alignment, and final position.
3. Deposit suitable soil material uniformly and simultaneously on each side of pipe in completed course layers to prevent lateral displacement.
4. Compact under pipe haunches and on each side of pipe to the pipe spring line as shown on the Contract Drawings to hold the pipe in the proper position during subsequent pipe backfilling and compaction operations.
5. Construct haunching as indicated on the Contract Drawings.

E. To trench backfill above pipe spring line to finished grade, the Contractor shall do the following:

1. Deposit suitable soil material around and above pipe in uniform layers as shown on the Contract Drawings.
2. Backfill and compact trenches from the spring line of the pipe to the top of the trench in completed course layers as shown on the Contract Drawings.
3. Use material previously defined in these Specifications as suitable soil material.
4. Compact by hand or mechanical tampers.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. The Contractor shall remove and legally dispose of waste materials, including excavated material classified as unsuitable soil material, trash, and debris from the property at no additional cost to the Owner.

END OF SECTION

SECTION 02316
PROOF-ROLLING

PART 1 GENERAL

1.01 SCOPE OF WORK

This Section covers the work necessary to excavate and construct embankments as required for the stormwater treatment area and maintenance access embankments and drives on the project.

A. The Contractor shall proof-roll earthwork to locate soft areas, check the subgrade compaction, and ensure uniform support for embankments. The Contractor will repair soft subgrade areas that are located through proof-rolling so that the subgrade density is maintained throughout the construction of the project.

1. The Contractor is responsible for performing all work so as not to damage existing roadways, facilities, utilities, structures, etc. and shall repair and replace such damage to equal or better than its original undamaged condition without cost to the Owner.
2. The Contractor shall examine the site before submitting a bid, taking into consideration all conditions that may affect the work.
3. The Contractor shall coordinate all additional subsurface investigations and testing included with this work with the Owner. In general, if the Contractor finds different and unsuitable/unsatisfactory soil conditions during the work, the Contractor shall notify the Owner immediately.

1.02 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. The Contractor shall submit records documenting the proof-roll. The Contractor shall note any discrepancies found immediately and notify the Owner. The records shall include the following:

1. Locations of proof-roll and proof-roll failures. Photographs of all proof-roll failures.
2. Locations of additional test borings, as required.

1.03 DEFINITIONS

A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.

B. *Borrow Soil*: Satisfactory soil imported from off-site for use as fill or backfill.

C. *Excavation*: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Owner. Authorized additional excavation and replacement material will be paid for according to the Contract provisions for unit prices.
2. *Bulk Excavation*: Excavation more than 10 feet in width and more than 30 feet in length.
3. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Owner. Unauthorized excavation, as well as remedial work directed by the Owner, shall be without additional compensation.

D. *Fill*: Soil materials used to raise existing grades.

E. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances.

F. *Subgrade*: The surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

G. *Utilities*: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 TESTING REQUIREMENTS

A. Proof-Rolling Equipment

1. Standard Proof Roller:

a. The proof-rolling equipment shall have a loading platform or body suitable for ballast loading that is supported on a minimum of two axles with no more than two pneumatic tired wheels per axle. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. Pneumatic proof-rolling equipment with multiple pivotal axles and more than two tires along the front or rear axle axis shall have articulating axle supports to equally distribute the load to all tires over uneven surfaces.

b. The proof-roller unit, under working conditions, shall have a minimum contact width of 7-1/2 feet (2.3 meters) and shall be designed so that the gross roller weight may be varied uniformly from 25 tons to 50 tons (23 megagrams to 45 megagrams) by ballast loading. The tires shall be capable of operating under various loads with variable air pressures up to 145 psi (up to 1,000 kiloPascals). The tires shall be smooth tread and shall impart a minimum ground contact pressure of 75 pounds per square inch (520 kiloPascals). Tires shall be practically full of liquid (i.e., when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Owner or designated representative.

c. The proof-roller shall be drawn by a power train of adequate tractive effort or may be of a self-propelled type. The proof-rolling equipment shall be equipped with a reverse mode transmission or be capable of turning 180 degrees in the street width. When a separate power train is used to draw the proof-roller, the power train weight shall not be considered in the weight of the proof-roller. The power train shall be rubber-tired when rolling subgrade and base materials. A cleated or track-type power train may be used on earth and rock embankments.

2. Alternate Equipment:

a. With the written approval of the Owner or designated representative, the Contractor may use alternate equipment on embankment courses, subgrade, and base courses subject to the requirements of the standard proof-roller except with respect to minimum contact width, axle/tire arrangement, and tire tread. Alternate equipment for stability testing of embankments shall be restricted to equipment that can be shown to impart a stress distribution on the embankment structure equivalent to or greater than the stress induced by the concentrated weight of a standard proof-roller.

B. The Contractor shall proof-roll in one direction. Limit vehicle speed to 3 mph. One pass with a proof-roller is adequate to achieve satisfactory proof-rolling results.

C. The Contractor shall proof-roll immediately after the subgrade compaction operation, while the moisture content of the subgrade soil remains near the optimum moisture content or at the moisture content that achieved compaction.

D. The Contractor shall not proof-roll areas that are obviously unstable and require undercutting. Do not proof-roll unnecessarily to demonstrate that subgrade correction is required.

E. The Contractor shall observe the proof-roll for the following indications of poor subgrade:

1. Displacement and rutting indicating the subgrade moisture content is too high.

F. The subgrade compaction is considered to FAIL the proof-roll if the following is observed:

1. Permanent rutting greater than 0.5 inch (13 mm), or
2. Elastic (rebound) movement or rutting in excess of 0.5 inch (13 mm) with substantial cracking or substantial lateral movement.

G. In areas that FAIL proof-roll the Contractor shall test the soil in the location using the testing procedure specified in Section 02300, Earthwork for Structures, Section 02301, Earthwork for the Stormwater Treatment Area, or Section 02305, Earthwork for Utilities, as applicable.

H. The Contractor shall correct all failed or soft locations in fill areas in accordance with the Specifications at no additional cost to the Owner. The repaired area shall be proof-rolled.

I. The Contractor shall notify the Owner of failed or soft locations in excavated areas. The Owner will provide the Contractor with a case-specific repair procedure.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02370
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall take every reasonable precaution throughout construction to prevent the erosion of soil and the sedimentation of streams, bays, storm systems, or other water impoundments, ground surfaces, or other property as required by federal, state, and local regulations.

B. The Contractor shall provide protective covering for disturbed areas upon suspension or completion of land-disturbing activities. Permanent vegetation shall be established at the earliest practicable time. Temporary and permanent erosion-control measures shall be coordinated to ensure economical, effective, and continuous erosion and siltation control throughout the construction and post-construction period.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. Florida Department of Transportation (FDOT)

1. FDOT Section 103—Temporary Work Structures.
2. FDOT Section 104—Prevention, Control, and Abatement of Erosion and Water Pollution.
3. FDOT Section 530—Riprap and Articulating Concrete Block Revetment Systems.
4. FDOT Section 982—Fertilizer.
5. FDOT Section 985—Geosynthetic Materials.

1.04 REGULATORY REQUIREMENTS

A. The Contractor shall prevent damage to properties outside the construction limits from siltation due to construction of the project and assume all responsibilities to the affected property owners for correction of damages which may occur. Erosion-control measures shall be performed conforming to the requirements of and in accordance with plans approved by applicable state and local agencies and as specified by the erosion-control portion shown on the Drawings and as required by these Specifications. The Contractor shall not allow mud and debris to accumulate in the streets or enter drainage ditches, canals, or waterways. Should the Contractor pump water from excavations during construction, appropriate siltation preventative measures shall be taken before the pumped water is discharged into any drainage ditch, canal, or waterway.

1.05 PRACTICES

The Contractor shall adhere to the following:

A. Avoid dumping soil or sediment into any stream bed, pond, ditch, or watercourse.

B. Maintain an undisturbed vegetative buffer where possible between a natural watercourse and trenching and grading operations.

C. Avoid equipment crossings of streams, creeks, and ditches where practicable.

1.06 EROSION AND SEDIMENT-CONTROL DEVICES AND FEATURES

A. The Contractor shall construct all devices (silt fences, retention areas, etc.) for sediment control at the locations required to protect federal, state, and local water bodies and water courses and drainage systems before beginning to excavate the site. All devices shall be properly maintained in place until a structure or paving makes the device unnecessary or until directed to permanently remove the device.

B. The Contractor shall use mulch to temporarily stabilize areas subject to excessive erosion and to protect seed beds after planting where required.

C. The control measures must be adequate to ensure that turbidity in the receiving water will not be increased more than 1 nephelometric turbidity unit (NTU), or as otherwise required by the State or other controlling body, in water used for public water supply or fish unless limits have been established for the particular water.

D. In surface water used for other purposes, the turbidity must not exceed 25 NTU, unless otherwise permitted.

E. Filter fabric, hay bales, or other approved methods shall be placed and secured over the grates of each existing inlet, grating, or storm pipe opening near the area of excavation to prevent silt and debris from entering the storm systems.

F. The Contractor shall use silt fences, hay bales, and floating turbidity barriers as shown on the plans or as directed by the Owner or Owner's Representative to restrict movement of sediment from the site.

G. The Contractor shall establish vegetative cover on all unpaved areas disturbed by the work.

PART 2 PRODUCTS

2.01 GENERAL

A. Open-mesh biodegradable mulching cloth.

B. Fertilizer shall be 10-10-10 grade or equivalent.

C. Lime shall be Dolomitic Agricultural Ground limestone, in accordance with FDOT Section 982.

D. Grass shall be in accordance with Section 02920, Seeding and Sodding.

E. Silt fence shall consist of non-biodegradable filter fabric (Trevira, Mirafi, etc.), in accordance with FDOT Section 985, wired to galvanized wire mesh fencing and supported by wood or metal posts.

F. Floating or staked turbidity barriers as specified in FDOT Section 985 and FDOT Section 104.

G. Erosion Stone: FDOT Section 530.

1. Sand-Cement Riprap.
2. Concrete Block.
3. Rubble 20 to 300 pounds each.

H. Filter Fabric for placing under Riprap shall meet the requirements of FDOT Section 985.

PART 3 EXECUTION

3.01 CLEARING

A. The Contractor shall schedule and perform clearing and grubbing so that subsequent grading operation and erosion-control practices can follow immediately after. Excavation, borrow, and embankment operations will be conducted as a continuous operation. All construction areas not otherwise protected shall be planted with permanent vegetative cover within 30 working days after completing active construction.

3.02 STABILIZING

A. The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures. All disturbed areas outside of embankment left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with either temporary or permanent ground cover, devices, or structures sufficient to restrain erosion.

3.03 REGULATORY REQUIREMENTS

A. Whenever land-disturbing activity is undertaken on a tract, a ground cover sufficient to restrain erosion must be planted or otherwise provided within 30 working days on that portion of the tract upon which further active construction is to be undertaken.

B. If any earthwork is to be suspended for any reason for longer than 30 calendar days, the areas involved shall be seeded with vegetative cover or otherwise protected against excessive erosion during the suspension period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility to control erosion in that area.

3.04 VEGETATIVE COVER

A. Preparation of Seedbed. Areas to be seeded shall be scarified a depth of 4 inches until a firm, well-pulverized, uniform seedbed is prepared. Fertilizer shall be applied during the scarification process in accordance with the following rates:

1. Fertilizer—10 to 15 pounds per 1,000 square feet.

B. Seeding. Disturbed areas along embankments shall be permanently seeded with mix specified in Section 02920, Seeding and Sodding.

C. The Contractor shall mulch all areas immediately after seeding. Mulch shall be applied and anchored as specified previously in this Section.

3.05 MAINTENANCE

A. The Contractor shall maintain all temporary and permanent erosion-control measures in functioning order. Temporary structures shall be maintained until such time as vegetation is firmly established and grassed areas shall be maintained until completion of the project. Areas which fail to show a suitable stand of grass or which are damaged by erosion shall be immediately repaired. No additional payment will be made to the Contractor for re-establishing erosion-control devices, which may become damaged, destroyed, or otherwise rendered unsuitable for their intended function during the construction of the project.

B. The Contractor shall remove all silt, sediment, and debris buildup regularly to maintain functioning storm systems and erosion-control devices.

3.06 REMOVAL OF SEDIMENT CONTROL DEVICES

A. Near completion of the project, when directed by the Owner, the Contractor shall dismantle and remove the temporary devices used for sediment control during construction. All erosion-control devices in seeded areas shall be left in place until the grass is established. The Contractor shall seed areas around devices and mulch after removing or filling temporary control devices.

B. The Contractor shall clean up all areas at the completion of the project.

END OF SECTION

SECTION 02532
MAINTENANCE OF FLOW

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall be responsible for base and storm drainage flow in the M-1 Canal and all public and private storm sewer pipes during construction. The Contractor shall staff all bypass pumping systems during non-working hours, 7 days a week.

B. Provide all labor, equipment, power, and materials necessary to maintain flow in the M-1 Canal and existing storm sewers, drains, and manholes and handle existing stormwater flows. Construct and maintain all temporary bypass channels and drains and be responsible for all bypass pumping of drainage that may be required to prevent backing up of drainage during excavation, construction, and installation of the Weir and to allow proper inspection and testing of the new work. Note that the M-1 Canal has a continuous base flow, which must be handled.

C. When bypass pumping is required, the Contractor shall supply pumps, conduits, power, and other equipment to safely divert the flow of drainage around the section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flows plus additional flows that may occur during a rain event.

D. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. Standby pump(s) of equal or greater capacity than the largest pump used shall be installed at the mainline flow bypassing locations ready for use if a primary pump fails.

E. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

F. The Contractor shall repair at his own expense any damage to property, public or private, caused by his operations.

G. The Contractor shall maintain Canal flow around the work area in a manner that will not cause surcharging of storm sewers or damage to sewers and that will protect public and private property from damage and flooding.

H. If damage of any kind occurs to the existing Canal, drains, or storm sewers, the Contractor shall at his own expense make repairs to the satisfaction of the Owner.

I. The Contractor shall not overflow, bypass, pump, or by any other means convey drainage to any brook or water course other than the M-1 Canal without permission of the Owner.

J. Before actual operations, the Contractor shall conduct leakage and pressure tests of the bypass pumping discharge piping using clean water. The Owner will be given 24-hour notice before testing.

K. The Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipeline. The Contractor shall locate his bypass pipelines to minimize any disturbances to existing utilities and shall obtain approval of the pipeline locations from the Owner. The Contractor shall pay all costs associated with relocating utilities and obtaining all approvals.

L. The pipeline must be off streets and sidewalks and within the M-1 Canal right-of-way. The Contractor is responsible for obtaining any approvals from municipalities having jurisdiction or property owners for placing the temporary pipeline outside the M-1 Canal right-of-way permitted work zone.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. All procedures for maintaining flows must meet the approval of the Owner and the Contractor shall be required to submit to the Owner, for approval, a detailed written plan of all methods of flow maintenance 10 days in advance of flow interruption, in accordance with Section 01330, Submittals and Acceptance.

B. The plan shall include but not be limited to details of the following:

1. Number, size, material, location, and method of installing suction piping.
2. Number, size, material, method of installation, and location of installations of discharge piping.
3. Bypass pump sizes, capacity, number of each size to be on site, and power requirements.
4. Standby power generator size, sound attenuation, and location.
5. Downstream discharge plan.
6. Calculations for selecting bypass pumping pipe size.

7. Schedule for installing and maintaining bypass pumping lines.
8. Plan indicating location of bypass pumping lines.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02635
REINFORCED CONCRETE DRAIN-PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary and install and test reinforced concrete pipe for drains complete as shown on the Drawings and as specified in this Section.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Within 30 days of the Effective Date of the Agreement submit the name of the pipe and fitting supplier and a list of materials to be furnished.

B. Submit shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths by diameter for the entire job.

C. Submit with the shop drawings certification from the manufacturer that the fine and coarse aggregates used in manufacture of the concrete pipe comply with the requirements of Paragraph 2.01C.

D. Before each shipment of pipe, submit the manufacturer's certification that the pipe for this Contract conforms to the ASTM Standards specified in this Section.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
2. ASTM C76—Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. ASTM C150/C150M—Standard Specification for Portland Cement.

4. ASTM C361—Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
5. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
6. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.04 QUALITY ASSURANCE

A. The manufacturer shall perform the acceptance tests specified in ASTM C76, Paragraph 5.1.2.

B. The Owner will examine the pipe after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified in this Section even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. Except as otherwise specified in this Section, pipe shall conform to ASTM C76, Class IV, Wall B. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform. The manufacturer in accordance with Section 7.2 of ASTM C76 shall design minimum reinforcement and wall thickness for sizes not tabulated in ASTM C76.

B. Cement shall be non-air-entraining Portland cement conforming to ASTM C150/C150M, Type II. The use of any admixture shall be subject to the specific approval of the Owner.

C. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM C33/C33M, except for gradation, with a maximum loss of 8% when subjected to five cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33/C33M, except for gradation, with a maximum loss of 8% when subjected to five cycles of the soundness test using magnesium sulfate. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the Owner as stated in Article 1.02.

D. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe, shall be equal to or greater than the design strength of the concrete. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipes. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling, and after installation. When cores indicate that reinforcing steel has less than 85% bond the pipe shall be subjected to a 3-edge bearing test to 13 psi to verify strength and water tightness.

E. Pipe may be rejected for any of the following reasons:

1. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement cage in position, or steel reinforcement in any surface of the pipe, except as permitted by Section 8.2 of ASTM C76.

2. Transverse reinforcing steel found to be in excess of 1/4-inch out of specified position after the pipe is molded.

3. Any shattering or flaking of concrete at a crack.

4. Voids, with the exception of a few minor bugholes, on the interior and exterior surfaces of the pipe exceeding 1/4-inch in depth unless properly and soundly pointed with mortar or other approved material.

5. Unauthorized application of any wash coat of cement or grout. Any pipe dressing procedures shall be subject to approval of the Owner.

6. A hollow spot (identified by tapping the internal surface of the pipe), which is greater than 30-inch in length or wider than three times the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified in Paragraph 2.01R.

7. Defects that indicate imperfect molding of concrete; or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension of 2-1/2 times the wall thickness or deeper than two times the maximum graded aggregate size. Repair of such defects not exceeding these limits may be made as specified in Paragraph 2.01R.

8. Any of the following:

   a. A crack having a width of 0.005 to 0.01-inch throughout a continuous length of 36 inches or more.
   b. A crack having a width of 0.0 to 0.03-inch or more throughout a continuous length of 1 foot or more.
   c. Any crack greater than 0.005-inch extending through the wall of the pipe and having a length in excess of the wall thickness.
   d. Any crack showing two visible lines of separation for a continuous length of 2 feet or more or an interrupted length of 3 feet or more anywhere in evidence, both inside and outside.
   e. Cracks anywhere greater than 0.03-inch in width.

F. The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the Owner. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained 4,000 psi.

G. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Owner. Sufficient pipe of various lengths should be available at the site to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure, etc. may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 feet, but the installation of 16-foot lengths will depend on the ability to handle such lengths of pipe in sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting, and avoid disturbance to adjacent ground. If in the opinion of the Owner the use of 16-foot lengths is impracticable, shorter lengths shall be used.

H. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1 1/2-inch longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C76 requirements.

I. During manufacturing, measuring devices shall be used to ensure joint assembly is within the tolerance of ASTM C76 and this Section.

J. The Owner shall have the right to take samples of the concrete after it has been mixed or as it is being placed in the forms or molds and to make such inspection and tests of the concrete as he/she may wish.

K. At the start of the work, a set of test cylinders shall be taken each day on which pipe is manufactured for the project or more often if required. This may ultimately be reduced to one set of three specimens for every 50 cubic yards of concrete placed, if the uniformity of results warrants and if approved by the Owner. At the start of the work, a relationship shall be established between ultimate strength of test cylinders stored in a standard manner compared to cylinders steam cured with the pipe and compared to cores taken from the corresponding finished pipe. At least five sets of tests shall be made.

L. The Owner shall have the right to cut cores from such pieces of the finished pipe as he/she selects for inspection and such tests as he/she may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his/her expense. The number of cores shall not exceed the requirements of ASTM C76.

M. Test cores may be taken for every 500 linear feet of pipe manufactured, but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week (or possibly fewer, but not less than one set for every 1,500 linear feet), if a satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10% more or less from the average ratio. Cores may be drilled in any manner that will provide a smooth core face. All pipe cylinders and cores shall be 4 inches in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness, at least 1 day before being tested.

N. Core testing shall conform to Standard ASTM Methods.

O. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM standard, as specified in this Section and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched at least once on every 50 square inches of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

P. The manufacturer shall use measuring devices to ensure joint assembly is within tolerances of ASTM C76 and as specified in this Section. If, during construction,

the pipes cannot be satisfactorily joined, the manufacturer shall pre-join the pipe at the plant.

Q. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only pipe actually conforming to the Specifications and accepted will be listed for approval, shipment, and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

R. Pits, blisters, rough spots, breakage, and other imperfections may be repaired, subject to the approval of the Owner, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3-inch cylinders stored in the standard manner. Subject to the approval of the Owner, epoxy mortar may be used for repairs.

2.02 JOINTS FOR CONCRETE PIPE

A. Joints for concrete pipe less than 72 inches in diameter shall be concrete and rubber tongue-and-groove or bell-and-spigot-type joint conforming to ASTM C361 with provisions for using a round rubber O-Ring gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2ºand 2-1/2º. The diameters of the joint surfaces that compress the gasket shall not vary from the true diameters by more than 1/16-inch.

B. The round rubber O-Ring gaskets shall conform to ASTM C443 except as otherwise specified in this Section.

C. The gaskets shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 13 psi for 10 minutes without showing any leakage by the gasket or displacement of it. The pipe manufacturer shall provide facilities for testing the effectiveness of the joints against leakage and one such test may be required for each 500 feet of pipe for each type of joint manufactured. Such tests shall be made by an internal or external pressure against the joint of at least 13 psi for 10 minutes in accordance with ASTM C443. The completed joint, when installed in place in the work, shall be capable of withstanding a groundwater pressure of 13 psi without exceeding the allowable leakage specified for the pipe testing.

D. The ends of the pipe shall be made true to form and dimension and the bell shall be made by casting against steel forms. The manufacturer shall inspect all pipe

joint surfaces for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Owner a notarized affidavit stating all pipe meets the requirements of ASTM C76, as specified in this Section and the joint design.

PART 3 EXECUTION

3.01 LAYING CONCRETE PIPE

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or fittings and the joint surfaces. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective.

B. As soon as the excavation is completed to the normal grade of the bottom of the trench, place crushed stone in the trench and the pipe shall be firmly bedded in this stone to conform accurately to the lines and grades indicated on the Drawings. Crushed stone shall conform to the requirements of Section 02230, Site Preparation. Blocking under the pipe will not be permitted.

C. Crushed stone shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe as indicated on the Drawings. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket immediately before being forced home. Before the pipe is lowered into the trench, the spigot and bell shall be cleaned and free from dirt. A vegetable lubricant that is not soluble in water, furnished by the pipe manufacturer and harmless to the rubber gasket, shall lubricate the gasket and bell. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come-alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gauge is used to check the final position of the gasket. The jacks or come-alongs shall be anchored sufficiently back along the pipeline (a minimum of five lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars be used nor shall any of the motor-driven equipment be used.

D. As soon as the pipe is in place and before the come-along is released, backfill shall be placed as indicated on the Drawings and compacted for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be

released. If any motion at joints can be detected, a greater amount of backfill shall be placed before pressure is released. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means.

E. Carefully regulate the equipment and construction operations so that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired or replaced at the Contractor's expense.

3.02 TESTING

A. General

1. All drains shall be tested for leakage by an infiltration test if the groundwater level is a minimum of 2 feet above the crown of the pipe for the full length of the section tested.
2. When drains cannot be tested by an infiltration test as specified above, they shall be tested by an exfiltration test using water.
3. Test the first section of pipeline as soon as it is installed to demonstrate that the work conforms to this Section.
4. Testing of pipe shall closely follow pipe laying. No more than 1,000 feet of pipe shall remain untested at any time.

B. Infiltration Test

1. Pipe shall be tested for infiltration after the backfill has been placed and the groundwater has been allowed to return to normal elevation. Infiltration tests shall be made under the supervision of the Owner, and the length of line to be tested shall not be less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 100 gallons per inch of diameter per day per mile of pipe in each section tested. There shall be no gushing or spurting leaks.
2. If an inspection of the completed sewer or any part thereof shows pipes or joints that allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.
3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe to be furnished and installed in an approved manner and at such times and locations as may be directed by the Owner.

C. Exfiltration Test

1. Leakage tests by exfiltration shall be made before or after backfilling at the discretion of the Owner. The length of pipe to be tested shall be such that the head over the crown at the upstream crown is not less than 2 feet and the head over the downstream crown is not more than 6 feet. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least 1 hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.
2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant level in the pipe does not exceed 100 gallons per inch of diameter per day per mile of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory. If the amount of leakage indicates defective joints or broken pipes, they shall be corrected or replaced.

3.03 CLEANING

A. At the conclusion of the work, thoroughly clean all pipelines by flushing or power jetting with water or other means to remove all dirt, stones, pieces of wood, or other material that may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Owner will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired.

END OF SECTION

SECTION 02700
PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the work necessary to provide for the construction of all pavement where indicated on the Drawings.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Limerock material submittal is to be made to include liquid limit, plastic index, gradation, certification regarding deleterious material, limerock bearing ratio (LBR), Florida Department of Transportation (FDOT) pit number, and other information as required to indicate performance in accordance with the specifications.

B. Information regarding asphaltic and Portland cement concrete materials and mix shall be submitted as required by the referenced FDOT specifications.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time, unless otherwise noted. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. The 2022 editions of the FDOT Standard Specifications for Road and Bridge Construction (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section.

1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to “the Owner” by this contract.
2. The Contractor shall retain an independent testing agency, as approved by the Owner, to perform all tests, including tests referenced to be performed by the Engineer.

3. Payment for this project is on a Lump-Sum Basis if defined as Lump Sum on the Bid Form. The FDOT sections defining the Basis of Payment shall be applied only when unit price work is defined on the Bid Form.

B. American Society of Testing and Materials (ASTM)

1. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
3. ASTM D2167—Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D6938—Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.04 QUALITY ASSURANCE

A. The Contractor shall perform field-density tests along the centerline of construction or as directed by the Owner and in accordance with the FDOT's *Standard Specifications for Road and Bridge Construction*, latest edition.

B. The Contractor shall field check the depth of stabilization and/or limerock at each road crossing with a pipeline.

C. The Owner may require additional testing as deemed necessary. The Owner shall interpret test results and the Contractor shall perform remedial work as directed by the Owner. The Contractor shall provide labor to the Owner for help in performing tests and/or checking line and grade at no additional cost to the Owner.

D. Laboratory maximum dry density of soil mixtures at optimum moisture shall be determined by ASTM D1557 for subgrade, stabilized subgrade, and limerock base course.

E. Field density of stabilized subgrade and soils or soil mixtures in fill or backfill shall be determined by ASTM D1556/D1556M, ASTM D2167, or ASTM D6938 for limerock base course.

F. Bearing value of stabilized subgrade shall be determined by the methods required for determining LBR according to the FDOT, Standard Specification FM 5-515.

G. Field density of stabilized subbase shall be 98% or greater of the Modified Proctor maximum dry density, ASTM D1557.

H. The Contractor shall bear the cost of all tests. The Owner shall have sole responsibility for interpreting all test results.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 ROCK BASE

A. The following sections of the Standard Specifications shall apply:

1. Section 200-1, Description.
2. Section 200-2, Materials.

2.03 STABILIZING MATERIALS

A. The following sections of the Standard Specifications shall apply:

1. Section 160-1, Description.
2. Section 160-2, Materials.

2.04 PRIME AND TACK COATS FOR BASE COURSES

A. The following sections of the Standard Specifications shall apply:

1. Section 300-1, Description.
2. Section 300-2, Materials.

2.05 ASPHALT

A. The following sections of the Standard Specifications shall apply:

1. Section 334-1, Description.
2. Section 334-2, Materials.
3. Section 334-3, General Composition of Mixture.
4. Section 334-5, Acceptance of the Mixture.

2.06 CEMENT CONCRETE PAVEMENT

A. The following sections of the Standard Specifications shall apply:

1. Section 350-1, Description.
2. Section 350-2, Materials.

2.07 TRAFFIC STRIPES AND MARKINGS

A. The following sections of the Standard Specifications shall apply:

1. Section 711-1, Description.
2. Section 711-2, Materials.

PART 3 EXECUTION

3.01 EXCAVATION AND EMBANKMENT

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description.
2. Section 120-2, Classifications of Excavation.
3. Section 120-3, Preliminary Soils Investigation.
4. Section 120-4, Removal of Unsuitable Materials and Existing Roads.
5. Section 120-5, Disposal of Surplus and Unsuitable Material.
6. Section 120-6.1, Materials for Borrow.
7. Section 120-7, Materials for Embankment.
8. Section 120-8, Embankment Construction.
9. Section 120-9, Compaction Requirements.
10. Section 120-10, Acceptance Program.
11. Section 120-11, Maintenance and Protection of Work.
12. Section 120-12, Construction.

B. Exceptions

1. Section 120-4.1, Subsoil Excavation: Unsuitable soils shall be those in Classifications A-6, A-7, or A-8 in the American Association of State Highway and Transportation Officials (AASHTO) System.
2. Section 120-4.2, Construction Over Existing Old Road: Where removal of existing pavement is called for, it shall be removed to the full depth as indicated in the cross-sections and replaced with new limerock and paving or other treatment in accordance with the Drawings and details.
3. Section 120-5.3, Disposal of Paving Materials: Disposing of muck on side slopes shall not apply.
4. Section 120-9.2.1, General: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D1557. Field densities shall be determined by ASTM D1556/D1556M, ASTM D2167, or ASTM D6938. All embankments shall be compacted to not less than 95% of the maximum dry density, as determined by modified Proctor, ASTM D1557.

5. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1 foot above or below the plan cross-section will be allowed.

3.02 STABILIZING

A. The following sections of the Standard Specifications shall apply:

1. Section 160-3, Construction Methods.
2. Section 160-4, Acceptance Program.

B. Exceptions

1. Section 160-2.4, Granular Subbase: Contractor may not substitute 6 inches of Granular Subbase for 12 inches of Stabilization unless such substitution is specifically indicated on the Drawings.
2. Section 160-4.2.1.2, Undertolerance in Bearing Value Requirements: no undertolerance will be acceptable.

3.03 LIMEROCK BEARING RATIO AND DENSITIES

A. Stabilized finish grade and stabilized shoulders shall have a minimum LBR value of 40.

B. Field density of stabilized finished grade shall be a minimum of 98% of the Modified Proctor maximum dry density as specified in ASTM D1557 to a minimum depth of 12 inches as shown on the Drawings.

3.04 PRIME AND TACK COATS

A. The following sections of the Standard Specifications shall apply:

1. Section 300-3.1, Pressure Distributor.
2. Section 300-3.2, Sampling Device.
3. Section 300-3.3. Temperature Sensing Device.
4. Section 300-5, Cleaning Base and Protection of Adjacent Work.
5. Section 300-6, Weather Limitations.
6. Section 300-7, Application of Prime Coat.
7. Section 300-8, Application of Tack Coat.

3.05 ROCK BASE

A. The following sections of the Standard Specifications shall apply:

1. Section 200-3, Equipment.

2. Section 200-4, Transporting Rock.
3. Section 200-5, Spreading Rock.
4. Section 200-6, Compacting and Finishing Base.
5. Section 200-7, Acceptance Program.
6. Section 200-8, Priming and Maintaining.

B. Exceptions

1. Section 200-7.2.1, Density: The minimum density that will be acceptable for paved areas will be 98% of the maximum dry density as determined by Modified Proctor, ASTM D1557.
2. Section 200-7.3.1.2, Depth and Surface Testing Requirements: Thickness of base shall be measured at intervals not to exceed 200 feet.

3.06 ASPHALT

A. The following sections of the Standard Specifications shall apply:

1. Section 320-6, Preparation of the Mixture.
2. Section 320-7, Transportation of the Mixture.
3. Section 330-1, Description.
4. Section 330-2, Quality Control (QC) Requirements.
5. Section 330-3, Limitations of Operations.
6. Section 330-4, Surface Preparation.
7. Section 330-5, Paving Equipment.
8. Section 330-6, Placing Mixture.
9. Section 330-7, Compacting Mixture.
10. Section 330-8, Joints.
11. Section 330-9, Surface Requirements.
12. Section 330-10, Protection of Finished Surface.

3.07 CEMENT CONCRETE PAVEMENTS

A. The following sections of the Standard Specifications shall apply:

1. Section 350-3, Equipment.
2. Section 350-4, Subgrade Preparation.
3. Section 350-5, Setting Forms.
4. Section 350-6, Protection from Weather.
5. Section 350-7, Placement of Reinforcement.
6. Section 350-8, Placing Concrete.
7. Section 350-9, Striking-off, Consolidating, and Finishing Concrete.
8. Section 350-10, Final Finish.
9. Section 350-11, Curing.

10. Section 350-12, Joints.
11. Section 350-13, Surface Requirements.
12. Section 350-14, Thickness Determinations.

3.08 PAVEMENT REPAIR

A. At his own expense the Contractor shall repair all damage to pavement as a result of work under this Contract in a manner satisfactory to the Owner. Pavement shall be repaired to match the original surface material thickness and original grade. However, the asphalt concrete thickness shall not be less than 2 inches. The repair shall include preparing the subgrade, placing and compacting the applicable base, priming the limerock base, and placing and maintaining the surface treatment as specified in this Section.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage or as shown on the Drawings. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

3.09 JOINTS

A. General pavement joints within asphalt or concrete driveways and roadways and where specified or directed by the Owner, shall be mechanically sawed butt joints. The edges of asphalt pavement shall be trimmed to straight lines which a roller can follow or formed.

3.10 TRAFFIC STRIPES AND MARKINGS

A. The following sections of the Standard Specifications shall apply:

1. Section 711-3, Equipment.
2. Section 711-4, Application.
3. Section 711-5, Contractor’s Responsibility for Notification.
4. Section 711-6, Protection of Newly Applied Traffic Stripes and Markings.

END OF SECTION

SECTION 02740
DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes furnishing all labor, materials, equipment, and incidentals necessary to complete each directional drill installation shown on the Drawings and as specified herein.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

A. Qualifications: Submit statement of qualifications, records, and references for previous similar jobs. Submit a minimum of three projects completed within the past five years that include directional drilling of 18-inch-diameter piping, with at least one project drilling 24-inch-diameter piping or larger, and at least one of these three projects covering a drill length of over 1,000 feet.

B. Product Pipe: Submit manufacturer's catalog data for the product pipe as required in the pipe specifications. The product data shall also include the dimension ratio, minimum allowable bending radius, and the safe pull force for each product pipe being installed by directional drill.

C. Drilling Fluids: Submit a complete list of all drilling fluids, additives, and mixtures to be used along with Material Safety Data Sheets and protocols for mixing, handling, and disposal.

D. Software: Submit indication of the software that the Contractor will use to perform analyses in accordance with Article 1.03, Quality Assurance.

E. Analyses: Submit software analyses results in accordance with Article 1.03, Quality Assurance.

F. Contingency Plan: Submit a hydraulic fracture (frac-out) contingency plan in accordance with Article 1.03, Quality Assurance.

G. Equipment: Submit a description of the rig(s) proposed for the project at each location, showing the method of control of the boring head, head type, pulling force of the equipment, age, reamer type(s), manufacturer type, and other

germane information. This information shall demonstrate that the equipment pulling force is at least 1.25 the maximum calculated peak-pulling requirement.

H. Certificates: Submit statement that Contractor has inspected the drill equipment including the drill rod and determined that they are in satisfactory condition for its intended use.

I. Record Drawings: Submit an electronic copy and three hard copies of the record drawings within 5 days after completing the pull back in accordance with the Article 1.06, Record Drawings.

J. Drilling Logs: Maintain and submit prior to substantial completion complete drilling logs of guided directional drill operations.

1.03 QUALITY ASSURANCE

A. The proposed product pipe installation lengths, depths, and curvatures presented on the Drawings are for bidding purposes only. The Contractor shall be solely responsible for the successful installation of each product pipe. The Contractor shall analyze each installation and make modifications necessary to successfully install each product pipe.

B. The Contractor shall analyze each installation using BoreAid ™, DrillPath ™, or other approved software and perform hand calculations as necessary if Contractor's software is not capable performing all of the required analyses. The results of the analyses/calculations shall be submitted and shall include as a minimum the following:

1. Proposed entry and exit angles.
2. Proposed radii of curvature for all directional changes.
3. Proposed profile and drill path. The profile shall show ground surfaces, waterway bottoms/beds (if applicable), and proposed product pipe installation.
4. Product pipe deflection, buckling, external pressure, and stress calculations demonstrating that the forces/stresses exerted on the product pipe during and after installation will not exceed 80% of the manufacturer's safe limits.
5. Pull back force calculations demonstrating that peak pulling requirement does not exceed 80% of the manufacturer's safe pull pack force.
6. Maximum borehole pressure calculations and demonstration that the maximum borehole pressure will not result in a hydraulic fracture (frac-out).
7. Method of buoyancy control (if required/used) to reduce forces/stresses exerted on the product pipe.

C. The Contractor shall submit a frac-out contingency plan that describes frac-out planning, prevention, monitoring, response, notification to the Owner and regulatory agencies, and cleanup procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section 01650, Delivery, Storage, and Handling, and the additional requirements herein.

B. Inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects shall be rejected and removed from the job site.

C. Disposal of fluids is the responsibility of the Contractor. Disposal of fluids shall be done in a manner that comply with all permits and applicable federal, state, and local regulations.

1.05 QUALIFICATIONS

A. The Contractor's superintendent and driller assigned to this project must be experienced in work of this nature and must have successfully completed a minimum of five (5) similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last three (3) years. Conventional open-trenching experience or bore-and-jacking experience will not be acceptable substitutes for directional drilling experience.

B. As part of the bid submission, the Contractor shall submit documentation of such project(s). The documentation for experience shall include but not be limited to the following:

1. Name(s) and description(s) of project(s).
2. Résumés of project manager, superintendent, and driller assigned to the specific project.
3. Pipe type(s), diameter(s), and lengths.
4. Type and manufacturer of equipment used.
5. Soil conditions encountered.
6. Start and completion dates.
7. Contact names, numbers, and addresses.

1.06 RECORD DRAWINGS

A. The record drawings shall include a plan, profile, and all information recorded during the progress of the work. The record drawings shall be tied to the project's

survey control. Record Drawings shall also meet all requirements of Section 01785, Record Documents.

1.07 DEFINITIONS

A. *Horizontal Directional Drilling (HDD):* A steer-able system for the underground installation of pipes, conduits, and cables using a surface launched rig. A pilot bore is drilled using a rotating drill string and then is enlarged by a back reamer to the size required for the product pipe. The necessary deviation during pilot boring is provided by a slanted face to the drill head, an asymmetric drill head, eccentric fluid jets, or a combination of these, usually in conjunction with an aboveground electronic locator or a remote guidance system.

B. *Maxi (Conventional) HDD*: Typically used for the largest-diameter pipelines/ conduits and longest length installations. Pipe diameters are typically 18 inches or larger, lengths can exceed 1,000 feet, and the pullback force is typically in excess of 70,000 pounds. The drill string is usually remote-tracked provided from sensors near the leading end of the drill string.

C. *Mini HDD:* Typically used for the smaller diameter pipelines/conduits and for shorter distances. Pipe diameters are typically 6 inches or smaller, lengths are less than 600 feet, and pullback forces are up to 20,000 pounds. The drill string is typically tracked with a surface held walkover transmitter/receiver.

D. *Midi HDD:* Typically used for intermediate sizes and lengths of pipelines/ conduits. Pipelines are typically between 6 inches and 18 inches diameter, lengths are up to 1,000 feet, and pullback forces from 20,000 to 70,000 pounds. Midi HDD equipment may employ similar capabilities to the Maxi HDD rigs but have more limitations on capacity. The drill string is typically tracked with a surface held walkover transmitter/receiver.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Boring equipment shall be matched to the conditions of the project and shall have a pulling force at least 1.25 the maximum calculated peak-pulling requirement for each installation given the site-specific conditions.

B. Boring equipment shall have a mechanical drilling rig with a controlled directional boring head using either a fluid or mechanical cutting head (or combination of both), assisted and cooled by an approved drilling fluid of low pressure and volume.

C. The location/tracking system employed for determining the location of the drilling head during the pilot bore shall include but not be limited to the position of the boring head, the roll angle, the tilt angle, depth below grade, temperature of data transmitter, and remaining battery life.

D. The Contractor shall select the appropriate drill equipment, which at least meets the minimum requirements established in this specification, to be used for this project.

E. The drill equipment including rod shall be inspected and approved for use by the Contractor prior to arrival at the work site.

2.02 DRILLING FLUIDS

A. A high-quality drilling fluid shall be used to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe. Composition of the fluid must comply with all federal, state, and local environmental regulations.

B. The drilling fluid shall be a bentonite slurry mixed with potable or reclaimed water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. Contractor is responsible for any required pH adjustments. A polymer-based slurry will be considered only if the Contractor demonstrates that a bentonite slurry will not suitable for this project and the proposed polymer slurry is acceptable to the Florida Department of Environmental Protection. Drilling fluids that are petroleum-based or that contain additives that may contaminate the surrounding soils or groundwater shall not be allowed.

C. The type of proposed drilling fluid with a complete listing of all additives along with Material Safety Data Sheets shall be submitted for approval before work begins.

D. Potable water or reclaimed water will be made available to the Contractor. This water will be metered and invoiced to the Contractor at the current effective rate.

2.03 PRODUCT PIPE

A. The nominal diameter and material type of each product pipe shall be as shown on the Drawings.

B. High-density polyethylene (HDPE) pipe shall conform to the requirements of Section 15146, High-Density Polyethylene (HDPE) Pipe. The maximum

dimension ratio (i.e., the thinnest allowable wall thickness) for HDPE pipe being installed by direction drill shall be 11 (DR11).

PART 3 EXECUTION

3.01 GENERAL

A. No work or drilling shall commence until the Contractor has submitted the required information and received written approval from the Owner regarding the drill path and related procedures.

B. The Contractor shall locate all utilities, structures, etc. within the construction area before any work begins and before equipment is mobilized.

C. Before drilling operations begin, all erosion control devices and dewatering shall be in-place and functional.

D. The boring rig shall be sufficiently and adequately anchored for the task.

E. Directional drilling equipment machine safety requirements shall include common grounding system to prevent electrical shock in the event of underground electrical cable strike. The grounding system shall connect all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operator’s booth, worker grounding mats, and any other interconnected equipment to a common ground. The drill shall be equipped with an "electrical strike" audible and visual warning system that will notify the system operators of an electrical strike.

F. The Contractor shall conform to all requirements of Section 02305, Earthwork for Utilities, including but not limited to, excavation, protection of persons and property, sheeting and shoring, backfill and compaction, and disposal of excess and waste materials.

G. The Contractor shall be responsible for transporting, containing, and storing any water required for the drilling operations, cleanup, and other needs.

H. All drilling fluid excess shall be contained in entry and/or exit pits and pumped/treated/stored as needed to preclude spills and escape to the surrounding environment. Ensure that entry and exit pits are of sufficient size and volume to contain the expected return of drilling fluids and cuttings.

I. Drilling fluid returns can be collected in the entrance pit, exit pit, or spoils recovery pit. The Contractor shall immediately clean up any drilling fluid spills or overflows from these pits.

J. Disposal of the drilling fluids shall be the responsibility of the Contractor and shall be conducted in compliance with all relative environmental regulations, right-of-way and workspace agreements, and permit requirements.

K. The product pipe shall be installed within the limits indicated on the Drawings.

3.02 DRILL SET-UP AND PITS

A. The Contractor may use the set-up areas identified on the Drawings. If additional areas are required, the Contractor shall be responsible for coordinating the additional areas at no additional cost to the Owner.

B. Drill entrance and exit pits are required. The Contractor shall be responsible for design and construction of the drill entrance and exit pits. Pit locations shall be coordinated with the Owner.

C. The drill entrance and exit pits shall be maintained at minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or processing system or removal from the site.

D. Drilling mud shall not be allowed to flow freely on the site or around the entrance or exit pits. Erosion and sediment control devices shall be set up around each pit. Mud spilled shall be removed as soon as possible and the ground restored to original condition. Pits shall be shored to OSHA standards and the requirement of Section 02305, Earthwork for Utilities.

3.03 DRILL ENTRANCE AND EXIT ANGLE

A. The entrance and exit angles shall such that the elevation profile maintains adequate cover to reduce risk of frac-out and that ground exit occurs as specified herein. Contractor shall be responsible for ensuring that entrance and exit angles ensure pullback forces do not over stress the pipe.

B. In no case shall the entry or exit angles of the installed pipeline shall be less than 8 degrees from the horizontal and or more than 18 degrees from the horizontal.

C. In addition to the allowable limits of Article 3.04, the entry and exit angles shall be in accordance with those used in the analyses performed in Article 1.03, Quality Assurance.

3.04 PILOT HOLE

A. A pilot hole shall be drilled for all product pipe installations 6-inch-diameter and larger.

B. The type and size of the pilot string cutting head and the diameter of the drill rod shall be selected by the Contractor for each specific application.

C. The cutting head shall be assisted by and cooled by drilling fluid of low pressure and volume.

D. The pilot hole shall be drilled along the approved path. Pilot hole tolerances are as follows:

1. Vertical Tolerance: Provide cover in accordance with the approved profile developed under Article 1.03, Quality Assurance.
2. Horizontal Tolerance: 3 feet from the centerline of the product pipe.
3. Curve Radius: No curve will be accepted with a radius less than 1.25 times the manufacturer's recommended minimum bending radius for the product pipe being installed by directional drill. NOTE: There are additional stresses imposed on the product pipe due to pulling it around curves versus bending the product pipe in a trench. The minimum bending radius for a product pipe installed by direction drill is greater than the minimum bending radius for the same product pipe installed in a trench.
4. Entry Point Location: The pilot hole entry point shall be established by the Contractor.
5. Exit Point Location: The exit point location shall be established by the Contractor.
6. The installed pipeline cover requirements as shown on the drawings and as specified herein shall not be violated.

E. If significant differing soils or strata from those provided in the geotechnical data and reports are encountered during the pilot boring, the Contractor shall be responsible for changing the drill head and slurry and other means as may be appropriate to complete the bore.

F. The Contractor shall adjust the viscosity of the drilling fluid to match the conditions of the project. The Owner shall bear no responsibility for loss of drilling fluid or loss of drilling equipment if an obstacle or unknown condition is encountered during the work.

G. The Owner shall not be responsible for underground obstacles (such as boulders, tree stumps, loose and unconsolidated soils, hard rock, or utilities) or structures that may be encountered during the work.

H. If hydraulic fracture occurs, the Contractor shall implement the approved frac-out contingency plan and repair all related damages, cleanup of fluids, and make corrections to preclude future events. Such corrections may include but not be limited to re-profiling the bore or changing the viscosity of the drilling fluid or plugging the fracture or a combination of these. If the borehole is abandoned and an alternate route is chosen, the abandoned borehole shall be filled with excavatable, flowable fill.

I. Where construction activities are close to or under water bodies (lakes, creeks, canals, retention basins) or wetlands, special attention shall be given to the proposed profile to ensure that hydraulic fracture does not occur under the water feature. Additionally, silt fences and similar approved erosion control devices shall be used to protect the water body(s) from the construction activities.

3.05 BACK-REAMING

A. Back-reaming shall be required for all product pipe installation 6-inch-diameter and larger.

B. The type of back-reamer to be used shall be determined by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The back-reamer type shall be selected by the Contractor for each specific application.

C. Back-reaming shall be conducted in single or multiple passes of the borehole and shall enlarge the borehole to at least 1.4 times the outer diameter of the product pipe to be installed. Larger reaming may be required depending on subsurface conditions encountered. The number of back-reaming passes and the borehole size, provided the minimum requirements are met, shall be the Contractor discretion.

3.06 PULL BACK

A. Unless approved otherwise, the entire product pipeline to be installed via directional drill shall be fully assembled prior to commencement of pull back operations.

B. The product pipeline shall be supported during pullback operations in a manner to enable it to move freely and prevent damage. Properly spaced rollers and at proper heights shall be used to transition the product pipe from the horizontal to oblique positions for insertion into the borehole.

C. Unless approved otherwise, the product pipeline shall be installed in one continuous pull.

D. The product pipe shall be installed with a continuous #10-gauge tracer wire of sufficient type to remain intact and usable upon completion of the installed product pipe.

E. Torsional stress shall be minimized by using a swivel to connect the pull section to the reaming assembly.

F. Maximum allowable tensile force imposed on the pull section shall not exceed 80% of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe size or materials, the lowest safe pull strength value shall govern and the maximum allowable tensile force shall not exceed 80% of this value.

G. External pressure shall be minimized during installation of the pullback section in the reamed hole. Damaged pipe resulting from external pressure shall be replaced at no cost to the Owner. Buoyancy modification shall be at the discretion of the Contractor.

H. The Contractor shall take precautions to protect the product pipeline from damage and marring during the installation and pullback operation. Such precautions shall include but not be limited to using rollers, pulleys, idlers, and trunnions.

I. After pullback is completed, the Contractor shall “rest” the product pipeline to allow for any contraction and shrinkage for at least 24 hours. No additional work on the pulled product pipeline shall be allowed during the resting period.

3.07 GUIDANCE SYSTEMS

A. Walkover guidance systems are acceptable for this project. A magnetic survey tool located behind the pilot string cutting head shall also be used for this project.

3.08 DOCUMENTATION

A. The Contractor shall maintain drilling logs that accurately provide drill bit entry location (Station/offset or northing and easting), drill bit location (both horizontally and vertically) at least every 15 feet along the drill path. In addition, logs shall be kept that record, as a minimum, the following every 15 minutes throughout each drill pass, back-reaming pass, or product pipe installation pass:

1. Drilling fluid pressure.
2. Drilling fluid flow rate.
3. Drilling fluid temperature.
4. Drill thrust force.

5. Drill pullback force.
6. Drill head torque.

B. Each day, the Contractor shall also record the total amount of drilling mud used and viscosity of the drilling mud. If the viscosity of the drilling mud is changed, the Contractor shall record the new viscosity and the time the mud viscosity was changed.

C. Samples of each log sheet shall be submitted to the Owner for approval before work begins.

D. The Owner shall have access to instrumentation, readings, and logs at all times during operation.

E. After the pull is completed, the Contractor shall provide record drawing information of the installed product pipeline. The record drawing information shall provide the horizontal and vertical location of the product pipeline tied to the project control datum. At a minimum, the entry and exit locations, angles, and elevations shall be recorded, and the locations and depths of the product pipeline shall be recorded at intervals along the entire length of the profile. For profiles under non-submerged surfaces, the interval shall be 10 feet. For profiles under submerged surfaces (such as a lake, stream, canal, or river), the interval shall be 20 feet. This information shall be provided to the Owner within 7 calendar days after the completion of each bore path.

3.09 MAINTENANCE OF TRAFFIC

A. During assembly and pullback of the pipe, the pipe must be laid out in such a way to minimize disrupting and interfering with vehicular and pedestrian traffic or other operational conflicts that the Owner identify.

B. The Contractor shall be responsible for safe maintenance of pedestrian and vehicular of traffic. If the construction activities require such action a maintenance-of-traffic plan shall be submitted to the FDOT for approval before work begins. The plan shall be in accordance with Florida Department of Transportation Standard Index 600 Series and Technical Specifications. The plan preparer shall be certified by FDOT.

3.10 UTILITY LOCATES

A. Contractor shall locate all utilities before the start of excavation or drilling. The Contractor shall be responsible for damage to utilities and shall repair damaged utilities at no cost to the Owner.

3.11 CLEANUP

A. Immediately upon completion of work of this Section, all rubbish and debris shall be removed from the job site. All construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat condition acceptable to the Owner.

B. "Blow holes" or "breakouts" of drilling fluid to the surface shall be cleaned up immediately and the surface area returned to its original condition. All drilling fluids, spoils, and separated materials shall be disposed of in compliance with federal, state, and local environmental regulations.

C. After the product pipe installation is completed, the Contractor shall restore the pits and drill rig anchors and work areas to their pre-construction or better condition. Seeding shall not be allowed in lieu of sod unless granted in writing by the Owner.

END OF SECTION

SECTION 02900
LANDSCAPE WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the requirements for landscape work where required on the drawings and includes provisions for the following items:

1. Trees.
2. Shrubs.
3. Groundcover.
4. Plant material.
5. Fertilizers.
6. Erosion-control fabric.
7. Initial maintenance of landscape materials.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Materials List:

1. The Contractor shall provide cutsheets of all products specified or required for all material specified. The cutsheets shall list the manufacturer's name, catalog name, and catalog number as well as the size, type, and illustration of the product to be supplied.

B. General: The Contractor shall submit the following in accordance with the Conditions of Contract and Division 1, General Requirements, sections:

1. Total quantities of the following items to the Owner before installation:

a. Topsoil planting area.
b. Planting Soil.
c. Fertilizer.
d. Mulch.
e. Erosion-control fabric.

2. Samples for verification: A 5-pound (2.2-kg) sample of materials listed in labeled plastic bags.

3. Plant and Material Certifications and Shop Drawings: The manufacturer's certificate of compliance and shop drawings of material as specified and required. Indicate quantity, size, and type of materials. Provide the vendor a list of all plant material and status of availability. Refer to the Drawings and Specifications for materials.

4. The manufacturer’s or vendor’s certified analysis for soil amendments, pre-emergent herbicide, and fertilizer materials.

5. Material test reports: For existing surface soil and imported topsoil, submit the following:

    a. Topsoil Analysis: Furnish soil analysis by a qualified soil testing laboratory stating the percentage of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ration deleterious material; PH; and mineral and plant nutrient content of topsoil.
    b. Report the suitability of topsoil for plant growth. State the recommended quantities of nitrogen, phosphorus, and potash nutrients and the soil amendments to be added to produce satisfactory topsoil.

6. Submit to the Owner all fertilizer and root treatment bags/containers for proof of installation.

7. Certificates of inspection as required by governmental authorities: All required inspection certificates shall accompany the invoices. Required transportation documents are to be submitted with invoices as back up.

8. The manufacturer's or vendor's certified analysis for soil amendments, pre-emergent herbicide, and fertilizer materials.

9. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.

10. Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in the area of the site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing after documentation of reasons for delay.

11. Maintenance Instructions: Typewritten instructions recommending procedures to be established by the Owner for maintenance of landscape work for 1 full year.

1.03 WORK SEQUENCE

The Contractor shall do the following:

A. Planting Time: Proceed with and complete landscape work as rapidly as portions of the site become available.

B. Correlate planting with specified maintenance periods to provide maintenance from the date of substantial completion.

C. Coordination with Lawns: Plant trees, shrubs, and groundcover after final grades are established and before the planting of lawns, unless otherwise acceptable to the Owner. If the planting of trees, shrubs, and groundcover occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

D. The work shall be coordinated with other trades to prevent conflicts. Coordinate planting and irrigation to ensure the availability of water and the proper location of irrigation equipment and plant materials.

1.04 REFERENCE STANDARDS

A. Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. Where this Section differs from these documents, the requirements of this Section shall apply.

B. Nomenclature: Nomenclature shall conform to the names given in *Standardized Plant Names*, 1942 Edition, prepared by the American Joint Committee on Horticultural Nomenclature or by the Bureau of Plant Industry, State of Florida. Names of varieties not included in this work shall conform generally with names accepted in the nursery trade.

1.05 QUALITY ASSURANCE

A. The Contractor shall subcontract landscape work to a single firm specializing in landscape work. All planting shall be performed by personnel familiar with planting procedures and under the supervision of a qualified planting foreman. Except as otherwise specified, the Contractor's work shall conform to accepted horticultural practices as used in the trade.

B. General: The Contractor shall comply with applicable federal, state, county, and local codes, ordinances, and regulations governing landscape materials and work.

C. General: The Contractor shall ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.

D. Substitutions will be permitted only upon submission of proof that any specified plant is not obtainable or suitable for the location as specified on the plan and upon written authorization of the Owner.

E. Analysis and Standards: The Contractor shall package standard products with the manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

F. Topsoil: Before the delivery of topsoil, the Contractor shall furnish the Owner with a written statement giving the location of properties from which topsoil is to be obtained, the names and addresses of Owner, the depth to be stripped, and the crops grown during the past 2 years.

G. Trees, Shrubs, and Plants: The Contractor shall provide trees, shrubs, and plants of the quantity, size, genus, species, and variety shown and scheduled for landscape work. Provide healthy, vigorous stock grown in a recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement. All material shall be graded Florida No. 1 or better as outlined under new Grades and Standards for Nursery Plants, Division of Plant Industry, State of Florida, unless otherwise noted.

H. The Contractor shall provide, at no additional expense to the Owner, certification by an independent certified horticulturist, botanist, and/or agricultural laboratory that the ground covers, shrubs, trees and palms comply with specified genus, species, variety, grade, and standards at the Owner's request.

I. The Contractor shall label at least one tree, shrub, and groundcover of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

1. Where the formal arrangements or consecutive order of trees, shrubs, and groundcovers are shown, select stock for uniform height and spread and label with a number to ensure symmetry in planting.

J. Irrigate plant material as it arrives at the planting site. After trees are unloaded from the truck, stand and store in the erect position and irrigate twice daily until they are planted. Store all plant material in the shade or under woven shade cloth.

K. Inspection: The Owner may inspect trees, shrubs, and groundcover, either at the place of growth or at the site before planting, for compliance with requirements for genus, species, variety, size, and quality. The Owner retains the right to further inspect trees, shrubs, and groundcover for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during the work. The Contractor shall remove rejected trees, shrubs, or groundcover immediately from the project site.

1.06 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

B. Warranty trees, shrubs, groundcovers, and palms for 1 year from final completion against defects including death and unsatisfactory growth, except for defects resulting from abuse or damage by others or unusual phenomena or incidents which are beyond the Contractor's control. The Contractor shall notify the Owner in writing 10 days before the expiration of the warranty period. The warranty period shall be continued until such written notification is received.

C. At the end of the guarantee period, the Owner will conduct an inspection. The Contractor shall remove from the site and immediately replace all plants that are dead or not in satisfactory growth, as determined by the Owner.

D. The Contractor shall remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during the warranty period. Make replacements during growth season following the end of the warranty period. Replace trees, shrubs, and groundcovers that are in doubtful condition at the end of the warranty period unless, in the opinion of the Owner, it is advisable to extend the warranty period for a full growing season. All replacements shall be plants of the same kind and size as specified in the Plant List. They shall be furnished and planted as specified at no additional cost to the Owner. All replacement shall be guaranteed for an additional 3 months.

1.07 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of the manufacturer. Protect materials from deterioration during delivery and while stored at the site.

C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune before delivery unless otherwise approved by the Owner. Do not bend or bind-tie trees or shrubs so as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

D. Deliver trees, shrubs, and groundcover after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees, shrubs, and groundcovers in shade; protect from weather and mechanical damage; and keep roots moist by irrigating all trees, shrubs, and groundcover until they have been planted.

E. Do not remove container-grown stock from containers until planting time.

1.08 JOB CONDITIONS

A. Utilities: Before preparing planting areas and plant pits, the Contractor shall ascertain the location of all electrical cables, conduits, utility lines, oil tanks, and supply lines so that proper precautions may be taken not to disturb or damage any sub-surface improvements. Properly maintain and protect existing utilities. Hand excavate as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Owner before planting.

C. The Contractor shall take all necessary precautions to avoid damage to existing structures or utilities while installing plants. The Contractor shall be responsible for all damages to existing structures or utilities caused by the Contractor’s operations.

D. The Contractor is required to have utility lines located and flagged before planting trees to avoid damage to utility lines during planting and to avoid planting trees directly above utility lines.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil for landscape work is not available at the site and must be furnished as specified.

B. The Contractor shall provide new topsoil that is fertile, friable, natural loam, surface soil. The topsoil shall be reasonably free of subsoil, clay lumps, brush, weeds, and other litter and free of roots, stumps, and stones larger than 1/2 inch in any dimension and other extraneous or toxic matter harmful to plant growth. Topsoil shall be obtained from naturally drained sources and shall contain at least 25% organic matter. Acidity shall range from pH 5.5 to pH 6.5 inclusive. Topsoil shall be proportioned by volume rather than weight. No site mixing will be accepted. Topsoil shall be spread at a minimum depth of not less than 2-1/2 inches over all areas to be planted.

2.02 PLANTING SOIL

A. Planting soil shall consist of an evenly blended mixture of the following and according to the depth shown on the planting details provided in the Contract Documents:

1. 2/3 approved topsoil as specified in this Section.
2. 1/3 Sphagnum Peat Moss: Finely divided peat may be provided in granular form, free of hard lumps, and with pH range suitable for the intended use.

B. All topsoil, planting soil, and planting beds shall be treated with a pre-emergent herbicide before plant material is installed.

2.03 MULCHES

A. Organic Mulch: The Contractor shall provide a minimum of 3 inches of organic mulch free from deleterious materials and suitable for the top dressing of trees and consisting of Pine Bark.

B. In-organic Mulch: The Contractor shall provide a minimum of 4 inches of inorganic mulch consisting of River Jack Stone.

2.04 FERTILIZER

A. Commercial Fertilizer: The Contractor shall provide a complete fertilizer of neutral character, with some elements derived from organic sources. The fertilizer

mixture shall contain minor elements suitable for the plants being used. The source of the nutrients shall be suitable for the various specific types of plants being used (acid or alkaline). All fertilizer is to be slow release.

1. All newly planted and relocated trees shall be treated with mycorrhizal fungi and biostimulants at the time of planting. Treat all trees as recommended by the manufacturer.
2. All trees and shrubs shall be fertilized with Agriform 20-10-5 Tablets at time of planting. Trees shall receive six tablets evenly spaced around the rootball. Shrubs shall receive three tablets evenly spaced around the rootball. Tablets shall be placed at the mid-depth point of the plant pit.
3. Fertilizer for ground cover beds shall be evenly applied to all newly planted areas at the rate of 1-1/2 pounds of actual nitrogen, 1-1/2 pounds of actual phosphorous and 1-1/2 pounds of actual potash per 1,000 square feet.

2.05 PLANT MATERIALS

A. Quality: All plant material shall be Florida #1 or better, as referenced in New Grades and Standards. The Contractor shall provide trees, shrubs, and other plants of the size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of New Grades and Standards. All plants shall have been transplanted or root pruned at least once in the 3 years before the contract date. Root-bound container plants will not be accepted. Collected plants shall not be used unless called for in the Specifications or approved in writing by the Owner.

B. Quantities: In the event of a variation between the Plant List and the actual number of plants shown on the plans, the plans shall control.

C. Trees: The Contractor shall provide trees of the height and caliper scheduled or shown and with branching configuration recommended by New Grades and Standards for the type and species required. Provide single-stem trees except where special forms are shown or listed. The caliper of tree trunks is to be taken 1 foot above the ground level.

1. Provide container-grown trees unless otherwise indicated on the plans.
2. Balled and burlapped (B&B) trees will be acceptable in lieu of container-grown trees with the Owner's written authorization.

D. Shrubs: Provide shrubs of the height shown or listed and with not less than the minimum number of canes required by New Grades and Standards for the type and height of shrub required.

1. Provide container-grown shrubs unless otherwise indicated on the plans.
2. Balled and burlapped (B&B) shrubs will be acceptable in lieu of container-grown shrubs with the Owner's written authorization.

E. Anti-desiccants: Anti-desiccants for retarding excessive loss of plant moisture and inhibiting shall be sprayable, water insoluble, vinyl-vinyledine complex that will produce a moisture-retarding barrier not removable by rain. Wilt-pruf Formula NCF as manufactured by Nursery Specialty Products, Greenwich, CT, or approved equal is required.

2.06 GROUND COVER

A. The Contractor shall provide plants established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by New Grades and Standards for the pot size shown or listed.

2.07 MISCELLANEOUS LANDSCAPE MATERIALS

A. Tree Support System: The Contractor shall provide pressure-treated timber of sound new hardwood or treated softwood, free of knotholes and other defects. Provide wire ties and guys of two-strand, twisted, pliable galvanized iron wire, not lighter than 12-gauge. Provide galvanized anchors with zinc-coated adjustable ratchet tensor and eyelets.

PART 3 EXECUTION

3.01 PREPARATION - GENERAL

A. Initial Site Preparation:

1. The Landscape Contractor shall verify that there is an adequate percolation rate of the soil. Provide new topsoil as indicated in Article 2.01.
2. After establishing finished grade and before planting, the Landscape Contractor shall roto-till any or all areas that have been compacted.

B. Finish Grade: The Landscape Contractor will grade the site to a finished grade for planting areas as required by the Specifications.

C. Lay out individual tree, shrub, and groundcover locations and areas for multiple plantings. Stake locations and outline areas and secure the Owner's acceptance before starting planting work. Make minor adjustments as may be required.

D. Plants shall be protected upon arrival at the site by being thoroughly watered and properly maintained until planted. Plants shall not remain unprotected for more than 6 hours. Methods customary in good horticultural practice shall be exercised at all times.

E. The existence and locations of underground utilities, if shown on the Drawings, are not guaranteed, and the Contractor shall investigate and verify these in the field before starting work. Excavation in the vicinity of existing structures and utilities shall be carefully done.

F. If overhead or underground obstructions which interfere with plantings are encountered, the Owner will select alternate locations.

3.02 PREPARATION OF PLANTING SOIL

The Contractor shall do the following:

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified topsoil and fertilizers with existing topsoil at rates specified. Delay the mixing of fertilizer if planting will not follow the placing of planting soil within a few days.

C. For pit- and trench-type backfill, mix the planting soil before backfilling, and stockpile at the site.

D. For planting beds and lawns, mix planting soil either before planting or apply on the surface of topsoil and mix thoroughly before planting.

3.03 PREPARATION OF PLANTING BEDS

In preparing planting beds, the Landscape Contractor shall do the following:

A. Loosen the subgrade of planting bed areas to a minimum depth of 12 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter. Where excessive soil compaction occurs, the Contractor shall loosen two-and-a-half times deeper than the specified depth as noted on the planting details in the Contract Documents.

B. Spread the planting soil mixture to the minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement, but not less than 12 inches deep. Place approximately one-half of the total amount of planting soil required. Work into the top of the loosened subgrade to create a transition layer and then place the remainder of the planting soil.

C. Dig beds at least 12 inches deep.

D. Remove 12 inches of soil and replace with prepared planting soil mixture and fertilizers.

3.04 EXCAVATION FOR TREES AND PALMS

The Contractor shall do the following:

A. Excavate pits, beds, and trenches with vertical sides and with the bottom of the excavation compacted and raised to provide proper drainage and prevent settling. Loosen hard subsoil in the remaining bottom of the excavation. Where excessive soil compaction occurs, the Contractor shall loosen two-and-a-half times deeper than the specified depth as noted on the planting details in the Contract Documents.

1. Excavate planting pits for palms with vertical sides. Loosen compacted subsoil in the bottom of the excavation. Where excessive soil compaction occurs, the Contractor shall loosen subgrade two-and-a-half times deeper than the specified depth as noted on the planting details in the Contract Documents.

2. For bare root trees and shrubs, make excavations at least 12 inches wider than root spread and deep enough to allow for the setting of roots on a 6-inch minimum layer of compacted backfill and with the collar set at the same grade level as in the nursery but 1 inch below finished grade at the site.

    a. Allow for a 9-inch setting layer of planting soil mixture.

3. For balled and burlapped (B&B) trees and shrubs, make excavations at least half as wide as the ball diameter and equal to the ball depth, plus following allowance for the setting of the ball on a 6-inch minimum layer of compacted backfill:

    a. Allow for a 3-inch-thick setting layer of planting soil mixture.

4. For container-grown stock, excavate as specified for balled and burlapped stock adjusted to the container's width and depth.

B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

C. Fill excavations (planting pits) for trees and shrubs with water and allow water to percolate out before planting. If percolation problems exist, the Contractor shall suspend planting in the area and notify the Owner immediately for resolution of the problem.

3.05 PLANTING TREES, PALMS, AND SHRUBS

The Contractor shall adhere to the following in planting trees, plants, and shrubs:

A. Set balled and burlapped (B&B) stock on a 6-inch layer of compacted planting soil mixture, plumb, and in the center of the pit or trench with the top of the ball at the same elevation as the adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. Remove completely any and all synthetic burlap or root ball covering before planting. When set, place additional backfill around the base and sides of the ball and work each layer to settle backfill and eliminate voids and air pockets. When the excavation is approximately two-thirds full, water thoroughly before placing the remainder of backfill. Repeat watering until no more is absorbed. Water again after placing the final layer of backfill.

B. Set bare rootstock on a cushion of planting soil mixture. Spread roots and carefully work backfill around roots by hand and puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers of soil mixture above roots. Set the collar 1 inch below the adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break.

C. Set container grown stock as specified for balled burlapped stock, except cut cans on two sides with an approved can cutter, and remove the bottoms of wooden boxes after partial backfilling so as not to damage the root balls.

D. Provide fertilizer and treatments as required according to the manufacturer's recommendations.

E. Dish the top of the backfill to allow for mulching.

F. Mulch pits, trenches, and planted areas. Provide not less than 4 inches minimum thickness of mulch in all areas specified and finish level with adjacent finish grades.

G. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Owner, do not cut tree leaders and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character. Pruning shall occur only after planting under the direction of the Owner.

H. Remove and replace excessively pruned or malformed stock resulting from improper pruning.

I. Wrap tree trunks with burlap at any point where wood baton braces will come in contact with the tree trunk.

J. Guy and stake trees immediately after planting as indicated on the planting details submitted by the Owner. Alternative methods must be approved by the Owner.

3.06 PLANTING GROUND COVER

A. Space ground cover plants as indicated or scheduled. Triangular spacing is to be used in all ground cover beds.

B. Excavate entire ground cover beds to allow for spreading of roots and backfill with planting soil. Work soil around the roots to eliminate air pockets and leave a slight saucer indentation around the plants to hold water. Water thoroughly after planting, taking care not to cover the crowns of plants with wet soil.

C. Mulch areas between ground cover plants as specified.

3.07 MAINTENANCE

A. Begin maintenance of plants upon delivery to the site, including irrigation. The Contractor shall maintain all plants until final acceptance or by special maintenance agreement as specified or indicated in the Contract Documents. Maintenance by the Contractor through Final Acceptance shall include all measures necessary to ensure a clean appearance and survivability of the plant material.

B. Maintain trees, palms, shrubs, and other plants by watering, pruning, cultivating, and weeding as required for healthy growth. The Contractor will be responsible for all landscape maintenance activities during this period including weeding,

fertilizing, mowing, and watering. The Contractor will be responsible for all costs associated with maintenance activities (including watering) during the maintenance period. The Contractor will be responsible for maintaining "weed free" planting areas, beds, and planters through final acceptance. All planting areas must be weed-free at the time of final acceptance. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades of vertical position as required. Spray as required to keep trees and shrubs free of insects and disease.

3.08 CLEANUP AND PROTECTION

The Contractor shall do the following regarding cleanup and protection:

A. During landscape work, keep pavements clean and the work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors, trades, and trespassers. Maintain protection during the installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

C. The Contractor shall repair damage resulting from erosion, gullies, washouts, or other causes by filling with topsoil, tamping, re-fertilizing, and slope stabilizing.

3.09 INSPECTION AND ACCEPTANCE

A. When landscape work is substantially completed, the Owner will, upon request, inspect the work to determine substantial completion acceptance. If all materials and workmanship are found to be acceptable, the Owner will furnish written notification of substantial completion, thus beginning the stipulated maintenance periods.

B. Landscape work may be inspected for substantial completion in portions as agreeable to the Owner provided each portion of the work offered for inspection is complete.

C. When inspected landscape work does not comply with requirements, the Contractor shall replace rejected work and continue specified maintenance until the work is re-inspected by the Owner and found to be acceptable. The Contractor shall remove rejected plants and materials promptly from the project site.

END OF SECTION

SECTION 02920
SEEDING AND SODDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all materials, equipment, labor, and work to construct the project in accordance with the Contract Documents. No time extensions shall be given to the Contractor for not establishing a grass or sod cover during the "proper" planting season.

B. This work includes but is not limited to the following items specified in this Section:

1. Placing sod to provide grass as finished ground cover as indicated on the Contract Drawings.
2. Placing seed to provide grass as finished ground cover in areas not designated to be sodded that were disturbed by the work. Provide seed and topsoil for all areas not designated to be sodded that have been disturbed or are indicated on the Contract Drawings to be seeded.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

B. Certificates:

1. Seed, hydroseed, and sod shall be accompanied by certificate from vendors certifying these items meet the requirements of these Specifications, stating botanical name, percentage by weight, and percentage of purity.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of

this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, January 2022:

1. FDOT Section 162—Prepared Soil Layer.
2. FDOT Section 570—Performance Turf.
3. FDOT Section 981—Turf Materials.
4. FDOT Section 982—Fertilizer.
5. FDOT Section 983—Water for Grassing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. Deliver, store, protect, and handle products to the site to prevent damage from wetness and weather conditions.

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of the manufacturer.

E. No sod that has been cut for more than 72 hours may be used unless specifically authorized. A letter of certification from the grassing Contractor as to when the sod was cut and what type shall be provided to the Owner upon delivery of the sod to the job site. Sod shall not contain plastic netting.

1.05 MAINTENANCE

A. Maintenance shall be as indicated under Part 3, Execution, of this Section.

1.06 DEFINITIONS

A. Weeds: Weeds include but are not limited to Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragqwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.07 REGULATORY REQUIREMENTS

A. The Contractor shall comply with regulatory agencies for fertilizer and herbicide composition.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 MATERIALS

A. Topsoil

1. Topsoil shall be supplied and installed in accordance with FDOT Standard Section 162.

B. Fertilizer

1. Fertilizer shall be a complete, commercial-grade mixture of 12-8-8 analysis.
2. Fertilizer shall conform to applicable state laws for the material used.
3. Commercial-grade mixture shall conform to FDOT Standards, Section 982.

C. Mulch

1. Mulch shall conform to FDOT Standards, Section 981.
2. Mulch shall be dry grain straw or hay, free of noxious weeds.
3. Mulch shall be thoroughly cured and dried before use.
4. Forest litter, pine needles, cypress or Spanish Moss will not be acceptable.

D. Seed

1. All grass seed shall be the product of a reputable supplier and shall conform to the requirements of the State Department of Agriculture and Consumer Services and all applicable state laws.

2. Grass seed shall conform to FDOT Standards Section 981, with a minimum 80% purity and 80% germination with no noxious weeds.

3. Seed:

a. Pump Station – Seed used shall be Argentine Bahia applied at a minimum rate of 10 pounds per 1,000 square feet. A thick stand of grass shall be provided.

b. Weir and Weir Access Road – Seed used shall be Argentine Bahia applied at a minimum rate of 10 pounds per 1,000 square feet. A thick stand of grass shall be provided.

c. Stormwater Treatment Area-Pond Slopes and Embankments:

(1) March 15 to September 15:

(a) Seed used shall be Argentine Bahia applied at a minimum rate of 10 pounds per 1,000 square feet. A thick stand of grass shall be provided.

(2) Remainder of the Year:

(a) 1/3 Argentine Bahiagrass.
(b) 1/3 Browntop Millet.
(c) 1/3 Rye.

d. Stormwater Treatment Area-Ditch Plugs Seed Mixture:

(1) March 15 to September 15:

(a) Florida Wet Flatwoods Mix.

(2) Remainder of the Year:

(a) 1/2 Browntop Millet.
(b) 1/2 Rye.

E. Sod

1. Sod shall conform to FDOT Standards Section 981. A thick stand of grass shall be provided at all locations.
2. Sod shall be Argentine Bahia.
3. All Sod shall be palletized sod and shall not contain plastic netting.
4. Sod shall match the existing sod when practical.

F. Water

1. The water used to produce grass may be obtained from any approved source, in accordance with FDOT Section 983. The water shall be free of excess and harmful chemicals, acids, alkalies, and all substances which may be harmful to plant growth or obnoxious to traffic. Salt or brackish water shall not be used. The Contractor shall arrange to secure and pay for water. The Contractor shall make all provisions necessary to water until a thick stand of grass is established.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. The entire area to be seeded, as shown on the Drawings or required in this Section, shall be covered with a 6-inch layer of muck or suitable topsoil, carefully spread and disked lightly into the existing soil and finished to the grades indicated.

3.02 FERTILIZING

A. Fertilizer shall be applied uniformly on the surface of the ground at a minimum rate as specified in Section 570 of FDOT Specifications. It shall be mixed into the soil with a disk harrow, where practicable, or by hand-raking in areas of limited accessibility. Mixing shall be continued until the fertilizer is uniformly incorporated into the top 3 inches of soil.

3.03 MULCHING

A. After spreading and mixing the fertilizer, the Contractor shall apply approximately 2 inches, loose thickness, of the mulch material uniformly over the grassing area and cut into the soil to produce a loose mulch thickness of 3 to 4 inches, in accordance with Section 570 of FDOT Specifications. Care shall be exercised to prevent the mulch from being cut too deeply into the soil.

3.04 SEEDING

A. Seed which has become wet or moldy shall not be used. Soon after the mulch material has been cut into the soil and while the soil is still loose and moist, the seed shall be scattered uniformly over the grassing area. Application shall be in conformance with FDOT Standards, Section 570.

3.05 SODDING

A. Application shall be in accordance with FDOT Standards, Section 575.

B. Use wooden stakes to secure sod to side slopes that are 4 (horizontal) to 1 (vertical) or steeper.

3.06 WEED CONTROL

A. The Contractor shall apply herbicides as required and as recommended by the County Agricultural Agent. Herbicides shall only be applied as needed.

3.07 COMPACTION

A. Immediately after the seeding is complete, the entire grassed or mulched area shall be compacted with a light roller. Rolling shall be continued until the area is firmly but not tightly packed.

3.08 EQUIPMENT

A. All equipment used in the operation of grassing shall be adequate to produce the required results. Equipment for placing mulch material into the soil shall be suitable for cutting the specified materials uniformly into the soil and to the required controlled depth. Rollers shall have corrugated or notched surfaces and shall be at least 12 inches in diameter. Smooth surface rollers will not be permitted.

3.09 GROUND COVER DATA

A. Planting dates, types of seeds, seed mixtures, and rates of application shall be as set forth in this Section. No changes may be made in the ground cover type without the approval of the Owner.

3.10 GROUND COVER ESTABLISHMENT

A. General Requirements

1. The Contractor shall provide ground cover (sod and seed) establishment of the specified permanent vegetation before final acceptance of the project with no dead areas of ground cover. Groundcover (sod and seed) establishment shall consist of necessary preserving and protecting to keep the grassed areas in a satisfactory condition. The Contractor shall water the grassed areas as long and as often as necessary to promote maximum practicable growth. At any time, the Owner may require replanting an area

or portion of an area which, for any cause, shows unsatisfactory growth. Except as otherwise specified or permitted by the Owner, the Contractor shall prepare areas to be replanted in accordance with the requirements of the Specifications as if such replanting were the initial planting. However, the type of fertilizer and the applicable rate of fertilizer to be furnished and applied by the Contractor as part of plant establishment occasioned by replanting shall be determined by soil tests or otherwise established.

B. Growth and Coverage

1. The Contractor shall be responsible for providing satisfactory growth and coverage as defined below. Growth and coverage shall be considered acceptable when all areas show a satisfactory visible growth with no bare spots larger than 1 square foot. Bare spots shall be scattered and the total bare areas should not comprise more than 1/100 of any given area.

3.11 EXTENT OF SOD/GRASS MAINTENANCE

A. The Contractor is responsible for all sod and grass maintenance until the date of final completion of the project. Sod and grass maintenance includes cutting, watering, fertilizing, re-seeding, and re-sodding as required to maintain the required coverage of healthy, vibrant grass and sod cover.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03301
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all concrete work as ordered by the Owner, as shown on the Drawings, and as specified in this Section.

B. Work shall conform to all requirements of ACI 301, except as modified by these Contract Documents.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance. Reproductions of contract drawing are unacceptable. Submit full fabrication drawings and technical data on all materials and components. Submit other data specified in this Section when required. Submittals shall include those required by ACI 301 and the following:

A. Shop Drawings and Technical Data

1. Concrete mix for each formulation of concrete proposed for use, including constituent quantities per cubic yard, water cementitious ratio, type, and manufacturer of cement.

B. Test Reports

1. Concrete mix for each formulation of concrete proposed for use, including constituent quantities per cubic yard, water cementitious ratio, type and manufacturer of cement, and either a. or b. below:

    a. Standard deviation data for each proposed concrete mix based on statistical records.
    b. Water cementitious ratio curve for each proposed concrete mix based on laboratory tests. Give average cylinder strength test results at 28 days for laboratory concrete mix designs. Provide results of 7- and 14-day tests if available.

2. Concrete compressive strength, air content, and slump tests.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the time the Contract Documents were signed and sealed by the Engineer of Record, unless indicated otherwise. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Concrete Institute (ACI)

1. ACI 117—Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301—Specifications for Structural Concrete.
3. ACI 308.1—Specification for Curing Concrete.
4. ACI 318—Building Code Requirements for Structural Concrete.

B. American Society for Testing and Materials (ASTM)

1. ASTM A615/A615M—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A775/A775M—Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
3. ASTM A934/A934M—Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
4. ASTM C31/C31M—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
5. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
6. ASTM C94/C94M—Standard Specification for Ready-Mixed Concrete.
7. ASTM C143/C143M—Standard Test Method for Slump of Hydraulic-Cement Concrete.
8. ASTM C150/C150M—Standard Specification for Portland Cement.
9. ASTM C171—Standard Specification for Sheet Materials for Curing Concrete.
10. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
11. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
12. ASTM C920—Standard Specification for Elastomeric Joint Sealants.
13. ASTM C1116/C1116M—Standard Specification for Fiber-Reinforced Concrete.
14. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.04 QUALITY ASSURANCE

A. Concrete shall comply with ACI 301 and other stated requirements, codes, and standards. Notify the Owner in writing when conflicts exist.

B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.

C. A firm providing field testing and inspection services will be approved by the Owner. The cost of such work shall be paid by the Contractor. The following items shall be tested to verify conformity with this Section:

1. Concrete placements—compressive strength (cylinders), compressive strength (cores), slump, and air content.
2. Other materials or products that may come under question.
3. All materials incorporated in the work shall conform to accepted samples.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials shall be the end products of one manufacturer to provide standardization of appearance, maintenance, and manufacturer's service.

B. Materials shall comply with this Section and any applicable State or local requirements.

C. Provide 1/2-inch chamfer on exposed edges of concrete.

2.02 CONCRETE MIX MATERIALS

A. Cement: Domestic Portland cement complying with ASTM C150/C150M, Type II. Air entraining cements shall not be used. The brand of cement shall be subject to approval by the Owner and one brand shall be used throughout the Work.

B. Water: Potable water conforming to ASTM C1602.

C. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When more than one admixture is required to be used 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.

D. Fly Ash: ASTM C618, Class F except that the Loss on Ignition (LOI) shall be limited to 3% maximum.

E. Synthetic Macro-Fiber Reinforcement: FORTA FERRO by FORTA Corporation, or approved equivalent 100% virgin copolymer/polypropylene twisted-bundle and fibrillated fibers conforming to ASTM C1116/C1116M, Type III.

2.03 CONCRETE MIXES

A. Comply with ACI 301 and the following concrete mix requirements:

1. Fiber Reinforced Slab on Grade:

   a. Exposure Classes: S1, F0, W0, C1.
   b. Nominal Maximum Aggregate Size: 1 inch.
   c. Concrete Compressive Strength: 5,000 psi at 28 days.
   d. Maximum water to Cementitious material ratio, w/cm, shall not exceed 0.43.
   e. Minimum Synthetic Macro-Fiber Reinforcement Content: 7 pounds per cubic yard of concrete.
   f. Use HRWR in all trucked concrete. Shotcrete does not require HRWR.

2. All other concrete:

   a. Exposure Classes: S1, F0, W0, C1.
   b. Nominal Maximum Aggregate Size: 1 inch.
   c. Concrete Compressive Strength: 5,000 psi at 28 days.
   d. Maximum water to Cementitious material ratio, w/cm, shall not exceed 0.43.

2.04 CONCRETE REINFORCEMENT

A. Reinforcing steel shall be deformed bars and shall comply with ASTM A615/A615M, Grade 60.

B. Dowels shall be epoxy-coated smooth bars complying with ASTM A775/A775M or ASTM A934/A934M.

2.05 CONCRETE JOINT MATERIALS

A. Joint Filler: ASTM D1751. The thickness shall be 1/2 inch unless indicated otherwise on the Drawings.

B. Bond Breaker: Adhesive-backed glazed butyl or polyethylene tape that will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.

C. Bonding Agent: 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 or approved equal.

D. Joint Sealant: ASTM C920, Type M, Class 25, Use T for horizontal surfaces. ASTM C920, Type M, Grade NS, Class 25, Use T for vertical surfaces greater than 3% slope.

2.06 CONCRETE CURING MATERIALS

A. If used, liquid curing compound shall conform to ASTM C309, Type 1-D (Class A or B) or ASTM C1315, Type 1-D (Class A). Compound shall contain no wax, paraffin, or oil.

2.07 FORMS (NOT USED)

2.08 EXPANSION / CONTRACTION JOINTS (NOT USED)

2.09 WATERSTOPS (NOT USED)

2.10 BONDING MATERIALS (NOT USED)

2.11 VAPOR BARRIER (NOT USED)

2.12 GROUT (NOT USED)

PART 3 EXECUTION

3.01 REINFORCING STEEL (NOT USED)

3.02 MECHANICAL COUPLER SYSTEM (NOT USED)

3.03 CONCRETE MIXING AND TRANSPORTING

A. Concrete shall be ready-mixed concrete in accordance with ASTM C94/C94M.

B. Furnish delivery tickets to the Owner as each truck arrives.

C. Transport concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate. Equip each transit mix

truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

D. Keep the water tank valve on each transit truck locked at all times. Addition of water will not be permitted.

E. Re-tempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar that has reached initial set will not be permitted.

3.04 CONCRETE APPEARANCE

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.

B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability, and appearance. When concrete surfaces are stripped, the concrete when viewed in good lighting from 10 feet away shall be pleasing in appearance and at 20 feet shall show no visible defects.

3.05 CONCRETE TESTS

A. The Contractor shall hire a testing agency meeting the requirements of ASTM E329 to perform field and laboratory tests.

B. The testing agency shall take sets of four concrete test cylinders during the progress of the work in accordance with ASTM C31/C31M. The number of sets of concrete test cylinders taken each day shall not be fewer than three sets nor fewer than one set for each 25 cubic yards of concrete.

C. The testing agency shall test each set of concrete test cylinders in accordance with ASTM C39. One cylinder shall be tested at 7 days and two cylinders shall be tested at 28 days for each set of concrete test cylinders. One cylinder shall be held in case a 56-day break is required. Submit test reports to the Owner for review.

D. The testing agency shall perform slump tests of concrete in accordance with ASTM C143/C143M. The number of slump tests shall be 1 for each required set of concrete strength test cylinders. Submit test reports to the Owner for approval.

3.06 PLACING CONCRETE (NOT USED)

3.07 FIELD TESTS

A. The firm providing field testing and inspection services will take sets of three field control cylinder specimens during the progress of the work, in compliance with ASTM C31/C31M. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be fewer than one set nor fewer than one set for each 100 cubic yards of concrete nor fewer than one set for each 5,000 square feet of surface area for slabs or walls. One cylinder shall be broken at 7 days and two cylinders shall be broken and their strengths averaged at 28 days. When the average 28-day compressive strength of the cylinders in any set falls below the specified compressive strength or below proportional minimum 7-day strengths (where the proper relation between 7- and 28-day strengths has been established by tests), the Owner may reject the concrete represented by the set of cylinders and may require modification of the concrete and/or require modification of the proportions, water content, or temperature conditions of the design mix to achieve the required strengths.

B. The Contractor shall cooperate in testing by allowing free access to the work for selecting samples, providing an insulated closed curing box for specimens, protecting the specimens against injury or loss through his/her operations, and furnishing material and labor required for taking concrete cylinder samples. All shipping of specimens will be paid for by the Contractor.

C. Slump tests will be made in the field in conformity with ASTM C143/C143M.

3.08 FORMED SURFACES (NOT USED)

3.09 ROUGH FORM FINISH (NOT USED)

3.10 RUBBED FINISH (NOT USED)

3.11 ABRASIVE BLAST FINISH (NOT USED)

3.12 FLOORS AND SLABS (NOT USED)

3.13 FLOATED FINISH (NOT USED)

3.14 MACHINE FLOATING (NOT USED)

3.15 HAND FLOATING (NOT USED)

3.16 FINISHING TOLERANCES (NOT USED)

3.17 BROOM FINISH (NOT USED)

3.18 STEEL TROWEL FINISH (NOT USED)

3.19 CONCRETE RECEIVING CHEMICAL HARDENER (NOT USED)

3.20 APPROVAL OF FINISHES (NOT USED)

3.21 SCHEDULE OF FINISHES (NOT USED)

3.22 CONCRETE CURING

A. Cure all concrete in accordance with ACI 308.1.

3.23 STRIPPING AND FINISHING CONCRETE (NOT USED)

3.24 SCHEDULE (NOT USED)

3.25 MISCELLANEOUS WORK (NOT USED)

3.26 CONCRETE FINISHES

A. Concrete for the following conditions shall be finished in accordance with ACI 301 as follows:

1. Formed Surfaces: Surface Finish-CSC2. Submit mock-up for Owner review before construction.
2. Driveway Slabs on Grade: Light broom finish.
3. Canal Bottom Slab on Grade: Float finish.
4. Top of Gate Slab: Trowel Finish to a very flat floor surface classification in accordance with ACI 117.

END OF SECTION

SECTION 03480
PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, and equipment required to install precast concrete structures as shown on the Drawings and as specified in this Section, including wet wells, valve vaults, manholes, and accessories. The work shall include the required inlet and outlet pipe connections; frames and covers; masonry; concrete; reinforcing steel; special pipe fittings; precast units; and all other materials, tools, and equipment necessary to produce complete structures.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Submittals shall include at least the following:

1. Base sections, riser sections, flat slab tops, and grade rings with notarized certificate indicating compliance with ASTM C478.
2. Location and elevation of all penetrations.
3. Applicable lifting and installation details or instructions.
4. Frames and covers with notarized certificate indicating compliance with specified standards (ASTM A48/A48M, Class 30; etc.).
5. Method of repair for minor damage to precast concrete sections.
6. Delivery, unloading, and receiving instructions.

B. Design Data

1. All precast structures shall be designed by an engineer registered in Florida. Calculations and design drawings shall be signed, sealed, and submitted for review before fabrication. Design drawings shall demonstrate that the applicable industry design standards listed in this Section have been met. The design shall include earth pressures associated with a water table at grade. The design of the top slab shall include a live load – 200 psf.

2. Precast concrete structures:

a. Sectional plans and elevations showing dimensions and reinforcing steel placement.
b. Structural calculations including assumptions.
c. Concrete design mix.

C. Test Reports

1. Precast concrete structures:

a. Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be in accordance with the currently effective Florida Building Code (FBC). The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO HB 17—Standard Specifications for Highway Bridges.

B. American Concrete Institute (ACI)

1. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
2. ACI 350/350R—Code Requirements for Environmental Engineering Concrete Structures and Commentary.

C. American Society for Testing and Materials (ASTM)

1. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
2. ASTM A536—Standard Specification for Ductile Iron Castings.
3. ASTM A615/A615M—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
4. ASTM C14—Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
5. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
6. ASTM C150/C150M—Standard Specification for Portland Cement.
7. ASTM C207—Standard Specification for Hydrated Lime for Masonry Purposes.

8. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
9. ASTM C478—Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
10. ASTM C497—Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
11. ASTM C923—Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
12. ASTM C1244—Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
13. ASTM D4101—Standard Specification for Polypropylene Injection and Extrusion Materials.

D. Occupational Safety and Health Administration (OSHA)

1.04 QUALITY ASSURANCE

A. All material shall be new and unused.

B. The quality, manufacturing process, and finished sections of the materials are subject to inspection and approval by the Owner. Inspection may be at the place of manufacture, at the work site following delivery, or both.

C. Materials may be examined for compliance with ASTM standards, this Section, and approved manufacturer's drawings. Additional inspection criteria shall include appearance, dimensions, blisters, cracks, and soundness. The surface shall be dense and close textured.

D. Materials shall be rejected for failure to meet any requirements specified in this Section. Materials may be rejected at the place of manufacture, at the work site, or following installation. Mark rejected materials for identification and remove them from the work site immediately. Rejected materials shall be replaced at no cost to the Owner.

E. If the Owner authorizes repair, repair minor damage to precast concrete sections by the approved method. Epoxy mortar may be used for minor repairs subject to the approval of the Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Precast reinforced concrete structures shall be produced in a plant approved by the Owner.

B. To provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service, like items of materials/equipment shall be the end products of one manufacturer.

C. Provide lifting lugs or holes in each precast section for proper handling.

2.02 CONCRETE

A. Concrete and aggregate shall conform to the requirements of Section 03301, Cast-In-Place Concrete, unless otherwise specified in this Section. Portland cement shall be ASTM C150/C150M, Type II. Compressive strength shall be not less than 5,000 psi at 28 days. Maximum size of aggregate shall conform to ASTM C33/C33M and shall not exceed one-fifth the narrowest dimension between sides of forms, nor three-quarters the minimum clear spacing between individual reinforcing bars or wires. Water-to-cement ratio shall not exceed 0.45. Slump shall be between 2 and 4 inches, unless otherwise approved by the Owner. The concrete proportions shall be developed using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for this project. Accelerators containing calcium chloride shall not be used in precast concrete.

2.03 PRECAST PUMP STATION

A. Precast vaults shall be sized as shown on the Drawings and shall conform to the requirements of ACI 318. The vaults shall also meet the permeability requirements specified by ASTM C14.

B. The units shall be cured as specified in Section 03301, Cast-In-Place Concrete, and shall not be shipped until at least 10 days after casting. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the outside of each precast section.

C. All pipe openings and access accessories shall be cast in at the precast plant.

D. The manufacturer shall reinforce the vaults to meet all applicable codes. Alternatively, the vaults may be redesigned using the applicable backfill, surcharge, and dead loads. Minimum live load shall be an equivalent lateral fluid pressure of 100 psf per foot of depth. Minimum surcharge live load shall be as stipulated by FDOT H20 highway loading.

E. The vault base and lid shall be integral with the sidewalls with slab reinforcing tied to wall steel.

2.04 JOINTING PRECAST SECTIONS

A. Seal tongue-and-groove joints of precast manhole sections with either rubber O-ring gaskets or preformed flexible joint sealant. O-ring gaskets shall conform to ASTM C443. Preformed flexible joint sealant shall be Kent Seal No. 2 by Hamilton-Kent, Ram-Nek by Henry, or equal.

B. After the joints are assembled the gap between sections shall be packed on the inside and outside with Anti-Hydro "Axpandaretes," Masterflow 713 by Master Builders or Five Star Grout by US Grout Corp., and shall be troweled smooth so that no projections remain on the inside.

C. The completed joint shall withstand 15 psi internal and external water pressure without leakage or displacement of gasket or sealant.

2.05 DAMPPROOFING

A. Apply two coats of bituminous waterproofing material to the exterior surfaces of precast concrete structures by brush or spray and in accordance with the manufacturer’s recommendations. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products, Dehydratine 4 by A.C. Horn Inc, RIW Marine Liquid by Toch Brothers, or equal.

PART 3 EXECUTION

3.01 PRECAST STRUCTURE INSTALLATION

A. Precast section ends shall be clean of foreign materials and carefully inspected for chips or cracks. Any sections with damaged joint tongue shall not be used. Preformed plastic gaskets and joint sealant shall be installed in strict conformance with the manufacturer's recommendations. Only primer furnished by the gasket manufacturer will be approved.

B. Invert elevations shall be in strict conformance with the Drawings. All sharp edges or rough sections that obstruct flow shall be removed.

C. Access door framing shall be cast in top slabs in methods approved by the Owner and shall be flush and level with the top of concrete. Set precast concrete sections vertical and in true alignment. Install O-ring rubber gasket in the recess in the base of previously set section or prime and double seal joint surfaces with “RAM-NEK” premolded plastic joint sealer or Owner-approved equal.

D. Completely plug, seal, and smooth all holes in sections used for their handling and the annular space between the wall and entering pipes with non-shrink grout. Finish grout smooth and flush with the adjoining interior and exterior manhole wall surfaces and make watertight.

E. All structures shall be installed plumb.

F. Dampproofing

1. Paint outer surfaces of precast structures with two coats of bituminous dampproofing at the rate of 30 to 60 square feet per gallon, in accordance with the manufacturer's instructions.

3.02 LEAKAGE TESTS

A. Test the pump station for leakage by one of the methods described below. The Owner shall observe each test.

B. Exfiltration Test

1. Assemble precast structure in place; fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved non-shrinking mortar. Test before placing the shelf and invert and before filling and pointing the horizontal joints below 6 feet of depth. Lower the groundwater table below the bottom of the structure for the duration of the test. Plug all pipes and other openings into the precast structures and brace to prevent blow out.
2. Fill the manhole or wetwell with water to the top of the structure. If the excavation has not been backfilled and no water is observed moving down the surface of the structure, the manhole or wetwell is satisfactorily watertight. If the test as described above is unsatisfactory as determined by the Owner or if the excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill the manhole or wetwell to the top of the structure, if necessary, and wait at least 8 hours. At the end of the test period, refill the manhole or wetwell to the top of the structure again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole or wetwell shall not exceed 1 gallon per vertical foot for a 24-hour period. If the manhole or wetwell fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, the Contractor may make repairs by approved methods as directed by the Owner. If leakage due to a defective section of joint exceeds 3 gallons per vertical foot per day, the structure shall be rejected. Uncover the rejected structure as necessary to disassemble, reconstruct, or replace it

as directed by the Owner. Retest the manhole or wetwell and, if satisfactory, fill and paint the interior joints.

3. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

C. An infiltration test may be substituted for an exfiltration test if the groundwater table is above the highest joint in the manhole. If the Owner determines there is no leakage into the manhole, the manhole will be considered watertight. If the Owner is not satisfied, the Contractor shall perform an exfiltration or air testing.

D. Vacuum Test

1. Vacuum testing shall conform to ASTM C1244.
2. If the pressure drop exceeds the acceptable limits, the Contractor will be allowed to make necessary repairs, as approved by the Owner. The manhole shall then be re-tested.
3. When a successful vacuum test has been completed, fill and point the interior and exterior joints.

3.03 CLEANING

A. The Contractor shall thoroughly clean all precast structures of all silt, debris, and foreign matter of any kind before final inspections.

END OF SECTION

DIVISION 9

FINISHES

SECTION 09900
PAINTING AND COATING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes materials for and application of painting and coating systems for the following surfaces:

1. Submerged metal.
2. Exposed metal.
3. Buried metal.
4. Submerged concrete and masonry.
5. Exposed concrete and masonry.
6. Fusion-bonded epoxy coated steel.
7. Bare wood requiring stains, sealers, or lacquers.
8. Concrete floors.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

B. Submit manufacturer's data sheets showing the following information:

1. Percent solids by volume (sbv).
2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
3. Recommended surface preparation.
4. Recommended thinners.
5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
6. Application instructions including recommended equipment and temperature limitations.
7. Curing requirements and instructions.

C. Submit color swatches.

D. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

E. Submit material safety data sheets for each coating.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Architectural Manufacturers Association (AAMA)

1. AAMA 2604—Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO T-259—Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration.

C. American Society for Testing and Materials (ASTM)

1. ASTM A780/A780M—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
2. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
3. ASTM C67/C67M—Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C97/C97M—Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
5. ASTM C140/C140M—Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
6. ASTM C307—Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
7. ASTM C501—Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
8. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Apparatus.
9. ASTM C579—Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
10. ASTM C580—Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete.

11. ASTM C793—Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
12. ASTM D520—Standard Specification for Zinc Dust Pigment.
13. ASTM D522/D522M—Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
14. ASTM D638—Standard Test Method for Tensile Properties of Plastics.
15. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
16. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
17. ASTM D870—Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
18. ASTM D1002—Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
19. ASTM D1014—Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates.
20. ASTM D1308—Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
21. ASTM D2240—Standard Test Method for Rubber Property—Durometer Hardness.
22. ASTM D2370—Standard Test Method for Tensile Properties of Organic Coatings.
23. ASTM D2697—Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings.
24. ASTM D2794—Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
25. ASTM D3273—Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
26. ASTM D3734—Standard Specification for High-Flash Aromatic Naphthas.
27. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
28. ASTM D4138—Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means.
29. ASTM D4141/D4141M—Standard Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings.
30. ASTM D4258—Standard Practice for Surface Cleaning Concrete for Coating.
31. ASTM D4260—Standard Practice for Liquid and Gelled Acid Etching of Concrete.
32. ASTM D4261—Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.

33. ASTM D4263—Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
34. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
35. ASTM D4585/D4585M—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
36. ASTM D4587—Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
37. ASTM D4787—Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
38. ASTM D5590—Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.
39. ASTM D5894—Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog-Dry Cabinet and a UV/Condensation Cabinet).
40. ASTM D6386—Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
41. ASTM D6695—Standard Practice for Xenon-Arc Exposures of Paint and Related Coatings.
42. ASTM D7091—Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
43. ASTM D7234—Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
44. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
45. ASTM F1869—Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
46. ASTM G210—Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus.

D. American Water Works Association (AWWA)

1. AWWA C203—Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied.
2. AWWA C209—Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings.

E. British Standards Institution (BSI)

1. BS EN 598—Ductile Iron Pipes, Fittings, Accessories, and their Joints for Sewerage Applications – Requirements and Test Methods.

F. National Association of Corrosion Engineers International (NACE)

1. NACE SP0188—Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
2. NACE TM0174—Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service.

G. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

H. Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE)

1. SSPC PA-1—Shop, Field, and Maintenance Painting of Steel.
2. SSPC PA-2—Procedure for Determining Conformance to Dry Coating Thickness Requirements.
3. SSPC SP-1—Solvent Cleaning.
4. SSPC SP-2—Hand Tool Cleaning.
5. SSPC SP-3—Power Tool Cleaning.
6. SSPC SP-5/NACE No. 1—White Metal Blast Cleaning.
7. SSPC SP-6/NACE No. 3—Commercial Blast Cleaning.
8. SSPC SP-7/NACE No. 4—Brush-Off Blast Cleaning.
9. SSPC SP-8—Pickling.
10. SSPC SP-10/NACE No. 2—Near-White Blast Cleaning.
11. SSPC SP-11—Power Tool Cleaning to Bare Metal.
12. SSPC SP-12/NACE No. 5—High- and Ultra-High-Pressure Water Jetting.
13. SSPC SP-13/NACE No. 6—Surface Preparation of Concrete.
    a. ICRI CSP1-6—Concrete Surface Profile 1 – 6.
14. SSPC SP-14/NACE No. 8—Industrial Blast Cleaning.
15. SSPC SP WJ-1—Waterjet Cleaning of Metals – Clean to Bare Substrate.
16. SSPC SP WJ-2—Waterjet Cleaning of Metals – Very Thorough Cleaning.
17. SSPC SP WJ-3—Waterjet Cleaning of Metals – Thorough Cleaning.
18. SSPC SP WJ-4—Waterjet Cleaning of Metals – Light Cleaning.

I. US Department of Defense (MIL)

1. MIL-C-5541—Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
2. MIL-C-18480B—Coating Compound, Bituminous, Solvent, Coal-Tar Base.
3. MIL-D-3134—Deck Covering Materials.
4. MIL-DTL-24441—General Specification for Paint, Epoxy-Polyamide.
5. MIL-P-21035—Paint High Zinc Dust Content, Galvanizing Repair.

PART 2 MATERIALS

2.01 PAINTING AND COATING SYSTEMS

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX		
No.	Title	Generic Coating
Submerged Metal Coating Systems		
2.	Submerged Metal, Mild to Moderate Wastewater, Raw Water (Nonpotable) or Raw Sewage in Aerobic Environments	Zinc+MIO blend urethane/Cycloaliphatic amine epoxy
Exterior/UV-Exposed Metal Coating Systems		
12.	Exposed Metal, Non-Immersion Environment	Epoxy/epoxy/aliphatic acrylic urethane
14.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Aromatic zinc-rich urethane primer
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy/epoxy/epoxy
22.	Buried Metal	Corrosion-resisting grease
Submerged Concrete and Masonry Coating Systems		
32.	Exposed Concrete and Masonry, Mild to Moderate Corrosive Environment	Cycloaliphatic amine epoxy primer, intermediate, and finish
Exterior/UV-Exposed Concrete and Masonry Coating Systems		
41.	New or Bare Concrete and Masonry, Atmospheric Weathering Environment	Modified waterborne acrylate/modified waterborne acrylate
PVC, CPVC, and FRP Coating Systems		
51.	PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding	Epoxy/aliphatic acrylic polyurethane

PAINT COATINGS SYSTEM INDEX		
No.	Title	Generic Coating
Nonferrous, Galvanized, and Other Miscellaneous Metals Coating Systems		
61.	Aluminum Insulation from Concrete and Carbon Steel	Polyamide epoxy-coal-tar primer and finish
Interior Plaster, Wood, Masonry, Stucco, Steel, and Drywall Coating Systems		
71.	Plaster, Wood, Masonry, Stucco, and Drywall (Normal/Mild Exposure)	Acrylic emulsion/acrylic emulsion
Fusion Epoxy-Coated Steel Surface Coating Systems		
81.	Fusion Epoxy-Coated Steel, Color Coding	Epoxy/aliphatic acrylic urethane

A. These systems are specified in detail in the following paragraphs. For each system, the required surface preparation, coating materials, and thickness are described. If the manufacturer's written instructions at the time of application differ from this Section, the manufacturer's written instructions shall control.

B. Only products of one manufacturer may be used throughout any particular coating system.

C. The following products are listed as a reference standard for this Section. All high-performance coatings shall be a product of Tnemec International or Induron. No other manufacturers will be permitted without prior approval of the Owner.

D. To be considered for approval, potential alternate products must:

1. Be submitted in accordance with the procedure set forth in the Contract Documents for review of substitute or equal products.
2. Be the same generic type and have the same solids by volume (sbv).
3. Maintain the specified total dry film thickness.
4. Meet or exceed the performance criteria of the originally specified coatings in Article 2.02 of this Section.
5. Include a side-by-side comparison of equality including generic coating description, volume solids, ASTM performance test results, etc.
6. Be endorsed by the manufacturer for their intended use on the project.

E. All dry film thicknesses in the coating systems below are listed in mils.

F. Coatings for Sheet Piles shall be in accordance with Section 02260, Steel Sheet Piling, Article 2.02.

G. Submerged Metal Coating Systems

1. System No. 2—Submerged Metal, Mild to Moderate Wastewater, Raw Water (Nonpotable) or Raw Sewage in Aerobic Environments:

a. Type: Tnemec Series 104 Cycloaliphatic Amine Epoxy (82% sbv) with a Series 1 Omnithane Zinc/Micaceous Iron Oxide Blend Modified Aromatic Polyurethane Primer (61% sbv) at a total film thickness of 14.5 to 19.5 mils.
b. Service Conditions: For use with metal pipes or structures (such as scum troughs, sluice gates, clarifier mechanisms, or piping) continuously submerged in mild to moderate (aerobic) wastewater conditions, such as clarifiers, chlorine contact basins, aeration basins, settling basins, and other open-top structures.
c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface; abrasive blast in accordance with SSPC SP-10/NACE No. 2.
d. Prime Coat: Tnemec Series 1 Omnithane at 2.5 to 3.5 mils.
e. Stripe Coat (Weld Seams and Edges): Tnemec Series 104 Hi-Build Epoxoline at 4.0 to 6.0 mils.
f. Intermediate Coat: Tnemec Series 104 Hi-Build Epoxoline at 6.0 to 8.0 mils.
g. Finish Coat: Tnemec Series 104 Hi-Build Epoxoline at 6.0 to 8.0 mils.

H. Exterior/UV-Exposed Metal Coating Systems

1. System No. 12—Exposed Metal, Non-Immersion Environment:

a. Type: Tnemec Series 1095 Endura-Shield Aliphatic Acrylic Polyurethane finish (66% sbv) with a Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) primer and intermediate coat at a total film thickness of 8.5 to 17.0 mils.
b. Service Conditions: For use with metal structures or pipes subjected to non-immersion conditions, where high-performance corrosion resistance, high-performance color and gloss retention, or resistance to chemical vapors are desired. This system is not suitable for areas of high H_2S concentrations or other similar extremely corrosive atmospheres.
c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-6/NACE No. 3.
d. Prime Coat: Tnemec Series 66 Hi-Build Epoxoline at 3.0 to 6.0 mils.

e. Intermediate Coat: Tnemec Series 66 Hi-Build Epoxoline at 3.0 to 6.0 mils.
f. Finish Coat: Tnemec Series 1095 Endura-Shield at 2.5 to 3.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

2. System No. 14—Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up:

a. Type: Tnemec Series 90-97 Tneme-Zinc aromatic zinc-rich urethane (63% sbv, 83% zinc) primer at a dry film thickness of 2.5 to 3.5 mils.
b. Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.
c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
d. Coating: Tnemec Series 90-97 at 2.0 to 3.5 mils. For single-component application, apply Series 90G-1K97 at the same thickness instead.

I. Buried Metal Coating Systems

1. System No. 21—Buried Metal:

a. Type: Tnemec Series N140 Pota-Pox Plus Polyamidoamine Epoxy (67% sbv) primer, intermediate and finish coat with a UV-stable fourth coat for exposed non-immersion areas. Total film thickness without fourth coat is 8.0 to 22.0 mils.
b. Service Conditions: Buried metal, such as pipe exteriors, valves, flanges, bolts, nuts, structural steel, and fittings.
c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
d. Prime Coat: Tnemec Series N140 at 2.0 to 10.0 mils.
e. Intermediate Coat: Tnemec Series N140 Pota-Pox Plus at 3.0 to 6.0 mils.
f. Finish Coat: Tnemec Series N140 Pota-Pox Plus at 3.0 to 6.0 mils.
g. UV-Stable Fourth Coat (UV-exposed, non-immersion areas): Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

2. System No. 22—Buried Metal:

    a. Type: Corrosion-resisting grease.
    b. Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.
    c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Power tool clean in accordance with SSPC SP-3 as a minimum. Abrasive blasting in accordance with SSPC SP-6/NACE No. 3 is preferred.
    d. Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.

J. Submerged Concrete and Masonry Coating Systems

1. System No. 32—Exposed Concrete and Masonry, Mild to Moderate Corrosive Environment:

    a. Type: Tnemec Series 104 HS Epoxy Cycloaliphatic Amine Epoxy (82% sbv) primer, intermediate and finish coat at a total dry film thickness of 18.0 to 24.0 mils.
    b. Service Conditions: Concrete and masonry exposed to mild to moderate corrosive atmospheres and immersion service, such as chlorine contact basins, chlorine storage areas, or open-top (aerobic) clarifiers, aeration basins, settling basins, etc.
    c. Surface Preparation: In accordance with Article 3.04. Clean to an ICRI CSP 5 standard.
    d. Resurfacing: Apply Tnemec Series 218 to all surfaces to mitigate outgassing and provide a smooth paintable surface. For localized repairs of large bugholes, honeycombs, and other cavities deeper than the recommended maximum thickness, clean sand or pea gravel may be post-added to Series 218. If more than 1/4-inch of repairs is needed, Series 217 may be used.
    e. Prime Coat: Tnemec Series 104 at 6.0 to 8.0 mils.
    f. Intermediate Coat: Tnemec Series 104 at 6.0 to 8.0 mils.
    g. Finish Coat: Tnemec Series 104 at 6.0 to 8.0 mils.

K. Exterior/UV-Exposed Concrete and Masonry Coating Systems

1. System No. 41—New or Bare Concrete and Masonry, Atmospheric Weathering Environment:

    a. Type: Tnemec Series 156 Enviro-Crete Modified Waterborne Acrylate (50.9% sbv) primer and finish coat with a Series 1254

Epoxoblock WB inorganic hybrid water-based epoxy (100% sbv) block filler at a total dry film thickness of 8.0 to 16.0 mils.

b. Service Conditions: Exterior concrete or masonry, exposed to ultraviolet light and weathering, which requires protection from hairline cracking, driving rain, or mold and mildew.
c. Surface Preparation: In accordance with Article 3.04.
d. Masonry Block Filler: Tnemec Series 1254 Epoxoblock WB at a rate of 100 to 150 square feet for dense substrates or 75 to 100 square feet for porous substrates.
e. Prime Coat: Tnemec Series 156 Enviro-Crete at 4.0 to 8.0 mils.
f. Finish Coat: Tnemec Series 156 Enviro-Crete at 4.0 to 8.0 mils.

L. PVC, CPVC, and FRP Coating Systems

1. System No. 51—PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding:

a. Type: Tnemec Series 1095 Endura-Shield Aliphatic Acrylic Polyurethane (66% sbv) finish with a Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) prime coat at a total dry film thickness of 4.5 to 10.0 mils.
b. Service Conditions: Color coding of PVC, CPVC, or FRP exposed to sunlight.
c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then, thoroughly and uniformly scarify and de-gloss the surface.
d. Prime Coat: Tnemec Series 66 at 2.0 to 3.0 mils.
e. Finish Coat: Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

M. Nonferrous, Galvanized, and Other Miscellaneous Metals Coating Systems

1. System No. 61—Aluminum Insulation from Concrete and Carbon Steel:

a. Type: Tnemec Series 46H-413 Hi-Build Tneme-Tar (75% sbv) prime and finish coats at a total dry film thickness of 16.0 to 20.0 mils.
b. Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.
c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then, thoroughly and uniformly scarify and de-gloss

the surface. Primer must be applied as soon as possible on the same day as surface preparation.

d. Prime Coat: Tnemec Series 46H-413 at 8.0 to 10.0 mils.

e. Finish Coat: Tnemec Series 46H-413 at 8.0 to 10.0 mils.

N. Interior Plaster, Wood, Masonry, Stucco, Steel, and Drywall Coating Systems

1. System No. 71—Plaster, Wood, Masonry, Stucco, and Drywall (Normal/Mild Exposure):

a. Type: Tnemec Series 1026 Enduratone Acrylic Emulsion (43% sbv, 100% acrylic resin) intermediate and finish coats with a primer/block filler as dictated by substrate. Total dry film thickness is 4.0 to 6.0 mils plus the primer/block filler.

b. Service Conditions: Interior, dry concrete masonry, drywall, wood, and plaster.

c. Surface Preparation: Surfaces shall be dry, clean, and free of contaminants.

(1) Masonry: Allow to cure 28 days, level protrusions, and remove mortar splatter. Then prepare surfaces in accordance with Article 3.04.

(2) Drywall: Sand joint compound smooth and feather edges.

d. Masonry Block Filler: Tnemec Series 54 Masonry Filler.

e. Wood Prime Coat (Wood Only): Tnemec Series V10-99W Tnemec Primers at 2.0 to 3.5 mil.

f. Concrete Prime Coat (Concrete Only): Tnemec Series 1026 Enduratone at 2.0 to 3.0 mils.

g. Intermediate Coat: Tnemec Series 1026 Enduratone at 2.0 to 3.0 mils.

h. Finish Coat: Two coats of Tnemec Series 1026 Enduratone at 2.0 to 3.0 mils.

O. Fusion Epoxy-Coated Steel Surfaces Coating Systems

1. System No. 81—Fusion Epoxy-Coated Steel, Color Coding:

a. Type: Tnemec Series 66 Hi-Build Epoxoline Polyamide Epoxy (56% sbv) prime and finish coats at a total dry film thickness of 4.5 to 9.0 mils.
b. Service Conditions: Color coding of pipe or steel surfaces already coated with fusion-bonded epoxy.
c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then, thoroughly and uniformly scarify and de-gloss the surface.
d. Prime Coat: Tnemec Series 66 at 2.0 to 4.0 mils.
e. Finish: Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

2.02 PERFORMANCE CRITERIA

The following shall serve as a basis of comparison for material substitution requests. Any substitutions which decrease the total film thickness, change the generic type of coating, or fail to meet the performance criteria of the specified materials shall not be approved.

A. Series 1 Omnithane – Zinc/Micaceous Iron Oxide Urethane

1. Adhesion: ASTM D4541 (Method B, Type II) – No less than 1,433 psi (9.88 MPa) adhesion, average of three tests.
2. Salt Spray (Fog): ASTM B117 – No blistering, cracking, or delamination of film. No more than .03% rusting on plane and no more than 3/16-inch rust creepage at scribe after 10,000 hours exposure.

B. Series 20HS Pota-Pox – Polyamide Epoxy

1. Special Qualification: Certified by NSF International in accordance with NSF 61.
2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 68.5 mg loss after 1,000 cycles with 1,000 gram load, average of three tests.
3. Adhesion: ASTM D4541 – No less than 1,909.3 psi (13.16 MPa) adhesion after 10 freeze/thaw cycles, average of three tests.
4. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of the film after 1,500 hours continuous immersion in deionized water at 140°F.

5. Salt Spray: ASTM B117 – No blistering, cracking, rusting, or delamination of the film and no creepage at the scribe after 5,000 hours.
6. Cyclic Salt Fog/UV Exposure: ASTM D5894 – No blistering, cracking, rusting, or delamination of the film after 10,000 hours.

C. Series 22 Epoxoline – Modified Polyamine Epoxy

1. Special Qualification: Certified by NSF International in accordance with NSF 61.
2. Product must be able to be applied in one single-coat application from 16.0 to 40.0 mils dry film thickness.
3. VOC Content: 0.10 pound/gallon (12 grams/liter).
4. Immersion: ASTM 870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F (60°C), average of three tests.

D. Series 46H-413 Hi-Build Tneme-Tar – Polyamide Epoxy-Coal Tar

1. Adhesion: ASTM D4541 – Exceeds the cohesive strength of the concrete substrate (400 psi), average of three tests.
2. Abrasion: ASTM D4060 (CS-17 wheel, 1,000 gram load) – No more than 142 mg loss after 1,000 cycles.
3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, checking, rusting, or delamination of film. No rust creepage at scribe after 9,000 hours continuous exposure.

E. Series 66 Hi-Build Epoxoline – Polyamide Epoxy

1. Adhesion: ASTM D4541 – No less than 1,930 psi (13.31 MPa) pull, average of three tests.
2. Salt Spray: ASTM B117 – No blistering, cracking, checking, or delamination of film. No more than 1/8-inch rust creepage at scribe after 8,000 hours exposure.

F. Series 90-07 Tneme-Zinc – Aromatic Zinc-Rich Urethane

1. Zinc Pigment: 83% by weight in dried film.
2. Adhesion: ASTM D4541 (Type II) – No less than 1,442 psi (9.94 MPa) adhesion, average of three tests.
3. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No more than 1/8-inch creepage at scribe and no more than 1% rusting on plane after 50,000 hours exposure.

G. Series 94H_2O Hydro-Zinc – Zinc-Rich Aromatic Urethane

1. Special Qualification: Certified in accordance with NSF 61 for use on interior potable water tanks of 500 gallons or greater.
2. Zinc Pigment: 83% by weight in dried film.
3. Adhesion: ASTM D4541 (Type V Self-Aligning Adhesion Tester) – No less than 1,713 psi adhesion, average of three tests.
4. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No rusting on plane and no more than 1/16-inch rust creepage at scribe after 10,000 hours.

H. Series 104 HS Epoxy – Cycloaliphatic Amine Epoxy

1. Adhesion: ASTM D4541 – No less than 900 psi (6.21 MPa) pull, average of three tests.
2. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, or delamination of film after 7 days.
3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film. No more than 1/32-inch (0.8 mm) rust creepage at scribe after 1,500 hours exposure.

I. Series 115 Uni-Bond DF – Self-Crosslinking Hydrophobic Acrylic

1. Adhesion: ASTM D4541 (Method C – Type V Tester) – No less than 1,472 psi pull (10.15 MPa), average of three tests.
2. Salt Spray: ASTM B117 – No more than 1/64-inch rust creepage at scribe, no more than 3% rusting on plane, and no less than a blister rating of 8 after 500 hours exposure.
3. Humidity: ASTM D4585/D4585M – No blistering, cracking, rusting, or delamination of film after 2,000 hours exposure.

J. Series N140 Pota-Pox Plus – Polyamidoamine Epoxy

1. Adhesion: ASTM D4541 – No less than 1,943 psi (13.40 MPa) pull, average of three tests.
2. Exterior Exposure: ASTM D1014 – No blistering, cracking, checking, rusting, or delamination of film. No rust creepage at scribe after 5 years exposure.
3. Humidity: ASTM D4585/D4585M – No blistering, cracking, or delamination of film after 10,000 hours exposure.
4. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F, average of three tests.

5. Salt Spray (Fog): ASTM B117 (Two Coats Series N140) – No blistering, cracking, or delamination of film. No more than 1% rusting on plane. No more than 1/16-inch rust creepage at scribe after 6,700 hours exposure.
6. Salt Spray (Fog): ASTM B117 (Series 91H_2O and Two Coats Series N140) – No blistering, cracking, checking, or delamination of film. No more than 1% rusting on plane and no more than 3/16-inch rust creepage at scribe after 20,000 hours exposure.

K. Series 142 Epoxoline – Modified Polyamine Epoxy

1. Suitable for methanol immersion service.
2. Adhesion: ASTM D4541 – No less than 2,042 psi (14.08 MPa) pull, average of three tests.
3. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film and less than 1/32-inch creepage at the scribe after 5,000 hours exposure.
4. Abrasion: ASTM D4060 – No more than 59.3 mg loss after 1,000 cycles, average of two tests.

L. Series 156 Enviro-Crete – Modified Waterborne Acrylate

1. Adhesion: ASTM D7234 – Exceeds the cohesive strength of concrete substrate (400 psi), average of three tests.
2. Salt Spray: ASTM B117 – No blistering, cracking, or delamination of film. No visible damage to coating or substrate after 5,000 hours.
3. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, chalking, or delamination of the film. No less than 69% gloss retention, no more than 1.1 units gloss loss, and no more than 3.59 DE (FMC-2) color change (white) after 5,000 hours QUV exposure.
4. Fungal/Mold/Mildew Resistance: ASTM D3273 – No More than slight mold growth after 5 weeks exposure.
5. Tensile Strength, Elongation, Modulus of Elasticity: ASTM D2370 – Elongation no less than 200%, average of five tests. Tensile strength no less than 250 psi (1.7 MPa), average of three tests.

M. Series 239SC Chemblock – Modified Novolac Polyamine Epoxy

1. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, rusting, or delamination of film after 72 hours continuous contact with chemical.
2. Compressive Strength: ASTM C579 – Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.

3. Flexural Strength and Modulus of Elasticity: ASTM D790 – Not less than 6,270 psi (43.23 MPa) flexural strength and 323,900 psi (2,233 MPa) flexural modulus of elasticity, average of five tests.
4. Impact: MIL D3134 (modified using 2.5 pound steel ball) – No more than 1/16-inch permanent indention. No cracking, checking, or delamination of film after 240 in-lb (27 J) direct impact, average of three tests.
5. Tensile Strength, Elongation, Modulus of Elasticity: ASTM D638 – No less than 7,913 psi (54.56 MPa) tensile strength, 222,975 psi (1,537 MPa) tensile modulus of elasticity and 6.14% elongation at break.

N. Series 241 Ultra-Tread MVT – Polyurethane Modified Concrete

1. Can be applied to 10-day old concrete.
2. Withstands moisture vapor transmission up to 20 pounds in accordance with ASTM F1869.
3. Withstands relative humidity up to 99% in accordance with ASTM F2170.
4. Adhesion: ASTM D7234 – Exceeds the cohesive strength of the concrete substrate (approximately 400 psi), average of three tests.
5. Compressive Strength: ASTM C579 – No less than 4,922 psi (33.94 MPa) compressive strength, average of six tests.
6. Flexural Strength and Modulus of Elasticity: ASTM C580 – No less than 2,438 psi (16.81 MPa) flexural strength and 313,614 psi (2,162 MPa) modulus of elasticity (tangent), average of five tests.
7. Tensile Strength: ASTM C307 – No less than 1,015 psi (7.00 MPa) tensile strength, average of six tests.

O. Series 248 Everthane – Aliphatic Moisture Cured Urethane

1. Chemical Resistance: ASTM D1308 (Covered Spot Test) – No blistering, cracking, checking, or delamination of film. No more than slight softening or very slight swelling and loss of gloss after 24 hours exposure to the following reagents: 30% Sulfuric Acid, 10% Hydrochloric Acid, 50% Phosphoric Acid, 10% Acetic Acid, 50% Sodium Hydroxide, 10% Ammonium Hydroxide, Methyl Ethyl Ketone, Ethyl Alcohol, Hexane, Xylene, Gasoline, Ethylene Glycol, Skydrol, Brake Fluid, Transmission Fluid, Aviation Gas, Jet Fuel (JP4).
2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 18 mg loss after 1,000 cycles, average of three tests.

P. Series 282 Tneme-Glaze – Polyamine Novolac Epoxy

1. Chemical Immersion: NACE TM0174, Procedure B – No blistering, cracking, rusting, or delamination of film after 72 hours continuous contact with chemical.

2. Compressive Strength: ASTM C579 – Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.
3. Immersion: 140°F Deionized Water Immersion – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion.
4. Impact: ASTM D2794 – No visible cracking or delamination of film after 59 in/lbs direct impact, average of three tests.
5. Salt Spray (Fog): ASTM B117 – No blistering, cracking, rusting, or delamination of film. No more than 1/16-inch rust creepage at scribe after 3,500 hours exposure.

Q. Series 365 Tank Armor – Novolac Epoxy

1. Suitable for immersion service in 98% sulfuric acid.
2. Adhesion: ASTM D4541, Type II – No less than 1,650 psi (11.38 MPa) adhesion, average of three tests.
3. Hardness: ASTM D2240 (Shore D Durometer) – Not less than 90 Shore Type D hardness, average of five tests.

R. Series 431 Perma-Shield PL – Modified Polyamine Ceramic Epoxy

1. Severe Wastewater Analysis Test (SWAT): ASTM G210 – Initial impedance of 11.18 log-Z at 0.001 Hz (ohms cm^2). No blistering, cracking, checking, or delamination. No less than 88.7% EIS retention or not more than 1.26 ohms cm^2 reduction in log-Z electrochemical impedance at 0.001 Hz after 28 days exposure. No less than 2,363 psi (16.30 MPa) adhesion or no loss of adhesion after 28 days in SWAT, average of three tests.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 cycles, 1,000 gram load) – No more than 41 mg loss, average of three tests.
3. Abrasion Resistance: BS EN 598: 2007+A1: 2009 (Rocking Abrasion) – No more than 0.14 mm (5.5 mils) thickness of coating loss after 1,000,000 cycles.

S. Series 434 Perma-Shield H_2S – Modified Aliphatic Amine Epoxy Mortar

1. SWAT: ASTM G210 – Initial impedance of 10.6 log-Z at 0.01 Hz (ohms cm^2). No blistering, cracking, or checking. No less than 86.7% retention or not more than 1.4 ohms cm^2 reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 88 mg loss after 1,000 cycles, average of three tests.
3. Impact: ASTM D2794 – No visible cracking or delamination after 160 inch-pounds (18.1 J) direct impact.

4. Compressive Strength: ASTM D695 – Not less than 12,331 psi (85.0 MPa) compressive strength, average of five tests.

T. Series 435 Perma-Glaze – Modified Polyamine Epoxy

1. SWAT: ASTM G210 – Initial impedance of 12.46 log-Z at 0.01 Hz (ohms cm^2). No blistering, cracking, checking, or delamination. No less than 84.3% retention and no more than 1.95 ohms cm^2 reduction in electrochemical impedance after 28 days exposure. No less than 93% loss of tensile adhesion after 28 days in SWAT average of three tests.
2. Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 72 mg loss after 1,000 cycles, average of three tests.

U. Series 436 Perma-Shield FR – Fiber-Reinforced Modified Polyamine Epoxy

1. SWAT: ASTM G210 – Initial impedance of 10.2 log-Z at 0.01 Hz (ohms cm^2). No blistering, cracking, or checking. No less than 83.7% retention or not more than 1.6 ohms cm^2 reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
2. Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 74.6 mg loss after 1,000 cycles, average of three tests.
3. Impact: ASTM D2794 – No visible cracking or delamination of film after 88 inch-pounds direct impact.
4. Compressive Strength: ASTM D695 – No less than 8,866 psi (6.13 MPa) compressive strength, average of five tests.

V. Series 626 Dur A Pell GS – RTV Silicone Rubber Water and Graffiti Protectant

1. Accelerated Weathering: ASTM C793 – No signs of deterioration except for dirt accumulation after 4,000 hours exposure.
2. Chloride Ion Penetration: AASHTO T-259 – No less than a 1500% reduction in the chloride ion content when compared to untreated concrete, average of two tests.

W. Series 662 Prime-A-Pell Plus – Modified Siloxane/Silane with Diffused Quartz Carbide

1. QUV Exposure: ASTM D4587 (UVA-340 bulbs, Cycle 4: 8 hours UV/4 hours condensation) – No reduction in water repellent performance after 5,000 hours exposure.
2. Water Absorption: ASTM C67/C67M (Applied to Ohio Sandstone) – No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.

3. Water Absorption: ASTM C97/C97M (Applied to Fire Clay Brick) – No less than a 93% reduction in water absorption as compared to untreated samples following 24 hours of immersion.
4. Water Absorption: ASTM C140/C140M (Applied to Cast Mortar Cubes) – No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.

X. Series 700 Hydroflon – Advanced Thermoset Solution Fluoropolymer

1. Exterior Exposure: ASTM D1014 (AAMA 2604) (South Florida Marine Exposure) – Exceeds the exterior weathering requirements of AAMA 2604 standard.
2. Exterior Exposure: ASTM D4141/D4141M, Method C (EMMAQUA) – No blistering, cracking, or chalking. No less than 100% gloss retention, no more than 1 unit gloss loss and no more than 0.23 DEHunter color change (white) after 1,500 MJ/m² (69,109MJ/m² total) EMMAQUA exposure.
3. QUV Exposure: ASTM D4587 – No blistering, cracking, or chalking. No less than 61% gloss retention (31.4 units gloss change) and 1.89 DEFMC2 (MacAdam units) color change (white) after 25,000 hours exposure.
4. Xenon Arc Weathering: ASTM D6695 – No blistering, cracking, or chalking. No less than 87% gloss retention (11.9 units gloss change) and no greater than 0.37 DE00 color change (white) after 8,000 hours Xenon Arc exposure.

Y. Series 971 Aerolon – Fluid-Applied Acrylic Insulation Coating

1. Immersion: ASTM D870 – No blistering, cracking, rusting, or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F (60°C), average of three tests.
2. Thermal Conductivity: ASTM C518 – Thermal conductivity shall not be greater than 0.0356 W/m-°K or 0.2468 BTU-in/ft²-hr-°F (R-value at 1 inch equals 4.1).

Z. Series 1026 Enduratone – Acrylic Emulsion

1. VOC Content: 0.38 pounds/gallon (1.4 grams/liter).
2. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, chalking, or delamination of film. No less than 49% gloss retention (2.3 units gloss change) and 0.39 DE00 color change after 10,000 hours exposure.

AA. Series 1029 Enduratone – HDP Acrylic Polymer

1. Algal Resistance: ASTM D5590 – No more than traces of fungal growth (less than 10%) after 3 weeks continuous exposure.
2. Fungal/Mold/Mildew Resistance: ASTM D5590 – No more than traces of fungal growth (less than 10%) after 4 weeks continuous exposure.
3. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, or delamination of film. No less than 100% gloss retention, no more than 0.45 DE00 color change and no unit gloss loss after 3,000 hours.

BB. Series 1095 Endura-Shield – Aliphatic Acrylic Polyurethane

1. Volatile Organic Compounds (Thinned 5%): 0.77 pounds/gallon (92 grams/liter).
2. QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) – No blistering, cracking, or delamination. No less than 52% gloss retention or 23 units gloss change and 0.59 DECIE2000 color change (white) after 2,000 hours exposure.

PART 3 EXECUTION

3.01 WEATHER CONDITIONS

A. Do not paint in the rain, wind, snow, mist, or fog or when steel or metal surface temperatures are less than 5°F above the dew point.

B. Do not apply paint when the relative humidity is above 85% or otherwise outside the manufacturer's recommended level.

C. Do not paint when temperature of the substrate is outside of the manufacturers listed surface temperature requirement.

3.02 SURFACE PREPARATION PROCEDURES

A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting. Power-washing with a biodegradable degreaser is also acceptable.

B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the

weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

C. Remove sharp edges, burrs, and weld spatter.

D. Do not abrasive blast or prepare more surface area in 1 day than can be coated in 1 day; prepare surfaces and apply coatings the same day. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Prime all areas before rust bloom forms and within the same day.

E. Surface preparation shall conform to the SSPC and NACE Standards as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5/NACE No. 1
Commercial Blast Cleaning	SP-6/NACE No. 3
Brush-Off Blast Cleaning	SP-7/NACE No. 3
Pickling	SP-8
Near-White Blast Cleaning	SP-10/NACE No. 2
Power Tool Cleaning to Bare Metal	SP-11
High- and Ultra-High-Pressure Water Jetting	SP-12/NACE No. 5
Surface Preparation of Concrete	SP-13/NACE No. 6
Industrial Blast Cleaning	SP-14/NACE No. 8
Waterjet Cleaning of Metals – Clean to Bare Substrate	SP WJ-1
Waterjet Cleaning of Metals – Very Thorough Cleaning	SP WJ-2
Waterjet Cleaning of Metals – Thorough Cleaning	SP WJ-3
Waterjet Cleaning of Metals – Light Cleaning	SP WJ-4

F. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these Specifications or in the paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC, surface preparation specifications listed above.

G. *Brush-off blasting* of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.

H. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be angular and from 2.0 to 3.0 mils unless specified otherwise. Verify the surface profile by measuring with an impresser tape acceptable to the Owner’s

Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.

I. Do not apply any part of a coating system before the Owner's Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner's Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this Specification.

3.03 ABRASIVE BLAST CLEANING

A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.

B. After abrasive blast cleaning and before coating is applied, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting.

C. Apply the specified primer or touch-up coating within an 8-hour working day. Do not apply coating over damp or moist surfaces. Reclean any blast-cleaned surface not coated within the 8-hour period before applying primer or touch-up coating. If enough time has elapsed that a bare surface no longer meets the surface cleanliness requirement, that surface must be re-blasted until the surface cleanliness requirement is met.

D. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

E. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating so that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.04 PREPARATION OF CONCRETE AND MASONRY SURFACES TO BE COATED

A. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13/NACE No. 6 and the following.

B. Do not apply coating until concrete has cured at least 28 days at 75ºF. Finish concrete surfaces in accordance with Section 03301, Cast-In-Place Concrete. Do not use curing compound on surfaces that are to be coated.

C. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.

D. Detergent clean the concrete or masonry surface with Trisodium Phosphate in accordance with ASTM D4258. Then abrade or blast surfaces to the required surface profile. Floor slabs may be acid etched as specified in ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust and salts in accordance with ASTM D4258 or ASTM D4261. Use ICRI standards for concrete and masonry surface preparation.

E. All concrete which has been subjected to low-pH or acidic conditions must be confirmed to have a pH of 9 or greater prior to application of coatings. If the desired surface profile has been achieved without a minimum pH of 9, that surface shall be considered contaminated and in need of further abrasion or blasting.

F. Before coating concrete, plaster, and masonry that is below-grade, on-grade, or new, determine the presence of capillary moisture in accordance with ASTM D4263, except as modified below. Tape a 4-foot-by-4-foot sheet of polyethylene plastic to the concrete surface to be coated. Allow the plastic sheet to remain in place at least 24 hours. After the specified time has elapsed, remove the plastic sheet and visually examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. If moisture is indicated, allow additional curing time for the concrete and then retest. Provide one test sheet for every 500 square feet of concrete surface to be coated. For walls, provide one test sheet for each 10 feet (or fraction thereof) of vertical rise in all elevations starting within 12 inches of the floor or base slab.

G. Acceptance criteria for concrete surfaces shall be in accordance with SSPC SP-13, Table 1, “Severe Service” or this Section, whichever is more stringent.

H. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable or declining, not rising. Apply concrete coatings when the temperature is falling to reduce the potential of outgassing.

3.05 COATING STAINLESS STEEL, NONFERROUS, AND COPPER

A. Solvent clean in accordance with SSPC SP-1. Solvents and cleaning solutions shall contain less than 200 mg/l of halogens. Then abrasive blast to give a surface

profile of 2.0 to 3.0 mils. Refer to the coatings for the correct surface profile. Use coatings that are low in chloride content.

B. Do not apply inorganic zinc primers to stainless steel if such primers are specified in the painting system required. Apply only the intermediate and finish coats in such cases.

C. All surfaces must be primed as soon as possible on the same day following surface preparation.

3.06 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

A. After applying primer to surfaces, allow coating to cure for a minimum of 2 hours before handling to minimize damage.

B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless the ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.07 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of Trisodium Phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.

C. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by scrubbing with a stiff bristle brush.

D. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7/ NACE No. 4. Take care that the remaining primers are not damaged by the blast cleaning operation. The remaining primers shall be firmly bonded to the steel surfaces with blast-cleaned edges feathered.

E. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10/NACE No. 2. Take care that the remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared in accordance with SSPC SP-11. The remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

F. Use repair procedures on damaged primer that protect adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.

G. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

H. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer as specified in System No. 14 to cover scratches or abraded areas.

I. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.08 PAINTING SYSTEMS

A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

B. Deliver paints to the jobsite in the original, unopened containers.

3.09 PAINT STORAGE AND MIXING

A. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well ventilated, with precautionary measures

taken to prevent fire hazards. Post “No Smoking” signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use.

B. Store paint in accordance with the manufacturer’s latest written recommendations, or at an ambient temperature from 50ºF to 100ºF, whichever is more stringent.

C. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.10 PROCEDURES FOR THE APPLICATION OF COATINGS

A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner before mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility in working area before applying coating. Remove dust from coated surfaces by dusting, sweeping, and vacuuming before applying succeeding coats.

E. Apply coating systems to the specified minimum dry-film thicknesses as determined in accordance with SSPC PA-2.

F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Before applying coating, re-clean surfaces that have surface colored or become moist by blast cleaning.

G. Apply a brush coat of the specified primer on welds, sharp edges, nuts, bolts, and irregular surfaces before applying the prime coat. Apply the brush coat before and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.

I. Each coat shall cover the surface of the preceding coat completely and there shall be a visually perceptible difference in applied shade or tint of colors.

J. Applied coating systems shall be cured at 75ºF or higher for 48 hours. If temperature is lower than 75ºF, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.

K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

3.11 SURFACES NOT TO BE COATED

A. Do not paint the surfaces listed below unless otherwise noted in the drawings or in other Specification sections. Protect the following surfaces during the painting of adjacent areas:

1. Concrete walkways.
2. Mortar-coated pipe and fittings.
3. Stainless steel.
4. Metal letters.
5. Glass.
6. Roofing.
7. Fencing.
8. Copper tubing, red brass piping, and unexposed PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.
9. Electrical fixtures except for factory coatings.
10. Nameplates.

11. Grease fittings.
12. Brass and copper.
13. Buried pipe, unless specifically required in the piping specifications.
14. Fiberglass items, unless specifically required in the FRP specifications.
15. Aluminum handrail, stairs, and grating.
16. Insulated pipe.

3.12 PROTECTION OF SURFACES NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.13 SURFACES TO BE COATED

A. The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below:

1. Coat aboveground and exposed piping or piping in vaults and structures as described below. The color of the finish coat shall be as shown below.

Piping Designation	Color of Finish Coat
Stormwater Piping	Green with “Stormwater” stenciling

2. Coat submerged ductile iron piping and piping in wet wells as specified in System No. 2.

3. Coat valves as described the same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.

4. Coat aluminum surfaces in contact with concrete as specified in System No. 61.

5. Coat buried bolt threads, tie bolt threads, and nuts as specified in System No. 22.

3.14 DRY-FILM THICKNESS TESTING

A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, aluminum, and copper surfaces with an eddy-current type thickness gauge in accordance with ASTM D7091. Provide certification that the gauge has been calibrated by a certified laboratory within the past 6 months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

B. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past 6 months. Provide detector as manufactured by Tinker and Rasor, K-D Bird Dog, or similar. Test using voltages recommended by the coating manufacturer.

C. If the Owner's representative suspects low film thickness, the coating thickness for concrete or masonry surfaces may be measured in accordance with ASTM D4138 (tooke gauge). Use of a "tooke" gauge is classified as a destructive test. Before performing any destructive tests on a newly applied coating system, the Owner and Contractor shall determine which of them is responsible for the cost of repairing the damaged coatings.

D. For severe environments, test the finish coat of concrete and masonry surfaces in accordance with NACE SP0188 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

E. Check each coat for the correct dry-film thickness. Do not measure within 8 hours after application of the coating.

F. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80% nor more than 120% of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

G. Perform tests in the presence of the Owner's Representative.

3.15 REPAIR OF IMPROPERLY COATED SURFACES

A. If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish the coat in accordance with the Specifications. The work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.16 CLEANING

A. During the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.

B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.

C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

DIVISION 11

EQUIPMENT

SECTION 11000
GENERAL EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general work requirements regarding the products and execution services that are specified in the Division 11 Sections incorporated in the Contract Documents. The requirements specified shall apply to all of the Division 11 Sections, unless noted otherwise.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. The submittal contents for equipment, instrumentation, controls, and appurtenances specified in the Division 11 Sections shall contain the general information listed below. Additional submittal requirements are contained in the Division 11 Sections.

1. A list and description of all deviations from the Contract Documents.
2. A list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.
3. Completely dimensioned plans, elevations, and cross-sections of system equipment and sub-assemblies.
4. Shop and erection drawings showing details, anchor bolt locations, and field connections.
5. Manufacturers' equipment installation instructions.
6. Descriptive literature, technical bulletins, and catalog data sheets for all equipment and purchased sub-components.
7. Installation, operation, maintenance and start-up procedures.
8. Submit to the Owner a plan for pre-startup testing, start-up testing, and performance testing for review and comments 21 calendar days before pre-startup.
9. Total equipment weight (while operating).
10. Drive mechanism torque rating and bearing life rating.
11. Motor data and catalog information.
12. Submit complete electrical drawings, schematics, and interconnecting wiring diagrams and schedules for the equipment control system, instrumentation, and control panel(s) showing numbered wiring terminals

in the control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.

13. Control panel construction and panel layout drawings.
14. Complete technical literature for all factory-applied paint systems. Clearly indicate the components to be coated and the corresponding paint system.
15. Manufacturers' descriptive literature, product specifications, and published details.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS-1—Industrial Control and Systems: General Requirements.

1.04 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: The Contractor shall comply with construction requirements of State, County, and other local political subdivision specifications as may exceed the requirements of the codes, standards, and approving bodies referenced in this Section.

1. NFPA Standards: The Contractor shall comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections and as directly appropriate to the work and workmanship.
2. Electrical Requirements: The Contractor shall comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the NEMA Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.

B. Certificates and Permits: Upon completion of work and before final payment, the Contractor shall furnish to the Owner formal certification of final inspections from authorities having jurisdiction over the work in this project and secure required permits, if any, from such authorities. Additionally, the Contractor shall prepare any detailed diagrams and drawings that are required by those authorities having jurisdiction over the work of this project at no additional cost to the Owner.

C. Source Quality Control: Products used throughout these Specifications and as indicated on the Drawings shall be from companies having established reputations in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make or products of others for which they assume full responsibility when used in finished products which are not manufactured completely by them and with replacement parts available.

D. Products: The equipment specified in the Division 11 Sections was based on the latest models that were available from the specified equipment manufacturers at the time the Contract Documents were developed. If any equipment models specified in the Division 11 Sections have been discontinued or will be discontinued within 1 year after the bid date, the Contractor shall furnish and install the latest and most recent equipment model at no additional cost to the Owner.

E. For each category of materials and equipment (Products) specified in the Division 11 Sections, the Contractor shall provide Products of the same manufacturer and type.

F. Equipment Selection: The Contractor may furnish equipment of higher electrical characteristics, physical dimensions, capacities, and ratings provided such proposed equipment is approved by the Owner in writing. Upon receiving the Owner's approval to provide such equipment, the Contractor shall furnish the connecting mechanical and electrical services including but not limited to circuit breakers, conduit, increased control panel enclosure size, motors, bases, and any other electrical equipment needed to accommodate the higher electrical characteristics at no additional cost to the Owner.

G. If minimum energy ratings or efficiencies of equipment are specified in Division 11, Equipment, the Contractor shall furnish and install equipment that meets or exceeds the specified design and commissioning requirements (no exceptions) as determined by the Owner.

H. All the equipment specified in the Contract Documents shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed.

1.05 QUALIFICATIONS

A. The manufacturer of each piece of equipment described in the Division 11 Sections shall meet the following requirements, unless noted otherwise:

1. Have a record of operation, manufacturing and servicing the items specified in the Division 11 Sections for a minimum of 10 years before the Bid Date.
2. Have a minimum of five installations of equipment similar to that specified in this Section at municipal wastewater treatment facilities in Florida before the bid date.
3. Have been in business for at least the 10 consecutive years before the Bid Date.

B. If the equipment manufacturer that the Contractor proposes to furnish and install the equipment described in the Division 11 Sections does not meet these qualifications and is not specified in the Contract Documents, the Owner reserves the right to reject the equipment from this manufacturer for use on this project. Any costs incurred by the Contractor as a result of providing equipment from a manufacturer that does not meet the qualifications described in this Section shall not be incurred by the Owner.

C. The Contractor shall furnish documentation that the manufacturer meets these qualifications as part of the submittals specified in Section 01330, Submittals and Acceptance.

1.06 MAINTENANCE

A. Spare Parts

1. The Contractor shall furnish the spare parts specified in the Division 11 Sections. The Contractor shall also submit a list of recommended spare parts, special tools, and lubricants for each equipment item. The list shall include contact information for local sources for supply of all parts and professional service.

PART 2 PRODUCTS

2.01 MOTORS

A. All motors identified in Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Division 16, Electrical.

2.02 CONTROLS

A. General

1. All control panels specified in the Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Division 16, Electrical, as applicable.

2. The Contractor shall furnish and install controls designed to operate on 120-volt, single-phase, 60 Hertz electric service unless otherwise specified. The Contractor shall furnish and install 120-volt step-down voltage transformers as specified in Division 16, Electrical, in each control panel as required.

3. The Contractor shall furnish and install elapsed time meters in each control panel for each piece of motor-driven equipment being controlled by that control panel. All elapsed-time meters shall be furnished and installed in accordance with Division 16, Electrical.

4. All control panels shall be furnished with a main circuit breaker to enable/disable electric service to the panelboard.

5. All control panels that will annunciate a local and/or remote alarm shall be furnished with an ALARM ACKNOWLEDGE reset pushbutton switch (momentary contact) wired to each alarm contact.

6. All indicating lamps in each control panel shall be furnished in accordance with the color-coded scheme:

    a. ON indicating lamps: Red.
    b. OFF indicating lamps: Green.
    c. Alarm indicating lamps: Amber.
    d. POWER ON indicating lamp: White.

7. Provide a heater inside of each control panel enclosure to prevent condensation. Heater size shall be in accordance with the equipment manufacturer’s recommendations.

8. The face of each control panel shall be installed so it is facing north whenever possible, or provided with a sunshield when not possible.

2.03 FLOAT SWITCHES

A. Unless specified elsewhere, float switches shall be of the suspended type with polypropylene or PVC body. Units shall have an integral electrical cable with two #19 AWG stranded conductors. Switches shall be pilot duty, normally open or normally closed, as required for application. Switches shall be suitable for use with intrinsically safe circuits. Each switch shall be supported from an AISI Type 316 stainless steel cable support bracket with individual stainless steel Kellems grip strain relief supports. Each switch shall be provided with sufficient cable length to extend from the float switch to the final termination point at the pump control panel with an additional 18 inches of looped cable. The float switch cables shall be bundled to an AISI Type 316 stainless steel cable with heavy-duty nylon strap wire ties. The upper end of the stainless steel cable shall be attached to the cable support bracket and the lower end attached to a 5-pound (minimum) cable weight. The cable weight shall be firmly attached to the cable and shall be constructed of noncorrosive metal and/or materials. Float switches and cables shall be intrinsically safe when used in classified locations.

2.04 EQUIPMENT ANCHORING SYSTEMS

A. All anchoring systems including, but not limited to, expansion anchors, adhesive anchors, anchor bolts, cinch anchors, and screws that are required to install the equipment and appurtenances specified in the Division 11 Sections shall be AISI Type 316 stainless steel unless noted otherwise. The Contractor shall furnish and install all equipment anchoring systems in accordance with the equipment manufacturer's installation instructions and Divisions 3 and 5 as applicable.

2.05 EQUIPMENT NAMEPLATES

A. The Contractor shall provide engraved laminated phenolic nameplates with white legend and black field that provides the following information for each piece of equipment described in the Division 11 Sections.

1. Equipment Description (i.e., Submersible Pump No. 1, etc.).
2. Equipment Identification Label No.

B. Letter height on each nameplate shall not be less than 3/4-inch. Nameplates shall be factory drilled for fasteners. Secure nameplates to equipment or nearby wall using AISI Type 304 stainless steel fasteners. The locations of each nameplate shall be coordinated with the Owner and approved by the Owner before their installation.

C. The Contractor shall obtain the Owner's approval for the nameplate information for each equipment item described in the Division 11 Sections before ordering these nameplates from the manufacturer.

2.06 PRESSURE GAUGE ASSEMBLIES – PUMPING UNITS

A. General: The Contractor shall provide a pressure gauge assembly as specified in Section 15125, Piping Appurtenances, on the discharge piping of the pumping units specified in the Division 11 Sections. The intent of the Drawings is not to show the locations of every pumping unit pressure gauge. Rather, the Contractor shall mount each pressure gauge as close to the pump discharge connections as possible, but so as not to impede the operation and maintenance of the pressure gauge assembly, pumping unit, and valves installed on the pumping unit suction and discharge piping. Coordinate the location of all pressure gauge assemblies with the Owner before installation.

2.07 PRESSURE GAUGE ASSEMBLIES – PUMPING UNITS

A. The Contractor shall provide a sluice gate assembly as specified in Section 15065, Fabricated Gates, on the inflow of the West Pump Station wet well as specified in the Division 11 Sections. The intent of the Drawings is not to show the exact placement of the sluice gate. Rather, the Contractor shall mount the sluice gate assembly according to the manufacturer's specification so that the sluice gate assembly meets the performance specifications of Section 15065, Fabricated Gates. Coordinate the location of the sluice gate assembly with the Owner and Engineer before installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: The Contractor shall install the equipment in accordance with the manufacturer's instructions, recommendations and approved submittals at the locations shown on the Drawings. If the equipment locations shown on the Drawings are in conflict with the manufacturer's recommendations or will interfere with the installation or operation of any other item indicated in the Contract Documents, the Contractor shall relocate this equipment and provide the necessary appurtenances to install the equipment in accordance with the manufacturer's recommendations at no additional cost to the Owner. The Contractor shall not install any equipment at locations not in accordance with the Contract Documents or approved submittals.

B. The Contractor shall install equipment, slabs, walls level and plumb, parallel and perpendicular to other building and components in exposed interior spaces, unless otherwise shown on the Drawings.

C. The Contractor shall apply an anti-seize compound to threaded fasteners of equipment components that require removal, replacement, or adjustment as part of any maintenance or inspection procedure.

D. The Contractor shall furnish and install the required oil and grease for initial operation in accordance with the manufacturer's recommendations.

E. Provide means of oil lubrication for bearings and other metallic parts in sliding contact. Use alemite industrial-type fittings except where otherwise specified. The Contractor shall also perform the following work:

1. Locate lubrication points on equipment readily accessible without the necessity of removing covers, plates, housings, or guards, or without creating safety hazards at installed equipment elevations.
2. The Contractor shall exhaust pressure-lubricated units to the atmosphere to prevent excessive greasing.
3. The Contractor shall extend grease fittings to locations that are readily accessible to the Owner. The Contractor shall coordinate the location of these grease fittings with the Owner before their installation.

F. The Contractor shall furnish and apply touch-up paint to any equipment's factory painting finish that is chipped or damaged during installation. All factory-finish touch-up paint shall be mutually compatible with the factory finish on the equipment and shall be furnished by the manufacturer of the equipment to be touched up in the field.

G. If equipment mounting heights are not shown on the Drawings, the Contractor shall install that piece of equipment to provide the maximum amount of headroom (defined as the distance from the bottom of the structure to the top of finished floor or grade), as possible. In such an instance, the Contractor shall obtain the Owner's approval for this mounting location before installing that piece of equipment in the field.

H. The Contractor shall furnish and install all mechanical equipment to facilitate service, maintenance, and repair or replacement of the equipment components. The Contractor shall connect equipment for ease of disconnecting, with minimum interference to other installations.

3.02 FIELD TESTING

A. General: The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally consist of performing the pre-startup and startup tests as specified in the Division 11 Sections and the final mechanical performance test specified in this Section. The Contract Documents may require the Contractor to perform factory testing on equipment items before the Owner approves their use for this project. The Contractor shall refer to the Division 11 Sections regarding equipment shop testing requirements.

B. The Contractor shall adhere to the following requirements regarding the field testing to be provided for this project:

1. The service representative shall be employed by the manufacturer of the equipment specified at the time field testing is being performed. The service representative shall be authorized by the factory to perform the field testing specified in Division 11, Equipment. Upon request by the Owner, the Contractor shall submit a letter from a company officer of the equipment manufacturer stating that the service representative performing the field testing is authorized by the manufacturer.
2. Before scheduling each field test with the equipment manufacturer, the Contractor shall coordinate with the Owner to obtain a list of dates that the Owner would be available to attend the testing. The Contractor shall submit a plan for the pre-startup testing, start-up testing, and performance testing at least 21 calendar days before pre-startup.
3. If directed by the Owner, the Contractor shall perform a second pre-startup and/or startup test, in accordance with the procedures specified in the Division 11 Sections, at no additional cost to the Owner if the original pre-startup and/or startup test did not pass because of any work that was deemed by the Owner to be non-compliant with the Contract Documents and/or manufacturer's recommendations.
4. The Contractor shall only perform startup testing after the Contractor has reached Substantial Completion for the project as defined in the Agreement and General Conditions.
5. The Contractor shall furnish, install, and remove any temporary piping, valves, appurtenances, and equipment necessary to perform the pre-startup and startup testing to the Owner's satisfaction.
6. All field testing shall be performed Monday through Friday at the project site, unless otherwise approved by the Owner.
7. The duration that the manufacturer's representative is required to be onsite to perform the pre-startup and startup training is specified in the Division 11 Sections.

C. Operating Costs

1. Costs for Pre-startup and Startup Testing: The Contractor shall include in the Contract Price the following operating costs for satisfactorily completing the Initial Performance Tests on equipment being tested:

    a. Lubricating grease.
    b. Lubricating oils.
    c. Such other materials or utilities not specifically identified in this Section, but required to conduct the pre-startup and startup testing.
    d. Portable diesel power generation sets and diesel fuel as needed for lighting, portable tools, and furnishing electrical to any temporary pumping units used to transfer potable water, reclaimed water, or stormwater to each structure for startup testing.

2. Costs for Final Performance Tests: The Owner will pay for the operating costs for the Final Performance Test, except for the Contractor's personnel needed to perform and supervise this testing as specified in this Section.

D. The intent of the field testing for each equipment item specified in the Division 11 Sections is provided in this Section. If the individual equipment field testing procedures specified in the Division 11 Sections are not sufficient to obtain a Manufacturer's Certification or to demonstrate compliance with the Contract Documents, the Contractor shall perform these additional field test procedures at no additional cost to the Owner.

1. Pre-startup Testing: Upon the Contractor's completion of the installation and adjustment of the equipment; the Contractor, with his own forces and with the manufacturer's representative(s), shall demonstrate to the Owner's satisfaction that the equipment has been furnished and installed in accordance with the Contract Documents and the manufacturer's recommendations.

    a. The Contractor shall repair any equipment items that do not pass the pre-startup test, as identified by the Owner and/or manufacturer's representative, to the satisfaction of the Owner before performing the startup testing for that equipment.

2. Startup Testing: Upon successful completion of the pre-startup testing, the Contractor shall demonstrate that the mechanical performance and controls of each equipment item, when operated in accordance with the design intent indicated by the Contract Documents, are satisfactory to the Owner.

a. Startup testing shall be performed with each equipment item and associated treatment structure simulated under similar operating conditions as the final mechanical performance testing specified in this Section. For equipment that will operate while being submerged as shown on the Drawings, the Contractor shall fill the respective treatment structure to its maximum water surface with reclaimed water for wastewater systems, potable water for water systems, or surface water for stormwater systems, and perform startup testing while that equipment is submerged. The Contractor shall not use wastewater to fill any treatment structures for startup testing.

b. After the startup testing procedures specified in the Division 11 Sections have been completed to the satisfaction of the Owner, the Contractor shall operate that equipment for one successful continuous 72-hour period without assistance from the Owner as a condition of startup testing. If the equipment needs to be taken out of service for repair during this 72-hour period because it not operating in accordance with the intent of the Contract Documents, this operating period shall cease. A new operating period will not begin until the equipment has been operating in accordance with the Contract Documents and manufacturer's recommendations for at least 72 consecutive hours. The Contractor shall furnish any additional supervision or provisions necessary to verify that each equipment item was successfully operated during this 72-hour operating period.

c. Upon completion of the startup test, the Contractor shall dewater each treatment and storage structure in accordance with local and State regulations and in a manner that is satisfactory to the Owner.

3. Final Mechanical Performance Testing: The Contractor shall perform final mechanical performance testing of the equipment specified in the Division 11 Sections once the following conditions have been satisfied:

a. The Contractor has successfully completed the pre-startup and startup testing requirements specified in the Division 11 Sections.

b. The Contractor has performed the training services specified in this Section.

c. The Contractor has procured all of the required permits for each building and treatment structure within the project site.

d. The Owner has received and approved all of the manufacturer's certifications of compliance, warranties, and O&M manuals for all required items as specified in the Contract Documents.

e. The intent of the final mechanical performance test is for the entire facility to be operated by the Owner for a continuous 30-day period while the facility is receiving and treating raw sewage or raw water. During this 30-day testing period the Contractor shall furnish personnel who shall be on-site as needed and available at all times 24 hours per day during the final mechanical performance test. Personnel shall be competent in the troubleshooting and repair of the equipment and related electrical and mechanical systems specified in the Contract Documents. The Contractor's electricians and mechanical technicians shall be on-site as needed (minimum 8 hours/week) and available 24 hours per day to assist with this testing. If the final mechanical performance testing needs to be stopped and suspended due to equipment not operating in accordance with the design intent of the Contract Documents as determined by the Owner, the following conditions shall apply:

   (1) The Contractor shall repair and troubleshoot these items immediately at no additional cost to the Owner.
   (2) The 30-day period for the final mechanical performance testing will start over (i.e., be reset to zero hours).

f. Upon restarting the final mechanical performance testing, the Contractor shall furnish the appropriate personnel defined above on-site as needed and available (minimum 8 hours/week) for 24 hours per day during the 30-day period at no additional cost to the Owner even though the total duration of the final mechanical performance testing (including restarts), may exceed 30 days.

g. The final mechanical performance test shall end when the Owner determines that all of the equipment and related systems are operating in accordance with the design intent of the Contract Documents and all deficiencies that hinder the normal day-to-day operation of the facility have been corrected to the satisfaction of the Owner. The Owner shall notify the Contractor in writing when the final mechanical performance testing has been successfully completed.

3.03 TRAINING SERVICES

A. Upon completion of the pre-startup and startup testing and before the final mechanical performance testing, the manufacturer of the equipment specified in the Division 11 and 15 Sections shall provide an authorized representative to train the Owner’s personnel in the operation and maintenance of the equipment. The representative shall provide additional onsite startup and troubleshooting services during this training upon request by the Owner while performing these training services. The duration of the training services for each equipment item are specified in the Division 11 Sections.

3.04 MANUFACTURER’S CERTIFICATIONS OF COMPLIANCE

A. Upon successful completion of the pre-startup testing, startup testing, and training services specified in this Section, the Contractor shall obtain the equipment manufacturer's certification that the equipment specified in the respective Division 11 Sections has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations. The Contractor shall furnish the Owner with Manufacturer's Certificates of Compliance and Equipment Manufacturer’s Certificate of Installation Testing and Instruction for each specified equipment item before performing the final mechanical performance testing specified in this Section.

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

_____ Installed in accordance with Manufacturer's recommendations.

_____ Inspected, checked, and adjusted.

_____ Serviced with proper initial lubricants.

_____ Electrical and mechanical connection meet quality and safety standards.

_____ All applicable safety equipment has been properly installed.

_____ System has been performance tested, and meets or exceeds specified performance requirements (when complete system of one manufacturer).

Comments: _____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment, and (iii) authorize the make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION

OWNER _____

PROJECT _____

CONTRACT NO. _____

Jones Edmunds No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

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

Installed for the subject project has have been installed in a satisfactory manner, has have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date:

_____ Time: _____.

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

OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

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

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

END OF SECTION

SECTION 11280
PNEUMATIC CONTROL GATE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the design and fabrication requirements for a pneumatic control gate and appurtenances for control of water in M-1 Canal, as well as a portable cofferdam system for long-term Owner maintenance of the system.

B. Items to be supplied by the pneumatic control gate supplier include (but are not limited to) the following:

1. Stainless steel pneumatic control gate panel(s) and rib(s).
2. Polyester reinforced air bladders for above gates and associated piping components to attach to the Contractor-supplied main air piping.
3. Reinforced rubber interpanel seals and stainless steel attachment hardware.
4. Pneumatic control gate clamping hardware and stainless steel anchor bolts, nuts, and washers.
5. Reinforced rubber restraining straps and stainless steel attachment hardware.
6. Knappe breakers and stainless steel attachment hardware.
7. Ultra-high molecular weight (UHMW) polyethylene abutment plates.
8. Mechanical control cabinet complete and ready for installation. NEMA 4, free-standing green powder-coated, stainless steel with associate air exhaust value and silencer.
9. Air compressor and receiver tank complete and ready for installation.
10. Outdoor enclosure, free-standing, green powder-coated, stainless steel.
11. Anchor bolt setting template.
12. Installation supervision and training by manufacturer’s technician as outlined in proposal.

C. Items to be supplied by the Contractor for long-term maintenance include:

1. Portable cofferdam system for long-term Owner maintenance of the pneumatic weir gate system.

D. Work to be performed by the Contractor:

1. Verify conditions.
2. Any required concrete work or civil modifications.

3. Air supply pipe and installation of same.
4. Install anchor bolts.
5. Install the pneumatic control gate system including air bladders, gate panels, and other related components.
6. Provide and install all air piping and supports.
7. Install abutment plates including any needed grouting.
8. Install all pneumatic control gate control equipment.
9. Install all mechanical equipment in accordance with original manufacturer's specification.
10. Start-up, debug, and test pneumatic control gate in conjunction with manufacturer.
11. Provide Neversieze or other approved lubricating compound for all stainless steel anchor bolts and fasteners.
12. Provide 100-percent silicone caulk for all interpanel seals.
13. Provide and install condensate purge valves in mechanical cabinet with a condensate drain to the ground outside the cabinet.

1.02 SUBMITTALS

A. The Contractor shall submit a list of qualifying projects in accordance with Article 1.06 of this Section.

B. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

C. The Contractor shall submit warranty information for all equipment in accordance with Section 01780, Warranties and Bonds. This equipment includes, but is not limited to:

1. Pneumatic Control Gate.
2. Mechanical Cabinet.
3. Air Compressor and Receiving Tank.
4. Exhaust Valve and Silencer.
5. Portable Cofferdam System.

D. Shop Drawings: The Contractor shall submit integrated shop drawings for the pneumatic control gate system illustrating the mechanical and electrical equipment and components specified in this Section and including the following:

1. Product Data: For each mechanical, structural, and electrical component include the manufacturer's descriptive literature, product specifications, published details, technical bulletins, performance with design conditions clearly noted, charts, and schedules, catalog data sheets, and other

submittal materials as required to verify that the proposed products conform to the quality and function of the specified products.

a. Identification: Clearly indicate by an arrow on submissions covering more than one product type or style exactly which product is being submitted for approval.
b. Equipment Characteristics: Provide bearing ratings, complete motor data, service factors, shaft diameters, coupling type, and weights of principal parts and assembled equipment.
c. Manufacturer: Include the catalog name, company name, address, and telephone number for the manufacturer of each product submitted.

2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross-sections of system equipment and sub-assemblies.

3. Layout Drawings: Submit completely dimensioned drawing of weir base, anchor bolt size and patterns, installation notes, and other pertinent setting details.

4. Product List: Provide a list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.

5. Wiring Diagrams: Submit complete interconnecting wiring diagrams and schedules for electrical apparatus showing numbered wiring terminals in the weir control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.

6. Control Panel Drawing: Submit a dimensioned drawing of the control panel indicating the primary electrical components and panel face with control devices, lights, indicators, and other panel-face-mounted apparatus located and identified. Provide an internal face view of the equipment arrangement with equipment identified.

7. Additional Requirements: See Division 13, Special Construction, for additional submittal requirements for the control panel furnished under this Section and specified below.

8. Operations and Maintenance Manuals: Submit four preliminary copies before the equipment arrives at the site.

9. Installation Certificate: Submit an installation certificate from the manufacturer.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Institute of Steel Construction (AISC)

1. Manual of Steel Construction Allowable Stress Design

B. American Society for Testing and Materials (ASTM)

1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A313/A313M—Standard Specification for Stainless Steel Spring Wire.
5. ASTM A572/A572M—Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
6. ASTM C501—Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
7. ASTM D751—Standard Test Methods for Coated Fabrics.
8. ASTM D1149—Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment.
9. ASTM D2000—Standard Classification System for Rubber Products in Automotive Applications.

C. American Welding Society (AWS)

1. AWS D1.1/D1.1M—Structural Welding Code – Steel.

1.04 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

B. The pneumatic control gate furnished shall be guaranteed to be free from defects for a warranty period of 60 months starting at the date of the final acceptance. During this warranty period, the manufacturer shall adjust, repair, or replace all

defective material and workmanship without additional cost to the Owner within 30 days of the receipt of a notice from the Owner regarding defective components, material, or workmanship.

C. The equipment, other that the pneumatic control gate, specified in this Section shall be guaranteed to be free from defects for a warranty period of 24 months from the date of the final acceptance. If the guarantees are not met, the manufacturer, upon notice from the Owner, shall immediately make changes to the equipment so that performance as guaranteed is obtained, without additional cost to the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.06 QUALIFICATIONS

A. Manufacturer shall submit certification, prior to the start of work, that the pneumatic control gate system has been successfully used on a minimum of three similar projects (e.g., flow, velocity, water elevation). The project list shall include:

1. Project name, location, contact name, phone number, and email address.

B. Installation Contractor shall submit a list of three previously constructed successful projects of similar size and magnitude and using a pneumatic control gate by the same manufacturer. The project list shall include:

1. Project name, location, contact name, phone number, and email address.

1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. O&M manuals shall be in accordance with Section 01830, Operations and Maintenance Manuals.

B. Functional description of the pneumatic control gate system for each mode of operation of equipment.

C. Automatic and manual operation.

D. Alarms and fail-safe features.

E. Interlocked and/or interfaced equipment operation and control.

F. Comprehensive parts and materials maintenance and repair list for each equipment element indicating the manufacturer and the manufacturer's identification number. Include the name, address, and telephone number of local sales and service office for major equipment items.

G. Schedules of recommended spare parts to be stocked, including part number, inventory quantity, and ordering information.

H. Performance rating and nameplate data for each major system component.

I. Procedures for starting, operating, adjusting, calibrating, testing, and shutting down system equipment.

J. Emergency operating instructions and trouble-shooting guide.

K. Schedule of routine maintenance requirements and procedures and preventative maintenance instructions required to ensure satisfactory performance and equipment longevity.

L. Maintenance instructions for extended out-of-service periods.

M. Schedule of lubrication requirements, including lubricant type, service interval, and lubrication points.

N. Field-verified power and control wiring schematics. Submit the approved schematics in each manual. After initial start-up and operation, correct these schematics to reflect any required field changes and submit the required copies for inclusion in the manuals.

O. O&M manuals for the portable cofferdam system for long-term maintenance.

P. Four preliminary copies of the O&M manuals shall be submitted before the equipment arrives at the site. The Contractor shall not be compensated for the equipment until the preliminary O&M manuals are received. Four copies of the final O&M manuals shall incorporate the Owner’s comments and be submitted with copies of the approved shop drawings and test reports.

Q. Installation Certificate: Submit a certificate from the manufacturer or from the manufacturer's qualified, factory-authorized representative for each equipment item furnished and installed and specified in this Section stating that the equipment has been installed, inspected, and adjusted as required in accordance

with the manufacturer's written installation procedures and operating instructions and is ready for

1.08 SPECIAL CONSIDERATIONS

A. The structural design and configuration of the pneumatic control gate shown on the Drawings is based on the equipment supplied by Obermeyer Hydro. If an alternate system is bid by the Contractor, the Contractor shall make all changes needed at no cost to the Owner. The Contractor shall coordinate the change with the pneumatic control gate manufacturer for design modifications required before the bid. All additional costs resulting from alternate system, including but not limited to structural, mechanical, civil and or electrical changes or revisions to the Drawings, shall be the sole responsibility of the Contractor.

PART 2 PRODUCTS

2.01 GATES

A. Pneumatic Crest Gate

1. Obermeyer Hydro.
2. Or Owner-approved equal.

B. The pneumatic control gate system, including gate panels, air bladders, air supply components, abutment plates, controls, and associated appurtenances shall be furnished by the pneumatic control gate supplier unless otherwise indicated. The pneumatic control gate shall be installed by the Installation Contractor.

C. The pneumatic control crest gates shall consist of a stainless steel gate panel attached to the spillway crest by an elastomeric hinge and an air bladder mounted between the hinged gate and the spillway crest. The hinge shall be anchored using stainless steel anchor bolts. The elastomeric hinge shall allow the pneumatic control gate to operate through a range from fully raised to fully lowered. Rubber-wiper-type abutment seals shall be provided to allow a watertight seal across the full range of gate motion. Pneumatic air control lines (supplied by the Contractor) to and from the gates shall be manufactured from stainless steel.

D. The pneumatic control gates shall be specifically designed for this project. The gates shall be designed for a top of gate elevation as shown on the construction drawings. The gates shall be designed for 12 inches of overtopping in the raised position.

E. The pneumatic control gate shall operate within the ambient temperature range of -40ºF to +120ºF.

F. The pneumatic control gate system shall be capable of withstanding impact from floating logs and debris and shall have a minimum gate steel thickness of 1/2 inch.

G. The pneumatic control gate system shall be designed to operate in both a fully raised and a partially raised position for extended periods of overtopping without experiencing significant oscillation, adverse flow conditions, or wear.

H. The pneumatic control gate system shall be anchored to the concrete spillway crest. The anchor bolt allowable shear and tension stresses for attachment to the concrete shall not exceed that recommended by the anchor bolt manufacturer. The pneumatic control gate system manufacturer shall include the design loads for the anchor bolts in their submittal.

I. The gap between adjacent gates shall be sealed by a rubber web clamped to each gate panel and made of polyester reinforced rubber. The leakage rate shall not exceed 0.20 gpm/ft of periphery.

J. The pneumatic control gate system shall be designed, manufactured, and installed so as not to cause binding or damage to component parts of the system.

K. A stainless steel abutment plate shall be supplied and installed at each concrete abutment. The abutment plate will provide a flat vertical sealing surface for the pneumatic control gate system.

L. A restraining strap shall be incorporated to limit the upstream travel of the gate and to define the maximum gate height.

2.02 PNEUMATIC CONTROL GATE CONTROL EQUIPMENT

A. The control system shall be supplied by the pneumatic control gate manufacturer and installed by the Contractor. The control system shall consist of an ACC (mechanical cabinet) located in accordance with Contract Drawings.

B. The ACC cabinet shall contain the manual inflate and deflate ball valves, pressure regulator, and other mechanical hardware required for controlling a single zone of pneumatic control gate.

C. An ASME stamped pressure relief valve shall be incorporated into the control system to protect the air bladders from overpressurization. The pressure relief valve shall be set at a pressure no more than 15-percent higher than maximum operating pressure.

D. The ACC equipment shall be mounted in a NEMA 4 rated electrical enclosures with size sufficient for easy installation and maintenance of said equipment.

2.03 STEEL

A. The stainless steel gate panels, hinge retainers, splitters, and restraining strap clamps shall be manufactured from 304 SST or Owner-approved equal.

B. All threaded fasteners including anchor bolts shall be from Type 304 stainless steel or Owner-approved equal.

C. All welded stainless steel components shall be passivated by stainless steel wire wheel or by acid.

D. All steel components to be designed so that the maximum stress level in each component is less than 40 percent of yield strength and less than 25 percent of ultimate strength.

2.04 AIR BLADDERS

A. The working pressure for the air bladder and controls shall not exceed 35 pounds per square inch.

B. The material for the air bladder shall be reinforced with no less than two layers of 1000/3/3 or 1500/2/3 polyester bias ply fabric. The polyester bias ply fabric shall have a minimum tensile strength of 2,080 lb/linear inch.

C. The outer rubber cover shall meet or exceed ASTM D2000.

D. The air bladder material shall have a minimum thickness of 0.3125 inch as measured in accordance with ASTM D751.

E. An abrasion test using an H18 stone with a 2.2 pound load for 1,000 repetitions as modified from ASTM C501 shall show less than 0.03 cubic inch of abrasion.

F. An ozone test shall show no abnormality in appearance when subjected to an ozone test conducted as 100mPa, 104 degrees Fahrenheit, and 50 percent elongation, in accordance with ASTM D1149.

G. The adhesion between the polyester reinforcement and the rubber shall be a minimum of 50 pounds per inch before aging and a minimum of 36 pounds per inch after aging in 158 degrees Fahrenheit for 96 hours.

2.05 AIR PIPING

A. The air supply piping between the control system mechanical cabinet and of the gates shall be Type 304 stainless steel 2-inch Schedule 10 pipe conforming to ASTM A313/A313M or Owner-approved substitute.

B. The Contractor shall provide all piping up to and including 2-inch-x-0.5-inch hex bushing at the connection to each air bladder. Gate system manufacturer shall provide connection hardware between 2-inch-x-0.5-inch hex bushing and air bladder.

C. The Contractor shall provide means of removing condensate from air line at the low point of air pipe system or at the mechanical cabinet.

D. Any exposed portions of the piping shall be securely supported on 6-foot centers using 14 gauge galvanized steel unistrut. A minimum of two 0.5-inch stainless steel epoxy-type anchor bolts per 6-foot section shall be used to mount unistrut.

E. All air piping shall use welded fittings. All welding shall be in accordance with AWS D1.1/D1.1M. All pipe joints shall be leak-proof.

F. Before the gate system is installed, the entire run of pipe and connections shall be inspected and pressure tested to 50 psi gauge and each joint checked for leaks in the presence of the Owner's representative.

2.06 AIR SUPPLY SYSTEM

A. The pneumatic control gate system manufacturer shall supply the compressed air supply system that is factory-assembled, tested, and ready for connection into the pneumatic control gates.

B. The air supply system shall be an Ingersoll Rand model R4iTAS, 5-hp, with an integrated air dryer housed in an outdoor enclosure.

C. The air supply system shall inflate the gates to operating pressure in less than 60 minutes.

2.07 CONTROL SYSTEM

A. The pneumatic control gate system manufacturer shall supply the control system that is factory-assembled, tested, and ready for connection into compressed air supply. The control system shall be packaged in one mechanical cabinet.

B. The mechanical cabinet shall include the inflate and deflate ball valves along with pressure regulator, pressure gauges, and other equipment required for gate operation.

C. The control cabinets shall be a NEMA 4 rated cabinet. Each enclosure will be sized for easy maintenance of all equipment.

D. The Contractor shall be responsible for providing and installing all external piping between control system components.

E. The pneumatic control gate system shall communicate via telemetry to the St. Johns River Water Management District (SJRWMD). Telemetry shall be compatible with SJRWMD's existing system. SJRWMD shall have the ability to monitor the canal water level and pneumatic control gate status.

F. A decision matrix showing the general control strategy is included as Figure 1 at the end of Section 11535, Submersible Non-Clog Centrifugal Pumps.

2.08 PORTABLE COFFERDAM SYSTEM

A. The Contractor shall supply two new and complete portable inflatable cofferdam systems for the Owner's use in weir maintenance after construction. The Contractor shall purchase and deliver the 8-foot-high Aqua-Barrier® and EZ Roller installation and removal tool, all by HSI Services, Inc. (www.aquabarrier.com) or approved equals.

B. The portable cofferdam system shall be engineered and sized by the manufacturer to enable cutting off flow to either one of the two flow channels on either side of the center wall, upstream and downstream of the weir mechanism.

C. The Contractor shall submit the manufacturer's engineering drawings, equipment specifications, and other supporting documentation for the portable cofferdams to the Owner for approval before ordering and delivery to the Owner.

D. The portable cofferdams shall be supplied to the Owner at Substantial Completion and shall be delivered to the St. Johns River Water Management District (SJRWMD) Palm Bay Service Center in Palm Bay, Florida.

2.09 ELECTRICAL (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

A. The installed work shall be in accordance with the pneumatic control gate manufacturer's approved written instructions to comply with the requirements specified herein and on the Drawings.

3.02 FIELD TESTING

A. All air supply pipes shall be tested before covering with concrete, backfilled, or otherwise concealed.

B. The air piping downstream of the mechanical cabinet shall be tested by pressurizing to 50 psi for 24 hours. Pressure readings and ambient air temperature shall be recorded at six different times during the test. Any joints or fittings exhibiting leakage during this time shall be repaired or replaced.

C. The air piping upstream of the mechanical cabinet shall be tested by pressurizing to 150 psi for 24 hours. Pressure readings and ambient air temperature shall be recorded at six different times during the test. Any joints or fittings exhibiting leakage during this time shall be repaired or replaced.

D. The pneumatic control gate supplier shall be present and shall aid in the startup, debugging, and testing of complete system.

E. After installation of the gate system, the pneumatic control gates shall be fully raised and lowered three times using the control system. The gate shall operate smoothly with no binding.

F. After installation of the pneumatic control gate system, the air bladders shall be inflated to -half normal operating pressure. The gate system shall be isolated form the air supply system and held at pressure for 24 hours. Pressure and outside ambient temperature shall be recorded at the beginning and end of the test and at four different intervals during the test. Any bladders exhibiting leakage will be repaired by the manufacturer at no cost to the Owner. If the Contractor is responsible for the damage, the Contractor shall be responsible for making the necessary repairs that shall be acceptable to the Owner and the gate supplier at no cost to the Owner or supplier.

END OF SECTION

SECTION 11535
SUBMERSIBLE NON-CLOG CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, new materials, equipment, and incidentals necessary for the complete installation of the submersible non-clog centrifugal pumps, including but not limited to pumps, pump bases, guide rail and lifting system, and/or controls as shown on the Drawings and specified in this Section.

B. The pumps, motors, control panels, guide rails, and access cover shall be furnished by a single supplier. The pump supplier shall be responsible for overall supply and quality of these items and shall be responsible for testing, start-up, troubleshooting, and personnel training for the submersible non-clog centrifugal pumps and lift station.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. The Contractor shall submit written certification from the pump supplier that the wet well size and layout are acceptable for the pump installation.

B. Shop Drawings: The Contractor shall submit integrated shop drawings for the pumping system illustrating the mechanical and electrical equipment and components specified in this Section and including the following:

1. Product Data: For each mechanical, structural, and electrical component include the manufacturer’s descriptive literature, product specifications, published details, technical bulletins, performance, and capacity-rating curves with primary and secondary design conditions clearly noted, charts, and schedules, catalog data sheets, and other submittal materials as required to verify that the proposed products conform to the quality and function of the specified products.

    a. Identification: Clearly indicate by an arrow on submissions covering more than one product type or style exactly which product is being submitted for approval.

b. Equipment Characteristics: Provide bearing ratings, complete motor data, service factors, shaft diameters, coupling type, and weights of principal parts and assembled equipment.

c. Manufacturer: Include the catalog name, company name, address, and telephone number for the manufacturer of each product submitted.

2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross-sections of system equipment and sub-assemblies.

3. Layout Drawings: Submit completely dimensioned drawing of pump, pump base, anchor bolt size and patterns, complete guide rails system, installation notes, recommended grout configuration of wetwell bottom, discharge elbow mounting instructions, and other pertinent setting details.

4. Product List: Provide a list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.

5. Wiring Diagrams: Submit complete interconnecting wiring diagrams and schedules for electrical apparatus showing numbered wiring terminals in the pump control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.

6. Control Panel Drawing: Submit a dimensioned drawing of the control panel indicating the primary electrical components and panel face with control devices, lights, indicators, and other panel-face-mounted apparatus located and identified. Provide an internal face view of the equipment arrangement with equipment identified.

7. Additional Requirements: See Section 16401, Low-Voltage Electrical Work—General Requirements, for additional submittal requirements for the control panel furnished under this Section and specified below.

C. Pump Test Report: Submit certified copies of factory-run pump performance test curves. Factory-certified performance test curves shall indicate the following:

1. Flow in gallons per minute.

2. Total head in feet of water.

3. Horsepower.

4. Pump efficiency in percent of input shaft horsepower.

5. Pump data:

    a. Model number.
    b. Serial number.
    c. Impeller diameter and type.
    d. Impeller speed.

6. Test condition data:

    a. Date of test.
    b. Mean water temperature.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Concrete Institute (ACI)

1. ACI 318/318R—Building Code Requirements for Structural Concrete and Commentary.

B. American Iron and Steel Institute (AISI)

C. American National Standards Institute/Hydraulic Institute (ANSI/HI)

1. ANSI/HI 1.1-1.2—Rotodynamic (Centrifugal) Pumps for Nomenclature and Definitions.
2. ANSI/HI 1.4—Rotodynamic (Centrifugal) Pumps for Manuals Describing Installation, Operation, and Maintenance.

D. American Society for Testing and Materials (ASTM)

1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
2. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
3. ASTM A105/A105M—Standard Specification for Carbon Steel Forgings for Piping Applications.
4. ASTM A123/A123M—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

5. ASTM C478—Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.

E. American Society of Mechanical Engineers (ASME)

1. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

F. American Waterworks Association (AWWA)

1. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).

G. International Standards Organization (ISO)

1. ISO 2858—End Suction Centrifugal Pump (Rating 16-Bar) Designation, Nominal Duty Point and Dimensions.
2. ISO 5199—Technical Specifications for Centrifugal Pumps, Class II.
3. ISO 7005-2—Metallic Flanges – Part 2: Cast Iron Flanges.

H. Electrical Specifications and Standards – See Division 16, Electrical.

1.04 QUALITY ASSURANCE

A. The pumps shall be shipped to the jobsite complete with the motor, local wiring, control, equipment base, and anchor bolts and other appurtenances as specified pre-installed. Control Panel and spare parts shall be shipped loose and ready for installation at the location shown on the Drawings.

B. Modifications to the manufacturer's standard design may be required to meet these Specifications. Equipment not complying with the mechanical, electrical, and material integrity established by these Specifications shall be identified by the Contractor and submitted to the Owner for review.

1.05 QUALIFICATIONS

A. The manufacturer(s) of the equipment specified shall meet the following requirements:

1. Shall have been in business for at least the 10 years before the Bid Date.
2. Shall have a record of operating, manufacturing, and servicing the types of items specified for a minimum of 10 years before the Bid Date.

3. Shall have a minimum of five installations of equipment similar to and meeting the requirements specified in this Section at municipal wastewater treatment facilities in Florida before the bid date.

1.06 SYSTEM DESCRIPTION

A. The pump station shall have submersible centrifugal non-clog pumps as specified in this Section with controls capable of operating the pumps either individually, alternately, and/or simultaneously, depending on the load condition.

B. The pump station shall be complete units with necessary appurtenances installed within the pump intake basin.

1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

O&M manuals shall be in accordance with Section 01830, Operations and Maintenance Manuals, and shall include the following:

A. Installation instructions.

B. Functional description of the pumping control system for each mode of operation of equipment.

C. Automatic and manual operation.

D. Alarms and fail-safe features.

E. Interlocked and/or interfaced equipment operation and control.

F. Exploded view drawings and illustrations with descriptions for assembly and disassembly of equipment.

G. Comprehensive parts and materials maintenance and repair list for each equipment element indicating the manufacturer and the manufacturer's identification number. Include the name, address, and telephone number of local sales and service office for major equipment items.

H. Schedules of recommended spare parts to be stocked, including part number, inventory quantity, and ordering information.

I. Performance rating and nameplate data for each major system component.

J. Procedures for starting, operating, adjusting, calibrating, testing, and shutting down system equipment.

K. Emergency operating instructions and trouble-shooting guide.

L. Schedule of routine maintenance requirements and procedures and preventative maintenance instructions required to ensure satisfactory performance and equipment longevity.

M. Maintenance instructions for extended out-of-service periods.

N. Schedule of lubrication requirements, including lubricant type, service interval, and lubrication points.

O. Field-verified power and control wiring schematics. Submit the approved schematics in each manual. After initial start-up and operation, correct these schematics to reflect any required field changes and submit the required copies for inclusion in the manuals.

P. Four preliminary copies of the O&M manuals shall be submitted before the equipment arrives at the site. The Contractor shall not be compensated for the pumping equipment until the preliminary O&M manuals are received. Four copies of the final O&M Manuals shall incorporate the Owner’s comments and be submitted with copies of the approved shop drawings and test reports.

Q. Installation Certificate: Submit a certificate from the manufacturer or from the manufacturer's qualified, factory-authorized representative for each pump furnished and installed and specified in this Section stating that the equipment has been installed, inspected, and adjusted as required in accordance with the manufacturer’s written installation procedures and operating instructions and is ready for acceptance by the Owner.

1.08 SPECIAL CONSIDERATIONS

A. All of the equipment, accessories, and controls specified in this Section shall be furnished by a single manufacturer and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.

PART 2 PRODUCTS

Materials and equipment shall conform to the referenced publications or as specified and indicated and shall be the products of manufacturers regularly engaged in the manufacture of such products.

2.01 SUBMERSIBLE CENTRIFUGAL NON-CLOG PUMPS

A. Major pump components shall be of grey cast iron**,** ASTM A48/A48M Class 30, with smooth well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. All exposed nuts or bolts shall be Type 316 stainless steel. The discharge nozzle shall be flanged and sufficiently rigid to support the guiderail-mounted pumping unit under all operating conditions.

B. Impeller: The impeller shall be an enclosed one-piece casting, ASTM A48/A48M Class 30 cast iron, with not more than two non-clog passages. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by a key and self-locking bolt or nut.

C. Coatings: All metal surfaces in contact with the pumped media, other than stainless steel, shall be coated in the factory with a zinc primer and polyester resin or high-solids epoxy finish.

D. Wearing Rings: Renewable Type 316 stainless steel wearing rings shall be provided in the casing and on the impeller. The rings shall be positively locked in place.

E. Oil Chamber Housing: The oil chamber shall contain a drain plug and a vent plug.

F. Seals: Each pump shall be provided with two mechanical rotating shaft seals arranged in tandem and with an oil chamber between the seals. John Crane Type 21 seals shall be used with the rotating face of the seal shall be carbon and the stationary seal faces shall be ceramic. The pump shall be equipped with 300 Series stainless-steel hardware and a 300 Series stainless-steel shaft sleeve for under the lower seal. A seal leak detection sensor shall be provided between the seals.

G. Sealing of Mating Surfaces: All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is required. Sealing shall be accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

H. Discharge Base

1. The manufacturer shall furnish a discharge base and discharge elbow for each pumping unit. The base shall be sufficiently rigid to firmly support the guiderails, discharge piping, and pumping unit under all operating conditions. The base shall be provided with one or more integral support legs or pads suitable for bolting to the floor of the pump intake basin. The face of the discharge elbow inlet flange shall be perpendicular to the floor and shall make contact with the face of the pump discharge nozzle flange. The diameter and drilling of the elbow outlet flange shall conform to ASME B16.1 Class 125.
2. The pump and motor assembly shall be automatically connected to and supported by the discharge base and guiderails so that the unit can be removed from the wet well and replaced without the need for operating personnel to enter the pump intake basin.

I. Pump Characteristics

Characteristic	East Pump Station	West Pump Station
Number of Units	3	3
Total Head at Primary Design Condition (feet)	28.0	40.5
Capacity at Primary Design Condition (gpm)	4,050	4,650
Minimum Efficiency at Primary Design Condition	71%	75%
Total Head at Secondary Design Condition (feet)	24.0	38.0
Capacity at Secondary Design Condition (gpm)	4,500	4,900
Minimum Efficiency at Secondary Design Condition	75%	75%
Shutoff Head	62.0	74.0
Rated Pump Speed (rpm)	1150	1150
Motor Power (hp)	40	60
Discharge Elbow Outlet Diameter (inches)	12.0	12.0
Minimum Discharge Sphere Diameter (inches)	6	6

1. Pump performance shall be stable and free from cavitation and noise through the specified operating head range at minimum suction submergences.
2. Each pumping unit shall be designed so that reverse rotation at rated head will not cause damage to any component.

J. Acceptable Pump Manufacturer/Model

1. Stormwater Pump Station:

    a. Pentair Hydromatic Model S12LXP.
    b. Approved equal.

2.02 ELECTRIC MOTORS

Electric motors shall be in accordance with Section 16401, Low-Voltage Electrical Work—General Requirements, unless noted otherwise in this Section:

A. Each pump shall be driven by a dielectric oil-filled, totally submersible electric motor manufactured by the pump manufacturer. Each motor shall be rated 460 volts, 60 Hz, three-phase and shall have a service factor of 1.15. The motor nameplate rating shall exceed the maximum horsepower required by the pump in the operating head of the entire pump curve. The motor shall operate over the entire range of the pump curve without overloading the motor or operating in the service factor of the motor. The stator housing shall be an oil-filled, watertight casing. Motor insulation shall be moisture resistant, Class F, 155°C. Each motor shall be NEMA Design B for continuous duty at 40°C ambient temperature and designed for at least 10 starts per hour.

B. The motor bearings shall be antifriction, permanently lubricated type. The lower bearing shall be fixed to carry the pump thrust and the upper bearing free to move axially. The bearing shall have a calculated AFBMA L_{10} Life Rating of 40,000 hours when operating at maximum operating head.

C. Each motor shall be capable of continuous operation in air (unsubmerged) for at least 24 hours under pump full load conditions without exceeding the temperature rise limits for the motor insulation system.

D. Each pump shall be equipped with one or more multiconductor cable assemblies for power and control. Each multiconductor assembly containing power cables shall be provided with a separate grounding conductor. Each cable assembly shall bear a permanently embossed code or legend indicating that the cable is suitable for submerged use. Cable sizing shall conform to NEC and ICEA requirements. All cables shall be of sufficient length to terminate at the control panel or as otherwise indicated in the Drawings, with 10 feet of slack which will be coiled in the pump intake basin. Each cable shall be supported by corrosion-resistant Type 316 stainless-steel Kellems or woven grips to prevent damage to the cable insulation. Mounting of cable supports in the basin shall be coordinated by the supplier to prevent damage to the cable. No splicing of cables shall be allowed.

E. The cable entry water seal shall be water-tight and include a strain relief.

2.03 CONTROLS

The submersible pumps shall be controlled by a locally mounted triplex motor starter control panel furnished with the pumps to provide complete automatic operation of pumps based on the liquid level setting shown on the Drawings.

A. Panel Enclosure

1. The main panel shall be free-standing NEMA Type 4X stainless-steel, white powder coat finish enclosures with internal dead front panel and stainless-steel continuous hinge and pin. The panel shall be located as shown on the Contract Drawings and shall house all relays, motor starters, control power transformers, fuses, and other controls required for a complete and operating system. The panel shall have terminal strips for all wiring connections internal and external to the enclosure. Terminal strips shall be labeled to identify cable terminations as shown on the panel shop drawings. All internal equipment shall be arranged for bottom entry of motor power cables, level float switch cables, power feed, and remote alarm circuit conduit.
2. The enclosure shall have circuit breaker operating handles mounted through the dead front panel for the main breaker and each motor starter. The door shall be equipped with a hasp for padlocking.
3. Indicating lights, selector switches, running time meters, and push buttons shall be mounted through the subpanel. All devices mounted through the subpanel shall be weatherproof, heavy-duty, oil-tight, with weatherproof boots.
4. One or more NEMA 4X SS junction boxes shall be provided between the panel enclosure and the pump intake basin. The junction box(es) shall be used for the power cables and the float cables. The weight of each junction box cover shall not exceed 50 pounds. Junction box(es) shall be supported by concrete support posts using stainless-steel hardware. Junction box shall have two sets of terminal strips for all incoming cable wires, plus eight spare terminal blocks. See terminal block requirements below.

B. Panel Wiring

1. All internal component device wiring shall be as normally furnished by the manufacturer. All interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90°C.
2. The power entrance to each panel shall be provided with a transient voltage surge suppressor (TVSS). See Section 16401, Low-Voltage Electrical Work—General Requirements, for TVSS requirements.

3. Power wiring shall be minimum 12 AWG. Control wiring shall be minimum 14 AWG.
4. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of the panel to provide space for conduit entrance and wiring. Not less than 25% spare terminals shall be provided.
5. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and bound by nylon cable ties or shall be routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40% of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

C. Controls

1. The pump station shall communicate via telemetry to the St. John's River Water Management District (SJRWMD). Telemetry shall be compatible with the SJRWMD's existing system. The SJRWMD shall have the ability to monitor and control the pumps.

2. Pump operation shall be linked through telemetry to the water level in the St. John's River at the USGS Gage at US 192 to initiate a remote override of local control. If the water level exceeds an adjustable level, initially set at Elevation 17.08 NAVD 88, local control shall be interrupted and all pumps will stop. If the remote river water level drops to an adjustable elevation, initially Elevation 16.58 NAVD 88, the pump station will be under local control. See Figure 1, (attached) for the Decision Matrix Flow Chart.

3. When operating normally under local control, pumps shall be controlled by water level in the wet well, measured by submersible level transducer. Backup float switches shall be provided for high and low water level alarms. Initial levels shall be those shown on the Drawings.

    a. On rising level with pumps initially off, the Lead On setpoint shall initiate the starting of the lead pump. If the level continues to rise, the Lag On set point shall initiate the starting of the lag pump. If

the level continues to rise, the Lag-Lag On setpoint shall initiate the starting of the lag-lag pump. A high-level alarm float switch shall provide a redundant start for the Lead, Lag, and Lag-Lag setpoint.

b. On falling level with pumps initially on, the All Off setpoint shall stop all pumps. A low-level alarm float switch shall provide backup for the All Off level set point and shall stop all pumps. The low-level alarm shall continue to alarm until acknowledged remotely.

c. The high and low level alarms shall have float switches to back up the level transducer. These backup level switches shall be wired separately from the pump station control system to act as an independent redundant system.

4. A second level transducer shall be located in a stilling well adjacent to the pump station influent screen. If the level measured by the level transducer at the screen exceeds the level measured by the level transducer in the wet well by an adjustable amount, initially 2 feet, an alarm shall signal that the screen must be checked for clogging. The alarm must be locally reset after the screen is cleared.

5. The pump controls shall be designed to alternate the lead pump at an operator selected interval, initially every 6 hours of run time. At the selected interval, the pump with the least total run time shall become the lead pump. The pump with the next to least total run time will become the lag pump. The pump with the most total run time will become the lag lag pump. Control panel circuitry shall be 120 volt, single-phase, 60 Hz. Control wiring between the control panel and the wetwell shall be 24 volts AC A control power transformer (CPT) shall be provided and mounted in the control panel and sized to serve all continuous loads, including motor starter coils.

6. A "Hand-Off-Auto" selector switch shall be provided for each pump. In the ON position pumps may be started and stopped independent of the level controls. In the AUTO position pumps shall be controlled by the local control components unless overridden by the remote SCADA telemetry.

7. Each motor shall be protected by motor temperature and moisture sensors as provided by the pump manufacturer. The sensors shall be connected in series with the motor starter coil so that the starter is tripped if a heat sensor opens.

8. The following local indicating lights shall be provided on the front of the panel for each pump:

Function	Color
Pump Overload/High Temperature	White
Pump On	Red
Pump Off	Green
Pump Motor Moisture	White

All local indicating lights shall be LED-type lights.

9. The following additional local indicating lights shall be provided on the front of the panel:

Function	Color
Control Power On	White
HL Alarm	White
LL Alarm	White

10. Normally open and normally closed alarm contacts, as required by the control system identified (in addition provide 20% spares), shall be provided for remote annunciation. A common alarm shall indicate motor overload, high motor temperature, high water level, and low water level. Local indication of the common alarm shall be by a red xenon strobe alarm strobe. The alarm shall produce a minimum of 1,000-effective-candlepower intensity and shall be mounted on top of the panel enclosure. The alarm strobe shall remain active until reset by a pushbutton on the front of the control panel. The panel shall be equipped with an alarm silence button. The alarm light shall remain until reset by a push button on the dead front portion of the control panel.

11. Motor starters shall be provided in the control panel for each pump. Motor starters shall be combination type with Motor Circuit Protector, equipped with NEMA rated isolation and bypass contactors . Solid State Reduced Voltage (SSRV). Refer to Section 16401, Low-Voltage Electrical Work—General Requirements, for additional requirements.

12. Circuit breakers shall be 600-volt magnetic motor circuit protectors with 22,000 AIC ratings. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism.

13. The control panel shall have an elapsed-run-time meter for each pump that is not resettable. Each elapsed run-time meter shall measure in hours and have read up to 99,999 hours before rolling over to 0.

14. Provide and install solid-state reduced-voltage (SSRV) starters if indicated on the Drawings. Refer to Section 16401, Low-Voltage Electrical Work—General Requirements, for SSRV requirements.

15. Terminal strips shall be by Marathon or Owner-approved equal.

16. Each control panel shall have a GFCI duplex-power receptacle rated at 20 amps. The receptacle shall provide 120-volt AC service.

D. Control panel shall have terminal strips and contacts to take all of the pump station alarms to the RTU.

2.04 SUBMERSIBLE LEVEL TRANSDUCER

A. Level transducers shall be suitable for the intended use.

B. Material shall be Type 316 stainless steel.

C. The level transducer range shall be 0 to 20 feet water column.

D. The level transducer shall have 4-20 mA output and an accuracy of +/-0.5%.

E. The level transducer shall be as manufactured by GE Druck or Owner-approved equal.

2.05 FLOAT SWITCHES

A. Float switches shall be of the suspended type with polypropylene or PVC body. Units shall have an integral electrical cable with two #19 AWG stranded conductors. Switches shall be pilot duty, normally open or normally closed, as required for the application.

B. Float switches shall be a direct-acting float switch which contains a mercury switch. Float switches shall be as specified below. The control panel shall have adjustable time delay switches (0 seconds to 300 seconds) so that the pump does not “chatter.” No splicing of the float switch cable shall be allowed. An extra 6 feet of looped float switch cable shall be looped and neatly tied in the basin with plastic ties.

2.06 PIPES, FITTINGS, AND VALVES

A. Piping, fittings, and valves shall be provided where indicated on the Drawings and conform to the requirements of relevant sections.

2.07 GUIDE RAIL AND LIFTING SYSTEM

A. Sliding Bracket: Each pumping unit shall be provided with an integral non-sparking, self-aligning guiderail sliding bracket. The bracket shall be designed to obtain a wedging action between flange faces as final alignment of the pump occurs in the connected position. The entire weight of the pump unit shall be wedged tightly against the inlet flange, making metal-to-metal contact with the pump discharge forming a seal without the use of bolts, gaskets, or O-rings. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions.

B. Guide Rails: Each pumping unit shall be equipped with two Type 316 stainless-steel guide rails. Guide rails shall be sized by the pump manufacturer to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to the access open at the top of the pump basin. An upper guide rail bracket of AISI Type 316 stainless steel shall be provided.

C. Lifting Chain: The pump manufacturer shall select and provide a stainless-steel lifting chain suitable for removing and installing each pump. The lifting chain shall be connected to a Type 316 stainless-steel lifting bail that is an integral part of the pump. A suitable Type 304 stainless-steel chain hook shall be provided at the top of the basin.

2.08 ACCESS HATCH COVER

A. The pump manufacturer shall furnish new access hatch covers and all embedded items shall be shipped to the pre-cast manufacturer to be cast into the structures. All coordination shall be the Contractor's responsibility. Access covers and accessories shall be as specified in this Section. The cover shall be of all-aluminum construction and suitable for a live load of 300 pounds per square foot with a maximum deflection of L/240. The cover shall be a reinforced diamond pattern checkered plate. Structural shapes and plates shall be at least 1/4-inch thick. Each leaf shall be provided with two hinges, torsion bars, or other devices to help open an automatic hold-open arm, a retractable handle, and a padlock hasp. The frame shall be provided with strap anchors bolted or welded to the exterior and shall be provided with a lifting chain hook and a guiderail support bracket. All aluminum surfaces to be in contact with concrete or mortar shall be coated in accordance with Section 09900, Painting and Coating.

2.09 MISCELLANEOUS

A. All metal fabrications, hangers, and hardware in the lift station shall be Type 316 stainless steel.

2.10 JOINTS AND PENETRATIONS

A. Joints and lift station penetrations shall be as specified and detailed on the Drawings.

2.11 ANCHOR BOLTS

A. Discharge connection anchor bolts shall be Type 316 stainless-steel epoxy anchors, not less than 3/4-inch diameter, designed for embedment in the concrete wet well floor. The anchor bolts and positioning templates shall be furnished by the pump manufacturer. All other anchor bolts shall be Type 316 stainless-steel epoxy anchors.

PART 3 EXECUTION

3.01 GENERAL

A. Pumps, guide rails, control panel, and appurtenances shall be installed as indicated, in accordance with the Drawings and the manufacturer's instructions. The Contractor shall provide services required to install the pumps, piping, panel, and accessories and perform wiring to connect pumps, level sensors, etc., with the control panel and the control panel with power as required to place the pumping system in service in accordance with requirements of the Contract Documents, all local codes, and NFPA 70.

B. Each discharge base shall be leveled, plumbed, aligned, and wedged into position to fit connecting piping. Installation procedures shall be as recommended by the pump manufacturer and Hydraulic Institute Standards.

3.02 PAINTING

A. All painting and associated work shall be performed in accordance with the paint manufacturer's recommendations for the particular application.

3.03 TESTS

Commercial testing shall be required and include the following:

A. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase, and hertz.

B. The motor and seal housing chambers shall be hi-potted to test for moisture content and/or insulation defects.

C. The pump shall be allowed to run dry to check for proper rotation.

D. Discharge piping shall be attached, the pump submerged in water, and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator will be replaced.

3.04 FIELD REPRESENTATIVE

A. A representative of the submersible centrifugal non-clog pump manufacturer hired by the Contractor shall inspect the pump installation and direct the startup of the station and shall instruct representatives of the Owner in startup and operation procedures. The Contractor shall procure the services of a representative of the submersible centrifugal non-clog pump manufacturer for the following:

1. A minimum of 1 full day on site to inspect, adjust, and test the pump station installations and provide certification as specified.
2. A minimum of 1 full day on site to place the pump station in operation to demonstrate compliance with requirements of the Contract Documents.
3. A minimum of 1 full day on site to train representatives of the Owner in the operation, maintenance, and repair of the pumps, control panel, and related appurtenances.

B. The manufacturer's services specified 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 Owner, all services required, including additional or extended trips to the job site by the manufacturer's representative to comply with these requirements.

Note: This Decision Matrix is for informational puposes only. Its purpose to show the general control strategy. The Contractor shall be responsible for providing a complete and fully functional system.

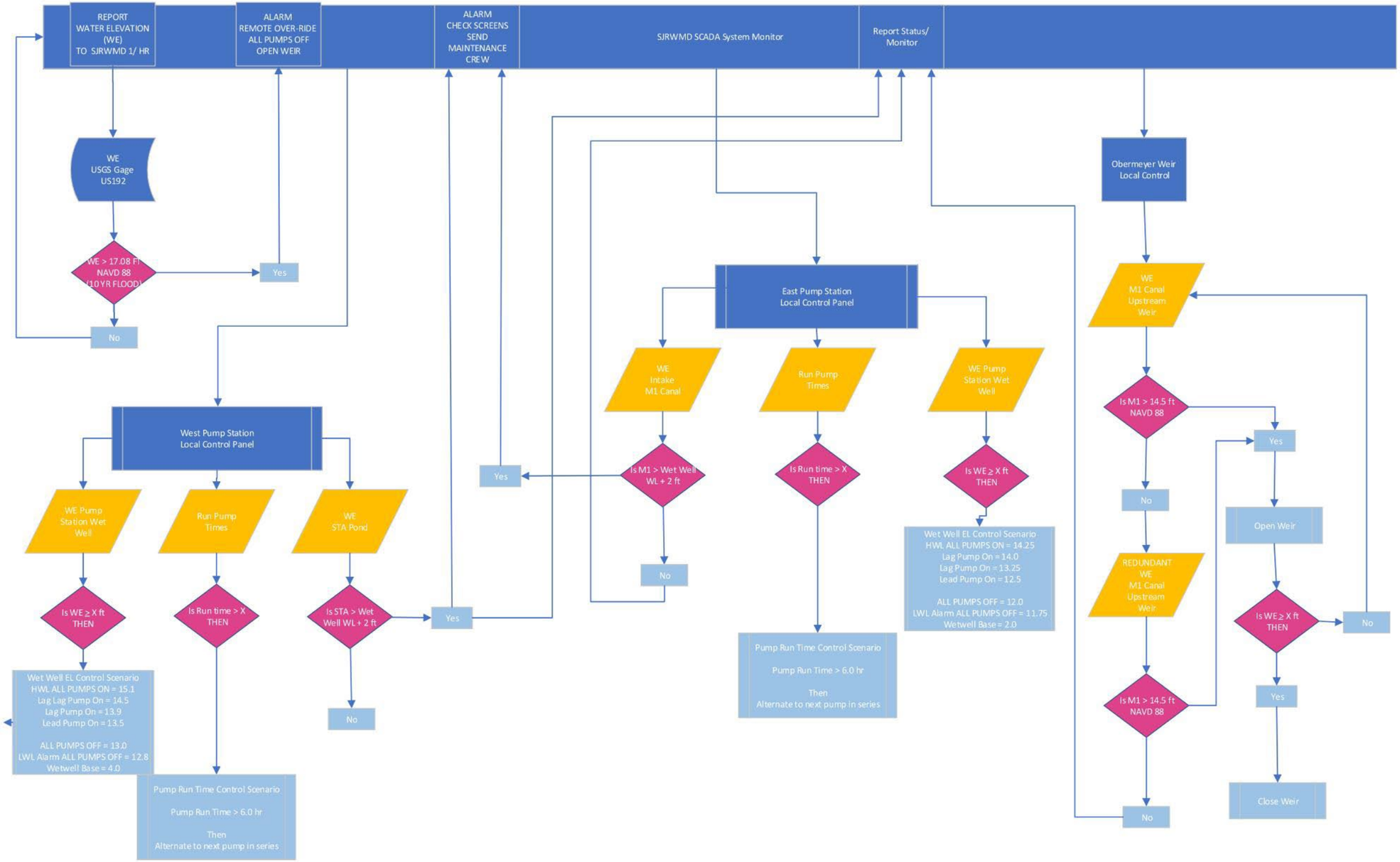

Figure 1 – Pump Station/Weir Decision Matrix

END OF SECTION

DIVISION 15

MECHANICAL

SECTION 15055
PIPING SYSTEMS—GENERAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Specification describes responsibilities and requirements for Piping Systems including the following:

1. Labor, materials, tools, equipment, and services to be furnished in accordance with the provisions of the Contract Documents. The materials to be used for the piping systems are shown on the Drawings.
2. Coordination of work with other trades.
3. Furnishing and installing all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, although such work is not specifically indicated.
4. Furnishing Record Drawings and documents for piping systems.

1.02 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

A. If the Contractor deviates from the piping layout as shown on the Contract Drawings, the Contractor shall submit scaled piping drawings showing locations and dimensions to and from fittings, valves, tanks, equipment, structures, and related appurtenances. Provide scaled drawings to a minimum scale of 1 inch equals 10 feet. Provide details to minimum scale of 1/8 inch equals 1 foot. Elevations shall correspond to reference vertical elevation datum shown or provided for this project.

B. Copies of any manufacturer's written directions regarding material handling, delivery, storage, and installation.

C. Record piping drawings shall meet the requirements of Section 01785, Record Documents. During the work, the Contractor shall maintain accurate, up-to-date Record Drawings of piping systems installed in the project, including pre-existing piping discovered, relocated, or at locations other than as originally shown on the Drawings. When the work is completed and accepted by the Owner, the Contractor shall submit Record Drawings in accordance with Section 01785, Record Documents. The Contractor shall identify complete location, elevations,

and description of piping systems. Piping systems and fittings are to be identified from three points on structures and/or stationary appurtenances.

D. Submit copies of forms documenting required field pressure testing work and results.

E. Submit welding certificate copies.

F. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

G. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

H. Support Systems:

1. Drawings of each piping system locating each support, guide, and anchor.
2. Identify support, guide, and anchor type by catalog number and shop/ Contract Drawing detail number.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society of Mechanical Engineers (ASME)

1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Forms).
2. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.
4. ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts, and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
5. ASME B18.2.2—Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
6. ASME B31.1—Power Piping.
7. ASME B31.3—Process Piping.
8. ASME BPVC—Boiler and Pressure Vessel Code.

B. American Society for Testing and Materials (ASTM)

1. ASTM A183—Specification for Carbon Steel Track Bolts and Nuts.

2. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
3. ASTM A194/A194M—Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
4. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
5. ASTM D1330—Standard Specification for Rubber Sheet Gaskets.
6. ASTM F467—Standard Specification for Nonferrous Nuts for General Use.

C. American Water Works Association (AWWA)

1. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).

D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP-58—Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.

E. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. The Contractor shall protect the pipe from kinks, cuts, end damage, and other defects when transporting all piping. Binding and tie-down methods shall not damage or deflect the pipes in any way. Pipe damaged during shipment shall be rejected.

C. Pipe shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking of any pipe shall be limited to a height that will not cause excessive deformation of the lower layers of pipe under anticipated temperature conditions. When necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths to not allow

deformation of the pipe at the point of contact with the sleeper or between supports. Pipe shall not be removed from storage until bedding or sub-grade work is complete and ready to receive the pipe.

D. The joined pipe shall be handled in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipe. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped. Slings for handling joined pipe shall not be positioned at socket-welded joints. Sections of the pipes with cuts and gouges shall be removed and the ends of the pipe rejoined. In accordance with the pipe manufacturer's written instructions, the Contractor shall repair all pipe with damaged linings and pipe exterior coatings that have been damaged before the pipe is installed.

E. The Contractor shall cover all pipe stored on the site with canvas or other opaque material to protect it from sunlight. Provide air circulation under the covering.

F. The Contractor shall inspect all pipe, fittings, and other accessories upon delivery and during the work. Any defective or damaged materials found during field inspection or during tests shall be removed from the site and replaced by, and at the expense of, the Contractor.

G. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Fittings shall be drained and stored in a manner that will protect them from damage by freezing.

H. Gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-delivered-to-site and first-to-be-installed rotation basis. Mechanical-joint glands, bolts, and washers shall be handled and stored in a manner that will ensure proper use with respect to types and sizes.

1.05 DEFINITIONS OF BURIED, EXPOSED, AND SUBMERGED PIPING

A. Buried piping is piping buried in soil, beneath a structure and/or encased in concrete. Where an exterior pipe coating is specified to be factory- or field-applied, the Contractor shall provide the coating up to the penetration of a structure. Piping encased in concrete does not require an exterior coating other than what is factory furnished.

B. Exposed piping is piping in any of the following conditions or locations:

1. Above ground.

2. Inside buildings, vaults, or other structures.
3. In underground concrete trenches or galleries.

C. Submerged piping is considered to be all piping within a liquid holding tank.

1.06 SYSTEM DESIGN REQUIREMENTS

A. General

1. The Specifications and Drawings are not all inclusive of explicit piping details; provide piping for intended use in compliance with laws and regulations, including ASME B31.1.
2. Pressure ratings and materials specified represent minimum acceptable standards for piping systems.
3. Piping Systems: Suitable for the services specified and intended.
4. Piping shall be color coded in accordance with the Florida Department of Environmental Protection (FDEP) requirements.

B. Support Systems

1. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of responsibility for sizing and providing supports for this project.

2. Select and design within the specified spans and component requirements.

3. Comply with requirements of MSS SP-58.

4. Criteria for structural design and selection of pipe support system components:

   a. Dead loads imposed by the weight of the pipes filled with water, within specified spans and component requirements, plus any insulation.
   b. Safety factor: Minimum of 5.

5. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support, to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

   a. Piping smaller than 30 inches: Supports are shown only where specific types and locations are required; additional pipe supports

may be required and are to be provided and installed by the Contractor at no additional cost to the Owner.

C. Adapters

1. No attempt has been made to show all adapters, spool pieces, reducers, bushings, or other fittings required to accommodate the connection of pipes, fittings, and valves of various joint design and sizes throughout the project. The Contractor is completely responsible for providing, at his expense, all adapters, reducers, sleeves, spool pieces, and other fittings and appurtenances necessary for connection of pipe (for the same pipe material of or a transition of pipe materials), valves, fittings, and appurtenances throughout the project, which shall be constructed of appropriate materials, coated and lined to match the materials, coatings, and linings specified for the connected components. All adapters, reducers, sleeves, spool pieces, and other fittings shall be coated and lined in accordance with the specifications for each individual pipe system.

D. Unions

1. No attempt has been made to show all unions required for the project. The Contractor shall provide unions at all connections of threaded pipe to installed equipment unless deleted by the Owner, in writing, at certain locations. The unions shall meet or exceed the quality of materials, pressure rating, service, and painting requirements of connected piping.

PART 2 PRODUCTS

2.01 PIPING SYSTEM GENERAL REQUIREMENTS SCHEDULE

A. Unless noted otherwise in the Drawings, piping system materials, fittings, and appurtenances are subject to requirements of the individual Specifications for the piping systems.

2.02 PIPING SCHEDULE

A. Pipe materials shall be as shown on the Drawings.

2.03 THREAD FORMING FOR STAINLESS STEEL BOLTS

A. Form threads for stainless steel bolts by rolling, not by cutting or grinding.

2.04 BOLTS AND NUTS FOR FLANGES FOR DUCTILE IRON PIPE FLANGES

A. Bolts, washers, and nuts for pipe installed indoors, outdoors above and below ground, and in vaults and structures shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

B. Bolts, washers, and nuts for submerged Class 150 flanges shall be Type 304 stainless steel conforming to ASTM A193/A193M (Grade B8) for bolts and ASTM A194/A194M (Grade 8) for nuts. Fit shall be Class 2A conforming to ASME B1.1 when connecting to cast-iron valves having body bolt holes.

2.05 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

A. Anti-seize thread lubricant shall be applied to the thread portion of all (above grade and below grade) stainless steel bolts (stainless steel tie rods, etc.) during assembly. Anti-seize lubricant shall be chloride free and shall be non-galling NSF approved. Anti-seize thread lubricant shall be Jet-Lube "Nikal," John Crane "Thred Gard Nickel," Never-Seez "Pure Nickel Special," or Permatex "Nickel Anti-Seize."

2.06 FLANGE GASKETS FOR STEEL, DUCTILE IRON, AND STAINLESS STEEL PIPE

A. Flange gaskets shall be in accordance with AWWA C207, except as modified in this Section. Gaskets shall be ring type. All gasket material shall be suitable for the fluid being conveyed and shall be resistant to free chlorine concentrations up to 10 mg/L. All gasket material shall be rated to the surge pressures listed in the pipe schedule. Gaskets shall be EPDM, Viton, or an approved equal.

2.07 POTABLE WATER PIPING SYSTEMS

A. All potable water piping systems including pipe, valves, fittings, weld-solvents, linings, gaskets, lubricants, grout disinfection agents, and surfaces in contact with potable water shall meet all local and State of Florida regulations and requirements including NSF 61. The Contractor shall coordinate the color of the potable water system piping color with the Owner's color standard and shall provide color as approved by the Owner.

2.08 LOCATOR WIRE

A. All 2-inch and larger buried piping shall be laid with an insulated, 10-gauge AWG, THWN strand copper wire taped with adhesive-backed tape or tied to the nonmetallic pipe at 5 feet on center for location purposes.

PART 3 EXECUTION

3.01 PREPARATION

A. Field Alignment:

1. The piping shown on the Contract Drawings is generally indicative of the work, with symbols and notations provided for clarity. However, the Contract Drawings are not an exact representation of all conditions involved; therefore, install piping to suit actual field conditions and measurements as approved by the Owner. No extra compensation will be made for work due to differences between indicated and actual dimensions.
2. The Contractor shall install all adapters, fittings, flanged connections, closures, restrained joints, etc. not specified but necessary for a complete installation acceptable to the Owner.
3. The Contract Drawings do not indicate all adapters, fittings, spool pieces, bushings, unions, supports, hangers, and other items required to accommodate the installing and connecting of pipe, fittings, valves, and equipment of various joint designs and sizes. Provide such required items of appropriate designs, materials, coatings, and linings.
4. Underground piping, duct, conduit, direct-buried conductors, and related structures of various sizes, materials, alignments, age, and function exist within the project site. Conclusive information concerning these facilities is not available. Consequently, the design of new piping indicated on the Contract Drawings is approximate. Adjust alignment, fitting, valve, and joint locations as required and as approved by the Owner to accommodate and protect existing facilities and provide the intended functionality of new piping.

3.02 FIELD LAYOUT AND MODIFICATIONS

A. Unless directed otherwise, the Contractor shall be responsible for setting construction layout stakes and/or offsets required to complete the designated work. The Contractor shall ensure that those stakes and/or offsets are protected and any re-staking required for any reason including work stoppage shall be included in the bid price and no additional compensation to the Contractor will be made.

B. The Owner has the right to make any modifications the Owner deems necessary due to field conditions, conflicts with other utilities, or to protect other properties.

3.03 PIPE PRODUCTS INSPECTION

A. The Contractor shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe, fittings, gaskets, glands, bolts, and nuts supplied for this Contract have been inspected at the plant and that they meet the requirements of these Specifications. The Contractor shall submit these certificates to the Owner before installing the pipe materials. The Contractor shall visually inspect all pipe and fittings at delivery and before they are lowered into the trench to be installed. Pipe or fittings that do not conform to these Specifications or have been damaged in any manner will be rejected and the Contractor must remove them immediately. The entire product of any plant may be rejected when, in the opinion of the Owner, the methods or quality assurance and uniformity of manufacturer fail to secure acceptable and uniform pipe products or where the materials used produce inferior pipe products.

3.04 CUT-IN TO EXISTING MAIN

A. Before connecting to existing lines, the Contractor shall notify and coordinate all work with the utility owner. The utility's personnel shall be responsible for turning valves. Cut into and connect mains constructed under this Contract to existing mains at locations shown or as directed by the Owner. Install cut-ins meeting conditions found in the field with standard fittings as detailed or as directed by the Owner. Provide sufficient fittings and operating equipment on the site before starting operations. Test, sterilize if a potable water main, flush new lines as specified in this Section, and obtain approval of the Owner before putting a connection to an existing line into service.

3.05 BURIED PIPING AND PIPE FITTINGS

A. Trenching and backfilling for all pipe and fittings shall also be in accordance with Section 02305, Earthwork for Utilities.

B. Installation

1. Inspect all piping for defects and remove all lumps or excess coatings before installation. The inside of the mechanical joint and outside of plain-end pipe shall be cleaned before joining pipe. Caution shall be taken to prevent damage to the pipe during lowering into the trench. Remove all foreign matter that has entered the pipe during storage and installation. The Contractor shall cover the pipe ends during installation to prevent debris from entering the pipe. No debris, tools, clothing, or other material shall be placed in the pipe.
2. After being placed in the trench, the pipe shall be brought to the proper line and grade by compacting the approved backfill material under it,

except at the bell end. Joint deflection shall not exceed 75% of the manufacturer's limit.

3. The Contractor shall install temporary water-tight plugs on the pipe ends during the time that the pipe is in the trench but no work is in progress. If there is water in the trench upon beginning work, this plug shall remain in place until the trench has been pumped dry, unless otherwise approved by the Owner.
4. Buried carbon steel bolts and nuts shall be coated in accordance with Section 09900, Painting and Coating, System No. 22.
5. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.
6. Restrained plugs or caps shall be inserted into all buried dead end pipes, tees, or crosses. Provide blind flanges for all flanged exposed piping. Restrained plugs and caps installed for pressure testing shall be fully secured and blocked to withstand the test pressure.
7. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a suitable ductile-iron plug/cap or blind flange with or without a blowoff cock, as shown on the Drawings. Installation or removal of such plugging shall be considered incidental to the work and the Contractor shall not be compensated by the Owner for performing this work.

3.06 FLANGED JOINTS FOR EXPOSED PIPE AND FITTINGS

A. When bolting flanged joints, the Contractor shall avoid restraint on the opposite end of the pipe or fitting, which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate to ensure uniform compression of the gasket, in accordance with pipe and fitting manufacturer’s recommendations.

B. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.

3.07 PIPING CONNECTIONS TO PUMPS AND OTHER EQUIPMENT

A. When connecting to pumps and equipment, the Contractor shall ensure that piping stresses are not transmitted to the pump and equipment. All connecting pipe shall be permanently supported and aligned so that accurate matching of bolt holes and uniform contact over the entire surface of pump flanges are obtained before any bolts are installed in the flanges or pipe is threaded into pump and equipment. In

addition, pump connection piping shall be free to move parallel to its longitudinal center line while the bolts are being tightened.

1. Pumps and equipment shall be leveled, aligned, and wedged into a position that will fit the connecting pipe, but shall not be grouted until the initial fitting and alignment of the pump and equipment may be shifted on its foundation if necessary to properly install the connecting pipe. Each pump and piece of equipment shall, however, be grouted before final bolting of the connecting piping.
2. After final alignment and bolting, the pump and equipment connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as required and then the flanges bolted back together. The flange bolts then shall be loosened and the process repeated until no movement is observed.
3. All carbon steel bolts and nuts shall be coated with the same exterior coating applied to the piping system.

3.08 ANCHORING AND RESTRAINING

A. Thrust blocks shall be used in new lines and shall be limited to areas in which a new fitting has been installed in an existing line and field restraining joints are not feasible or when directed by the Owner.

3.09 FLUSHING, CLEANING, TESTING, AND INSPECTION OF PIPING

A. See Section 15144, Pressure Testing of Piping, for the requirements of pipe flushing, cleaning, pressure testing, and inspection requirements.

3.10 SPECIAL REQUIREMENTS AND PIPING SPECIALTIES

A. Welding:

1. Use only certified welders meeting procedures and performance outlined in Section IX of the ASME BPVC and other codes and requirements in accordance with local building and utility requirements. Submit Welder’s certificates to the Owner for the project record before beginning any welding on the project. The Welder must be certified for all positions (flat, vertical, and overhead).
2. Have all welds conform to highest industrial practice in accordance with ASME B31.1 and ASME B31.3 or other codes and requirements in accordance with local building and utility requirements.

3.11 PIPE COLOR CODING

A. The pipe color shall be as identified on the Drawings. The Contractor shall coordinate with the Owner to generate a list of acceptable pipe colors for exposed piping systems. Where color-coding is achieved by painting exterior surfaces of the piping systems, painting shall be provided in accordance with Section 09900, Painting and Coating. On applicable pipes, color shall be in accordance with FDEP color-coding requirements.

B. On applicable pipes, the color shall be in accordance with FDEP color-coding requirements: (1) blue for potable water, (2) green for sanitary sewer, and (3) purple for reclaimed water. Stormwater pipes shall be brown.

C. Underground plastic pipe shall be solid-colored, shall have a co-extruded colored external skin, or shall be white or black pipe with colored stripes incorporated into or applied to the pipe wall; underground metal or concrete pipe shall have colored stripes applied to the pipe wall. Pipe striped during manufacturing of the pipe shall have continuous stripes that run parallel to the axis of the pipe, that are located at no greater than 90° intervals around the pipe, and that will remain intact during and after installation of the pipe. If tape or paint is used to stripe pipe during installation of the pipe, the tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and that is along the top of the pipe; for pipes with an internal diameter of 24 inches or greater, tape or paint shall be applied in continuous lines along each side of the pipe as well as along the top of the pipe. Marking tape shall be 3 inches wide with adhesive backing. Paint stripe shall be 3 inches wide. Aboveground pipe shall be color-coded or marked like underground pipe.

END OF SECTION

SECTION 15065
FABRICATED GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, and incidentals required to provide the fabricated gates specified herein and shown on the Drawings. The fabricated gates for this project include, but are not limited to:

1. Stainless steel sluice gates.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittal and Acceptance.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Iron and Steel Institute (AISI)

1. AISI 410—Stainless Steel.
2. AISI 416—Stainless Steel plus Related Metals.

B. American Society for Testing and Materials (ASTM)

1. ASTM A193—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High-Pressure Service.
2. ASTM A240—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip.
3. ASTM A276—Standard Specification for Stainless Steel Bars and Shapes.
4. ASTM A380—Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
5. ASTM B584—Standard Specification for Copper Alloy Sand Castings.
6. ASTM D3935—Standard Specification for Polycarbonate (PC) Unfilled and Reinforced Material.

C. Welding Certification

1. ANSI/AWS D1.6—Structural Welding Code-Stainless Steel.

D. American Society of Mechanical Engineers (ASME)

1. ASME Section IX—Welding and Brazing Qualifications.

E. American Water Works Association (AWWA)

1. AWWA C561—Fabricated Stainless Steel Slide Gates.

1.04 QUALITY ASSURANCE

A. The Contractor shall provide quality assurance measures for the items specified in this Section in accordance with Section 11000, General Equipment Requirements.

1.05 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, and this Section for the storage and protection of the items specified in this Section.

1.07 QUALIFICATIONS

A. The manufacturer(s) of the equipment specified in this Section shall meet the qualifications specified in Section 11000, General Equipment Requirements.

1.08 OPERATIONS & MAINTENANCE (O&M) MANUALS

A. O&M Manuals shall be in accordance with Section 01830, Operations and Maintenance Manuals.

1.09 SPECIAL DESIGN CONSIDERATIONS

A. All fabricated gates and appurtenances specified in this Section shall be furnished by a single manufacturer.

B. The fabricated gate embedded frame concrete cutouts in the structures shown on the Drawings are for representation purposes only. The Contractor shall be

responsible for determining the actual cutout dimensions required for each embedded fabricated gate frame before pouring the concrete walls, decks, and slabs around each frame.

C. The Contractor shall verify with the fabricated gate manufacturer that all fabricated gates of sufficient width and height function as intended.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. Equipment Identification Labels

1. Not applicable.

B. Performance Requirements: The leakage from slide gates in the fully lowered position shall not exceed the following:

1. 0.05 gallon per minute per foot around the wetted gate perimeter when subjected to the design head (measured from the gate invert).

C. General Design Conditions

1. Design unseating head is 12.5 feet based on a pond elevation of 16.5 feet and the pump station is empty.
2. Design seating head is 0 foot.

D. Acceptable Manufacturers

1. RW Gate Company, Troy, NY.
2. WACO Products, Baltimore, MD.
3. Engineer-approved equal.

2.02 EQUIPMENT

A. General: The fabricated sluice gates specified in this Section shall be used to isolate flows to the pump station wet well by lowering a disc or to control the rate of flow from the pond to the wet well using a gate operator above the operating floor. The sluice gates specified in this Section shall be of the upward-opening type that shall close when the disc is lowered into the flow channel or basin.

B. Materials: The specifications below shall apply to each fabricated gate specified in this Section.

1. Disc: The gate disc shall consist of a flat plate reinforced with structural or formed members welded to the plate with structural shapes or U-shaped extrusions welded to the plate as required. The reinforcing members shall be of the same material as the disc. Each disc shall be a minimum thickness of 1/2 inch where the disc engages the slides and be designed to limit deflection of the disc to 1/720 of its span, or 1/16 inch, whichever is less, when subjected to the design conditions. All disc components shall have a minimum material thickness of 1/4 inch. Working stresses shall not exceed 50% of the material's yield strength or 25% of the material's ultimate strength, whichever is less.

2. Frame: The gate frame shall consist of guides, an invert member, and operator yoke welded or bolted together to form a rigid one-piece frame. Each frame shall be furnished with guides that are built-up of plates, angles, and formed shapes in full accordance with the latest AWWA standards. Yoke members to be designed to limit the deflection to 1/360 of its span, or 1/8-inch, whichever is less, and shall be arranged to permit removing the disc from the frame.

a. General:

(1) Self-contained Frames: The frame assembly for fabricated slide gates furnished with self-contained frames shall extend out of the gate opening to at least above the full-height of the disc in the "open" position. The frame assembly for fabricated weir gates furnished with self-contained frames shall extend out of the gate opening so that the openings can be fully opened and fully closed (weir invert lined up with or below top of mounting wall) with the discs. The yoke to support the gate operator shall be formed by structural shapes welded at the top of the guides to provide a one-piece rigid frame. Angles are not acceptable guide extensions. The arrangement of the yoke will be such that the disc and stem can be removed without disconnecting the yoke. The yoke members shall be designed for the maximum output of the gate hoist.

(2) Embedded Frames: Each fabricated gate to be mounted within a flow channel (guide slots recessed in the concrete walls on the seating and unseating side of the gate) shall be furnished with an embedded frame assembly suitable for installing the fabricated gate in the flow channel. The invert

of embedded unit frames shall have an angle welded to the lower ends of the guides to incorporate a flush-bottom seal that is attached to the bottom of the frame invert. Seals attached to the disc are not acceptable. All seats and seals shall be mechanically fastened and field replaceable.

(3) Wall-Mounted Frame: Each fabricated gate to be wall-mounted shall be furnished with a frame assembly suitable for mounting the fabricated gate to the concrete surfaces at the end of the flow channel or wall opening.

b. Slide Gates: The frame assembly for slide gates shall be furnished with an invert structural member or formed shape welded to the bottom of the frame to form a flush surface and to meet with the disc seal. A specially molded resilient seal shall be mounted on the bottom of the disc to provide a flush-bottom closure. The shape of the slide-mounted seals shall produce a seating surface with a minimum width of 3/4 inch. The vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.

3. Guides: Each side of the gate frame shall engage the disc a minimum of 1 inch.

a. Each fabricated gate shall be furnished with ultra-high molecular weight polyethylene (UHMWPE) strips securely attached by mechanical fasteners in the guide to provide a low-friction surface on which the disc will slide. The guide shall be designed for maximum rigidity and shall be provided with keyways to lock it into the concrete. The invert of the frame on upward opening gates shall be a structural member welded to the lower ends of the guides to form a mounting surface for the flush-bottom resilient seal.

b. For self-contained frames, the guides extending above the operating floor shall be sufficiently strong to be free-standing so that no further reinforcing will be required. Guides shall be sufficiently rigid to handle wind loads when the slide is in its highest travel position. The yoke to support the operating bench stand for standard frames shall be formed by two channels welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yoke shall be such that the disc and stem can be removed without disconnecting the yoke. The design of the yoke shall be such to limit its deflection to 1/360 of its span or 1/18 inch, whichever is less, under full operating load.

c. The guide shall weigh no less than 4.5 pounds per foot for aluminum gates, 6.5 pounds per foot for embedded or in-channel

mounted stainless steel gates, and 13 pounds per foot for wall-mounted stainless steel gates and will be provided with holes for anchor bolts at a maximum of 16 inches for wall-mounted frames or embedded key ways for embedded frames.

d. Guides shall extend beneath the channel or basin opening a sufficient amount to support the disc in the fully open position for downward opening gates and shall extend above the channel to support the full height of the disc when the gate is in the fully open position.

4. Stems: Each fabricated gate shall be of the rising-stem type and shall be furnished with a stem extending from the yoke to the top of the gate disc at its lowest operating elevation. Each stem shall have a minimum diameter of 1-1/2 inches and shall be ASTM A276 Type 316 stainless steel. Each gate stem shall be designed to withstand twice the force transmitted to the gate disc from an 80-lb pull on the gate operator when subjected to the design head conditions. Stems shall be cut-threaded or rolled-threaded with full depth Acme threads and threaded adequately to provide full travel of the gate disc. Stem threads shall be polished to a 16-microinch finish. The stem length/stem radius (L/r) ratio of the unsupported stem segment shall not exceed 200.

   a. Stem Guides: Stem guides shall be furnished as needed to limit the unsupported stem length to the specified L/r ratio.
   b. Stem Covers: Each fabricated gate shall be furnished with a stem cover to indicate the gate position (open/closed), permit inspection of the stem threads, and protect the stem from contamination. The stem cover material shall be clear polycarbonate meeting ASTM D3935. Vent holes shall be provided in each stem cover to prevent condensation, and a stem cap shall be provided at the top of the stem cover. Each stem cover shall be furnished with a clear mylar position-indicating marking tape. The marking tape shall be adhesively backed and shall be permanently marked and calibrated in feet and inches.
   c. Stem Couplings: Stem couplings, if needed, shall be fabricated from ASTM A276 Type 316L stainless steel and shall be threaded and keyed or threaded and bolted to ensure a true and stable connection.

5. Gate Operators:

   a. General: The manual operators for each gate shall consist of a gearbox hoist with a stainless steel input shaft suitable for operation with a portable operator. Hoists shall have a minimum

gear ratio of 2:1. Each hoist shall be operated by crank to raise or lower each fabricated gate as needed.

(1) All gate operators shall be designed for manual operation.
(2) All gate operators shall be located at a height of 36 inches above the operating platform elevation, unless noted otherwise on the Drawings.
(3) All crank-operated hoists shall be geared and shall have a weatherproof cast iron or ductile iron housing or pedestal with a 2-inch bronze operating nut.
(4) Operators shall be grease lubricated and provided with grease fittings at readily accessible locations.
(5) The bench stand or floor stand hoists for standard frames shall be sized to permit operation of each fabricated gate subjected to the design head condition specified on the Drawings, with a maximum 40-lb pull on the crank.
(6) All gates with openings that are 48 inches or wider with widths greater than two times their height shall be provided with two lifting devices connected by a stainless steel tandem shaft for simultaneous operation.

b. Hoist: Each hoist shall be furnished with thrust bearings, bronze hoist nuts, and an internally threaded bronze stop nut to limit the downward travel of the stem and slide. All hoist nuts shall be manganese bronze alloy C86500 conforming to ASTM B584. The hoist nut shall be supported on roller bearings. A lubrication fitting shall be provided for lubrication of hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of crank rotation to open the gate shall be clearly and permanently marked on the hoist.

c. Cranks: Crank operators shall be self-locking at any position of stem travel. Cranks shall be 316 stainless steel. Cranks shall be no less than 12 inches long and shall be keyed to the input shaft.

6. Seals: Provide seals in the guides of each frame to allow each fabricated gate to meet the performance requirements specified in this Section when subjected to the design head conditions on the Drawings.

a. Self-Adjusting Ultra-High-Molecular-Weight Polyethylene (UHMWPE) Seals: Each fabricated gate shall be furnished with self-adjusting UHMWPE seals and a nitrile compression cord within the guides to minimize leakage around the disc. Each seal shall be self-adjusting and replaceable in the field without

removing the frame from the wall or wall thimble. The minimum self-adjustment for each seal shall be 1/8 inch. “J” type seals are not considered acceptable.

b. Bottom Seals: Each upward opening fabricated gate shall be furnished with a resilient EPDM or neoprene seal mounted into the invert member to provide flush-bottom closure. The shape of the seal shall produce a seating surface with a minimum width of 3/4 inch. The seal shall be designed to extend into the guide and the vertical face of the seal shall contact the surface of the vertical inside the guide to provide a proper seal at the corners.

C. Stainless Steel Fabricated Gates

1. General: The specifications below shall apply to the stainless steel fabricated gate components specified in this Section.
2. Materials: All metal components of each fabricated gate, including wall brackets and floor stands, shall be ASTM A240 or A276, AISI Type 316 stainless steel. All welded components shall be Type 316L stainless steel. The stainless steel fabricated gates and appurtenances specified in this Section shall be designed to withstand the corrosion, abrasion, and stresses from being submerged in raw sewage and exposed to acidic gases.
3. Stem Guides: Stem guides, where required to limit the unsupported stem length, shall be AISI Type 316 stainless steel with UHMWPE bushings. The stem shall be connected to the disc by a Type 316 stainless steel stem connector that is bolted to the stem, with a minimum of two bolts, and welded to the disc.

2.03 EQUIPMENT LABELS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the equipment specified herein in accordance with Section 11000, General Equipment Requirements.

B. All fabricated gates shall be thoroughly cleaned of grout and debris and installed in strict conformance with the manufacturer’s recommendations before installation. Stem threads shall be cleaned and coated with an anti-galling compound before installation.

C. Fabricated gate components shall be machined and/or adjusted as needed to meet the design tolerances specified in this Section and recommended by the manufacturer.

D. Install the equipment in the locations as shown on the Drawings and in accordance with manufacturer's instructions and recommendations and the approved shop drawings.

E. The Contractor shall apply a non-shrink grout, resilient gasket, or polyurethane sealant between the frame and wall surfaces as needed to produce a watertight seal. The seal type shall be as recommended by the fabricated gate manufacturer and shall be suitable for submerged applications.

3.02 PAINTING AND SURFACE PREPARATION

A. The gate manufacturer shall passivate all welds on stainless steel in accordance with ASTM A380.

3.03 FIELD TESTING

A. The Contractor shall provide the services of a factory-authorized service representative to perform, approve, and certify the pre-startup testing and startup testing specified herein. The service representative shall be certified and employed by the manufacturer of the equipment specified herein. All field testing shall be provided in accordance with Section 11000, General Equipment Requirements.

1. Pre-Startup Testing: The factory-authorized service representative shall inspect each fabricated gate and verify that the components have been furnished and installed in accordance with the Contract Documents and manufacturer's recommendations.

2. Startup Testing: Each basin or flow channel completely dewatered, the gate disc for each fabricated gate shall be fully raised and lowered along its guide system a minimum of three times to ensure that it operates freely and that the required clearance between the disc tongue and gate guide groove are maintained at all times. During the startup testing, the geared hoists shall be adjusted as needed so that the maximum pull needed to raise and lower the disc does not exceed the value specified in this Section.

3. Final Mechanical Performance Testing: The Contractor shall perform final mechanical performance testing for this equipment in accordance with Section 11000, General Equipment Requirements.

a. With each basin or flow channel is submerged, each fabricated gate shall be operated so that is fully closed. When the downstream

flow channel or basin has been isolated and dewatered below the gate disc invert, the Contractor shall measure the average leakage rate from each fabricated gate over a period of 30 minutes. If the leakage rate exceeds the design requirements specified herein, the Contractor shall adjust the gate components in the field as needed. If the leakage rate still exceeds the design requirements specified in this Section after the field adjustments have been performed, the Contractor shall furnish a factory-authorized service representative on site to inspect, repair, and adjust the fabricated gates as needed. These service representative services shall be furnished to the Owner at no additional cost.

3.04 TRAINING SERVICES

A. The factory-authorized service representative shall be on site to perform training services during the field testing services in accordance with Section 11000, General Equipment Requirements. Training services shall be in accordance with Section 11000, General Equipment Requirements.

3.05 MANUFACTURER'S CERTIFICATION OF COMPLIANCE

A. The Contractor shall furnish a Manufacturer's Certification of Compliance for the equipment specified herein in accordance with Section 11000, General Equipment Requirements.

END OF SECTION

SECTION 15110
MANUAL, CHECK, AND PROCESS VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves as shown in the Drawings and as specified in this Section. All valves shall be complete with all necessary manual actuators, valve boxes, extension stems, and floor stands, which are required for proper valve operation and completion of the work.

1. All valves shall be of the sizes shown in the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Owner.

2. The valves shall include but not be limited to the following:

a. Air Valves.
b. Ball Valves.
c. Check Valves.
d. Gate Valves.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Product technical submittal data shall contain the following information and data:

1. Acknowledgment that products submitted meet requirements of standards referenced.

2. Manufacturer’s installation instructions.

3. Manufacturer’s operation and maintenance manuals.

4. Data of valves, actuators, and accessories:

a. Pressure and temperature rating.
b. Materials of construction, with ASTM reference and grade.
c. Linings and coatings.

d. Dimensions and weight.
e. Flow coefficient.
f. Actuators and accessories details.
g. Manufacturer's product brochure, cut-sheets, and parts diagrams.

B. Dimensions and orientation of valve actuators as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

C. The following test reports: Performance Tests; Leakage Tests; Hydrostatic Tests; and Proof-of-Design Tests as applicable or required.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Petroleum Institute (API)

1. API SPEC 6D—Specification for Pipeline and Piping Valves.
2. API SPEC 6FA—Specification for Fire Test for Valves.
3. API STD 594—Check Valves: Flanged, Lug, Wafer, and Butt-Welding.
4. API STD 607—Fire Test for Quarter-Turn Valves and Valves Equipped with Nonmetallic Seats.

B. American Society for Testing of Materials (ASTM)

1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
2. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
4. ASTM A105/A105M—Standard Specification for Carbon Steel Forgings for Piping Applications.
5. ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
6. ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
7. ASTM A148/A148M—Standard Specification for Steel Castings, High Strength, for Structural Purposes.
8. ASTM A181/A181M—Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

9. ASTM A182/A182M—Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
10. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
11. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
12. ASTM A216/A216M—Standard Specification for Steel Castings, Carbon, Suitable for Fusion-Welding, for High-Temperature Service.
13. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
14. ASTM A269/A269M—Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
15. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
16. ASTM A313/A313M—Standard Specification for Stainless Steel Spring Wire.
17. ASTM A322—Standard Specification for Steel Bars, Alloy, Standard Grades.
18. ASTM A351—Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
19. ASTM A395/A395M—Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
20. ASTM A436—Standard Specification for Austenitic Gray Iron Castings.
21. ASTM A439/A439M—Standard Specification for Austenitic Ductile Iron Castings.
22. ASTM A449—Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
23. ASTM A479/A479M—Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
24. ASTM A494/A494M—Standard Specification for Castings, Nickel and Nickel Alloy.
25. ASTM A516/A516M—Standard Specification for Pressure Vessel Plates, Carbon-Steel, for Moderate- and Lower-Temperature Service.
26. ASTM A536—Standard Specification for Ductile Iron Castings.
27. ASTM A564/A564M—Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
28. ASTM A582/A582M—Standard Specification for Free-Machining Stainless Steel Bars.

29. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
30. ASTM A743/A743M—Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
31. ASTM A744/A744M—Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
32. ASTM A890/A890M—Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.
33. ASTM B16/B16M—Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
34. ASTM B21/B21M—Standard Specification for Naval Brass Rod, Bar, and Shapes.
35. ASTM B61—Standard Specification for Steam or Valve Bronze Castings.
36. ASTM B62—Standard Specification for Composition Bronze or Ounce Metal Castings.
37. ASTM B98/B98M—Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
38. ASTM B99/B99M—Standard Specification for Copper-Silicon Alloy Wire for General Applications.
39. ASTM B127—Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
40. ASTM B148—Standard Specification for Aluminum-Bronze Sand Castings.
41. ASTM B150/B150M—Standard Specification for Aluminum Bronze Rod, Bar, and Shapes.
42. ASTM B164—Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
43. ASTM B169/B169M—Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
44. ASTM B193—Standard Test Method for Resistivity of Electrical Conductor Materials.
45. ASTM B371/B371M—Standard Specification for Copper-Zinc-Silicon Alloy Rod.
46. ASTM B427—Standard Specification for Gear Bronze Alloy Castings.
47. ASTM B443—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip.
48. ASTM B446—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar.

49. ASTM B462—Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
50. ASTM B463—Standard Specification for UNS N08020 Alloy Plate, Sheet, and Strip.
51. ASTM B472—Standard Specification for Nickel Alloy Billets and Bars for Reforging.
52. ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.
53. ASTM B763/B763M—Standard Specification for Copper Alloy Sand Castings for Valve Applications.
54. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
55. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
56. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
57. ASTM D2000—Standard Classification System for Rubber Products in Automotive Applications.
58. ASTM D3222—Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
59. ASTM D4101—Standard Specification for Polypropylene Injection and Extrusion Materials.
60. ASTM F441/F441M—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
61. ASTM F467—Standard Specification for Non-Ferrous Nuts for General Use.
62. ASTM F468—Standard Specification for Non-Ferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.

C. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
2. ASME B1.20.7—Hose Coupling Screw Threads (Inch).
3. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
4. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
5. ASME B16.10—Face-to-Face and End-to-End Dimensions of Valves.
6. ASME B16.11—Forged Fittings, Socket-Welding and Threaded.

7. ASME B16.18—Cast Copper Alloy Solder Joint Pressure Fittings.
8. ASME B16.24—Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valve Classes 150, 300, 600, 900, 1500, and 2500.
9. ASME B16.34—Valves – Flanged, Threaded, and Welding End.
10. ASME B16.42—Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
11. ASME B16.47—Large Diameter Steel Flanges NPS 26 through NPS 60 Metric/Inch Standard.
12. ASME B36.10M—Welded and Seamless Wrought Steel Pipe.

D. American Society of Safety Engineers (ASSE)

1. ASSE 1011—Performance Requirements for Hose Connection Vacuum Breakers.

E. American Water Works Association (AWWA)

1. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
2. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
5. AWWA C500—Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C504—Rubber-Sealed Butterfly Valves.
7. AWWA C507—Ball Valves 6-Inch through 60-Inch (150 mm through 1,500 mm).
8. AWWA C508—Swing-Check Valves for Waterworks Service, 2-Inch through 48-Inch (50 mm through 1,200 mm) NPS.
9. AWWA C509—Resilient-Seated Gate Valves for Water-Supply Service.
10. AWWA C512—Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service.
11. AWWA C515—Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
12. AWWA C550—Protective Interior Coatings for Valves and Hydrants.
13. AWWA C606—Grooved and Shouldered Joints.
14. AWWA C800—Underground Service Line Valves and Fittings.

F. Fluid Controls Institute (FCI)

1. FCI 70-2—Control Valve Seat Leakage.

G. Manufacturers Standardization Society (MSS)

1. MSS SP-61—Pressure Testing of Valves.
2. MSS SP-67—Butterfly Valves.
3. MSS SP-68—High Pressure Butterfly Valves with Offset Design.
4. MSS SP-81—Stainless-Steel or Stainless-Steel-Lined Bonnetless, Knife Gate Valves with Flanged Ends.
5. MSS SP-83—Class 3000 Steel Pipe Unions Socket Welding and Threaded.
6. MSS SP-108—Resilient-Seated Cast Iron Eccentric Plug Valves.

H. National Association of Corrosion Engineers International (NACE)

1. NACE MR-0103/ISO 17945—Petroleum, Petrochemical, and Natural Gas Industries – Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.
2. NACE MR-0175/ISO 15156—Petroleum, Petrochemical, and Natural Gas Industries – Materials for Use in H2S-Containing Environments in Oil and Gas Production.

I. National Fluid Power Association (NFPA)

1. NFPA T3.6.7—Fluid Power Systems and Products – Square Head Industrial Cylinders – Mounting Dimensions.
2. NFPA T3.6.68—Fluid Power – Square Head Cylinders – Determination of the Static Failure Pressure Rating of Pressure-Containing Components.

J. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. All valves, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall not be stacked or placed under pipe, fittings, or other valves in such a manner that damage could result.

C. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior linings and valve components. If

any part of the coating, lining, or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Owner before attempting to install such valves.

D. Only new valves will be allowed for installation and shall be stored in a manner to prevent damage and be kept free of dirt, mud, or other debris.

1.05 QUALIFICATIONS

A. All of the valves shall be products of well-established firms which are fully experienced, reputable, have been selling this product for a minimum of 10 years, and are qualified in the manufacture of the particular product furnished. The valves shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

1.06 VALVE TYPE CLASSIFICATIONS

A. Air Valves (Type 100 series):

1. Type 140: Air Valves for Sewage Services, Air Release.

B. Ball Valves (Type 200 series):

1. Type 221: Full-Port Threaded Stainless-Steel Ball Valves, 2 Inches and Smaller, for Water Service.

C. Check Valves (Type 400 series):

1. Type 420: Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and Larger.

D. Gate Valves (Type 600 series):

1. Type 680: Cast-Iron Resilient Wedge Gate Valves, 3 Inches through 20 Inches, for Exposed Service (AWWA C509).

PART 2 PRODUCTS

2.01 GENERAL

A. Valves are identified in the Drawings by size and type number. For example, a callout of 36V300 refers to a 36-inch-diameter Type 300 valve. A Type 300 valve

is a flanged, rubber-seated butterfly valve that is 4 inches through 72 inches for exposed service.

B. All valves shall be complete with all necessary geared actuators, chainwheels and chains, handwheels, levers, valve bonnets, valve boxes, extension stems, operating nuts, and T-handle wrenches, which are required for proper valve operating and completing of the work included under this Section. Renewable parts including discs, packing, and seats shall be of types specified in this Section and acceptable by valve manufacturer for the intended service. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached stainless-steel plate in raised embossed letters. All isolation valves shall be suitable for the intended service with bubble-tight shutoff to flow in either direction.

C. Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

D. Valves and valve operators shall be factory prepared and primed and field finish coated in accordance with Section 09900, Painting and Coating.

2.02 VALVE ACTUATORS

A. The valve actuator shall be an integral part of a valve. The valve actuator shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by the Owner.

B. All valves shall open counter-clockwise as viewed from the top. Unless otherwise required by the Owner, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counter-clockwise). Each valve body or actuator shall have the word "Open" cast on it and an arrow indicating the direction to open.

C. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be AISI

Type 304 stainless steel. Unless noted otherwise, valves shall be equipped with the following manual actuators:

1. Exposed Valves 6 Inches and Smaller: Removable lever or handwheel actuators.
2. Exposed Valves 8 Inches and Larger: Geared actuators with handwheels.
3. Buried or Submerged Valves 6 Inches and Smaller: 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and T-handle wrench.
4. Buried or Submerged Valves 8 Inches and Larger: Geared actuators with 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and wrench.

D. Levers or handwheels shall be provided to actuate the valves where the valves are within 6 feet and 7 inches from finished grade or the operating floor. Handwheels shall be constructed of ductile-iron. Levers and handwheels shall be coated in accordance with Section 09900, Painting and Coating. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

E. Chainwheel and guide actuators shall be provided for all exposed valves installed with their centerlines more than 6 feet and 9 inches above finished grade. Chainwheels shall be cast-iron with stainless-steel stem, clip, and pins. The actuating chain shall be AISI Type 304 stainless steel. Stainless-steel chain baskets shall also be provided with these units. Chainwheels shall be coated in accordance with Section 09900, Painting and Coating.

1. Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal.

F. Gear actuators for valves 8 inches through 20 inches shall be of the worm-and-gear or of the traveling-nut type. Gear actuators for valves 24 inches and larger shall be of the worm-and-gear type. Gear actuators for motorized valves shall be of the worm-and-gear type, regardless of size.

1. Gear actuators should be designed assuming that the differential pressure across the valves is equal to the test pressure of the connecting piping and assuming a line fluid temperature range of 33°F to 125°F, unless otherwise required in the detailed valve specifications.
2. Gear actuators shall be enclosed and oil lubricated with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves aboveground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug.

3. Traveling nut and worm-and-gear actuators shall be of the totally enclosed design and proportioned to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Stop-limiting devices shall be provided in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.
4. The self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B584, Alloy C86200) that is accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148/A148M, Grade 105-85) with thread ground and polished. Support worm-gear shafts at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

G. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

H. All buried valves shall have non-rising stems. All buried valves 3 feet below grade or deeper as measured at the valve centerline shall be furnished with an operator stem extension to extend the operating nut within 6 inches from the top of the valve box cover.

2.03 VALVE END CONNECTIONS

A. Provide valve end connections conforming to connected piping and as shown in the Drawings. Generally, all buried valves shall be mechanical joint type end connectors. Exposed valves shall be screwed-end, socket-weld end, or flanged to conform to adjacent exposed connected piping system.

B. Comply with the following standards:

1. Threaded: ASME B1.20.1.
2. Flanged: ASME B16.1 Class 125 unless other noted or AWWA C207.

3. Mechanical (gland) Type: AWWA C111/A21.11.
4. Soldered: ASME B16.18.

C. Nuts, Bolts, and Washers: Wetted or internal to be bronze or stainless-steel. Exposed to be zinc or cadmium-plated.

D. Epoxy Interior Coating: Provide epoxy coating for all interiors of ferrous valve body surfaces in accordance with AWWA C550. Coatings shall be NSF-approved for valves in all potable water piping services. Coatings shall not be required for stainless-steel valve interiors.

2.04 VALVE BOXES

A. All buried valves 2-inch size and larger shall be equipped with a standard cast-iron roadway valve box. Valve boxes shall be of the slip or sliding type with a round lid marked "Water" for potable water valves or “Sewer” for wastewater and a square lid marked “Reclaimed Water” for reclaimed water valves. The box shall be designed to prevent transfer of the surface loads directly to the valve or piping. Valve boxes must have a minimum adjustable range of 12 inches and a minimum inner diameter of 6 inches. All valve boxes and lids shall be produced from grey cast-iron conforming to the latest revision of specification for grey iron castings, ASTM A48/A48M, Class 20A-25A. All castings shall be true and free of holes and shall be cleaned according to good foundry practice, chipped and ground as needed to remove fins and rough places on castings. Valve boxes have to be rated to sustain FDOT H-20 loadings and have a minimum depth of 8 inches. The valve box lid shall fit flush in the top of the box without forcing and shall not rock, tip, or rattle.

B. Provide debris cap as required in the Drawings.

C. Coat buried cast-iron pieces as specified in Section 09900, Painting and Coating, System No. 21 or with fusion-bonded epoxy.

D. Valve boxes shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal.

2.05 EXTENSION STEMS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The

connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1-1/8
10, 12	1-1/4
14	1-3/8
16, 18	1-1/2
20, 24, 30, 36	1-3/4
42, 48, 54	2

C. Provide buried valves or valves located inside manholes or vaults with valve boxes cast in the manhole or vault roof with a valve position indicator designed to fit standard 5-1/4-inch valve boxes. The indicators shall show valve position and the direction and number of turns required to fully open (or close). All internal gearing shall be sealed. Ship each unit ready for field installation complete with valve box cast-iron adapter, capscrews, guide bushing, position indicator, flexible washer, centering plate, and 2-inch AWWA nut. Valve box and indicator shall be provided by the valve manufacturer. Indicators shall be Westran Position Indicator, Pratt Diviner, or equal.

2.06 FLOOR STANDS

A. When required by the installations, provide floor stands for the operation of valves. Floor stands shall be of the non-rising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

B. Provide Type 316 stainless-steel anchor bolts.

C. Provide Type 316 stainless-steel extension stems for valves in exposed service. Provide Type 316 stainless-steel stems for valves in submerged service.

D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide

bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be Type 316 stainless-steel. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.07 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

A. Bolts, nuts, and gaskets for flanged valves shall be as described in Section 15055, Piping Systems—General.

2.08 PAINTING AND COATING

A. Coat metal valves located aboveground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, coat valves as specified in Section 09900, Painting and Coating, System No. 12. Apply the specified prime and finish coat at the place of manufacture. The finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

B. Coat buried metal valves at the place of manufacture as specified in Section 09900, Painting and Coating, System No. 21.

C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture as specified in Section 09900, Painting and Coating, System No. 2.

D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless-steel pieces, as specified in Section 09900, Painting and Coating, System No. 2. Apply lining at the place of manufacture.

E. Coat floor stands as specified in Section 09900, Painting and Coating, System No. 12.

F. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

G. Measure the thickness of the valve interior linings as specified in Section 09900, Painting and Coating. Repair areas having insufficient film thickness as specified in Section 09900, Painting and Coating.

2.09 AIR VALVES (TYPE 100 SERIES)

A. General Description

1. All valves shall meet or exceed all applicable provisions of the latest revision of AWWA C512. All valves for drinking water services shall comply with NSF 61. Design pressure is 150 psig. Valves shall be operable for water temperatures of above freezing to 125°F.
2. All valves shall consist of a float or a float assembly. Valves shall be identified properly in plates attached permanently on the valve body. The body and cover shall be cast-iron ASTM A126, Class B, or ASTM A48/A48M, Class 35. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends. Threaded ends shall comply with ASME B1.20.1. Flanges shall comply with ASME B16.1, Class 125. All flanges shall be flat faced.
3. The float shall be Type 304 or 316 Stainless-Steel. For valves with inlet sizes less than 4 inches, the float shall be able to withstand a collapse pressure of 1,000 psig. For inlet sizes 4 inches and larger, the float shall be capable of withstanding collapse pressures of 750 psig. Trim shall be Type 304 or 316 Stainless-Steel. The valve seat shall be of EPDM or other rubber materials applicable to wastewater and sludge. The valve seat shall be easily removed and replaced in the field.
4. Drain/test ports on all valves with inlet size 1 inch or larger shall have two 1/2-inch NPT minimum plugged ports, one near the bottom of the valve body and the other near the top of the valve. The plug shall be of bronze, ASTM B584, Alloy C83600.

B. Type 140—Air Valves for Sewage Services, Air Release

1. Type 140 air valves for sewage service shall have elongated cylindrical chambers. All valves shall provide the following: 1/2-inch clearance around the float in the chamber; minimum size 1/2-inch isolation valve and quick-disconnect couplings at the valve venting for back-flushing; blowoff port and valve at the bottom of the chamber; and inlet valve at the valve inlet. A back-flushing assembly shall be provided for all valves. The back-flushing assembly shall consist of an inlet shutoff valve, a flush valve, a clear water inlet valve, rubber supply hose, and quick-disconnect couplings. Type 140 valves shall be air-release valves. Valves shall be APCO 450 Series, Val-Matic Model 49ABW, or equal.

2.10 BALL VALVES (TYPE 200 SERIES)

A. Type 221—Full-Port Threaded Stainless-Steel Ball Valves, 2 Inches and Smaller, for Water Service

1. Stainless-steel ball valves 2 inches and smaller for water service shall be rated at a minimum pressure of 1,000 psi WOG at a temperature of 100°F. Provide full-port ball and body design. Valve body, ball, and stem shall be Type 316 stainless-steel, ASTM A276/A276M or A351. Seat and seals shall be reinforced PTFE. Valves shall have lever actuators, plastic coated. Valves shall have screwed ends (ASME B1.20.1) and non-blowout stems. Valves shall be Worcester Series 59, Apollo 86A-100 Series, or approved equal.

2.11 CHECK VALVES (TYPE 400 SERIES)

A. Type 420—Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and larger:

1. Check valves 4 inches and larger shall be swing-check type with outside lever and weight and shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of cast-iron conforming to ASTM A126 Class B with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be 316 stainless-steel. The valve body shall be the full waterway type, designed to provide a net flow not less than the nominal inlet pipe size when swung open no more than 25º. The valve shall have a replaceable stainless-steel body seat, a cast-iron disc faced with a renewable resilient seat ring of rubber and held in place by stainless-steel screws. The disk arm shall be ductile-iron or steel, suspended from and keyed to a stainless-steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The check valve shall be GA Industries, Inc. Figure 220 Lever and Weight or approved equal.

2.12 GATE VALVES (TYPE 600 SERIES)

A. Type 680—Resilient Wedge Gate Valves, 3 Inches through 20 Inches for Exposed Service (AWWA C509)

1. Valves 3 inches and larger for exposed service operation shall be of cast-iron or ductile-iron body construction and conform to AWWA C509 for resilient seated gate valves. The valve design shall incorporate non-rising stems and "O" ring stem seals. Valves shall open counterclockwise. Valves shall be designed for bubble-tight shutoff to flow in either direction. Before shipment, the valve manufacturer shall test each valve to 200 psi pressure differential in both directions and provide a certificate to the Owner stating that each valve provided bubble-tight shutoff during testing. The valve interior shall be epoxy coated on the entire ferrous surface of the waterway. The valve exterior shall be coated in accordance with Section 09900, Painting and Coating.
2. Exposed valves 3 inches and larger shall be flanged.
3. Gate valves shall be manufactured by Mueller, American Flow Control, Kennedy, or approved equal.

PART 3 EXECUTION

3.01 JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

D. Install grooved-end couplings for valves in accordance with Section 15055, Piping Systems—General.

3.02 INSTALLING EXPOSED VALVES

A. Unless otherwise indicated in the Drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.03 INSTALLING BURIED VALVES

A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement as required on the Drawings, and place and compact the backfill to the height of the valve stem.

B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

D. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb but include a marker post. Cut the marker post from 4-inch-by-4-inch dense structural grade Douglas fir No. 2 or Southern Pine No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the valve, letter in black the word “VALVE” and the distance in feet from the marker post to the valve box cap.

E. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe.

3.04 INSTALLING EXTENSION STEM GUIDE BRACKETS

A. Install extension stem guide brackets at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.05 FIELD COATING BURIED VALVES

A. Coat flanges of buried valves and the flanges of the adjacent piping and the bolts and nuts of flanges and mechanical joints, as specified in Section 09900, Painting and Coating, System No. 12.

B. Wrap buried metal valves 6 inches and larger with polyethylene sheet as specified in Section 15155, Ductile Iron Pipe and Fittings.

3.06 VALVE LEAKAGE AND FIELD TESTING

A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 15144, Pressure Testing of Piping, for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

C. Test gear actuators through three full cycles from full-open to full-close without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 foot-pounds. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be lubricated in accordance with the manufacturer’s recommendations before operating.

END OF SECTION

SECTION 15125
PIPING APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all piping appurtenances as shown on the Drawings and as specified in this Section.

B. All piping appurtenances shall be of the size shown on the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Owner.

C. All piping appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon the body.

D. The piping appurtenances shall include, but not be limited to, the following:

1. Tapping Saddles.
2. Tapping Sleeves and Valves.
3. Pressure Gauge Assembly.
4. Annular Diaphragm Seal and Pressure Gauge Assembly.
5. Water Meter.
6. Corporation Stop.
7. Curb Stop.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Product technical submittal data shall contain the following information and data:

1. Acknowledgment that products submitted meet requirements of standards referenced.

2. Manufacturer’s installation instructions.

3. Expansion joints, flexible joints, couplings, adaptors, tapping sleeves, water meters, and other appurtenances:

    a. Pressure and temperature rating.
    b. Materials of construction.
    c. Linings.
    d. Dimensions and weight.
    e. Accessories.
    f. Manufacturer's product brochures, cut-sheets, and parts diagrams.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Iron and Steel Institute (AISI)

1. AISI Type 304L—Stainless Steel.
2. AISI Type 316—Stainless Steel, Annealed Sheet.

B. American Society for Testing and Materials (ASTM)

1. ASTM A536—Standard Specification for Ductile Iron Castings.
2. ASTM C285—Standard Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel.

C. American Society of Mechanical Engineers (ASME)

1. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standards.

D. American Water Works Association (AWWA)

1. AWWA C105/A21.5—Polyethylene Encasement for Ductile-Iron Pipe Systems.
2. AWWA C153/A21.53—Ductile-Iron Compact Fittings.
3. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
4. AWWA C210—Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
5. AWWA C213—Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.

6. AWWA C500—Metal-Seated Gate Valves for Water Supply Service.
7. AWWA C502—Dry-Barrel Fire Hydrants.
8. AWWA C700—Standard for Cold-Water Meters—Displacement Type, Metal Alloy Main Case.
9. AWWA C800—Underground Service Line Valves and Fittings.

E. National Sanitation Foundation (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.04 DELIVERY, HANDLING, AND STORAGE

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

B. All piping appurtenances, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall any piping appurtenances be dropped, skidded, or rolled.

C. Slings, hooks, or tongs used for lifting shall be padded to prevent damage to exterior surface or interior linings of piping appurtenances. If any part of the coating, lining, or components is damaged, the Contractor shall make repairs or replacement at his expense and in a manner satisfactory to the Owner before attempting to install such piping appurtenances.

D. Only new piping appurtenances will be allowed for installation and shall be stored to prevent damage and be kept free of dirt, mud, or other debris.

1.05 QUALIFICATIONS

A. All of the piping appurtenances shall be products of well-established firms that are fully experienced, reputable, have been selling this product for a minimum of 10 years, and qualified in the manufacture of the particular product furnished. The piping appurtenances shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

PART 2 PRODUCTS

2.01 TAPPING SADDLE

A. Saddle body shall be made of malleable iron, ductile iron, or bronze. Malleable iron and ductile iron shall be epoxy or nylon coated. Saddles shall be of the

single- or multiple-strap design (multiple straps are required for sizes 10 inches and above). The straps shall be made from Type 304 stainless steel or bronze. The straps shall have a nominal width of 2 inches. Strap studs shall be made from AISI Type 304L stainless steel.

B. Nuts and washers shall be made from Type 304 stainless steel and shall be treated to prevent galling. The straps shall have a curvature accurately formed to meet the diameter of the pipe on which the service saddle is to be installed. A Neoprene gasket shall be securely glued to or imbedded in the body of the clamp to ensure positive sealing against the pipe. Outlet sizes of 3/4 inch and 1 inch shall have female C.C. thread while the outlet for 1-1/2 inches and 2 inches shall be female I.P. thread.

C. Tapping saddles shall not be used on HDPE due to expansion and contraction problems unless specifically approved in writing by the Owner on a case-by-case basis.

2.02 TAPPING SLEEVES AND VALVES

A. Tapping sleeves and valves shall be designed for a minimum water working pressure of 150 psi and shall be tested at 300 psi. The design shall allow for the insertion of bolts from either side and the internal seal is to be the "O-ring" type. The tapping sleeve shall be furnished complete with bolts, nuts, and gaskets.

B. With the exception of the valve ends and other modifications necessary for tapping service, tapping valves shall conform to AWWA C500 and shall be Mueller "No. T-2360" or approved equal. Each tapping valve shall be provided with a flanged inlet end designed, faced, and drilled for attachment to the outlet flange of the tapping sleeve; an outlet end provided with a tapping flange for attachment of a standard drilling machine; and a mechanical-joint-type bell end for connection of the branch main.

C. Tapping sleeves for 4-inch- through 24-inch-diameter pipe shall be epoxy-coated fabricated-steel construction and manufactured to meet material specification ASTM C285 Grade C for the body. The flange shall conform to AWWA C207 Class D and have an ANSI 150-pound drilling and recessed for tapping valve.

D. Tapping sleeves shall be of the flanged outlet type designed for attachment to the flanged inlet end of the tapping valve and shall be provided with mechanical joint ends at each end of the run. Tapping sleeves shall be Mueller "No. H-615" or approved equal.

2.03 PRESSURE-GAUGE ASSEMBLY

A. Pressure-gauge assemblies shall be provided at locations shown on the Drawings. All pressure-gauge assemblies shall include a pressure gauge, AISI Type 316 stainless steel, NPT threaded ball valves for isolation and venting, and sensor piping. Sensor piping tubing and fittings shall be Type 316 stainless steel. The pressure gauge shall be constructed of Type 316 stainless-steel wetted parts and Type 304 stainless-steel case and bayonet ring, adjustable pointer, laminated safety-glass window, glycerin liquid-filled case, 1.5% span accuracy, and shall have a 2.5-inch-diameter dial size, minimum. The pressure gauge shall be as manufactured by WIKA Instrument Corporation, Type LM 233.54, or approved equal.

B. The Contractor shall furnish and install pressure-gauge assemblies with pressure-gauge ranges as follows and/or shown on the Drawings.

2.04 ANNULAR DIAPHRAGM SEAL AND PRESSURE GAUGE ASSEMBLY

A. Annular diaphragm seal and pressure gauge assemblies shall be provided at locations shown on the Drawings. All annular diaphragm-seal pressure gauge assemblies shall include an ethylene-glycol factory liquid-filled pressure-gauge and an annular seal assembly factory calibrated and ready for field installation. The annular seal assembly shall consist of a Buna-N diaphragm annual seal sleeve, carbon steel body, and ASME B16.5 Class 150 full-faced flanges (through bolted configuration). Pressure gauges shall be constructed with a stainless steel case. Annular diaphragm seal and pressure-gauge assemblies shall be as manufactured by the Red Valve Company, Incorporated, Series 48, or approved equal.

2.05 WATER METER

A. 12-Inch Magnetic Flow Meter

1. The flow element shall be of the electromagnetic type using the pulsed DC-type coil excitation principle with high preamp input impedance. The flow measuring system, consisting of flow element, transmitter, and appurtenances, shall have an overall accuracy of 1% of rate with a 10:1 turndown for all flows resulting from pipe velocities of 1 to 33 feet per second. The system shall operate on 120-volt (10%), 60-Hz power. The unit shall have a zero-stability feature thereby eliminating the need to stop flow to check zero alignment.
2. The flow element shall be watertight NEMA 4 construction unless otherwise noted. The meter shall consist of a 316 stainless steel meter tube, 150-pound ANSI carbon steel raised face flanges, Teflon liner, and

316 stainless steel electrodes, unless otherwise noted. Electrodes shall be flush or bullet-nose type. Meters 4 inches and smaller with Teflon liners shall be wafer-style design. Suitable covers shall be provided for flow element ends to protect the tube liner during shipment. The unit shall be furnished with grounding rings or shall be provided with built-in grounding electrodes.

3. The remote flow transmitter shall indicate flow rate and totalized flow, be suitable for pipe stand mounting, and be furnished with integral indicators and totalizers. The transmitter output shall be a 4 to 20mA DC signal in linear proportion to flow and shall drive loads with impedances in the range of 0 to 800 ohms without load adjustments for a 24 VDC supply. Output span and zero shall be manually adjustable. Both transmitter and primary element shall be powered from the same 120-volt, 60-Hz source.
4. Sufficient special cable(s) shall be provided for interconnection between the flow element and the transmitter. Cable(s) shall facilitate signal and power for the flow element (120-volt, 60-Hz power shall be made available at the transmitter).
5. For each size of flow tube, provide one spool piece with identical laying length and flanges. Provide lifting rings on each spool piece to facilitate the replacement of a flow tube by the spool piece.
6. Provide stainless steel sunshield and transient surge protection for the incoming 120 VAC and DC signals as manufactured by EDCO, SLAC series. Transient surge protection shall be mounted in a stainless steel box.
7. The manufacturer of the flow meter shall be Krohne Optiflux 2300, or approved equal.

2.06 CORPORATION STOPS

A. Corporation stops (through 2 inches in diameter) shall be manufactured from cast bronze with machined fitting surfaces and in accordance with AWWA C800. Corporation stops shall withstand a minimum working pressure of 200 psi and be constructed for direct buried service. The inlet and outlet connections shall be coordinated to connect to the adjoining equipment, tubing, piping, couplings, unions, adapters, reducers, etc. by the Contractor. The inlet and outlet size shall be the same. The corporation stop outlet shall have the required all-bronze adapters, unions, reducers, bushings, or couplings to properly secure to the adjacent items and appurtenances. Corporation stops shall be Model FB series as manufactured by Ford Meter Box Company, Inc., or approved equal. Each corporation stop shall be furnished with a solid bronze square-head plug for plugging the corporation stop outlet. Ford stainless-steel insert stiffeners shall be used as required for connection to tubing, PVC pipe, HDPE pipe, or as required.

2.07 CURB STOPS

A. Curb stops shall be manufactured from cast bronze with machined fitting surfaces. Curb stops shall withstand a minimum working pressure of 150 psi. For curb stops (through 2 inches in diameter), the inlet and outlet connections shall be threaded or have 2-hole flanges to connect to the adjoining equipment, tubing, piping, couplings, unions, adapters, reducers, etc. as coordinated by the Contractor. The nuts and bolts for the flanges shall be cadmium-coated or zinc-plated. The inlet and outlet size shall be the same diameter, unless otherwise approved by the Owner. The curb stop inlet and outlet shall have the required all-bronze adapters, unions, bushings, or couplings to properly secure it to the adjacent items and appurtenances. Curb stops shall have padlock wings and be lockable with standard size padlocks. Curb stops shall be as manufactured by Ford Meter Box Company, Inc., or approved equal. Each curb stop shall be furnished with a solid bronze square-head plug for plugging the curb stop outlet. Ford stainless-steel insert stiffeners shall be used as required for connection to tubing, PVC pipe, HDPE pipe, or as required.

B. Buried curb stops shall be equipped with a standard cast-iron roadway valve box. The valve box is specified in Section 15110, Manual, Check, and Process Valves.

2.08 TOOLS

A. If required for normal operation and maintenance, special tools shall be supplied with the equipment. Two T-handle wrenches to operate standard 2-inch nuts on buried valves and buried valve actuators shall be provided as part of the work.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall install all piping appurtenances as shown on the Drawings.

B. All piping appurtenances shall be installed in the location shown, unless approved otherwise, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Owner.

C. Install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and shall be responsible for the proper location of these piping appurtenances during the construction of the structures.

3.02 SHOP PAINTING

A. Exterior surfaces of ferrous valves and piping appurtenances shall be painted in accordance with Section 09900, Painting and Coating, unless noted or specified otherwise.

3.03 INSPECTION AND TESTING

A. Completed valves and piping appurtenances shall be subjected to hydrostatic pressure test as described in Section 15055, Piping Systems—General, and the detail pipe sections of these Specifications. All leaks in valves and piping appurtenances shall be repaired and lines retested as approved by the Owner. Before testing, the valves and pipelines shall be supported and thrust restrained for forces in excess of the test pressure to prevent movement during tests.

END OF SECTION

SECTION 15144
PRESSURE TESTING OF PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the hydrostatic, pneumatic, and leakage testing of piping for pumping stations, wastewater treatment plants, water treatment plants, and other facilities; water distribution and transmission mains; and raw sewage and stormwater force mains.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

B. Six copies of the test records to the Owner upon completion of the testing.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Water Works Association (AWWA)

1. AWWA C600—Installation of Ductile Iron Mains and Their Appurtenances.
2. AWWA C605—Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

1.04 TEST PRESSURES

A. At a minimum, the Contractor shall perform a pressure and leakage test on pressure pipes at 1.5 times the maximum system pressure or 100 psi, whichever is greater (based on the elevation or the lowest point of the section under test and corrected for gauge location).

1.05 TESTING RECORDS

A. The Contractor shall provide records of each piping installation during the testing. These records shall include the following information:

1. Date and times of test.
2. Identification of process, pipeline, or pipeline section tested or retested.
3. Identification of pipeline material.
4. Identification of pipe specification.
5. Test fluid.
6. Test duration.

B. Test pressure at low point in process, pipeline, or pipeline section.

C. Remarks: Leaks identified (type and location), types of repairs, or corrections made.

D. Certification by Contractor that the leakage rate measured conformed to the Specifications.

PART 2 PRODUCTS

2.01 VENTS AND DRAINS FOR ABOVEGROUND PIPING

A. The Contractor shall install vents on the high points of aboveground piping, whether shown in the Drawings or not. Install drains on low points of aboveground piping, whether shown in the Drawings or not. Provide a valve at each vent or drain point. Valves shall be 3/4 inch for piping 3 inches and larger and 1/2 inch for piping smaller than 3 inches. Valves shall be ball or gate valves unless otherwise shown on the Drawings. Valves shall be rated for the pressure of the adjacent piping and shall be suitable for use with the adjacent pipe material.

2.02 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

A. The Contractor shall provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and, after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

2.03 TEST BULKHEADS

A. The Contractor shall design and fabricate test bulkheads in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall

comply with Part UCS of the code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.04 TESTING FLUID

A. Testing fluid shall be potable or surface water. The Contractor shall be responsible for arranging and paying for the water source. The City of West Melbourne owns the potable water mains in the vicinity of the pump station to be constructed along Coastal Lane.

B. The Contractor shall provide backflow prevention control for temporary connections to existing water mains.

2.05 TESTING EQUIPMENT

A. The Contractor shall provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing. The Contractor shall provide any necessary assistance required for testing.

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. Pipes shall be in place, backfilled, and anchored before beginning pressure testing.

B. The Contractor shall conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

C. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. However, perform the final pressure test after completely backfilling and compacting the trench.

D. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the Specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.

E. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing.

F. Before starting the test, the Contractor shall notify the Owner.

3.02 CLEANING

A. Before conducting hydrostatic tests, the Contractor shall flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes. Maintain a flushing velocity of at least 3 feet per second (fps) for water testing and at least 2,000 feet per minute (fpm) for pneumatic testing. Flush pipes for the period given by the formula:

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds).
L = pipe length (feet).

B. For pipelines 24 inches or larger in diameter, acceptable alternatives to flushing are use of high-pressure water jet, sweeping, or scrubbing. Water, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the pipe.

3.03 LENGTH OF TEST SECTION FOR BURIED PIPING

A. The maximum length of test section for buried pipe of 12 inches or smaller in diameter is 3,500 feet; for buried pipe larger than 12 inches, 1 mile. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

3.04 INITIAL PIPELINE FILLING FOR HYDROSTATIC TESTING

A. The maximum rate of filling shall not cause the water velocity in the pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

3.05 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

A. Before testing new pipelines that are to be connected to existing pipelines, the Contractor shall isolate the new line from the existing line by test bulkheads, spectacle flanges, or blind flanges. After the new line has been successfully tested, remove test bulkheads or flanges and connect to the existing piping.

3.06 HYDROSTATIC TESTING OF ABOVEGROUND OR EXPOSED PIPING

A. Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.

B. Subject the piping system to the test pressure as determined in Paragraph 1.04 above. Maintain the test pressure for a minimum of 2 hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

3.07 HYDROSTATIC TESTING OF BURIED PIPING

A. Where any section of the piping contains concrete thrust blocks or encasement, the Contractor shall not make the pressure test until at least 10 days after the concrete has been placed. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 24 hours to absorb water before conducting the pressure test.

B. Apply and maintain the test pressure by a positive displacement hydraulic force pump.

C. Maintain the test pressure for the 2 hours by restoring the pressure whenever it falls 5 psi.

D. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formulas:

PVC Pipe:

$$L = \frac{ND(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons).
N = number of rubber-gasketed joints in the pipe tested.
D = diameter of the pipe (inches).
P = specified test pressure (psig).
C = 7,400.

Ductile Iron Pipe:

$$L = \frac{SD(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons).
S = length of pipe tested (feet).
D = diameter of the pipe (inches).
P = specified test pressure (psig).
C = 133,200.

HDPE Pipe: As specified in Section 15146, High-Density Polyethylene (HDPE) Pipe.

E. The leakage test shall be a separate test following the pressure test and shall not be less than 2 hours long. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines that fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be removed and replaced.

F. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

G. Submit plan for testing to the Owner for review at least 10 days before starting the test.

H. Peening shall not be used to repair pinhole leaks in welded pipes. Any leakage in welded pipes shall be repaired by appropriate welding techniques.

I. Repair and retest any pipes showing leakage rates greater than that allowed in the criteria above.

3.08 REPETITION OF TEST

A. If the actual leakage exceeds the allowable leakage, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

3.09 BULKHEAD AND TEST FACILITY REMOVAL

A. After a satisfactory test, the Contractor shall remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings/linings.

END OF SECTION

SECTION 15146
HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Description: The Contractor shall provide all materials and incidentals, including piping, molded and ductile iron fittings, flanged adapters, flanged joints, mechanical joint adapters, hardware, and appurtenances for the HDPE piping systems shown on the Drawings and the Drawing Process Flow Identification.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance, and Section 15055, Piping Systems—General.

A. In general, shop drawings and related manufacturer's product certification shall be made in accordance with the General and Special Conditions of the Contract for approval before the manufacturer constructs or fabricates the material. The following items, which require shop drawings, are brought to the Contractor's attention. The list may not include all items for which shop drawing submittals are required to meet the requirements of the project.

1. Detail drawings of all classes of pipe, joints, and fittings.
2. Detail Drawings of all joints, including manufacturer's certified factory and/or laboratory test reports to confirm thrust-restraint capacities and restraining mechanism application.
3. Existing piping connection details.
4. Adapters for connection to mechanical joint valves and ductile iron pipe fittings.

B. Certification and test reports for the materials, manufacturing, and testing of the types of pipe supplied shall be furnished by the HDPE pipe manufacturer for the manufacturer's own products in accordance with the latest standards of the industry as described in this Section.

C. Provide a statement in writing from the HDPE pipe manufacturer that the manufacturer is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin to be used in the manufacture of the pipe for this project.

D. All persons making heat fusion joints shall receive training in the manufacturer's recommended procedures. The Contractor shall maintain records of trained

personnel and certify that training was received not more than 12 months before construction began. Additionally, the Contractor shall have worked on one or more projects involving combined installation of at least 10,000 feet of HDPE butt-fusion-welded pipe and shall provide the Owner with a written list of HDPE pipeline installation experience, including project location, date, Owner, and personnel assigned and installing on this project.

E. The pipe manufacturer shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be onsite to oversee all pipe joining. All costs for the manufacturer's representative shall be paid for by the Contractor.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
2. ASTM D3261—Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
3. ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
4. ASTM D4976—Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
5. ASTM F714—Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

B. American Water Works Association (AWWA)

1. AWWA C151/A21.51—Ductile Iron Pipe, Centrifugally Cast, for Water.
2. AWWA C901—Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch (13 mm) through 3-Inch (76 mm), for Water Service.
3. AWWA C906—Polyethylene (PE) Pressure Pipe and Fittings, 4-Inch through 65-Inch (100 mm Through 1,650 mm), for Waterworks.

C. International Organization for Standardization (ISO)

1. ISO 9001—Quality Management Systems – Requirements.

1.04 QUALITY ASSURANCE

A. The pipe and fitting manufacturer(s) shall have an established quality-control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination. The cell classification properties of the material shall be certified by the supplier and verified by the manufacturer's quality control.

1.05 TESTING REQUIREMENTS

A. See Section 15144, Pressure Testing of Piping.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. General

1. All HDPE shall be DriscoPlex PE 4710 HDPE; or approved equal.
2. All HDPE pipe 4 inches in diameter or greater shall have a ductile iron pipe outside diameter, and HDPE pipe 3 inches in diameter and smaller shall be IPS unless otherwise specified or shown in the Drawings.
3. Pipe and fittings shall be manufactured by an ISO 9001-certified manufacturer.

B. HDPE Pipe

1. HDPE pipe 4 inches in diameter and larger shall conform to material standard ASTM D3350 345434 E cell classification rated as PE 4710 by the Plastics Pipe Institute. Minimum pressure rating shall be in accordance with Piping Schedule Drawing or as specified in this Section. Minimum pressure rating shall be 200 psi SDR 11 (Standard Dimension Ratio) for pipe sizes greater than 4 inches in diameter. For pipe sizes 3 inches and smaller in diameter, the minimum pressure rating shall be 250 psi SDR 9.
2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light.
3. The maximum allowable hoop stress shall be 800 psi at 73.4ºF.
4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the requirements of the resin manufacturer to manufacture pipe from the resin used.

C. Fittings

1. The pipe manufacturer shall mold or fabricate the polyethylene fittings. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.

a. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the test required under ASTM D3261. The manufacturer shall submit samples from each molded fitting production lot to x-ray inspection for voids and shall certify that voids were not found.

(1) Polyethylene Flange Adapters: Flange adapter shall be made with sufficient throughbore length to be clamped in a butt fusion joining machine without the use of a subend holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to restrain the gasket against blow-out. Flange adapters shall be fitted with ductile-iron backup rings pressure rated equal to or greater than the mating pipe. The Contractor shall provide flat ring-type EPDM gaskets with gasket thickness and hardness as recommended by the pipe manufacturer for use with HDPE flanged joints. Provide carbon steel hardware (bolts, nuts, washers, etc.) conforming to ASTM A307, Grade B for use with the flange adapters assemblies in accordance with the pipe manufacturer's recommendations. Gaskets shall be made from material suitable for exposure to the liquid within the pipe.

b. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Pressure de-rated fittings are not acceptable. Directional fittings 16 inches IPS and larger, such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

2. HDPE Mechanical Joint Adapters.

a. The manufacturer of the HDPE pipe shall supply all HDPE mechanical joint adapters and accessories required to connect plain-end HDPE piping to mechanical joint fittings, valves, and appurtenances.

b. The HDPE mechanical joint adapter shall consist of:

(1) A molded or fabricated HDPE mechanical joint transition fitting.
(2) A Buna-N gasket for a D.I. mechanical joint.
(3) A ductile iron mechanical joint backup drive ring.
(4) Cor-Ten mechanical joint tee bolts.
(5) A stainless-steel sleeve stiffener molded or fabricated within the MJ end of the HDPE mechanical joint adapter fitting.

c. The HDPE mechanical joint adapter shall be connected to the HDPE pipe by a heat-fused joint on one end and connected to a ductile iron pipe valve, fitting, or appurtenance with the internally stiffened mechanical joint end.

d. The tee bolts and backup drive ring shall act as a joint restraint for connections to mechanical joints.

e. All molded fittings shall be fully pressure rated to match the SDR pipe pressure rating.

f. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

g. Solvent epoxy cementing and mechanical joining with bolt on wrap-around clamps shall not be used.

3. Ductile-iron fittings connected to HDPE pipe (4 inches and larger) shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

D. HDPE Pipe Jointing Method

1. HDPE pipe shall be jointed by butt fusion in accordance with the pipe manufacturer's directions and only for pipe within one SDR ratio of each other.

2. For SDR ratios that are two or more apart (i.e., SDR 21 to SDR 11), the joint shall be made using a restrained joint. Same-diameter pipe may be joined by using HDPE flange adapters and backup rings bolted to each other.
3. All HDPE pipe joined by butt fusion shall be made from the same class and type of raw material made by the same raw material supplier.
4. *Butt fusion* means the butt joining of the pipe by heat fusion aligned faces of the pipe ends (butts) in a suitable apparatus and joining under controlled pressure and alignment.
5. The external bead resulting from the butt-fusion process shall be visible and examined for complete butt-fusion 360^{o} around the pipe exterior.
6. Short spools of pipe between valves and fittings shall be ductile iron pipe, with all joints restrained for sizes 4 inches and larger. For 2-inch, the spool shall be Schedule 40 Type 304 stainless steel piping or Schedule 80 PVC piping with IP threads stainless steel or PVC fittings and all joints restrained.
7. Where approved by the Owner, the HDPE pipe and fittings may be fused with Electrofusion Couplings, as manufactured by Central Plastics Company, or approved equal. Technical information must be provided to demonstrate that the fused coupling will not compromise the structural integrity of the HDPE pipe.

2.02 LOCATOR WIRE

A. All HDPE piping shall be installed with two insulated 12-gauge minimum AWG solid strand copper wires for location purposes as specified in Section 15055, Piping Systems—General.

PART 3 EXECUTION

3.01 GENERAL

A. All polyethylene pipe shall be cut, fabricated, joined, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with HDPE pipe.

3.02 LAYING PIPE

A. Joints

1. All HDPE to HDPE pipe joints shall be joined by heat fusion that produces homogeneous, sealed, leak-tight joints.

2. Restrained mechanical joint adapters shall be provided at tie-ins with valves, ductile iron fittings, and other pipe materials.

B. Butt Fusion Testing

1. The Contractor shall test the first fusion of each day.
2. In testing, the fusion shall be allowed to cool completely and then fusion test straps shall be cut out. The test shall be a minimum of 12 inches or 30 times the wall thickness in length with the fusion in the center and a minimum of 1 inch or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. The Contractor shall not begin until a fusion test has passed the bent strap test.

C. Pipe Deflection

1. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed 75% of that recommended by the manufacturer.

D. Pipe Cutting

1. Cutting HDPE butt fusion connections to HDPE pipe, valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without damaging the pipe. Ends shall be cut square and perpendicular to the pipe axis.

3.03 FLUSHING AND CLEANING

A. Flushing and Cleaning shall be as specified in Section 15144, Pressure Testing of Piping.

3.04 TESTING AND LEAKAGE

A. Hydrostatic Tests—General

1. All testing shall comply with Section 15144, Pressure Testing of Piping, except as specified in this Section.

2. All field tests shall be made in the presence of the Owner. Except as otherwise directed, all pipelines shall be tested. All piping to operate under liquid pressure shall be tested in sections of approved length, typically from valve to valve and in no case longer than 2,000 feet.

3. Hydrostatic testing shall consist of a combined pressure test and leakage test. The field test pressure shall be as specified in Paragraph 1.04 in Section 15144, Pressure Testing of Piping. The pressure shall be applied by a pump connected to the pipe in a manner satisfactory to the Owner. The pump, pipe connection, and all necessary apparatus shall be furnished by the Contractor and shall be subject to the satisfaction of the Owner.

4. The maximum duration for any test, including initial pressurization, initial expansion, and time at test pressure, must not exceed 8 hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section and allow it to "relax" for at least 8 hours before bringing the test section up to test pressure again.

5. Monitored Make-Up Water Test: The test procedure consists of initial expansion and test phases.

    a. During the initial expansion phase, the test section is filled with water. Once the line is filled, make-up water is added at hourly intervals as required to maintain the test pressure for 3 hours.
    b. At the end of the initial expansion period, the addition of make-up water will cease. During the test phase the pipe will not have any water added to it for the following 2 hours. The 2 hours will be the actual leakage test. At the end of the 2-hour period, measured make-up water will be added to the pipe to return it to the original test pressure.
    c. If the amount of make-up water added is greater than calculated using the numbers listed below, the section being tested will be considered to have a leak. The leak shall be found and fixed at the Contractor's expense and that section of the line retested before continuing with subsequent leakage tests. Testing and repairs shall be repeated at the Contractor's expense until the amount of make-up water is less than the amount calculated using the numbers listed below.

ALLOWABLE FOR EXPANSION UNDER TEST PRESSURE*
POLYETHYLENE PIPE

Nominal Pipe Size (in.)	Allowances for Expansion (US Gal/100 Feet of Pipe)		
	1-Hour Test	2-Hour Test	3-Hour Test
2	0.08	0.12	0.15
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
24	4.5	8.9	13.3
30	6.2	12.6	19.1
36	9.0	18.0	27.0
42	12.0	24.0	36.0
48	15.0	27.0	43.0

*These allowances only apply to the test phase and not to the initial expansion phase.

END OF SECTION

SECTION 15155
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all materials and incidentals, including piping, fittings, flanged joints, mechanical joints, retainer glands, polyethylene bagging for buried ductile iron piping, fittings, valves, and appurtenances for the ductile iron piping systems required for the work shown on the Drawings.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. All ductile iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry where the material for this project is manufactured. The Contractor shall submit sworn certificates of such tests and their results.

B. Shop Drawings, including layout drawings, shall be submitted as specified in Section 15055, Piping Systems—General.

C. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
2. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

3. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
4. ASTM A536—Standard Specification for Ductile Iron Castings.
5. ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts.
6. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
7. ASTM C150/C150M—Standard Specification for Portland Cement.
8. ASTM C283—Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
9. ASTM D714—Standard Test Method for Evaluating Degree of Blistering of Paints.
10. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
11. ASTM D1238—Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
13. ASTM G95—Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Form).
2. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.

C. American Water Works Association (AWWA)

1. AWWA C104/A21.4—Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C150/A21.50—Thickness Design of Ductile-Iron Pipe.
6. AWWA C151/A21.51—Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153/A21.53—Ductile-Iron Compact Fittings.
8. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
9. AWWA C600—Installation of Ductile-Iron Mains and their Appurtenances.
10. AWWA C651—Disinfecting Water Mains.

D. International Organization for Standardization (ISO)

1. ISO 9001—Quality Management Systems – Requirements.

E. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.04 QUALITY ASSURANCE

A. Source Quality Control:

1. The ductile iron pipe manufacturer shall submit certification that the pipe and fitting products meet all tests required by AWWA C151/A21.51.
2. All materials shall be new and have a manufacturer's certificate verifying compliance to all tests and inspections as required in this Section. The weight, class, and casting period shall be shown on each piece of pipe. The manufacturer's "mark," the year produced, and the word "Ductile" or the letters "DI" shall be cast or stamped on all pipe.

1.05 TESTING REQUIREMENTS

A. See Section 15144, Pressure Testing of Piping, for testing requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. All ductile iron piping shall be designed and manufactured in accordance with AWWA C150/A21.50 and AWWA C151/A21.51 for the following minimum operating conditions:

1. The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi.

2. The external loads design criteria shall be for the minimum cover indicated on the Drawings at 120 pounds per cubic feet soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150/A21.50.

3. The horizontal deflection of cement-mortar-lined ductile iron pipe resulting from external load conditions shall not exceed 3% of the pipe diameter based on the trench design shown on the Drawings.

4. Pressure Class: All ductile iron piping shall meet the following minimum working pressure classes:

   a. 4 inches through 12 inches: 350 psi
   b. Pipe greater than 12 inches: 250 psi

2.02 JOINTS

A. Ductile iron fittings shall be furnished with push-on joint, mechanical joints, and flanged joint ends as shown on the Drawings and specified in this Section:

1. Push-On Joints: Push-on joints shall conform to AWWA C111/A21.11. Gaskets shall be Viton.
2. Mechanical Joints: All buried ductile iron fittings shall be furnished with mechanical joint ends unless noted otherwise. Mechanical joints shall conform to AWWA C111/A21.11. Glands shall be constructed of ductile iron.
3. Flanged Joints: Pipe for threaded flange fabrication shall be Special Thickness Class 53 in accordance with AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C115/A21.15. Bolt circle and bolt holes shall match those of ASME B16.1 Class 125 flanges. The flanges shall be rated for a maximum working pressure of 250 psi. Threaded flanges shall be individually fitted and machine tightened on the pipe ends. Flange facing shall be smooth or with shallow serrations in accordance with AWWA C115/A21.15.

2.03 FITTINGS

A. General: Ductile iron pipe fittings shall be the compact type meeting the requirements of AWWA C110/A21.10 and AWWA C153/A21.53 where applicable. Ductile iron fittings shall be cement lined and seal coated. Lining of fitting shall conform to lining specified for piping and service as specified on the Drawing—Flow Stream Identification. Fittings shall be manufactured in accordance with AWWA C110/A21.10. Where taps are shown on fittings, tapping bosses shall be provided. At a minimum, fittings shall have the same pressure rating as the connecting pipe.

1. Flanged Joint: AWWA C110/21.10 and ASME B16.1, faced and drilled 125-pound ANSI standard.

2. Mechanical Joint: AWWA C110/A21.10

a. Provide mechanical joint fittings for all buried fittings as shown in the Drawings, unless noted otherwise.
b. Provide specified gaskets.

2.04 LINING AND COATING

A. The Contractor shall provide lined ductile iron piping and fittings in accordance with the Drawings. The Contractor shall perform all field measurements confirming the accuracy of the piping sizes and lengths shown on the Drawings. The Contractor shall notify the Owner immediately before deviating from or altering the lining of ductile iron piping shown on the approved layout schedule.

B. Cement-Lined Ductile Iron Pipe and Fittings: Interior surfaces of all cement-lined ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104/A21.4, Portland cement mortar. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the Contractor shall repair or replace damaged or unsatisfactory portions with lining conforming to these Specifications at no additional cost to the Owner. Pipe linings for potable water lines shall be NSF 61 approved.

1. All ductile iron pipe and fittings cement-mortar linings shall be surface sealed with an asphaltic seal coating, 1 mil, in accordance with AWWA C104/A21.4.

2.05 MANUFACTURERS

A. Acceptable ductile iron pipe manufacturers include US Pipe, American Ductile Pipe, Griffin Pipe, or approved equal.

2.06 BOLTS

A. General: The Contractor shall provide carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Threads shall be as specified in ASME B1.1 coarse thread series, Class 2A external and Class 2B internal. Nuts, bolts, and gaskets for flanged fittings and blind flanges shall be designed to withstand the design and test pressure ratings for the pipe.

2.07 GASKETS

A. Gaskets for mechanical joints shall be compatible with stormwater pipe service. See Section 15055, Piping Systems—General, for gasket requirements.

B. Gaskets for flanged joints shall be 1/8-inch-thick, cloth-inserted rubber conforming to applicable parts of ASME B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage and reclaimed water lines. Gaskets shall be full-face type for 125-pound flanges.

2.08 RETAINER GLANDS

A. Retainer glands shall be provided for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Retainer glands shall be designed for joint retaining through the use of a follower gland and set screw-anchoring devices that impart multiple wedging action against the pipe. The mechanical joint-restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

1. Gland: Manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall match AWWA C111/A21.11 and AWWA C153/A21.53.

2. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist-off nut bolt to ensure the proper actuating of the restraining device. The twist-off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.

3. Joint Deflection: Retainer gland joint deflection shall be limited to manufacturer's recommended maximum deflection angle. Joint deflection shall be applied before the set screws are torqued.

4. Acceptable Manufacturers:

   a. EBAA Iron, Inc. – Megalug 1100 Series.
   b. Or approved equal.

2.09 EXTERNAL PIPE RESTRAINTS

A. Ductile iron pipe push-on (bell and spigot) joint restraint shall be provided by a restraining harness consisting of a restraint ring, connecting tie-rods, and split-ring assembly installed at all push-on joints. The restraint ring shall consist of wedging components made from 60-42-12 ductile iron conforming to ASTM A536 and wedges heat treated to minimum 370 BHN. Torque limiting twist-off nuts shall be provided on each wedge to ensure proper applied installation torque. The split ring shall be made from 60-42-12 ductile iron conforming to ASTM A536. The connecting rods shall be made of steel

conforming to AWWA C111/A12.11. Sizes 4- to 16-inch-diameter restraining harnesses shall have 350 psi maximum working pressure rating and 18- to 36-inch-diameter restraining harnesses shall have 250 psi maximum working pressure rating. All harnesses shall be designed with a 2-to-1 safety factor applied to the maximum working pressure rating.

B. Acceptable Manufacturers

1. EBAA Iron, Inc. – Series 1700.
2. Or approved equal.

2.10 INTERNAL PIPE RESTRAINT

A. Acceptable Manufacturers

1. American Ductile Iron Pipe:

a. Fast Grip ® Gasket.
b. Flex Ring ® Joint.

2. US Pipe:

a. Field Lok ® Gasket.
b. TR Flex Restrained Joint Pipe and Fittings.

3. Or Owner-approved equal.

2.11 POLYETHYLENE BAGGING

A. Polyethylene bagging for buried ductile iron pipe, fittings, and valves shall be 8 mils thickness minimum polyethylene, manufactured in accordance with ASTM D1238, Type I, Class C, Grade E1.

PART 3 EXECUTION

3.01 HANDLING PIPE AND FITTINGS

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, fitting, lining, and coating. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece that the Owner finds defective shall be installed. The Contractor shall repair any damage to the pipe and fittings coating and/or lining as directed by the Owner. If the Owner determines that the coating and/or lining cannot be repaired, the Contractor shall replace the damaged pipe and fittings at no additional compensation.

B. All pipe and fittings shall be subjected to a careful inspection immediately before installation.

C. If any defective pipe is discovered after it has been installed, the Contractor shall remove and replace it with a pipe in satisfactory condition at no additional expense to the Owner.

D. Ceramic epoxy and glass-lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

3.02 PIPE INSTALLATION

A. The Contractor shall provide and use proper implements, tools, and facilities for the safe and convenient performance of the work. All pipe, fittings, valves, and appurtenances shall be lowered carefully into the trench and at above-grade locations to prevent damage to the pipe, protective coating, lining, and polyethylene bagging. Under no circumstances shall pipeline materials be dropped off or dumped. A trench shall be dewatered before the pipe is installed.

B. The Contractor shall carefully examine all pipe fittings, valves, and other appurtenances for damage and other defects immediately before installation and before bagging buried ductile-iron pipe. The Contractor shall mark and hold defective materials for inspection by the Owner, who may prescribe corrective repairs or reject the materials.

C. The Contractor shall remove all lumps, blisters, and excess coating from the socket and plain ends of push-on joint pipe for buried service. The outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid in trench.

D. The Contractor shall prevent foreign material from entering the pipe while the pipe is being placed in the trench. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe.

E. As each length of buried pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

F. When pipe is not being laid, the open ends of pipe shall be closed by a watertight plug or other means approved by the Owner. When practical, the plug shall remain in place until the trench is pumped completely dry. Care shall be taken to prevent pipe flotation should the trench fill with water.

G. Trench width at the top of pipe, bedding conditions, and backfill placement and compaction shall be such that design loadings on the pipe will not be exceeded.

H. Joint Assembly: Pipe joints shall be assembled in accordance with the manufacturer's instructions and the requirements of AWWA C600.

1. Flanged Joint: Before connecting flanged pipe, the Contractor shall thoroughly clean all faces of the flanges of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper sealing of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
2. Push-On, Restrained Joint, or Mechanical Joint: The Contractor shall joint piping in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstance.

I. Pipe Deflection: When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed that shown in AWWA C600 and that recommended by the retainer gland manufacturer for mechanical joint pipe and fittings.

J. Pipe Cutting: For inserting valves, fittings, or closure pieces pipe shall be cut in a neat, workmanlike manner without damaging the pipe or lining. Ductile cast iron may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw, or oxyacetylene torch. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled.

3.03 ABOVE-GROUND PIPE INSTALLATION

A. The Contractor shall install pipe in horizontal or vertical planes, parallel or perpendicular to building surfaces unless otherwise shown. Support pipe and fittings to prevent strain on joints, valves, and equipment. Install flanged joints so that contact faces bear uniformly on the gasket. Tighten bolts in accordance with the pipe manufacturer's recommendations.

3.04 SURFACE PREPARATION AND PAINTING

A. All exposed pipe and fittings shall be painted as specified in Section 09900, Painting and Coating.

B. All buried steel bolts, nuts, washers, rods, harnesses, clamps, sleeves, and appurtenances shall be painted with System No. 21 as specified in Section 09900, Painting and Coating.

3.05 INSPECTION AND TESTING

A. See Section 15055, Piping Systems—General; and Section 15144, Pressure Testing of Piping.

END OF SECTION

SECTION 15250
SMALL-DIAMETER PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide small-diameter pipe and fittings (nominal diameters less than 4 inches unless noted otherwise on the Drawings) as shown on the Contract Drawings and described in Section 15055, Piping Systems—General.

1.02 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance, and Section 15055, Piping Systems—General.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A53/A53M—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A90/A90M—Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A105/A105M—Standard Specification for Carbon Steel Forgings for Piping Applications.
4. ASTM A182/A182M—Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
5. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and other Special Purpose Applications.
6. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
7. ASTM A312/A312M—Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenistic Stainless Steel Pipes.
8. ASTM A320/A320M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.

9. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
10. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
11. ASTM D2464—Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
12. ASTM D2466—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
13. ASTM D2467—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
14. ASTM D2564—Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
15. ASTM F439—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
16. ASTM F441/F441M—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
17. ASTM F493—Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
18. ASTM F656—Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
2. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standards.
3. ASME B16.11—Forge Fittings, Socket-Welding and Threaded.
4. ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
5. ASME B36.10M—Welded and Seamless Wrought Steel Pipe.
6. ASME B36.19M—Stainless Steel Pipe.

C. Plastic Pipe Institute (PPI)

1. PPI TR-31—Underground Installation of Polyolefin Piping.

D. National Sanitation Foundation (NSF)

1.04 QUALITY ASSURANCE

A. Piping materials and manufacturing shall adhere to the standards referenced in Section 15055, Piping Systems—General.

B. The Contractor shall strictly adhere to the manufacturer's written storage, handling, installation, and joining.

PART 2 PRODUCTS

2.01 GENERAL

A. All pipe joints and fittings shall have the same schedule, pressure ratings, thermal resistance, chemical resistance, and other pertinent properties as the pipe being joined or connected. Plastic fittings shall be manufactured of the same resin as used in the manufacture of the pipe being joined.

B. Each pipe length shall be clearly marked with the manufacturer's name or trademark, applicable ASTM standards, size, pressure rating, and/or schedule.

C. Provide line size reducing tees for connecting lateral or instrumentation to pipe systems. Seal threaded fittings with Teflon™ tape or Teflon™ paste. Engage threaded fittings in accordance with ASTM A53/A53M.

D. All flange bolts, nuts, and washers shall be AISI Type 304 stainless steel, ASTM A193/A193M, Grade B8M hex head bolts and ASTM A194/A194M, Grade 8M hex head nuts unless noted otherwise. Bolts shall be fabricated in accordance with ASME B18.2.1 and shall be provided with washers. Treat all bolts with anti-galling compound before assembly.

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Pipe: ASTM D1785, manufactured from Class 12454-B rigid PVC compounds with a hydrostatic design stress of 13.8 MPa (2,000 psi) designated as PVC 1120. Provide Schedule 40 PVC piping and socket welded fittings and Schedule 80 PVC threaded fittings, unless noted otherwise on the Drawings or in the Specifications.

B. Joints: Solvent-welded unless flanged or threaded joints are indicated on the Drawings or required for connection to equipment. Solvent cement shall be as specified in ASTM D2564 for PVC pipe and ASTM F493 for CPVC pipe.

C. Fittings

1. Solvent-welded: ASTM D2466 or D2467, manufactured from Class 12454-B rigid PVC compound; solvent cement conforming to ASTM D2564. Solvent cement shall be as specified in ASTM D2564 for PVC pipe and ASTM F493 for CPVC pipe.

2. Threaded: ASTM D2464 manufactured from Class 12454-B rigid PVC compound; thread tape of Teflon. Only Schedule 80 PVC threaded pipe fittings shall be used.

D. Flanges: PVC Schedule 80 ANSI Class 150 flanges manufactured from rigid PVC compounds conforming to ASTM D1784.

1. Gaskets: Flat-face elastomer as specified and compatible for pipe system service.
2. Bolts: AISI Type 304 stainless steel conforming to ASTM A320/A320M, Grade B.

E. Unions: ASTM D2467 manufactured from Class 12454-B rigid PVC compound with elastomer o-rings as specified and compatible for service. Schedule 40 or 80 to match adjacent piping.

2.03 HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

A. See Section 15146, High-Density Polyethylene (HDPE) Pipe.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. The Contractor shall lay and maintain all pipes straight and true to line in conformance with the lines, grades, and elevations indicated on the Drawings. Line and grade tolerances, where applicable, shall be in accordance with limits given for specific material.

B. Trenching, bedding, and backfill shall be in accordance with Section 02305, Earthwork for Utilities, and shall be installed in accordance with Section 15055, Piping Systems—General.

C. During laying operations, the Contractor shall not permit debris, tools, clothing, or similar items to be placed inside pipes. Pipe interior shall be free of mud and kept clean at all times. The Contractor shall secure the open ends of all piping at the end of construction each workday or any portion of a workday to prevent the intrusion of debris, precipitation, or soil from erosion. The proposed method of securing pipe open ends shall be approved by the Owner. If the Contractor fails to secure piping of if the secured end is dislodged, the Owner shall require the Contractor to flush all affected piping to remove accumulated debris and verify that the piping is free of debris using a method acceptable to the Owner, at no additional cost to the Owner.

D. Pipe ends shall be kept clear and clean and the Contractor shall ensure that inside surfaces are maintained smooth and free from any projections that may interfere with joint assembly or flow through the completed line.

E. The Contractor shall be careful when lowering pipe into trenches or on subgrade to prevent damage or twisting of the pipe. After laying and before completing backfill or cover operations, pipe shall be protected from any vehicular traffic.

F. Existing piping flanged joints that are disassembled by the Contractor shall be fitted with new gaskets, as specified, upon reassembly.

3.02 PRESSURE AND LEAKAGE TESTS

A. Pressure Testing

1. The Contractor shall pressure test and leak test all new PVC, stainless steel, CPVC, and galvanized steel piping shown on the Drawings, the Flow Stream Identification Drawing, and Section 15055, Piping Systems—General, and Section 15144, Pressure Testing of Piping.

END OF SECTION

SECTION 15291
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the work necessary to furnish, install, and complete the AWWA C900 DR 18DR 25 PVC pipe and ductile iron fittings specified.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. All PVC pipe and fittings to be installed under this Contract shall be inspected and tested at the location where the material for this project is manufactured. The Contract shall submit certificates of such tests and their results.

B. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society of Testing Materials (ASTM)

1. ASTM A242/A242M—Standard Specification for High-Strength Low-Alloy Structural Steel.
2. ASTM A536—Standard Specification for Ductile Iron Castings.
3. ASTM D2241—Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
4. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA)

1. AWWA C900—Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch Through 60-Inch (100 mm Through 1,500 mm).

PART 2 PRODUCTS

2.01 LARGE PVC PRESSURE PIPE

A. Large PVC Pressure Piping

1. Unless otherwise noted, PVC pressure pipe for nominal diameters 4 inches and larger shall conform to the requirements of AWWA C900 DR 18 with gasketed integral bell ends. Pipe shall be designed for maximum working pressure of not less than 150 psi. Pipe shall be made to ductile iron pipe ODs instead of IPS.

B. Bell and Spigot

1. Pipe joints shall be made with integral bell and spigot pipe ends. The bell shall consist of an integral thickened wall section designed to be at least as strong as the pipe wall. The bell shall be supplied with a factory glued rubber ring gasket that conforms to the manufacturer's standard dimensions and tolerances. The gasket shall meet the requirements of ASTM F477 "Elastomeric Seals (Gaskets) for Joining Plastic Pipe." PVC joints shall be "Ring-Tite" as manufactured by J-M Manufacturing Company, Inc. or an equal approved by the Owner. Nontoxic gasket lubricant shall be as specified by the pipe manufacturer.

C. Restrained Joints

1. The following pipe joints and fittings restraint methods can be used to prevent pipe joints and fittings from separating under pressure. No additional financial compensation will be provided to the Contractor for providing the following methods of restraint:

a. C-900 PVC pipe bell and spigot joints (4-inch- through 12-inch-diameter pipe) shall be restrained with the EBAA Iron MEGALUG® Series 1600 Restrainer or an equal approved by the Owner. The Series 1600 restrainers shall provide a minimum of 150-psi restraint to DR 18 (Class 150) pipe with a 3-to-1 safety factor. PVC pipe larger than 12 inches shall have bell and spigot restrained with the EBAA Iron MEGALUG® Series 2800 Restrainer or an equal approved by the Owner. The Series 2800 restrainers shall provide a minimum of 200 psi restraint to DR 18 (Class 235) pipe with a 2-to-1 safety factor. The restraining device and tee head bolts shall be manufactured of high-strength ductile iron meeting ASTM A536, Grade 65-42-10. Clamping bolts and

nuts shall be manufactured of corrosion-resistant, high-strength, low-alloy CORTEN steel meeting the requirements of ASTM A242/A242M.

b. Mechanical joint fittings used with PVC pipe (3-inch- through 36-inch-diameter DR 18 pipe) shall be restrained with the EBAA Iron MEGALUG® Series 2000 PV Restrainer or an equal approved by the Owner. The Series 2000 PV restrainers shall provide a minimum of 150-psi restraint with a 2 to 1 safety factor. The restraining device and Tee head bolts shall be manufactured of high-strength ductile iron meeting ASTM A536, Grade 65-42-10. Clamping bolts and nuts shall be manufactured of corrosion-resistant, high-strength, low-alloy CORTEN steel meeting the requirements of ASTM A242/A242M.

c. All parts of the joint restraint systems shall be coated with coal tar epoxy as in Section 09900, Painting and Coating, Mega-Bond coating system by EBAA Iron, Inc. or Owner-approved equal.

2.02 LARGE PVC PRESSURE PIPE FITTINGS

A. Fittings for use with large PVC pipe shall be ductile-iron fittings conforming to the requirements of mechanical joint fittings as specified in Section 15155, Ductile Iron Pipe and Fittings.

B. Exterior Coating

1. Exterior coating for fittings shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

C. Lining

1. Lining for fittings shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.
2. Any damaged lined areas shall be repaired in accordance with the manufacturer's recommendations so that the repaired area is equal to the undamaged lined areas.

2.03 SMALL PVC PRESSURE PIPE

A. See Section 15250, Small-Diameter Piping, for Schedule 40 and Schedule 80 PVC pipe.

PART 3 EXECUTION

3.01 EXAMINATION

A. The Contractor shall examine pipe and appurtenances shall be examined at the point of delivery. Material found to be defective due to manufacture or damage in shipment shall be rejected. Tests as specified in the applicable material standard may be performed to ensure conformance with the standard.

3.02 PIPE INSTALLATION

A. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, and valves shall be lowered carefully into the trench using suitable tools or equipment to prevent damage to pipeline materials. Under no circumstances shall pipeline materials be dropped or dumped into the trench. The trench shall be dewatered before installing the pipe in accordance with the Specifications.

B. The sealing surface of the pipe, the inside of the bell, and the inside of the gasket shall be cleaned immediately before assembly.

C. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

D. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

E. At all times when pipe laying is in progress, except when joining another piece of pipe, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Owner to prevent the entrance of objectionable materials. Care shall be taken to prevent pipe flotation.

F. Trench width at the top of the pipe, bedding conditions, and backfill placement and compaction shall be in accordance with the Contract Documents.

G. Joint Assembly

1. Pipe joints shall be assembled in accordance with the manufacturer’s instructions.

H. Pipe Deflection

1. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, the amount of deflecting shall not exceed 75% of that recommended by the manufacturer.

I. Pipe Cutting

1. Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without creating damage to the pipe. Ends shall be cut square and perpendicular to the pipe axis.
2. Burrs shall be removed from spigots, and ends shall be smoothly beveled. Field cut ends shall be marked for proper depth of joint assembly.

J. Thrust Restraint

1. All pipe, tees, valves, bends, etc., unless otherwise specified, shall be restrained using mechanical means as specified. Pipe restraint using the specified mechanical restraining system with the restrained joint schedule or tie-rods is also acceptable. Reaction blocking shall not be used on this project.
2. All ductile iron fittings, valves, mechanical restraint harnesses, and other forms of mechanical restraint shall be installed and wrapped in polyethylene tube material as specified in Section 15155, Ductile Iron Pipe and Fittings.

3.03 LOCATION AND IDENTIFICATION

A. All non-metallic stormwater mains shall be installed with a continuous, insulated 10-gauge copper wire in accordance to Section 15055, Piping Systems—General.

3.04 TESTING

A. See Section 15144, Pressure Testing of Piping, for the requirements of pipe flushing, cleaning, pressure and leakage testing, and inspection requirements.

END OF SECTION

DIVISION 16

ELECTRICAL

SECTION 16401
LOW-VOLTAGE ELECTRICAL WORK—GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary for a complete corrosion-resistant and operable electrical installation, including all fees, charges, and permits necessary. Work of this Section includes electrical installation requirements for equipment of other sections. This Section is general and may include specifications for materials and equipment not contained within the scope of this project.

B. The Contractor shall provide temporary and permanent electrical services of proper voltage and phase as required for the Project. All single-phase temporary receptacle outlets shall be provided with ground fault protection in accordance with NEC Article 590.6 and installed in accordance with NEC 406.8.

C. The Contractor shall coordinate the work of this Section with others involved in the construction of the project.

D. The Contractor shall coordinate with the local power company to schedule and arrange for connection of the proposed electrical systems to the electrical distribution system.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. The Contractor shall submit a complete list of materials and equipment to be incorporated in the work to the Owner for review within 30 days after the Award of Contract.

B. The list shall include catalog numbers, cut sheets, diagrams, and other descriptive data required to demonstrate conformance with the Specifications. Partial lists will not be acceptable.

C. The basis of acceptance shall be the manufacturer’s published ratings for the equipment. The manufacturer shall be regularly engaged in the manufacture of products specified.

D. Shop drawings shall be submitted for the following items of equipment:

1. Wiring Devices.
2. Safety Switches.
3. Circuit Breakers.
4. Motors.
5. Motor Starters.
6. Relays.
7. Control Devices.
8. Transformers.
9. Lighting Fixtures.
10. Concrete Posts/Poles.
11. Surge Protection Device.
12. Handholes and Pull Boxes.

E. Contents of the shop drawings shall include the following:

1. Details of construction, outline, and assembly drawings.
2. Dimensions.
3. Materials.
4. Finish.
5. Ratings.
6. Accessories.
7. Trim.
8. Engineering data.
9. Ladder-type schematic control diagrams and wiring diagrams.
10. Calculations for harmonic current and voltage distortion.
11. Test Equipment datasheets and proposed test procedures for testing the grounding system.

F. The Contractor shall submit the manufacturer's literature for the equipment listed in Paragraph 1.02.D above to the Owner for review, including the following:

1. Written description of equipment function, normal operating characteristics and limiting conditions.
2. Recommended assembly, installation, alignment, adjustment, and calibration instructions.
3. Operating instructions.
4. Guide to troubleshooting.
5. Maintenance instructions and timetables.
6. Parts List and an assembly drawing with the parts identified.

G. Surge protection device submittals shall include the following:

1. UL 1449 peak let-through voltage documentation.
2. Category C3 peak let-through voltage test results.

1.03 REFERENCES

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American National Standards Institute (ANSI)

1. ANSI C12.20—Electricity Meters 0.1, 0.2, and 0.5 Accuracy Classes.
2. ANSI C80.1—Electrical Rigid Steel Conduit.
3. ANSI C82.9—Lamp Ballasts – High-Intensity Discharge and Low-Pressure Sodium Lamps – Definitions.

B. American Society for Testing and Materials (ASTM)

1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
2. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
3. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM B8—Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. American Bearing Manufacturers Association (ABMA)

1. ABMA STD 20—Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types, Metric Design.

D. Federal Specifications and Standards (FSS)

1. FSS A-A-50552—Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.
2. FSS A-A-50553A—Fittings for Conduit, Metal (Thick-Wall (Rigid) and Thin-Wall (EMT) Type).
3. FSS A-A-50563A—Conduit Outlet Boxes, Bodies and Entrance Caps, Electrical: Cast Metal.
4. FSS A-A-55809B—Insulation Tape, Electrical, Pressure-Sensitive Plastic.
5. FSS A-A-55810—Conduit, Metal, Flexible.
6. FSS A-A-59213—Splice Connectors.

7. FSS A-A-59544—Cable and Wire, Electrical (Power, Fixed Installation).
8. FSS W-C-375D—Circuit Breakers, Molded Case; Branch Circuit and Service.
9. FSS W-C-596G/GEN—Connector, Electrical Power (General Specification).
10. FSS W-S-896G—Switches, Toggle (Toggle and Lock), Flush-Mounted (General Specification).

E. Illuminating Engineering Society of North America (IESNA)

1. LM-79—Electrical and Photometric Measurements of Solid-State Lighting Products
2. LM-80—Measuring Lumen Maintenance of LED Light Sources

F. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 112—Standard Test Procedure for Polyphase Induction Motors and Generators.
2. IEEE 117—Standard Test Procedure for Thermal Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery.
3. IEEE 519—Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
4. IEEE C2—National Electrical Safety Code (NESC).
5. IEEE C62.41.1—Guide on the Surges Environment in Low-Voltage (1,000 V and Less) AC Power Circuits.
6. IEEE C62.45—Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

G. Intertek

1. ETL-PVC-001—Independent third-party testing standard to signify compliance to coating adhesion performance.

H. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 1—Industrial Control and Systems: General Requirements.
2. NEMA ICS 6—Industrial Control and Systems: Enclosures.
3. NEMA MG 1—Motors and Generators.
4. NEMA PB 1—Panelboards.
5. NEMA ST 20—Dry Type Transformers for General Applications.
6. NEMA TC 2—Electric Polyvinyl Chloride (PVC) Conduit.
7. NEMA TC 3—Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
8. NEMA WD 1—General Color Requirements for Wiring Devices.

I. National Fire Protection Association (NFPA)

1. NFPA 70—National Electrical Code (NEC).
2. NFPA 101—Life Safety Code.

J. Underwriters Laboratories, Inc. (UL)

1. UL 6—Electrical Rigid Metal Conduit – Steel.
2. UL 50—Enclosures for Electrical Equipment, Non-Environmental Considerations.
3. UL 67—Standard for Panelboards.
4. UL 83—Thermoplastic-Insulated Wires and Cables.
5. UL 360—Standard for Liquid-Tight Flexible Metal Conduit.
6. UL 467—Grounding and Bonding Equipment.
7. UL 489—Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
8. UL 498—Standard for Attachment Plugs and Receptacles.
9. UL 508—Standard for Industrial Control Equipment.
10. UL 510—Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
11. UL 514A—Metallic Outlet Boxes.
12. UL 514B—Conduit, Tubing, and Cable Fittings.
13. UL 514C—Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
14. UL 651—Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
15. UL 797—Electrical Metallic Tubing - Steel.
16. UL 844—Standard for Luminaires for Use in Hazardous (Classified) Locations
17. UL 1029—Standard for High-Intensity-Discharge Lamp Ballasts.
18. UL 1449—Standard for Surge Protective Devices.
19. UL 1598— Standard for Safety Luminaires
20. UL 1660—Liquid-Tight Flexible Nonmetallic Conduit.

1.04 QUALITY ASSURANCE

A. PVC-coated metal conduit must comply with UL6 for safety and ETL PVC-001 for performance.

1.05 WARRANTIES

A. Warranties shall be in accordance with Section 01780, Warranties and Bonds.

B. All equipment and materials supplied shall be warranted against defective design, materials, and workmanship for a minimum of 1 year, or as specified in this Section, against normal use. The warranty period shall begin once the total project is accepted by the Owner and shall cover replacement of equipment and/or repair, including labor, travel time, and miscellaneous expenses at no cost to the Owner for the full warranty period.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storage and protection of the items specified in this Section.

B. The Contractor shall deliver materials with manufacturer's tags and labels and UL labels intact. Packaged material shall be delivered in the manufacturer's original, unopened containers bearing the manufacturer's name, brand, and UL label. Materials and equipment shall be stored in a dry, clean location. Handle and store so as to avoid damage. Items delivered in broken, damaged, rusted, or unlabeled condition shall be removed from the project site immediately and replaced with acceptable items. The Contractor shall provide suitable protection of materials and equipment from dust and moisture. The Contractor shall be responsible for the condition of materials and equipment until they are accepted by the Owner.

1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. O&M Manuals shall be in accordance with Section 01830, Operations and Maintenance Manuals.

B. Before final acceptance of this project, an O&M Manual shall be submitted to the Owner. The manual shall include manufacturer's literature as outlined in Paragraph 1.02.F above, drawings corrected in accordance with shop drawing review comments, and including all modifications and lists of suppliers and/or service shops that can provide parts and accessories and equipment repair for the items of equipment listed in Paragraph 1.02.D above. The lists shall include a contact name, telephone number, and address.

C. A test report detailing the results of the grounding system test shall be provided with the O&M Manual.

1.08 CODES, INSPECTIONS, AND FEES

A. The Contractor shall obtain all necessary permits and inspections required for the work of this Section and pay all charges incidental to this work. The Contractor

shall deliver to the Owner all certificates of inspection issued by authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All material and equipment shall be new and listed or labeled for use within the United States by a Nationally Recognized Testing Laboratory (NRTL). Equipment shall be provided with a specific listing, such as UL, when indicated in this Section or in other portions of the Contract Documents. Only products by manufacturers regularly engaged in the production of specified units will be acceptable.

B. Where two or more units which perform the same function or are of the same class of equipment or materials are required, provide all units from a single manufacturer.

C. Provide materials and equipment of suitable composition to perform satisfactorily when exposed to corrosive conditions of the project site.

1. Provide breather and drain fittings in all raceways and enclosures where necessary to prevent condensation or trapping of moisture.
2. Provide heaters in all control panels to prevent condensation.

2.02 CONDUIT

A. Rigid Metal Conduit: Rigid metal conduit shall be zinc-coated steel and shall conform to UL 6. Fittings shall be cast or malleable iron, zinc-coated, and shall conform to FSS A-A-50563A and UL 514B.

1. PVC-coated rigid steel conduit, elbows, and fittings shall be coated with a bonded polyvinylchloride which is permanently fused on at the factory.

    a. Must meet UL6 safety standards and carry the ETL-PVC-001 verified label.
    b. Aboveground conduit system PVC coating shall have a minimum thickness of 40 mils. Couplings and condulets shall have overlapping pressure sealing sleeves.
    c. Below-ground conduit system PVC coating shall have a minimum thickness of 40 mils.
    d. Below-ground conduit system PVC coating for extreme corrosive conditions shall have a minimum thickness of 40 mils and shall have external and internal bonded coatings.

B. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be polyvinyl chloride compound and shall conform to NEMA TC-2 and UL 651. Conduit shall be sunlight resistant, rated for use with 90 °C conductors. Fittings shall be of the same polyvinyl chloride compound and from the same manufacture as the conduit and shall conform to NEMA TC-3 and UL 514B. Conduit and fittings shall be joined by a solvent cement. The type of cement and the procedure for application shall be as recommended by the conduit manufacturer. The conduit shall be Carlon Plus 40 and Plus 80, or equal.

C. Electrical Metallic Tubing: Electrical metallic tubing shall be zinc-coated steel and shall conform to UL 797. Fittings shall be compression type and shall conform to FSS A-A-50553A.

D. Flexible Metal Conduit: Flexible metal conduit shall be zinc-coated steel and shall conform to FSS A-A-55810. Fittings shall conform to FSS A-A-50552.

E. Liquidtight Flexible Metal Conduit: Liquidtight flexible metal conduit shall be made with galvanized steel flexible conduit covered with an extruded PVC jacket. Fittings shall be compression type specifically designed for use with flexible conduit and shall form watertight connections. Box connectors shall have an "O" ring between the fitting body and the enclosure.

F. Liquidtight Flexible Nonmetallic Conduit: Liquidtight flexible nonmetallic conduit shall be an assembly of a hard PVC spiral completely surrounded by flexible PVC. Conduit shall conform to UL 1660 for use as indicated in Article 351 of the NEC and shall be sunlight resistant.

1. Fittings shall be compression type designed for use with the flexible conduit. Box connectors shall have "O" ring between the fitting body and the enclosure.
2. Conduit shall be "Carflex" manufactured by Carlon, or equal.

2.03 BOXES

A. General: Boxes shall be sized as recommended by the NEC or as shown on the Drawings.

1. Boxes shall be nonmetallic or Code-gauge galvanized steel, stainless steel, or cast metal, as specified or shown on the Drawings.
2. Cast metal boxes shall be cast iron and shall be gasketed of the type indicated on the Drawings.

B. Outlet Boxes: Outlet boxes shall be sheet steel, cast metal, or nonmetallic.

1. Sheet steel boxes shall be cadmium-coated or zinc-coated.
2. Cast metal boxes shall conform to FSS A-A-50563A.
3. Non-metallic boxes shall conform to UL 514C.
4. Fixture outlet boxes and junction boxes shall be 4-inch, octagonal.
5. Switch and receptacle outlet boxes shall be 2 inches wide by 4 inches high by 2 inches deep.
6. Junction box extensions and covers shall conform to UL 514A.
7. Boxes installed in wet locations or on exterior surfaces shall be cast metal with gasketed covers.

2.04 WIRING DEVICES

A. Toggle Switches: Toggle switches shall be specification grade and shall conform to FSS W-S-896F(1) and shall be totally enclosed with bodies of molded compound and a mounting strap.

1. Handles shall be ivory.
2. Wiring terminals shall be screw type, back- or side-wired.
3. Switches shall be rated, quiet type, 20 amperes, 277 volts.
4. Switches shall be suitable for control of tungsten filament lamp loads with "T" marking of UL.
5. No more than one switch is allowed in a single gang position of a switch box.

B. Receptacles: Receptacles shall be specification grade and shall conform to FSS W-C-596G(2), NEMA WD-1 and UL 498.

1. Single and duplex receptacles for general purpose use shall be heavy-duty specification grade, 20 amperes, 125 volts, three-wire grounding, NEMA 5-20R.

2. Special purpose single receptacles shall be heavy-duty specification grade, 20 amperes, 250 volts, three-wire grounding, NEMA 6-20R, unless indicated otherwise on the Drawings.

3. Ground fault circuit interrupter receptacles shall be duplex, 20 amperes, 125 volts, three-wire grounding, NEMA 5-20R.

    a. Receptacles shall have a nominal sensitivity to ground leakage current of 4 to 6 milliamps and shall interrupt the current supply for any value of ground leakage current exceeding the trip level of

4 to 6 milliamps on the load side of the receptacle with a maximum tripping time of 1/30th of a second.

b. Receptacles shall provide protection for any device connected to the circuit beyond the receptacle.

c. Receptacles shall have test and reset buttons accessible on the face of the receptacle.

4. Receptacles shall be suitable for mounting in a standard outlet box and shall have a high-impact nylon face.

5. Wiring terminals shall be screw type, back- or side-wired.

6. Color of device face shall be ivory.

7. Receptacles shall be Leviton, Hubbell, Pass & Seymour or approved equal.

2.05 DEVICE PLATES

A. Cover Plates: Cover plates shall conform to UL 514A.

1. Furnish one-piece type to suit devices installed, with round or beveled edges.
2. Weatherproof switch cover plates shall be spring-loaded gasketed type with individual cover for each switch. Receptacle covers shall be weatherproof with or without the attachment plug cap inserted.
3. Waterproof receptacle cover plates shall have screw cap for each outlet. The plug shall have a matching screw attachment to maintain the rating when the plug is attached. The screw cap shall be permanently attached to the cover plate by a chain. A matching plug shall be provided for each cover plate.
4. Zinc-coated steel or cast-metal plates shall be used on unfinished walls.
5. Satin-finish stainless steel plates shall be used on finished walls.
6. The Contractor shall provide metal screws with countersunk heads and finish to match the finish of the plate.

2.06 WIRE AND CABLE

A. Conductors: All conductors shall be annealed soft drawn copper, conforming to ASTM B8, FSS A-A-59544, UL 83, and the latest requirements of the NEC. All

conductors shall have THW or THWN type insulation, rated at 600 volts, unless specifically noted otherwise.

1. Other types of insulation may be used as permitted by the NEC. The Contractor shall be responsible for change in conduit size and conductor size to maintain the ampacity of the circuit.
2. Wire #8 AWG and larger shall be stranded concentric lay. Wire sizes #14, #12, and #10 AWG shall be stranded for control and motor power and solid for light and receptacle circuits.
3. Conductors shall be as manufactured by General Cable Corp., BICC Cables Corp., ESSEX International, Inc., Southwire Company, Pirelli Cable Corp., or equal.
4. Conductors installed between Adjustable Speed Drives (ASD) and motors shall be shielded ASD cables for conductor sizes AWG 4/0 and below. ASD cables shall be rated for up to 1000V and have cross-linked polyethylene (XLPE) Type XHHW-2 insulation on current-carrying conductors. ASD cables with current-carrying conductors of size No 2 and smaller shall have an insulated grounding conductor. Larger cables may have insulated or bare grounding conductors. ASD cables shall have a braided or tape shield. The outer jacket shall be black sunlight and oil-resistant PVC. ASD cables shall be rated for 90°C in wet or dry locations and shall be suitable for direct burial. ASD cables shall be designed specifically for use in ASD applications. The Contractor shall install the ASD cables in accordance with the cable manufacturer's and the ASD manufacturer's recommendations. ASD cables shall be manufactured by Belden, or approved equal.

B. Conductor splices shall conform to FSS A-A-59213. Acceptable: Scotchcast Splicing Kit, 3M Company. Plastic tape shall conform to FSS A-A-55809A.

2.07 PANELBOARDS

A. Panelboards shall be Type 1, Class 1 circuit-breaker type, conforming to FSS W-P-115C, as indicated on the panelboard schedules and where shown on the Drawings. Panelboards shall be of a dead-front safety type, equipped with thermal-magnetic molded case, bolted-in circuit breakers. Bus structure and main lugs or the main breaker shall have current and voltage ratings as shown on the panelboard schedules. Such ratings shall be established by heat rise tests, with the maximum hot spot on any bus bar or connections not to exceed a 50°C rise above ambient. All current-carrying parts of the bus assembly shall be copper.

B. The panelboard bus assembly shall be enclosed in a steel cabinet for surface mounting or mounting within a motor control center (MCC). The size of the wiring gutters and gauge of steel shall be in accordance with NEMA PB 1 and

UL 67 for electric panelboards. The box shall be fabricated from galvanized steel or equivalent rust-resistant steel. Fronts shall include doors and shall have flush, brushed stainless steel cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Fronts shall have adjustable indicating trim clamps. Doors shall be mounted by concealed steel hinges. Fronts shall not be removable with the door in the locked position. Complete panelboard enclosure shall be of Code-gauge, full-finished steel with rust-inhibiting primer and baked enamel finish.

C. A directory card shall provide a space for each circuit and shall designate the type of load (lights, receptacle, or equipment name). Entries on the directory card shall be typewritten.

D. Circuit breakers shall be arranged and numbered as shown on the panelboard schedule. Circuit numbering shall be such that, starting at the top, odd numbers shall be used in sequence down the left-hand side and even numbers shall be used in sequence down the right-hand side. Connect adjacent breaker poles to Line 1 and Line 2, respectively, and maintain the same relationship of sequence.

E. Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified. Terminals for branch circuit wiring, breaker, neutral, and ground shall be UL listed as suitable for the type of conductor specified.

F. All panelboards shall be equipped with a copper neutral bus bar and separate copper equipment grounding bar.

G. Panelboard circuit breakers shall comply with FSS W-C-375C.

1. All molded-case circuit breakers shall be quick-make, quick-break, thermal-magnetic with trip indication and have common trip on all multi-pole breakers. Trip indication shall be clearly shown by the breaker handle taking a position between ON and OFF when the breaker is tripped.
2. All breakers shall be calibrated for operation in an ambient temperature of 40°C.
3. The circuit breakers shall be labeled or imprinted on the case with frame size, trip size, voltage rating, UL approval, and shall be sealed at the factory.

H. The panelboards shall have a single integrated equipment fault current interrupting the rating as shown on the panelboard schedules. The rating shall be indicated on the equipment nameplate.

I. The panelboard assembly shall be designed such that any individual breaker can be removed without disturbing an adjacent unit, loosening or removing supplemental insulation supplied as a means of obtaining clearances, or affecting other requirements of UL.

J. Panelboards shall be listed by Underwriters Laboratories and bear the UL label and shall be rated for service entrance use where required. Panelboards shall be as manufactured by Square D, General Electric, Cutler-Hammer, or Siemens. Panelboard installed in MCC shall be of the same manufacture as the MCC.

2.08 SAFETY SWITCHES

A. Safety switches shall be NEMA heavy-duty type and UL listed. Switches shall be rated as indicated on the Drawings.

1. All switches shall have switch blades which are fully visible in the OFF position when the door is open. Switches shall have permanently attached arc suppressors, hinged or otherwise attached to permit easy access to line-side lugs without removal of the arc suppressor. Lugs shall be UL listed for copper and aluminum cables and front removable. All current-carrying parts shall be plated by electrolytic processes.
2. Switches shall have a quick-make and quick-break operating handle and mechanism which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for padlocking in the OFF position only, with at least three padlocks. Switches shall have a dual-cover interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open.

B. Enclosures: Switches installed indoors shall be furnished in NEMA 1 general-purpose enclosure with knockouts, unless otherwise specified. Switches located outdoors shall be furnished in NEMA 3R or NEMA 4X enclosures as indicated on the Drawings.

1. Covers on NEMA 1 enclosures shall be attached with butt-type pin hinges.
2. NEMA 3R switches through 200 amperes shall be provided with closing caps and/or interchangeable hubs as required. Rain-tight covers shall be securable in the open position.
3. NEMA 4X switches shall be furnished in stainless steel enclosures without knockouts. The means of sealing the cover shall be positive, with 30- through 200-ampere switches having quick release latches with pin type hinges and gaskets. Enclosures shall be of Code-gauge stainless steel.

C. The switch jaws shall be multi-spring type for positive grip of the switch blades. The fuse clips shall be spring-reinforced, positive-pressure type, or electrolytic copper.

D. Switches shall be as manufactured by Square D, General Electric, Cutler-Hammer, or Siemens. All switches shall be by the same manufacturer.

2.09 CIRCUIT BREAKERS

A. The Contractor shall provide molded-case thermal magnetic circuit breakers of the type, size, and electrical characteristics specified or indicated on the Drawings. Circuit breakers used as service entrance disconnects shall be suitable and rated as service entrance equipment.

B. Circuit breakers shall be of single-unit construction, and multi-pole circuit breakers shall have trip elements in each pole with common trip bar. Frame size 225 amperes or larger shall have adjustable magnetic instantaneous trip and shall have interchangeable thermal magnetic trip units.

C. Shunt trip shall be installed in circuit breakers where required by the Drawings or Specifications.

D. Circuit breaker interrupting ratings shall be equal to the available short circuit current at the point of installation with the minimum ratings as follows:

Frame Size	240 V	480 V
100 A	18,000	14,000
225 A	25,000	22,000
400 A	42,000	30,000
800 A	42,000	30,000
1,200 A	42,000	30,000

E. Provide NEMA Type 1 enclosures for general duty indoor use. Enclosures shall be NEMA 4X stainless steel for exterior locations unless indicated otherwise.

F. Circuit breakers shall be as manufactured by General Electric, Siemens, Square D, or Cutler-Hammer.

2.10 MOTORS

A. Motors shall be provided with the equipment driven by the motor, unless otherwise indicated or specified, and shall conform to the latest requirements of

NEMA, IEEE, ANSI, NEC, and Anti-Friction Bearing Manufacturer's Association (AFBMA) standards, where applicable.

1. Motors shall be of sufficient capacity to operate the driven equipment, under all load and operating conditions, without exceeding 100% of the motor's nameplate horsepower rating, excluding the service factor, and without exceeding the motor's rated temperature limits.
2. Motors shall be furnished with permanent, highly visible stainless steel nameplates. Nameplates shall include all motor ratings, accessories, and special features.

B. Motors may be single speed or variable speed as required for the application.

1. Motors for variable-speed applications shall be designed for operation at the rated maximum speed and at reduced speed throughout the variable-speed range without overloading. Motors for variable-speed operation shall be inverter duty rated and compatible with the associated variable-speed control equipment and operating conditions, including the effects of harmonic current and voltage distortion. Motors for variable-speed operation shall be equipped with a normally closed automatic reset winding thermostat in addition to all accessory equipment recommended by the variable-speed equipment manufacturer. Thermostat leads shall be brought to the motor connection box.
2. Motors 100 HP and above shall be equipped with two normally closed automatic reset winding thermostats. Thermostats shall be imbedded in the stator winding, between phases, connected in series, with leads brought to the motor connection box.

C. Motors shall be NEMA Design B, unless otherwise indicated or specified, and shall be suitable for continuous duty operation. Motor currents and torque shall be in accordance with NEMA MG 1-12.34 and MG 1-12.37.

1. Three-phase, single-speed, squirrel-cage induction motors less than 50 HP shall be rated 208-230/460 volt for use on 208-, 240-, or 480-volt, three-phase, 60-Hz systems.
2. Multi-speed motors and motors 50 HP and larger may be single voltage as required for the particular voltage.
3. Single-phase general-purpose induction motors shall be split-phase or capacitor start rated 115/230-208-volt, single-phase, 60-Hz. Motors 1-1/2 HP and larger shall be NEMA Design M. Motors smaller than 1-1/2 HP shall be NEMA Design L or N. Motor currents and torque shall be in accordance with NEMA MG 1-12.31, MG 1-12.32, and MG 1-12.33.

D. Motors shall be provided with Class F non-hygroscopic insulation system using materials and an insulation system evaluated in accordance with IEEE 117 classification tests. Temperature rise shall be limited to a maximum of 80°C, by resistance, at a service factor of 1.0 in an ambient temperature of 40°C. Motors shall have multiple dips and bakes of varnish treatment for additional protection.

E. Motors larger than 5 HP shall be provided with locked-rotor current not exceeding NEMA Code letter "G."

F. Motors shall be furnished with a minimum service factor of 1.15.

G. Motors shall be suitable for full voltage across-the-line-type starting, unless otherwise specified or indicated on the Drawings.

H. Motors shall be equipped with ball, open, single-row, deep-groove Conrad-type bearings conforming to the AFBMA Standard 20. Drive end bearings may be cylindrical roller type for belted drives.

1. Bearing life shall be 17,500 hours minimum for belted applications and 100,000 hours minimum for flexible direct-coupled applications.
2. The bearing identification number shall be stamped on the motor nameplate.
3. The lubrication system shall consist of a capped grease fitting inlet, a relief plug 180 degrees from inlet, and a grease reservoir in bracket and cast inner cap.
4. Bearings shall be greased by the manufacturer with a premium moisture-resistant polyuria-thickened grease containing rust inhibitors and suitable for operation over a temperature range of -25° C to 120° C.

I. The motor enclosure, including frame with integrally-cast feet and/or vertical P-base mounting, end brackets, bearing inner caps, fan guards, and conduit box and cover shall be ASTM A48, Class 25 cast iron or better.

1. Conduit boxes shall be provided with the number and size of conduit connections, as shown on the Drawings. The conduit box shall allow rotation to accommodate conduit connection. Provision for grounding shall be made using a mounted clamp-type lug in the conduit box.
2. Motors shall be equipped with lifting lugs. Motor enclosures shall be equipped with stainless-steel screens for all openings in accordance with NEMA MG 1 for guarded machines.
3. Vertical hollow-shaft motors shall be equipped with non-reverse ratchets to prevent backspin.

4. Motors shall be NEMA MG 1 open drip-proof, weather-protected Type I, totally enclosed fan-cooled, or explosion-proof as specified in other sections of the Specifications or indicated on the Drawings.

J. Submersible motors shall be explosion-proof and NRTL listed for Class 1, Division 1, Group C & D hazardous locations as defined by the NEC.

1. All electrical components shall be housed in an air-filled or oil-filled cast-iron, watertight enclosure which is sealed by the use of O-rings. Joints shall be rabbeted with extra-large overlaps.
2. Automatic reset, normally closed, thermal overloads shall be imbedded in the motor winding to provide overheating protection.
3. Moisture-detection probes shall be incorporated to detect moisture in either the seal or stator cavity by measuring resistivity between the probes. Float-type devices or single probe-to-ground moisture detectors are not acceptable.
4. Submersible motors shall have power and control conductors housed in multi-conductor cables of sufficient length to reach the control panel or junction box as indicated on the Drawings. Cable leads shall allow cable-to-motor connections to be accomplished in the field without soldering. Cable entrance to the motor shall be sealed.
5. Submersible motors shall be designed to allow either fully submerged or completely dry operation.

K. Polyphase motors shall be of an energy-efficient design having a minimum efficiency rating as listed in NEMA MG 1-12.55, Table 12-6C.

1. Motor efficiency shall be determined in accordance with NEMA MG 1-12.54.1 and IEEE 112, Method B.
2. Efficiency rating shall be labeled on the motor nameplate in compliance with NEMA MG 1-12.54.2.

L. Motors shall be capable of the following starts per hour, unless otherwise specified, without overheating or causing damage to the motor.

1. 60 HP and below, six starts per hour.
2. Above 60 HP, four starts per hour.
3. Submersible motors, 10 starts per hour.

M. Motors 5 HP and above, except submersible motors, shall be provided with a 120-volt single-phase space heater. Leads shall be brought to the motor terminal box.

2.11 MOTOR STARTERS

A. Manual Motor Starters: Manual motor starters shall be toggle, key, or pushbutton type and shall be equipped with melting alloy overload protection on each pole.

1. Fractional horsepower manual motor starters shall be Square D Class 2510 Type F (or equal) single-unit with handle guard/lock-off feature. The handle shall be toggle type unless otherwise specified or indicated on the Drawings.

2. Integral horsepower manual motor starters shall be Square D Class 2510 Type M or T (or equal) rated 600 VAC/250 VDC, with lock-off feature and auxiliary contact. Auxiliary contact shall be normally open unless otherwise indicated. Control shall be pushbutton or toggle as indicated on the Drawings.

3. Manual motor starters shall be provided in surface-mounted enclosures unless otherwise indicated.

    a. Type F units mounted outdoors shall be in NEMA 4 cast-metal enclosures.
    b. Type M or T units mounted outdoors shall be in NEMA 4 stainless-steel or cast-metal enclosures.
    c. Manual motor starters in hazardous locations shall be Class 2510 NEMA 7 and 9, by Square D or equal.

B. Magnetic Motor Starters: Magnetic motor starters shall be rated in accordance with NEMA standards, sizes, and horsepower ratings. Starters shall be sized for the horsepower ratings as indicated on the Drawings or required by the driven equipment. Minimum sizes and type of starter shall be as indicated on the Drawings and shall have the following features:

1. Magnetic starters shall be equipped with double-break silver-alloy contacts. All contacts shall be replaceable without removing power wiring or removing the starter from the panel or enclosure.
2. Coils shall be of molded construction. All coils shall be replaceable from the front without removing the starter from the panel or enclosure.
3. Overload relays shall be the melting-alloy type with a replaceable control module. Thermal units shall be of one-piece construction and inter-changeable. The starter shall be inoperative if the thermal unit is removed. Three-phase starters shall have overload relays in all three phases. Reset button shall be accessible without opening the door or panel. Visible trip indication for overload phase indication shall be provided. The relay shall

have a Form C contact, which operates when the overload relay trips; the contact shall be wired to terminal blocks for remote use.

4. A phase-failure relay shall be provided for all motor starters and shall have solid-state sensing circuitry monitoring all three phases. The relay shall have isolated DPDT contacts and shall protect the motor against the loss of one of the three phases: voltage unbalance in excess of 10% rated voltage, phase reversal, and undervoltage. Undervoltage shall be adjustable to 75% of rated voltage. The relay shall be Square D Company Class 8430 or approved equal.
5. All motor starters shall have their own control power transformer for individual starter control voltage, except where installed in control panels in which a common control power transformer may be incorporated. Control voltage shall be 120 VAC. Control power transformers shall be sized to include motor space heater load, starter or contactor coil, timers, relays, and other devices as indicated or specified. Primary inputs and the ungrounded secondary output of the control power transformer shall be fused.
6. Starters shall be suitable for adding at least four external electrical interlocks of any arrangement, normally open or normally closed. Starters shall be supplied with a minimum of two interlock contacts.
7. All magnetic starters shall be provided with terminal blocks for wiring devices external to the starter enclosure. The starter shall be supplied in a NEMA 1 enclosure unless otherwise indicated or specified.
8. The starter shall be capable of starting the motor the number of times per hour stated for motors or as required by the pumping sequence, without causing damage to the starter.
9. Panel-mounted elapsed-time meters shall have six register wheels indicating up to 99,999.9 hours, without a reset knob, and be rated at 115 VAC, 60-Hz. The panel manufacturer shall provide one meter for each motor installed and connect the meter so that the meter will record the time that the motor is energized.
10. Equip all magnetic controllers and/or starters, unless otherwise noted, with a three-position selector switch labeled “Hand-Off-Automatic” or as indicated. Switch in Hand position shall start motor.
11. Equip all magnetic controllers and/or starters with indicating lights as follows: green-power on, red-running.
12. A list of overload relay heater elements installed in each starter shall be included in the Operation and Maintenance Manual. The list shall identify the starter by name of equipment and show the type, size, and model number of the heater element.

C. Full-Voltage Non-reversing (FVNR) Starters: FVNR motor starters shall be designed for across-the-line full-voltage starting and stopping of squirrel-cage

motors and shall be the combination type with motor circuit protector unless otherwise indicated.

1. The starters shall be rated 600 VAC, 60-Hz.

D. Full-Voltage Reversing (FVR) Starters: FVR motor starters shall be designed for across-the-line full-voltage starting and stopping of squirrel-cage motors and shall be the combination type with motor circuit protector unless otherwise indicated.

1. The starters shall be rated 600 VAC, 60-Hz.

E. Two-speed (TS) Starters: TS motor starters shall be designed for across-the-line starting and stopping of constant torque and variable torque two winding squirrel-cage motors and shall have a separate three-pole starter for each speed matched to the motor requirements. Starters shall be the combination type with motor circuit protector unless otherwise indicated.

1. The starters shall be rated 600 VAC, 60-Hz.
2. The starters shall be equipped with an accelerating relay/timer to start the motor on low speed before accelerating to high speed and requiring the off or stop position to be selected before shifting from high speed to low speed.

F. Solid-State Reduced-Voltage (SSRV) Starters: SSRV motor starters shall be equipped with a solid-state soft-start controller designed for reduced voltage starting and stopping of squirrel-cage motors. Starters shall be the combination type with motor circuit protector or fused disconnect and shall be equipped with an isolation contactor and bypass contactor unless otherwise indicated. Contactors shall be NEMA rated.

1. The starters shall be rated 480-volt and be suitable for operation on a 60-Hz system. Current rating of the soft-start controller shall be based on the applicable motor current.

2. The soft-start controller shall be a microprocessor device which continuously monitors the starter and motor. The controller shall be protected from voltage transients by a MOV. The power module shall be capable of providing starting currents of 300% of full load current for 60 seconds. SCRs shall have a minimum peak inverse voltage of 1,400 V at 480 V. The controller shall use a minimum of six SCRs to limit the effect of harmonics on other equipment. SCRs shall be protected against fault currents with current-limiting fuses.

3. The soft-start controller shall be self-calibrating and shall require no adjustments for various line voltages, frequencies, or currents.

4. The soft-start controller shall provide three modes of starting:

    a. Soft start, to ramp the motor voltage during an adjustable acceleration period after an initial torque voltage has been applied. The ramp period shall be adjustable from 1 to 30 seconds.
    b. Current limit, to limit the maximum starting current. The starting current shall be adjustable from 250% to 500% of full load amperes.
    c. Pump control, to provide controlled acceleration and deceleration of centrifugal pumps to reduce surges in the pumping system during starting or stopping. Starting time shall be adjustable from 1 to 30 seconds. Stopping time shall be adjustable from 2 to 120 seconds. The controller shall not require feedback devices to accomplish the acceleration or deceleration.
    d. The Contractor shall adjust all times and set points of the controller for the driven equipment.

5. The soft-start controller shall provide protection during the starting and running modes for internal fault, thermal fault, and phase failure. Starting of the controller shall be inhibited or the controller shall be shut down if in operation when any of the fault conditions occur.

6. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited. At a minimum, digital indication shall provide the following conditions:

    a. Soft starter status—Ready, starting/stopping, run.
    b. Motor status—Current, torque, thermal state, power factor, operating time, power in kW.
    c. Fault status—Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor under-load, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor over-current fault.

7. The soft starter must be preset to the following for adjustment-free operation in most applications:

    a. Linear (torque-controlled) acceleration ramp of 15 seconds.

b. Current limitation to 400% of the motor full load current rating.
c. Class 10 overload protection.
d. Motor current preset in accordance with NFPA 70 Table 430.150 for standard-HP motors.

8. A digital keypad shall be used to configure the following operating parameters as required:

a. Motor full load amps adjustable from 40 to 130% of the soft starter's rating.
b. Current limitation on starting adjustable from 150 to 700% of the motor current rating, not to exceed 500% of the soft starter rating.
c. Linear (torque-controlled) acceleration ramp adjustable from 1 to 60 seconds.
d. Initial torque adjustable from 10 to 100% of nominal motor torque.
e. Torque limit adjustable from 10 to 200% of nominal motor torque.
f. Maximum start time adjustable from 10 to 999 seconds.
g. Voltage boost adjustable from 50 to 100% of the nominal supply voltage.
h. Selection of freewheel, soft stop, or braking.
i. Linear (torque-controlled) deceleration ramp time adjustable from 1 to 60 seconds.
j. Threshold to change to freewheel from a controlled deceleration ramp to freewheel stop: adjustable from 0 to 100% of the nominal motor torque.
k. Braking torque level adjustable from 0 to 100% effectiveness.

9. Auxiliary contacts, one normally open and one normally closed Form C, shall be provided.

10. The mode of operation shall permit starting and stopping the motor using the soft-start controller in a preselected adjustable mode. The starter shall be suitable for continuous operation through the soft-start controller and isolation contactor. The isolation contactor shall be interlocked with the soft-start controller such that it is energized before the SCRs are gated "on" and the SCRs are gated "off" before the isolation contactor is de-energized. An alternate mode of operation shall also be provided for starting the motor using the soft-start controller in a preselected adjustable mode and upon completion of the starting period, shifting the load to the bypass contactor for the running period and, upon a stop signal, shifting the load back to the soft-start controller and a preselected adjustable mode for stopping the motor. The starter shall be operable as a full-voltage magnetic starter with the soft-start control module removed from service.

11. Start-up service shall be provided by a representative of the equipment manufacturer. A factory-trained field service engineer, trained in the maintenance and troubleshooting of the specified equipment, shall inspect the installation and perform start-up of the equipment. The field service engineer shall provide for a minimum of a 1-hour class, which shall include a review of the equipment manuals and instruction in the operation, calibration, maintenance, and troubleshooting of the equipment.

12. The SSRV motor starter shall be Square D ATS 48 or approved equal.

G. Combination Starters

1. All motor starters shall be combination type unless noted otherwise.
2. Combination starters shall be manufactured in accordance with the latest published NEMA Standards. Combination starters shall consist of circuit breaker, a fused disconnect, or a motor circuit protector, as indicated on the Drawings, and a magnetic motor starter as specified above. Combination starters shall have an interrupting rating sufficient for the short circuit current available at the line terminals with a minimum rating of 14,000 RMS symmetrical amperes at 480 volts. All combination starters shall be mounted in a NEMA 1, General Purpose enclosure, unless otherwise indicated on the Contract Drawings.
3. The operator and operator arm shall be permanently attached to the handle of the breaker with positive indication of switch position with door either open or closed. The door and switch shall be interlocked to prevent closing the switch when the door is open.
4. The door latch shall be tamper-proof with a coin-proof slot in the door handle latch. The door handle shall have double safety interlocking of the operator and door handle to prevent opening of the door when the breaker is in the “ON” position. An interlock bypass shall be provided to allow access to authorized personnel. All exposed parts shall be dead when the switch is in the “OFF” position.
5. Padlocking facilities shall be provided to positively lock the disconnect in either the “ON” or “OFF” position with from one to three padlocks with the door open or closed.
6. Combination starters shall be Allen-Bradley, Cutler-Hammer, Square D, or approved equal.

H. Control Devices

1. Pushbutton control, when indicated on the Drawings, shall be non-illuminated, momentary contact (unless otherwise indicated), oil-tight, pushbutton with no guard. Pushbutton controls shall be Square D Type “K” or approved equal.

2. Selector switch operators, when indicated on the Drawings, shall be two- or three-position, non-illuminated, oil-tight switches with normal return to all positions. Selector switch operators shall be Square D Type "K" or approved equal.
3. Pilot lights shall be 120-volt LED push-to-test type.
4. Control relays shall be double-pole, double throw sealed, plug-in type relays with din rail or panel mount base, rated for 10A current at 120 VAC, with internal LED pilot light to indicate relay coil is energized.
5. Provide time delay relays in all motor starters larger than 5 HP to provide a sequenced start-up of motors upon energization. Sequence shall start with largest motor, next largest, etc. The timer shall have a range of 5 to 180 seconds.

2.12 DRY-TYPE TRANSFORMERS

A. Dry-type transformers for power and lighting shall be self-cooled with ratings as indicated on the Drawings. Transformers 25 kVA and larger shall have a minimum of four 2-1/2% full-capacity primary taps, two above and two below the rated voltage. Transformers shall be UL listed.

B. The core shall be constructed of high-grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. The core lamination shall be clamped together with structural steel angles. The core and coil assembly shall be mounted to the enclosure by neoprene rubber vibration-absorbing mounts. The neoprene rubber mounts shall eliminate metal-to-metal contact between the enclosure and the core and coil assembly.

C. Insulating material shall be in accordance with NEMA ST-20 for a 220°C component recognized insulation system. A temperature rise above 40°C ambient shall be 150°C for transformers 15 kVA and above, and 115°C for transformers below 15 kVA, with maximum temperature of the top of the enclosure not exceeding a 50°C rise above a 40°C ambient.

D. Coils shall be continuous-wound construction and shall be impregnated with a non-hygroscopic thermosetting varnish.

E. Transformers shall be mounted in drip-proof and rodent-proof heavy-gauge steel enclosures, ventilated according to current manufacturing standards. Outdoor units shall be weatherproof.

F. Transformer enclosures shall be painted with a gray baked-enamel finish applied after the unit has been degreased, cleaned, phosphate, and primed. Enclosures may be designed for floor or wall mounting. Floor mounting units shall be mounted on a 3-1/2-inch raised concrete pad.

G. Transformers shall be as manufactured by Square D, General Electric, Cutler-Hammer/Westinghouse, Siemens, or approved equal.

2.13 LIGHTING FIXTURES AND COMPONENTS

A. Lighting fixtures similar and equal to the types indicated on the Drawings shall be furnished and installed complete with all drivers, luminaires, lenses, accessory hardware, and associated equipment to provide a complete and working lighting system. Each fixture shall be designed for lumens and lamp type indicated on the Drawings and/or as specified in this Section. Lighting supplier shall have extensive experience successfully building robust, reliable luminaires for outdoor environments.

B. Fixtures shall conform to UL 1598 and in hazardous areas conform to UL 844.

C. A label shall be provided indicating lamp and driver type.

D. Lighting will only use LED chips that have been tested for lumen maintenance according to LM-80.

E. Predicted lifetimes shall encompass the whole system including driver, LED lumen maintenance, and LED catastrophic failures.

F. The lifetime of the driver shall match the lifetime of the luminaire.

G. All LED drivers shall be highly efficient, have a minimum power factor of 0.9, and have THD less than 20%.

H. Outdoor products shall include a circuit module that is designed to survive a 10kV TIL surge test.

I. Lighting shall be rated for an ambient operating range of -30ºC to 40ºC (-22°F to 104°F).

J. LED drive currents and the selection of drive current depend on the LED package chosen. For each luminaire specified, the LEDs operating current shall be specified.

K. Passive cooling techniques shall only be used for all outdoor lighting products.

L. Photometric Performance

1. Outdoor lighting products shall range in delivered lumens per watt from 61 to 70 LPW depending on the distribution specified.
2. Published lighting photometry for LED luminaires shall comply with LM-79.
3. Data shall be confirmed by a photometric laboratory that is NVLAP accredited for LM-79-compliant absolute photometry for LED luminaires.
4. Outdoor lighting products shall range in lumens output from 1,600 to 21,600 lumens.
5. Lighting optics shall provide industry-established performance in distribution uniformity and light control.
6. Housings shall be manufactured from cast aluminum unless otherwise specified or approved.
7. Lighting outdoor products shall use modular LED bars that can easily be upgraded by swapping bars.
8. LED luminaires shall be RoHS compliant and lead free.

M. Warranty and Certifications

1. Lighting shall be provided with a 5-year limited warranty on all luminaires.
2. Lighting warranty shall cover fixture mechanicals, electrical components, drivers, and paint.
3. Lighting products shall be listed UL certified.
4. LED luminaires are intended to operate for extended periods without maintenance; however, if the luminaire requires repair due to unusual events, both drivers and LED bars shall be easily accessible for replacement.

2.14 SURGE PROTECTION DEVICE

A. Primary surge protection device (SPD) shall be installed at the main service on the load side of the main breaker or automatic transfer switch as indicated on the Drawings.

1. Primary service SPD shall be listed in accordance with UL 1449-3RD Edition and shall be tested to Category C3 (20 kV, 10 kA, 8/20 µsec. Waveform) in accordance with IEEE C62.41.1 and IEEE C62.45. Suppressors shall meet or exceed the following criteria:

   a. Single impulse current rating of 160,000 amperes per phase (8/20 µsec. waveform).

b. Pulse life rating of 1,000 occurrences with no clamping drift for Category C (8/20 µsec. waveform).

c. UL 1449 peak let-through voltage shall not exceed the following:

Voltage	L-N	N-G
120/208 or 120/240	500	500
277/480	800	800

d. The test for Category C3 peak let-through voltage IEEE C.62.41.1 (20 kV-1.2/50 µs) shall be conducted by an independent testing laboratory. Documentation of the test shall be submitted with the shop drawings.

e. Peak let-through voltage measured in UL and ANSI/IEEE testing shall include the effect of 6-inch leads connected to the complete unit.

f. Turn-on and turn-off times shall be less than 1.0 nanosecond.

B. Secondary surge protection device (SPD) shall be installed on the secondary side of step-down transformers or at the associated panelboards, at control panels, and at motor disconnects or junction boxes as indicated on the Drawings. Suppressors at panelboards shall be connected to a 30-amp multi-pole breaker. All other suppressors shall be fused.

1. Secondary SPD shall be listed in accordance with UL 1449-3RD Edition. Suppressors shall meet or exceed the following criteria:

a. Single impulse current rating of 80,000 amperes per phase (8/20 µsec. waveform).

b. Pulse life rating of 1,000 occurrences with no clamping drift for Category C (8/20 µsec. waveform).

c. UL 1449 peak let-through voltage shall not exceed the following:

Voltage	L-N	N-G
120/208 or 120/240	500	500
277/480	800	800

d. The test for Category C3 peak let-through voltage IEEE C.62.41.1 (20 kV-1.2/50 µs) shall be conducted by an independent testing

laboratory. Documentation of the test shall be submitted with the shop drawings.

e. Peak let-through voltage measured in UL and ANSI/IEEE testing shall include the effect of 6-inch leads connected to the complete unit.

f. Turn-on and turn-off times shall be less than 1.0 nanosecond.

C. Minimum requirements for surge suppressors:

1. Provide suppression elements between each phase or leg and the system neutral and between the neutral conductor and ground.
2. Each module of modular type suppressors shall be externally fused. The status of each module shall be monitored on the front of the enclosure and on each module.
3. The suppressor failure mode shall be of a "fail-short" design.
4. Visible indication of proper connection and operation shall be provided.
5. Modular-type suppressors shall have an internal disconnect and current limiting fuses. Encapsulated suppressors shall have external fuse or circuit breaker protection.
6. Terminals shall be provided for all necessary power and ground connections and shall accommodate #10 to #1 AWG wire sizes.
7. Suppressors shall be of solid-state componentry and shall operate bidirectionally.
8. Suppressors shall have a warranty guarantee period of at least 5 years.

D. All surge protection devices shall be of the same manufacture and shall be installed in accordance with the manufacturer's installation instructions. The mounting position shall be selected to provide the shortest lead possible between the suppressor and the point of connection.

E. Surge protection devices shall be as manufactured by Advanced Protection Technologies, Inc., PQ Protection, LEA or approved equal.

2.15 THERMOSTATS

A. Thermostats shall be single-temperature electric thermostat using fast-responding bi-metal element which makes and breaks silver contacts. The thermostat shall be in a general-purpose enclosure with contacts and all parts in electrical circuit enclosed under a dust cover. Contacts shall be rated at 150 VAC, 10 amperes, inductive load, and shall have a positive OFF position. The set point shall be adjustable over a range of 50°F to 100°F. Thermostats shall be as manufactured by Honeywell, Johnson Service, or Barber Colman, or equal.

2.16 GROUNDING

A. Ground rods shall be copper-clad steel, 3/4-inch-x-10-foot sectional type, with couplings and driving studs for installation.

B. The conductor shall be bare, stranded copper, complying with ASTM B8, for main power ground and instrument ground, unless otherwise indicated. Grounding conductors run in conduit shall have green insulation.

C. Connection to the ground rod shall be made with exothermic welding kits by Cadweld or approved equal. “Acorn” type clamps are not acceptable. Ground connections to equipment frames, building steel, etc., shall be made with equipment grounding lugs or clamps intended for grounding purposes.

2.17 PLASTIC CAUTION TAPE

A. The Contractor shall provide a continuous non-metallic caution tape, 12 inches below finished grade, above each duct or conduit run. The tape shall be 6 inches wide, imprinted to indicate underground electric utilities, as manufactured by Griffolyn, Terra-Tape, or equal.

2.18 PRECAST PRODUCTS

A. Concrete Handholes: Concrete handholes shall conform to the dimensions shown on the Drawings, shall be designed to AASHTO H-20 loading, and shall be constructed of 4,000 psi (minimum) reinforced concrete.

1. Handholes shall have full-size aluminum (T6061-T6) diamond plate pedestrian covers with reinforcing angles, rated for 300 pounds per square foot unless otherwise indicated. Covers shall be removable and shall be provided with lifting holes (four per cover). Covers larger than 4-foot-x-4-foot nominal shall be of sectional construction. Aluminum angles with flat bars shall be set into the inside of walls flush with the top to match covers.
2. Handholes shall be open bottom unless otherwise indicated or specified.
3. Handholes shall have pulling eyes cast in the wall opposite duct entry. The conduit shall be terminated in a handhole with end bells grouted in entrance windows with non-shrink grout.
4. Power and/or signal cables shall be supported on heavy-duty non-metallic cable racks with adjustable arms and be held in place with non-metallic tie wraps. Racks shall be maximum 3 feet apart with a minimum of one per wall of handhole. Racks shall be attached to handhole walls in accordance with the rack manufacturer’s recommendation with a minimum of three

anchors per rack. An anchor shall be located in holes immediately above each adjustable arm.

5. Handholes shall be installed on a 6-inch-thick bed of gravel. The gravel shall be compacted before casting or setting handholes. Handholes shall protrude 2 inches minimum above surrounding grade.

B. Concrete Pull Box: The pull box shall be constructed of reinforced concrete or polymer concrete and shall be Brooks Products, Inc., Quazite, or equal. Covers shall be provided with lifting slot, bolts, and "ELECTRIC" logo.

PART 3 EXECUTION

3.01 LAYOUT OF CONDUIT AND WIRING SYSTEMS

A. The Contractor shall lay out the work and shall be responsible for all necessary lines, levels, elevations, and measurements. The Drawings indicate the extent and general arrangement of the components. The Contractor shall become familiar with the work of other trades engaged in the construction. The exact routing of raceways and locations of equipment may be governed by structural conditions and obstructions. The Contractor shall coordinate with the details of equipment shop drawings for power and control connections to equipment furnished by others. This is not to be construed as permitting redesigning systems.

B. Submit all requests for changes in the proposed layout due to structural features, equipment locations, and similar conditions to the Owner, with the following provisions:

1. Detail the reasons for the changes.
2. Submit requests within 30 days after award of Contract.
3. Make no changes without written approval of the Owner.

C. Examine areas scheduled to receive electrical equipment and material for conditions which will adversely affect the execution, permanence, or quality of the work. Determine field conditions by actual measurement. Do not proceed with installation until defects have been corrected.

3.02 INSTALLATION

A. General: Comply with NEC, NESC, local codes, and rules and regulations of local agencies having jurisdiction. Coordinate electrical installation of systems and packaged equipment items specified in other sections of these Specifications.

1. Conductors, circuit breakers, motor controllers, and protective devices indicated or specified shall be sized to serve the electrical equipment

furnished and shall meet all requirements of the NEC. Voltage drop shall be limited to 3%, including main service, feeder, and branch circuit.

2. Coordinate protective, control, and signaling devices.

B. Grounding and Bonding: The Contractor shall establish a grounding and bonding system that electrically connects metal structural materials, equipment enclosures, conduits, outlet boxes, cabinets, motor frames, fixtures, devices, transformer cases, switchgear enclosures, incoming service neutral conductor, and the earth. The common point of attachment for the grounding and bonding system shall be at the main service disconnect unless otherwise indicate in this Section or in the Drawings. The grounding and bonding system shall be properly bonded and sized in accordance with NEC. Solidly bond all non-current-conducting metal parts to the electrical installation grounding bus. A green insulated grounding conductor shall be carried with each circuit.

1. Provide common grounds throughout the system.
2. Provide a ground grid consisting of driven copper-clad steel ground rods connected by bare copper conductor at the service entrance and/or as shown on the Drawings. Resistance to remote earth shall be 10 ohms or less before connection to the system.

C. Identification: Equipment such as but not limited to disconnect switches, motor starters, control panels, etc., shall be clearly marked.

1. Identify all devices operating at more than 250 VAC phase-to-phase or 125 VAC phase-to-ground with red enamel letters or numerals of appropriate height applied with a stencil.

2. Except as otherwise noted, all equipment shall be marked with engraved nameplates of laminated two-color phenolic plastic having white letters. Attach each nameplate with stainless steel screws. Align nameplates on equipment being marked in the center near the top.

3. Panelboards and control panels shall have designation in 1/2-inch-high letters and voltage in 1/4-inch-high letters centered above the door on exterior trim.

4. Mark equipment mounted remotely from the source of power (such as pumps and fans) with equipment number, source of power, and starter location. Where starters are remotely mounted, marking shall include equipment name, number, and location.

5. Conductors shall be identified at each termination, pull box, junction box, handhole, point of entry to or exit from wireways, panelboards, control

panels, and other points of access. Tags or labels shall be securely affixed to the conductor in visible locations. Tags shall be durable plastic with the designation stamped on one side with suitable dies. Labels shall be permanent with legible black characters on white heat-shrink tubing or equivalent identification acceptable to the Owner.

a. Power conductors shall be color-coded to identify phases, neutral and switch legs, using plastic, self-sealing tape. Tags or labels shall identify the switchboard, MCC, panel, etc., it is served from and the circuit number.
b. The control conductor (including monitor and instrumentation conductors) shall be identified by color coding and tag or label as to wire number (corresponding to the manufacturer's wiring diagram) and equipment name.
c. Power wiring and control wiring shall be identified in all handholes with a waterproof permanent tag attached to the cable with plastic cable ties.

D. Equipment Connections: Provide complete system with all power and control connections required for proper operation.

E. Conduit

1. Rigid galvanized steel (RGS) conduit may be used as follows:

a. Exposed in buildings.
b. Exposed with PVC coating where indicated on the Drawings.
c. Concealed in poured concrete.
d. Below grade with PVC coating where indicated on the Drawings.

2. Electrical metallic tubing (EMT) may be used as follows:

a. Concealed above ceilings, suspended ceilings, and within walls.
b. Exposed in buildings with non-corrosive atmospheres where acceptable to the Owner.

3. Rigid non-metallic (PVC) conduit may be used as follows:

a. Concealed in walls and floors, Schedule 40.
b. Below-grade direct burial, Schedule 40.

4. Burial depth of conduit shall be measured from the top of the conduit to the top surface of finished grade, pavement, concrete, or similar cover as follows:

    a. 24 inches (minimum) below unpaved areas,
    b. 30 inches (minimum) below stabilized subbase in paved areas.

5. For concretes slabs on grade and foundations, conduit burial depth shall be measured from the bottom of the concrete slab or foundation as follows:

    a. 12 inches (minimum) below concrete slabs on grade or foundations.

6. It shall be the responsibility of the Electrical Contractor to coordinate the location and depths of all electrical conduits to be installed under this Contract with other trades. Particular attention shall be given to all locations where conduits enter a structure or building from underground. Proper clearances from the top of the conduits to the bottom of slabs and foundations shall be maintained.

7. Where conduits rise through slabs on grade, curved portion of bends shall not be visible above the finished slab.

8. Conduit stub-up to above grade and conduit stub-up out of or from below floor slab shall be rigid galvanized steel from and including the last 90º bend.

9. Galvanized conduits which penetrate concrete in wet locations shall be protected by a 20-mil sheath of PVC at the penetration extending from 2 inches within the concrete to the first coupling or fitting outside the concrete.

10. Stub-ups through concrete slabs for connection of future equipment or conduits runs shall be provided with couplings threaded inside for plugs and shall be set flush with the finished floor or slab. Install screwdriver-operated threaded flush plugs in couplings. Provide pull wire in all empty conduit runs.

11. Avoid bends and offsets, where possible. Make bends and offsets with an approved hickey or conduit bending machine. Install plastic (PVC) coated conduit and fittings in accordance with the manufacturer's installation manual using tools designed for installing plastic (PVC) coated conduit and fittings. Touch up any and all damaged areas with manufacturer-recommended coating compound. Do not install crushed or deformed

conduit. Use expansion fittings or other approved devices where conduit or tubing crosses expansion joints. Prevent dirt or trash from lodging in conduits, boxes, and fittings. Free clogged conduit of all obstructions or replace conduit.

12. Installers of PVC coated metal conduit shall be certified by the manufacturer and be able to present a valid, unexpired, certified installer card prior to starting installation.

13. Supports:

    a. Pipe straps, wall brackets, hangers, or ceiling trapeze.
    b. Use wood screws or screw-type nails for fastening to wood. Use toggle bolts for fastening to hollow masonry units. Use concrete inserts or expansion anchors for fastening to concrete. Use machine screws, welded threaded studs, or spring-tension clamps for fastening to steel work.
    c. Power-driven threaded studs may be used in lieu of expansion bolts or machine or wood screws where acceptable to the Owner.
    d. Use threaded C-clamps on rigid steel conduit only.
    e. Do not weld conduit or pipe straps to steel structures.
    f. Non-metallic conduit through 1-inch size shall use one-hole snap-strap clamps and 1-1/4-inch through 2-inch shall use two-hole snap-strap clamps, with maximum spacing between supports as outlined in the NEC based on 50°C conductor temperature. Clamps shall be manufactured from a nylon compound.

14. Expansion couplings shall be used in all straight lengths of non-metallic conduit in exposed applications. Maximum spacing between expansion couplings shall be 100 feet.

15. Connections: All conduits, where they enter sheet metal enclosures such as panelboards, pull boxes or outlet boxes, shall be secured in place by galvanized locknuts and bushings, one locknut inside of box with bushing on conduit end and one locknut outside of box for rigid conduit. The locknuts shall be tightened against the box without deforming the box.

    a. Conduit connections shall use fittings to maintain NEMA rating of enclosures.
    b. All bushings and conduit box connectors shall have the insulating material permanently fastened to the fittings.
    c. Grounding bushings shall be used in switchgear and MCCs.
    d. Conduit connections exposed in wet locations shall be by watertight threaded hub. Metallic conduit box connections may use

a two-piece hub with built-in recessed neoprene gasket such as Appleton Uni-Seal. Non-metallic conduit box connectors may use a neoprene flat washer or "O" ring placed over threads of the fitting between the shoulder of the fitting and the box.

F. Boxes

1. The Contractor shall provide outlet, pull, junction, or terminal boxes in wiring or conduit systems wherever required for pulling wires, making connections, and mounting devices or fixtures.

    a. Indicated locations are approximate only. Coordinate actual location with all work to be performed in the space or area and for the equipment to be served.
    b. Locate outlets so that fixtures and other items will be symmetrically located according to the space or area layout.
    c. Outdoor switch and receptacle outlets shall use non-metallic boxes and covers.

2. Outlet boxes in exposed work or wet locations shall be cast metal. Sheet metal boxes shall be concealed in walls or ceiling. Non-metallic boxes shall be used with non-metallic conduit.

3. Supports:

    a. In open overhead spaces, cast boxes threaded to rigid metallic conduit need not be separately supported unless used for fixture support.
    b. Use wood screws or screw-type nails for fastening to wood. Use toggle bolts for fastening to hollow masonry units. Use concrete inserts or expansion anchors for fastening to concrete. Use machine screws or welded, threaded studs for fastening to steel work.
    c. Power-driven threaded studs may be used in lieu of expansion bolts or machine or wood screws where acceptable to the Owner.

G. Wiring Devices: Receptacles installed outdoors shall be the ground-fault circuit-interrupter type.

H. Wiring

1. The Contractor shall provide a complete system of conductors as indicated.

2. Size shall be as required by the NEC and shall be #12 AWG minimum for power and lighting circuits and #14 AWG minimum for control and alarm circuits.
3. Crimp-on insulated wire terminals shall be used on stranded wire for terminations.
4. Splices shall be in accessible locations only and shall be insulated-pressure type for #10 AWG and smaller wires. For #8 AWG and larger, use solderless connectors covered with an insulation material equivalent to the conductor insulation.

I. Lighting Fixtures: All fixtures and supports shall be carefully laid out and equipped with suitable swivel hangers, canopies, and/or other auxiliaries as required to ensure that fixtures are plumb without bending or offsetting stems, rods, or supports and properly aligned both lengthwise and crosswise except that where obstructions or conflicts are encountered the fixtures shall be relocated as directed by the Owner and installed in such a manner as to provide a finished, neat, and workmanlike installation.

J. Appearance: All items shall be cleaned or touched up as necessary to ensure first-class condition.

3.03 FIELD TESTS AND OBSERVATION

A. General: Do not enclose or cover any work until it has been observed, tested, and accepted.

1. Provide all personnel, equipment, and instruments required for observation and testing.

2. Demonstrate that all circuits and devices are in operating condition. Tests shall include the following:

a. Megger all motor windings before operation for insulation resistance and, if found low, dry out windings to secure acceptable insulation resistance.
b. Check control center components, buses, starters, breakers, relays, alarms, interlocks, etc., and place in service in accordance with the manufacturer's instructions. Inspect and adjust electrical equipment before energization.
c. Megger all power cables and wiring for insulation resistance and record.
d. Check all motors for correct lubrication and lubricate, if required, in accordance with the manufacturer's instructions.
e. Check direction of rotation of all motors and reverse, if necessary.

3. Assemble in binders and turn over to the Owner all instruction bulletins, lubrication schedules, operating instructions, pamphlets, parts lists, prints, etc. accompanying or attached to apparatus and equipment.

4. Notify the Owner 1 week before test date.

B. Ground Rod Test: Before any wire is connected to ground rods, test each rod for resistance to ground.

1. The testing instrument shall be a direct reading, single test, portable ground testing megger.
2. The test procedure shall be as recommended by the manufacturer of the test instrument used.
3. The make and model of the test instrument and a copy of the test procedure shall be submitted to the Owner before the test is conducted.
4. Do not conduct tests within 48 hours after rainfall or during foggy weather.
5. If ground resistance exceeds 10 ohms, additional grounds shall be driven.
6. The grounding test shall be witnessed by the Owner. A copy of the test results and method shall be included in the maintenance manual. Deliver one copy of the test results to the Owner within 1 week after the test.

3.04 ADJUST AND CLEAN

A. The Contractor shall remove excess and waste materials from the project site.

B. Remove defective work and replace with material that meets Specification requirements or repair to the satisfaction of the Owner.

C. Touch up scratches, abrasions, voids, and other defects in factory- or shop-finished surfaces.

END OF SECTION

APPENDIX A

SUBSURFACE SOIL EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION

and

GEOTECHNICAL INVESTIGATION REPORT FOR DISCHARGE SYSTEM

Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
Crane Creek / M-1 Canal
Flow Restoration Project
Brevard County, Florida

Ardaman & Associates, Inc.

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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

May 3, 2019
File No. 18-23-5319

Jones Edmunds & Associates, Inc.
3910 S. Washington Avenue
Titusville, Florida 32780

Attention: Mr. Rich Koller, P.E.

Subject: Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
Crane Creek / M-1 Canal Flow Restoration Project
Brevard County, Florida
Jones Edmunds Project No.: 19750-066-01

Dear Mr. Koller:

As requested and authorized by you, we have completed a shallow subsurface soil exploration for the subject project. The purposes of performing this exploration were to evaluate the general subsurface conditions at the locations of the proposed improvements for this flow restoration project, and to provide recommendations for site preparation and foundation support. In addition, we have estimated the normal seasonal high groundwater level at the boring locations. This report documents our findings and presents our engineering recommendations.

SITE LOCATION AND SITE DESCRIPTION

The project site is located in areas just west and east of Interstate I-95, a short distance north of US Highway 192. In addition, the project site includes a proposed utility easement area beneath Interstate I-95 in this area. The above areas are located within and in close proximity to West Melbourne, Brevard County, Florida (Sections 2 and 3, Township 28 South, Range 36 East). The general location of the areas described above is shown superimposed the Melbourne West, Florida USGS quadrangle map presented on Figure 1.

A second project area is located east of the area described above. This second project area is located immediately north of the M-1 Canal in an area just southeast of the intersection of Hibiscus Boulevard and Evans Road. This area is located in Melbourne, Brevard County, Florida (Section 5, Township 28 South, Range 37 East). The general location of the area described above is shown superimposed the Melbourne West, Florida USGS quadrangle map presented on Figure 2.

The areas within the project site where our field exploration was performed are mostly grassed and/or vegetated with sparse brush and trees. Paths were mowed in areas on the west end of the project site to provide drill rig access to the boring locations.

PROPOSED CONSTRUCTION AND GRADING

Based on information provided by Jones Edmunds & Associates, Inc., the improvements proposed for this project include the following:

- A flow diversion structure along the south bank of the M-1 Canal in an area immediately east of Dike Road. This structure is anticipated to be founded on a combination of shallow spread footings and sheet piles installed to a maximum depth of approximately 17 feet below the top of canal bank. A short concrete driveway will be constructed just south of the structure;

- A stormwater pump station just west of Dike Road. The pump station will include pipes and equipment supported on concrete pads as well as a wet well structure that will extend to a depth of approximately 18.5 feet below existing ground surface. The wet well structure will be placed on a minimum 2-foot thick No. 57 stone bedding;

- A short segment of directionally drilled force main pipeline that will be located between the pump station and the Interstate I-95 right-of-way. The depth to the top of the pipe will be at least 3 feet below existing ground surface;

- A gravity stormwater culvert pipe or pressure pipe that will be installed beneath Interstate I-95. This pipe will be installed beneath I-95 using the jack and bore method with a minimum depth of approximately 30 feet below existing ground surface adjacent to the roadway;

- On the west side of I-95 an additional segment of force main pipeline will be installed using the directional drill method from the west right-of-way of I-95 to an area approximately 2,900 feet west of the right-of-way. The depth to the top of the pipe will be at least 3 feet below existing ground surface; and

- A cast-in-place concrete weir and control gate system will be installed across the M-1 Canal in an area just southeast of the intersection of Hibiscus Boulevard and Evans Road. The bottom slab of the weir/gate structure is anticipated to be installed approximately 24 feet below the top of canal bank.

For the purposes of our analyses, we have assumed the maximum loading conditions for the proposed structures to be on the order of 1 to 2 kips per linear foot for continuous foundations and 10 to 20 kips for individual spread foundations. Grading plans are not complete at this time, therefore we have assumed that no more than 2 to 3 feet of fill is required to raise the structure areas to final elevations. If actual structure loads or fill height exceed our assumptions, then the recommendations in this report may not be valid.

REVIEW OF SOIL SURVEY MAPS

Based on the 1974 Soil Survey for Brevard County, Florida, as prepared by the U.S. Department of Agriculture Soil Conservation Service, the west portion of the project site is located in an area mapped as the "Eau Gallie sand", “Felda sand”, and “Pineda sand” soil series. The east portion of the project site is located in an area mapped as the "Spoil banks” soil series. A description of

these soil types, as obtained from the Soil Survey, is provided below.

Eau Gallie sand (Eg):

Eau Gallie sand is a nearly level, poorly drained soil on broad low ridges in the flatwoods. A representative profile consists of sand to a depth of about 50 inches underlain by sandy clay loam and loamy sand to a depth of 84 inches. In most years the water table is within a depth of 10 inches for 1 to 4 months and between 10 and 40 inches for more than 6 months. In dry seasons it is below a depth of 40 inches. The soil is flooded for 7 days to a month once in 5 years to 20.

Felda sand (Fa):

Felda sand is a nearly level, poorly drained soil on broad, low flats and in sloughs, depressions, and poorly defined drainageways. In a representative profile the surface layer is sand about 5 inches thick. Below this is 10 inches of dark gray sand that has common mottles and 15 inches of mottled grayish-brown sand. The next layer between depths of 30 and 41 inches is dark gray sandy loam that has mottles and streaks. Below this layer to 62 inches is gray sandy loam with mottles. Permeability is rapid in the sandy layers and moderate to moderately rapid in the loamy layers. The water table is within a depth of 10 inches for 2 to 6 months in most years and is typically between 10 and 40 inches for the rest of the year. Water rises above the surface for 2 to 7 days in 1 to 3 months of each year.

Pineda sand (Pn):

“Pineda sand” is a nearly level, poorly drained sandy soil on broad hammocks and in low sloughs. A representative soil profile consists of a surface layer of 5 inches of black sand followed by 8 inches of dark gray sand. Below this is 6 inches of light brownish-gray sand. The subsoil extends to a depth of 60 inches and includes sandy soil in the top 35 inches and loamy soils between 35 and 60 inches. The water table is within 10 inches of the surface for 1 to 2 months in most years and is between depths of 10 and 40 inches for more than 6 months. In dry periods, it is at a depth of more than 40 inches. The soil is flooded for 2 to 7 days once in 1 to 5 years.

Spoil banks (Sp):

“Spoil banks” are piles of soil material dug from large ditches and canals or dredged from ship channels in the Indian River. On the mainland Spoil banks occur as long, narrow areas adjacent to the ditches and canals from which they were dug. In the Indian River they occur as scattered islands near the ship channels from which they were dredged. One area south of Patrick Air Force Base consists of alternating low ridges of sand and shell dredged form the Indian River and tidal swamps.

The texture in most areas adjacent to ditches and canals is a mixture of sand and loamy sand or sandy clay loam, but some areas are entirely sand. Shells and marl are common, particularly where canals were dug into deep substrata. The islands of dredged material consist mostly of mixed sand and shell. In some places this material contains lumps of clay and in a few places, layers or pockets of peat or muck. Most areas on the mainland are nearly level to steep and do not have a water table within the spoil. Areas on the islands are nearly level or gently sloping and generally have a water table that fluctuates between depths of 30 and 60 inches.

FIELD EXPLORATION PROGRAM

SPT Borings

The field exploration program included performing 12 Standard Penetration Test (SPT) borings within the proposed improvement areas. Each of the borings, with the exception of Borings B-11 and B-12, were drilled in the west project area. A summary of the soil boring locations is provided in the following table.

Boring ID	Location
B-1	Flow Diversion Structure
B-2 and B-3	Stormwater Pump Station
B-4	Directional Drill Force Main Installation - East Side of I-95
B-5 and B-6	I-95 Jack and Bore Pipe Installation
B-7 through B-10	Direction Drill Force Main Installation - West Side of I-95
B-11 and B-12	Weir and Control Gate System at M-1 Canal (East Project Area)

Due to the potential presence of underground utilities in the project area, the top 4.5 feet of each boring was advanced using a 3-inch diameter, hand-held bucket auger. Below 4.5 feet, the borings were advanced to depths ranging from 20 to 50 feet below the existing ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level was measured at each of the boring locations during drilling. Upon completion, each of the borings, except for Borings B-5 and B-6, were backfilled with soil cuttings. Borings B-5 and B-6 were grouted with neat cement grout upon completion of drilling.

Test Locations

The approximate locations of the borings are schematically illustrated on aerial photograph plans shown on Figures 3 through 5. These locations were determined in the field by estimating distances from existing site features and should be considered accurate only to the degree implied by the method of measurement used.

LABORATORY PROGRAM

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profiles presented in Appendix II.

In addition, we conducted four natural moisture content tests (ASTM D2216), 24 percent fines analyses (ASTM D1140), and one Atterberg limits test (ASTM D4318) on selected soil samples obtained from the borings. The results of these tests are presented adjacent to the sample depth on the boring profiles in Appendix II.

GENERAL SUBSURFACE CONDITIONS

General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profiles presented in Appendix II. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The soils encountered in the SPT borings consisted of very loose to dense fine sand (Unified Soil Classification SP), fine sand with silt (SP-SM), silty fine sand (SM), clayey fine sand (SC), and partially-cemented sand and shell to the termination depth of the deepest borings, 50 feet below ground surface. In addition, very soft clay (CL/CH) was encountered in Boring B-6 at depths of approximately 32.5 to 37.5 feet below existing ground surface. Various amounts of shell were encountered in the soil samples collected from the borings. We noted that a high shell content, identified by the term “and shell” on the soil boring profiles in Appendix II, and partially-cemented sand and shell were encountered in soil samples collected from the borings at depths ranging from approximately 6 to 50 feet below existing ground surface. This soil profile is outlined in general terms only. Please refer to Appendix II for soil profile details.

Groundwater Level

The groundwater level was measured in the boreholes on the day drilled. As shown in Appendix II, groundwater was encountered in the borings at depths that ranged from approximately 2 to 8.1 feet below the existing ground surface on the dates indicated. Fluctuations in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted.

For Borings B-11 and B-12 referenced “GNM” at the bottom of the boring profiles in Appendix II, groundwater was not encountered within the top 10.5 feet (and could not be measured below a depth of 10.5 feet due to the mudded condition of the boreholes). However, this does not necessarily mean that groundwater would not be encountered within the vertical reach of the borings or within the top 10.5 feet of the borings at some other time.

NORMAL SEASONAL HIGH GROUNDWATER LEVEL

The normal seasonal high groundwater level each year is the level in the August-September period at the end of the rainy season during a year of normal (average) rainfall. The water table elevations associated with a higher than normal rainfall and in the extreme case, flood, would be higher to much higher than the normal seasonal high groundwater level. The normal high water levels would more approximate the normal seasonal high groundwater levels.

The seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, the land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

In addition to evaluating the conditions above, we have reviewed annual precipitation data available from the Melbourne Office of the National Weather Service. Based on this data, the annual rainfall to date in Brevard County is approximately 13 inches, which is approximately 3.3 inches above normal for this time of year.

Based on our interpretation of the site conditions using our boring logs, we estimate the normal seasonal high groundwater level at the locations of Borings B-1 through B-4 and B-7 through B-10 to be approximately 3 feet above the groundwater levels measured at the time of our field exploration. This indicates that the groundwater level may rise above the ground surface at the location of Boring B-7. The height that the water level may rise above the ground surface at this boring location should be determined by the project drainage engineer.

Based on our interpretation of the site conditions using our boring logs, we estimate the normal seasonal high groundwater level at the locations of Borings B-5 and B-6 to be approximately 2 feet above the groundwater levels measured at the time of our field exploration.

We note that at each of the boring locations, the groundwater table may temporarily perch at higher levels during or after heavy or prolonged rainfall due to the shallow silty and clayey soils present within the project areas.

ENGINEERING EVALUATION AND RECOMMENDATIONS

General

The results of our exploration indicate that, with proper site preparation as recommended in this report, the existing soils are suitable for supporting the proposed structures on a conventional shallow foundation system. Spread footings should provide an adequate support system for the structures. Additionally, the encountered soils are suitable for installation of the sheet piles to be installed at the M-1 Canal flow diversion structure location and for support of the concrete driveway to be constructed at the same location.

Borings B-5 and B-6 were drilled to a depth of 50 feet below existing ground surface at the location of the proposed jack and bore beneath Interstate I-95. The soils encountered in these two borings consisted of loose to dense fine sand (SP), fine sand with silt (SP-SM), silty fine sand (SM), clayey fine sand (SC), and partially-cemented sand and shell. Additionally, very soft clay (CL/CH) was encountered in Boring B-5 from 32.5 to 37.5 feet below existing ground surface. Various amounts of shell were encountered in the soil samples collected below a depth of 9 feet below existing ground surface in these two borings. A high shell content, designated by the term “and shell” on the soil boring profiles in Appendix II was encountered in soil samples obtained from depths ranging from 9 to 32.5 feet below existing ground surface in Borings B-5 and B-6. Additionally, partially-cemented sand and shell was encountered in both borings at depths ranging from approximately 47.5 to 50 feet below existing ground surface.

We anticipate that drilling through/penetrating the partially-cemented sand and shell soils and the soils containing high shell content that were encountered in Borings B-5 and B-6 at depths ranging from approximately 9 to 32.5 feet and 47.5 to 50 feet may be difficult during the jack and bore procedure. These difficulties are even more likely if the soils with high shell content are found to be partially-cemented. The other soils encountered in Borings B-5 and B-6 are anticipated to require typical effort to penetrate during the jack and bore procedure based on the results of the exploration.

Borings B-4 and B-7 through B-10 were drilled to a depth of 20 feet below existing ground surface in the areas east and west of Interstate I-95 where force main pipes will be installed using the directional drill procedure. The soils encountered in these borings consisted of very loose to dense fine sand (SP), fine sand with silt (SP-SM), silty fine sand (SM), and clayey fine sand (SC). Various amounts of shell were encountered in the soil samples collected below a depth of 4.5 feet below existing ground surface in these borings. A high shell content, designated by the term “and shell” on the soil boring profiles in Appendix II was encountered in soil samples obtained from depths ranging from 6 to 20 feet below existing ground surface in Borings B-4 and B-7 through B-10. Additionally, partially-cemented sand and shell was encountered in the samples obtained from Boring B-10 at depths ranging from approximately 6 to 9 feet below existing ground surface.

We anticipate that drilling through/penetrating the partially-cemented sand and shell soils and the soils containing high shell content that were encountered in Borings B-4 and B-7 through B-10 at depths ranging from approximately 6 to 20 feet may be difficult during the directional drill procedure. These difficulties are even more likely if the soils with high shell content are found to be partially-cemented. The other soils encountered in these borings are anticipated to require typical effort to penetrate during the directional drill procedure based on the results of the exploration.

The following are our recommendations for overall site preparation, foundation support, and driveway construction which we feel are best suited for the proposed facility and existing soil conditions. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project's specifications. It is noted that the following report sections pertain to all of the proposed structures other than the wet well structure proposed for the pump station. Specific recommendations for the wet well structure are presented on Page 9 of this report.

Stripping and Grubbing

The "footprints" of the proposed structure and driveway areas, plus a minimum margin of 5 feet, should be stripped of all surface vegetation, stumps, debris, asphalt, concrete, organic topsoil or other deleterious materials, as encountered. In existing ditch areas; any vegetation, debris, or soft sediment present on the ditch bottom within the structure area, plus a minimum margin of 5 feet, should be removed. Buried utilities should be removed or plugged to eliminate conduits into which surrounding soils could erode.

After stripping, the site should be grubbed or root-raked such that roots with a diameter greater than ½ inch, stumps, or small roots in a dense state, are completely removed. The actual depth(s) of stripping and grubbing must be determined by visual observation and judgment during the earthwork operation.

Proof-rolling

We recommend proof-rolling the cleared surface to locate any unforeseen soft areas or unsuitable surface or near-surface soils, to increase the density of the upper soils, and to prepare the existing surface for the addition of the fill soils (as required). Proof-rolling of the structure areas should consist of at least 10 passes of a compactor capable of achieving the density requirements described in the next paragraph. Each pass should overlap the preceding pass by 30 percent to achieve complete coverage. If deemed necessary, in areas that continue to "yield", remove all deleterious material and replace with clean, compacted sand backfill. The proof-rolling should occur after cutting and before filling. The number of passes can be reduced to three within the proposed driveway area.

A density equivalent to or greater than 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value for a depth of 2 feet in the structure area and 1 foot in the driveway area must be achieved beneath the stripped and grubbed ground surface. Additional passes and/or overexcavation and recompaction may be required if these minimum density requirements are not achieved. The soil moisture should be adjusted as necessary during compaction.

Care should be exercised to avoid damaging any neighboring structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified and the existing condition (i.e. cracks) of the structures documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures, and Ardaman & Associates should be notified immediately. Heavy vibratory compaction equipment should not be used within 200 feet of existing structures.

Suitable Fill Material and the Compaction of Fill Soils

All fill soil should be free of organic materials, such as roots and vegetation. We recommend using fill with less than 12 percent by dry weight of material passing the U.S. Standard No. 200 sieve size. The fine sand and fine sand with silt (Strata Nos. 1 and 2 as shown in Appendix II) are suitable for use as fill soil and, with proper moisture control, should densify using conventional compaction methods. Soils with more than 12 percent passing the No. 200 sieve (Stratum Nos. 3 and 4) can be used in some applications, but will be more difficult to compact due to their inherent nature to retain soil moisture. The clay (Soil Stratum No. 6) should not be used for fill on the project site.

We note that partially-cemented sand and shell soils were encountered in Borings B-5, B-6, and B-10. Partially-cemented sand and shell soils can be problematic for several reasons. First, these soils can be difficult to excavate, often requiring special equipment; especially in confined excavations such as utility trenches, footings, etc. Excavated partially-cemented sand and shell soils are often boulder-size chunks of cemented soils which are not easily broken down for re-use as structural fill.

All structural fill should be placed in level lifts not to exceed 12 inches in uncompacted thickness. Each lift should be compacted to at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value. The filling and compaction operations should continue in lifts until the desired elevation(s) is achieved. If hand-held compaction equipment is used, the lift thickness should be reduced to no more than 6 inches.

Foundation Support by Spread Footings and Foundation Compaction Criteria

For the structures supported on shallow spread foundations, excavate the foundations to the proposed bottom of footing elevations and, thereafter, verify the in-place compaction for a depth of 2 feet below the footing bottoms. If necessary, compact the soils at the bottom of the excavations to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557) for a depth of 2 feet below the footing bottoms. Based on the existing soil conditions and, assuming the above outlined stripping, proof-rolling and compaction criteria are implemented, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used in the foundation design. This bearing pressure should result in foundation settlement within tolerable limits (i.e., 1 inch or less).

All bearing wall foundations should be a minimum of 18 inches wide and column foundations 24 inches wide. A minimum soil cover of 18 inches should be maintained from the bottom of the foundations to the adjacent finished grades.

Floor Slab Moisture Reducer and Slab Compaction Requirements

Compaction beneath all floor slabs should be verified for a depth of 12 inches and meet the 95 percent criteria (modified Proctor, ASTM D-1557). A modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be used for design of slabs on the project site.

Precautions should be taken during the slab construction to reduce moisture entry from the underlying subgrade soils. Moisture entry can be reduced by installing a membrane between the subgrade soils and floor slab. Care should be exercised when placing the reinforcing steel (or mesh) and slab concrete such that the membrane is not punctured. We note that the membrane alone does not prevent moisture from occurring beneath or on top of the slab.

If interior columns are isolated from the floor slab, an expansion joint should be provided around the columns and sealed with a water-proof sealant.

Dewatering

If the control of groundwater is required to achieve the necessary stripping, excavation, proof-rolling, filling, compaction, and any other earthwork, sitework, and/or foundation subgrade preparation operations required for the project, the actual method(s) of dewatering should be determined by the contractor. Dewatering should be performed to lower the groundwater level to depths that are adequately below excavations and compaction surfaces. Adequate groundwater level depths below excavations and compaction surfaces vary depending on soil type and construction method, and are usually 2 feet or more. Dewatering solely with sump pumps may not achieve the desired results.

Pump Station Wet Well

<u>Braced Excavation Installation Method – Wet Well</u>

Borings B-2 and B-3 were drilled in the proposed pump station area on the project site. The results of our exploration indicate that the existing soils encountered in Borings B-2 and B-3 are suitable

for supporting the proposed wet well structure. The bottom of the structure should extend below the very loose soils designated by weight of hammer (WOH) on the soil boring profiles in Appendix II that were encountered in Boring B-3 from approximately 6 to 8 feet below existing ground surface. A mat foundation should provide adequate support for the wet well structure. In addition, the encountered soils are suitable for use as pipe/structure backfill.

A positive head should be maintained in the wet well to prevent a quick condition from occurring in the excavation bottom. A quick condition is defined as a condition where the soil in the bottom of the excavation has zero contact stress between the soil particles due to an overwhelming upward hydraulic gradient, and the soil structure breaks up. The bottom of the excavation can fail by heaving under this condition. In addition, "sinkholes" could occur around the perimeter of the excavation if a quick condition occurs in the bottom of the excavation. We note that if a quick condition occurs during wet well installation, the soil parameter estimates beginning on Page 12 of this report may not be valid.

Excavation and Backfilling – Wet Well

We note soils with a high shell content, identified with the term "and shell" in Appendix II and partially-cemented sand and shell were encountered in Borings B-2 and B-3 at depths ranging from approximately 12 to 30 feet below existing ground surface. Excavation within these soils may be difficult, particularly if these soils are found to be partially-cemented, and the contractor should be prepared for difficulty associated with excavating within these soils.

The bottom of the wet well excavation should be compacted to achieve a density of at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value for a depth 1 foot below the bottom of the excavation. Any overexcavated areas should be backfilled with suitable fill soil as outlined below in the "Suitable Fill Material and Compaction of Fill Soils" section of this report presented below.

Excavation and backfilling should be performed "in the dry". Therefore, extensive dewatering will be necessary to lower the groundwater level 2 to 3 feet below the bottom of the excavation and compaction surfaces. Dewatering of the excavation is discussed in a subsequent section of this report.

The excavation should be safely braced to prevent injury to personnel or damage to equipment. Temporary safe slopes should be cut at a minimum in accordance with OSHA, 29 CFR Part 1926 Final Rule, Excavations Requirements. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations and spoil piles adjacent to excavations should be sloped no steeper than 2.0H to 1.0V. Provisions for maintaining workman safety within excavations is the sole responsibility of the Contractor.

Suitable Fill Material and the Compaction of Fill Soils – Wet Well

All fill soil should be free of organic materials, such as roots and vegetation. We recommend using fill with less than 12 percent by dry weight of material passing the U.S. Standard No. 200 sieve size. The fine sand and fine sand with silt (Strata Nos. 1 and 2 without roots, as shown in Appendix II) are suitable for use as fill soil and, with proper moisture control, should densify using conventional compaction methods.

All structural fill should be placed in level lifts not to exceed 12 inches in uncompacted thickness. Each lift should be compacted to at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value. The filling and compaction operations should continue in lifts until the desired elevation(s) is achieved. If hand-held compaction equipment is used, the lift thickness should be reduced to no more than 6 inches.

Backfill placed adjacent to the structure walls should consist of granular soils that are free draining and relatively free of fines. The backfill within 5 feet of the structure walls should be placed in lifts and compacted with hand-held compactors to between 95 and 98 percent of the modified Proctor (ASTM D-1557) maximum dry density value. Overcompaction of the backfill should be avoided since it could cause excessively large earth pressures to develop against the walls. Heavy equipment should be kept at least 5 feet away from the walls.

We note that soils with a high shell content, identified by the term “and shell” in Appendix II, and partially-cemented sand and shell soil were encountered in Borings B-2 and B-3 at depths ranging from approximately 12 to 30 feet below the existing ground surface. If these soils are found to be partially-cemented, they can be difficult to excavate, often requiring special equipment; especially in confined excavations such as wet well excavations, utility trenches, footings, etc. If these soils are found to be partially-cemented, excavation of these soils may result in boulder-size chunks of cemented soils which are not easily broken down for re-use as structural fill.

Foundation Support by Shallow Foundations and Foundation Compaction Criteria – Wet Well

Excavate the wet well foundation to the proposed bottom of footing elevation and, thereafter, verify the in-place compaction for a depth of 1 foot below the footing bottom. If necessary, compact the soils at the bottom of the excavation to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557) for a depth of 1 foot below the footing bottom. Based on the existing soil conditions and, assuming the above outlined compaction criteria are implemented, an allowable soil bearing pressure of 1,500 pounds per square foot (psf) may be used in the design of the wet well structure foundation. This bearing pressure should result in foundation settlement within tolerable limits (i.e., 1 inch or less).

The No. 57 stone that will be placed in the bottom of the excavation as a bedding material for the wet well structure should be tamped to achieve a “firm and unyielding” condition.

Dewatering – Wet Well

If the control of groundwater is required to achieve the necessary excavation, filling, compaction, and any other earthwork, site work, and/or foundation subgrade preparation operations required for the project, the actual method(s) of dewatering should be determined by the contractor. Dewatering should be performed to lower the groundwater level to depths that are adequately below excavations and compaction surfaces. Adequate groundwater level depths below excavations and compaction surfaces vary depending on soil type and construction method, and are usually 2 feet or more. Dewatering solely with sump pumps may not achieve the desired results.

Due to the existence of shallow low permeability silty fine sand and clayey fine sand (Soil Strata Nos. 3 and 4) immediately above sandy soils with a high shell content, there is a potential for

significant groundwater flows to be encountered during construction in the proposed wet well area. This possible condition should be considered when determining the method(s) of dewatering that will be implemented at the site.

SOIL PARAMETERS

Presented below are our recommendations for various soil parameters that may be used for wet well and sheet pile design. We note that if a quick condition occurs during construction/installation, the soil parameter estimates presented below may not be valid. A quick condition is defined as a condition where the soil in the bottom of the excavation has loss of contact stress between the soil particles due to an overwhelming upward hydraulic gradient, and the soil structure breaks up. The bottom of the excavation can fail by heaving under this condition.

At-Rest Earth Pressures Acting on Embedded/Buried Structures

At-rest pressures acting on embedded or buried structures include lateral loading due to soil, water and surcharge, if any. The lateral earth pressure will be a function of both the soil unit weight (submerged) and the depth below the ground surface. The following equation can be used to determine the lateral at-rest earth pressure:

$$P_h = K_o \gamma h$$

Where:

- P_h = lateral at-rest earth pressure (psf)
- K_o = coefficient of at-rest earth pressure (0.5) (this value assumes that the backfill is lightly compacted yet not overcompacted)
- γ = unit weight of soil (γ_m for moist soil above the water table and γ_b for saturated soil below the water table)
- γ_m = effective moist unit weight of soil = 110 pcf for compact moist soil above the water table
- γ_b = buoyant unit weight of soil = 60 pcf for compacted saturated soil below the water table
- h = depth (feet) below grade at which lateral earth pressure is determined

For design, an appropriate safety factor should be applied to the lateral at-rest earth pressure determined in accordance with the above equation. In addition, lateral pressure distributions determined in accordance with the above equation do not include hydrostatic pressures or surcharge loads. Where applicable, they should be incorporated in the design.

Earth Pressure on Shoring and Bracing

If temporary shoring and bracing is required for any excavations, the system should be designed to resist lateral earth pressure. The design earth pressure will be a function of the flexibility of the shoring and bracing system. For a flexible system restrained laterally by braces placed as the excavation proceeds, the design earth pressure for shoring and bracing can be computed using a uniform earth pressure distribution with depth. It is recommended that soils be de-watered around the excavations. For such de-watered excavations, we recommend using the following uniform pressure distribution over the full braced height as follows:

Uniform Soil Pressure Distribution, $P = 0.65K_a\gamma_m h$

where:

P = uniform pressure distribution for design of braced excavation
K_a = coefficient of active earth pressure = 0.33
γ_m = moist weight of soils = 100 pcf
h = depth of excavation

An appropriate factor of safety should be applied for the design of the braced excavations.

Lateral pressure distributions determined in accordance with the above do not take hydrostatic pressures or surcharge loads into account. To the extent that such pressures and forces may act on the walls, they should be included in the design.

Construction equipment and excavated fill should be kept a minimum distance of 5 feet from the edge of the braced or shored excavation. Backfill material placed adjacent to (maintaining a minimum 5-foot horizontal clearance) the braced or shored excavation should have a minimum slope of 2H:1V, or flatter if required by site specific conditions and/or to meet OSHA requirements.

Means and methods of excavation and bracing should be the responsibility of the Contractor. However, excavation and/or bracing should at a minimum adhere to the requirements of the Occupational Safety Health Administration (OSHA).

Buoyancy/Uplift Resistance

Permanent structures submerged below the water table will be subject to uplift forces caused by buoyancy. The components resisting this buoyancy include: 1) the total weight of the structure divided by an appropriate factor of safety, 2) the buoyant weight of soil overlying the structure, and 3) the shearing forces that act on shear planes that radiate vertically upward from the edges of the structure to the ground surface. The allowable unit shearing resistance may be determined by the following formula:

Allowable Unit Shearing Resistance (above groundwater table):

$$P=K_o\gamma_m h(2/3\ \tan\Phi)/S.F.$$

Allowable Unit Shearing Resistance (below groundwater table):

$$P=K_o[\gamma_m h_w+ \gamma_b(h-h_w)]\ (2/3\ \tan\Phi)/S.F.$$

Where:

P = unit shearing resistance (psf)
K_o = coefficient of at-rest earth pressure (0.5)
γ_m = unit weight of moist compacted soil = 100 pcf
γ_b = buoyant unit weight of compacted soil = 48 pcf
h = vertical depth (feet) below grade at which shearing resistance is determined
h_w = vertical depth (feet) below grade to groundwater table
Φ = angle of internal friction of the soil = 32 degrees
S.F. = safety factor = 2

The values given for the above parameters assume that the sides of the structure are in intimate contact with the surrounding soil, and that the ground level within 15 feet of the structure is relatively flat.

Soil Parameters for Sheet Pile Design

It is our understanding that steel sheet piles will be installed for the flow diversion structure along the south bank of the M-1 Canal, near where Boring B-1 was conducted. In the table presented in Appendix III, we offer a generalized subsurface profile based on the findings of our subsurface exploration, including our estimates of pertinent engineering parameters of the subsurface materials, for others to use in the design of the proposed sheet pile. Appropriate safety factors, which are beyond the scope of this exploration, should be applied to the soil parameters provided in Appendix III.

QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation and foundation and pavement construction is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

As a minimum, an on-site engineering technician should monitor all stripping and grubbing to verify that all deleterious materials have been removed and should observe the proof-rolling operation to verify that the appropriate number of passes are applied to the subgrade. In-situ density tests should be conducted during filling activities and below all footings, slabs and driveway areas to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the foundations and other structural components.

IN-PLACE DENSITY TESTING FREQUENCY

In Central Florida, earthwork testing is typically performed on an on-call basis when the contractor has completed a portion of the work. The test result from a specific location is only representative of a larger area if the contractor has used consistent means and methods and the soils are practically uniform throughout. The frequency of testing can be increased and full-time construction inspection can be provided to account for variations. We recommend that the following minimum testing frequencies be utilized.

In proposed structural areas, the minimum frequency of in-place density testing should be one test for each 2,500 square feet of structural area (minimum of three test locations per structure). In-place density testing should be performed at this minimum frequency for a depth of 2 feet below natural ground and for every 1-foot lift of fill placed in the structural area. In addition, density tests should be performed in each individual spread footing for a depth of 2 feet below the bearing surface. For continuous footings, density tests should be performed at a minimum frequency of one test for every 50 linear feet of footing, and for a depth of 2 feet below the bearing surface.

Representative samples of the various natural ground and fill soils should be obtained and transported to our laboratory for Proctor compaction tests. These tests will determine the maximum dry density and optimum moisture content for the materials tested and will be used in conjunction with the results of the in-place density tests to determine the degree of compaction achieved.

CLOSURE

The analyses and recommendations submitted herein are based on the data obtained from the soil borings presented on Figures 3 through 5, and in Appendix II, and on the assumed loading conditions. This report does not reflect any variations which may occur adjacent to or between the borings. The nature and extent of the variations between the borings may not become evident until during construction or additional exploration. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations. This study does not include an evaluation of the environmental (ecological or hazardous/toxic material related) condition of the site and subsurface.

This report has been prepared for the exclusive use of Jones Edmunds & Associates, Inc. in accordance with generally accepted geotechnical engineering practices. In the event any changes occur in the design, nature, or location of the proposed facility, we should review the applicability of conclusions and recommendations in this report. We recommend a general review of final design and specifications by our office to verify that earthwork and foundation recommendations are properly interpreted and implemented in the design specifications. Ardaman & Associates should attend the pre-bid and preconstruction meetings to verify that the bidders/contractor understand the recommendations contained in this report.

We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

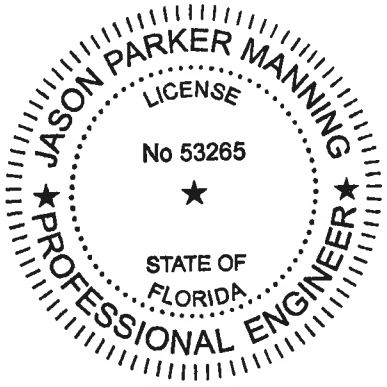
Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

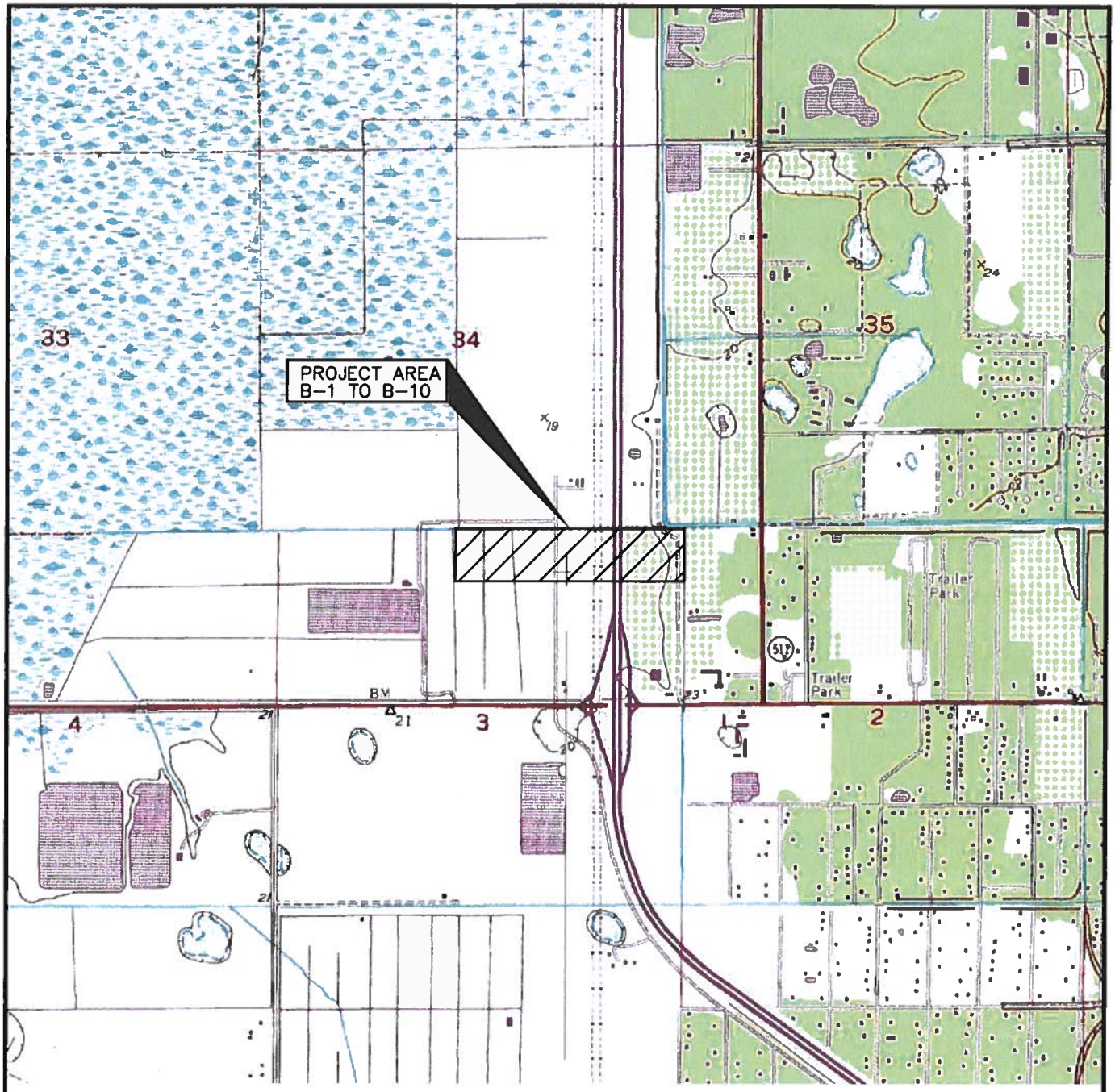
Dustin M. Cone
Assistant Project Engineer

5/6/19
Jason P. Manning, P.E.
Branch Manager
Florida License No. 53265

DMC/JPM/dk

Cc: Mr. Walt Nickle, P.E. - Jones Edmunds & Associates, Inc.





SECTIONS 2,3
TOWNSHIP 28 SOUTH
RANGE 36 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: MELBOURNE WEST, FLORIDA

N

0 1000 2000

SCALE: — 1"=2000'

QUADRANGLE LOCATION

SITE LOCATION MAP– WEST AREA

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE: 1

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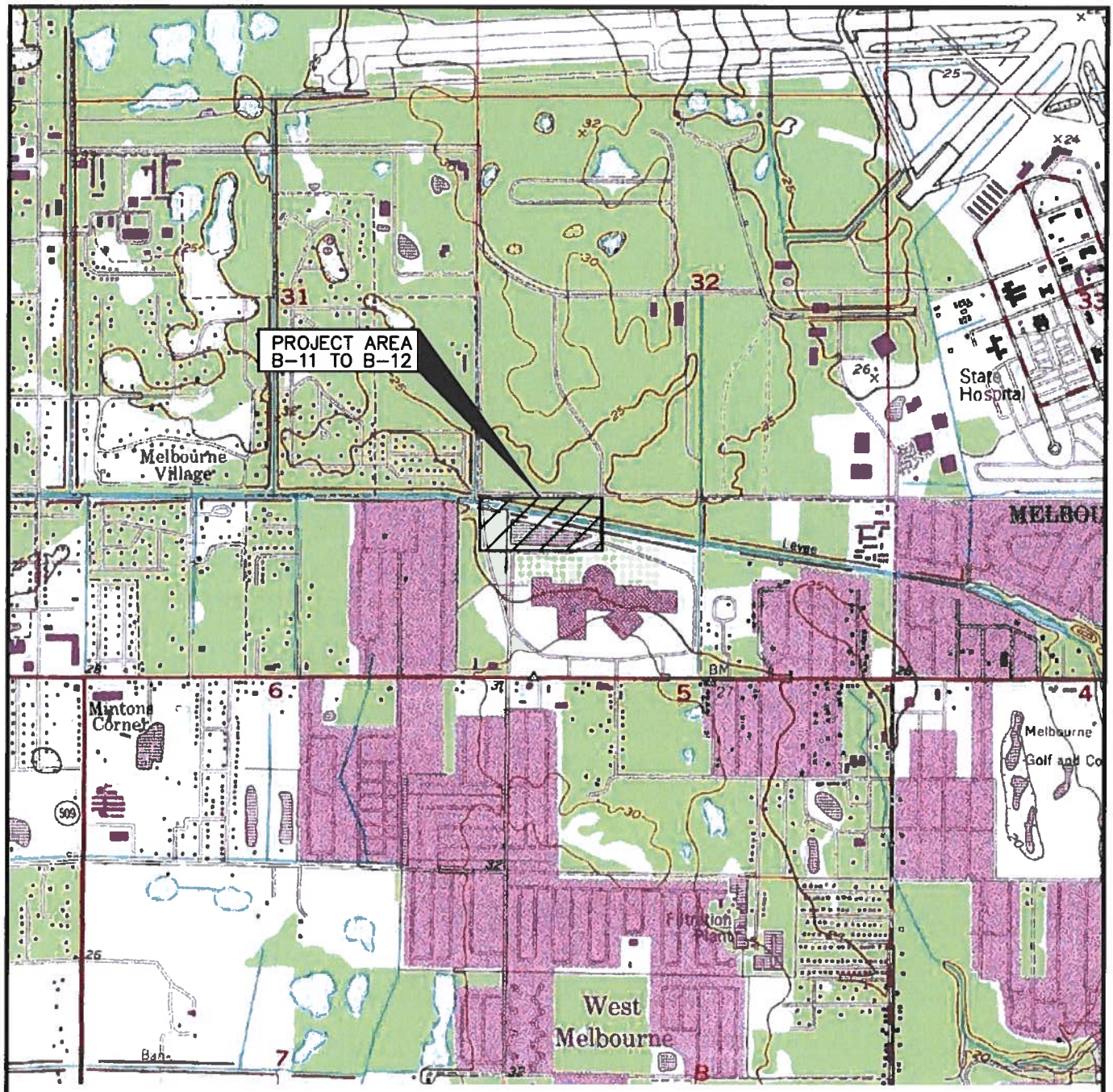
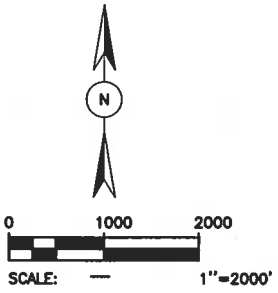


SECTIONS 5
TOWNSHIP 28 SOUTH
RANGE 37 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: MELBOURNE WEST, FLORIDA



QUADRANGLE LOCATION

SITE LOCATION MAP- EAST AREA

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE: 2

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N

0 50 100

SCALE: — 1"=100'

LEGEND

B STANDARD PENETRATION TEST (SPT) BORING LOCATION

BORING LOCATION PLAN– WEST AREA 1/2

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Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE: 3

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N

0 75 150

SCALE: — 1"=150'

LEGEND

B STANDARD PENETRATION TEST (SPT) BORING LOCATION

BORING LOCATION PLAN– WEST AREA 2/2

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

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FILE NO. 18-5319	APPROVED BY:	FIGURE: 4

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N

0 50 100

SCALE: — 1"=100'

LEGEND

B STANDARD PENETRATION TEST (SPT) BORING LOCATION

BORING LOCATION PLAN– EAST AREA

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M–1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

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FILE NO. 18–5319	APPROVED BY:	FIGURE: 5

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APPENDIX I

Standard Penetration Test Procedures

STANDARD PENETRATION TEST

The standard penetration test is a widely accepted test method of *in situ* testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, NX-size flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid.

Representative split-spoon samples from the soils at every 5 feet of drilled depth and from every different stratum are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for 30 days prior to being discarded. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed, if necessary, and backfilled.

APPENDIX II

Soil Boring Profiles

LEGEND

SOIL DESCRIPTIONS

1. FINE SAND (SP)
2. FINE SAND WITH SILT (SP–SM)
3. SILTY FINE SAND (SM)
4. CLAYEY FINE SAND (SC)
5. PARTIALLY CEMENTED SAND AND SHELL
6. CLAY (CL/CH)

COLORS

A. LIGHT BROWN TO BROWN

B. GRAYISH–BROWN

C. LIGHT GRAY TO GRAY

D. DARK GRAY OR DARK BROWN

B	STANDARD PENETRATION TEST (SPT) BORING
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
NM	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D–2216)
–200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D–1140)
LL	LIQUID LIMIT IN PERCENT (ASTM D–423)
PI	PLASTICITY INDEX IN PERCENT (ASTM D–424)
WOH	SAMPLER ADVANCED BY STATIC WEIGHT OF HAMMER AND RODS ONLY
GNM	GROUNDWATER NOT MEASURED ABOVE 10.5 FEET ON DATE DRILLED
▽	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
SP,SP–SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM

ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR.

SOIL PROFILES LEGEND

Ardaman & Associates, Inc.
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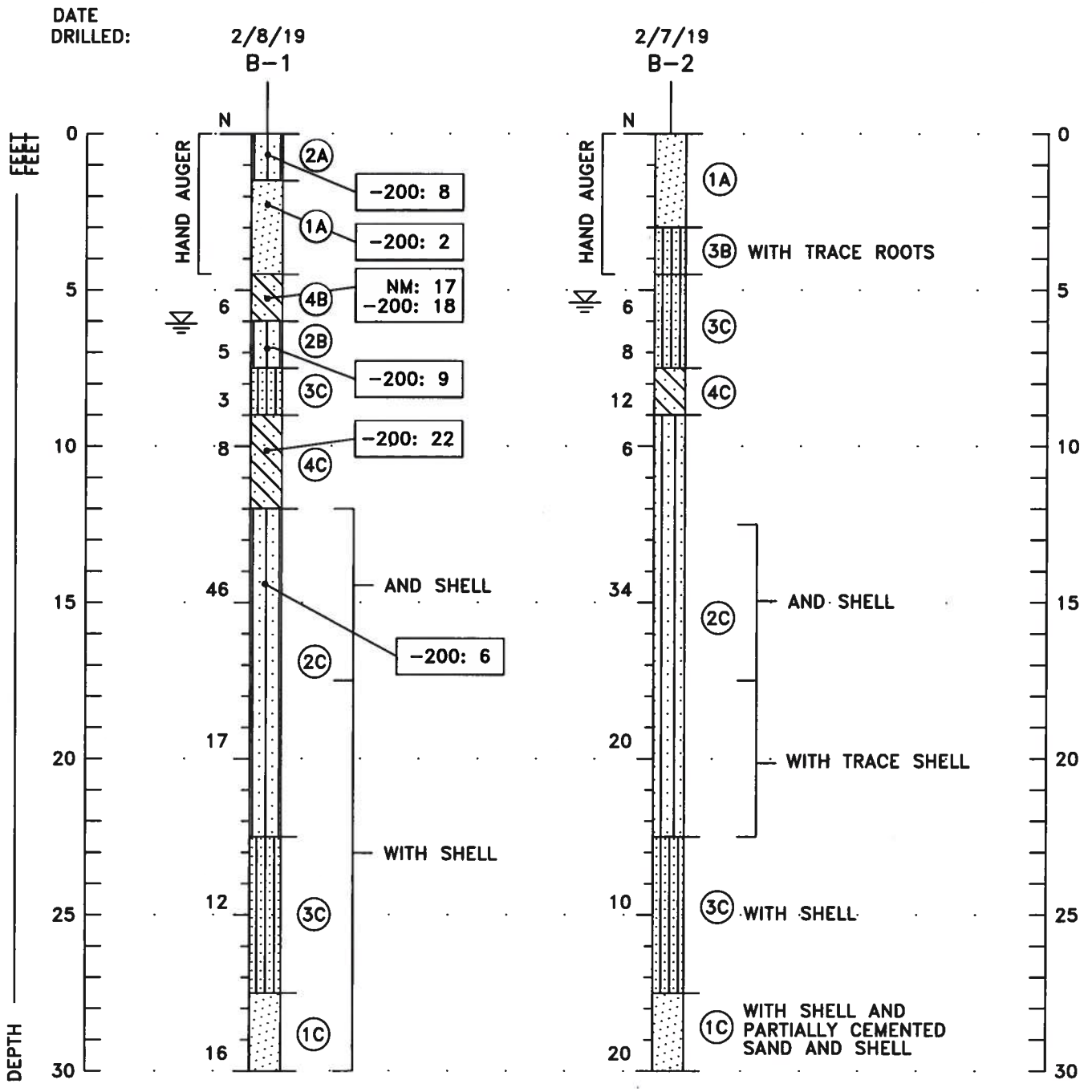
SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M–1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 4/26/19
FILE NO. 18–5319	APPROVED BY:	FIGURE:



SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE:

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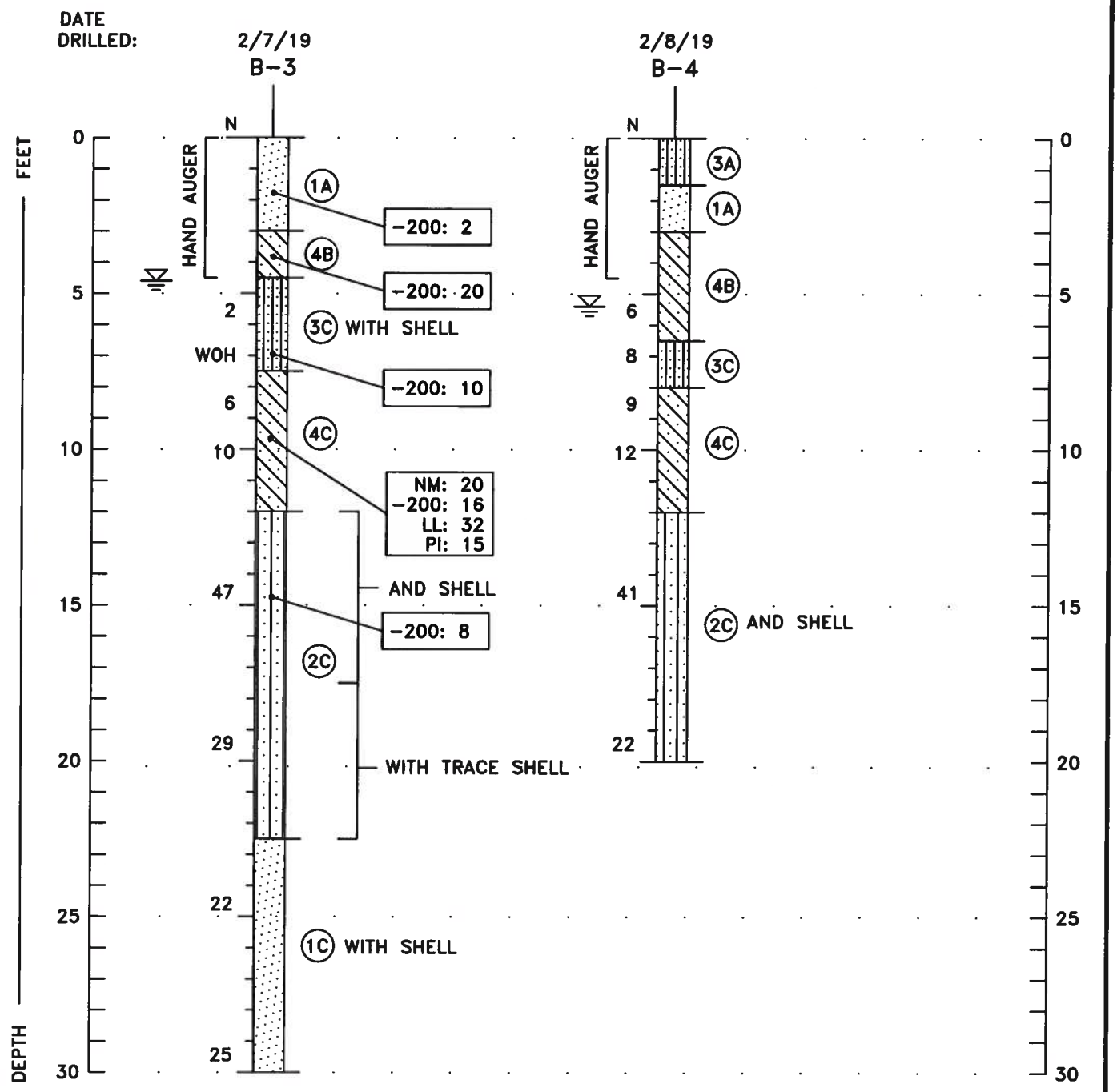

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE:

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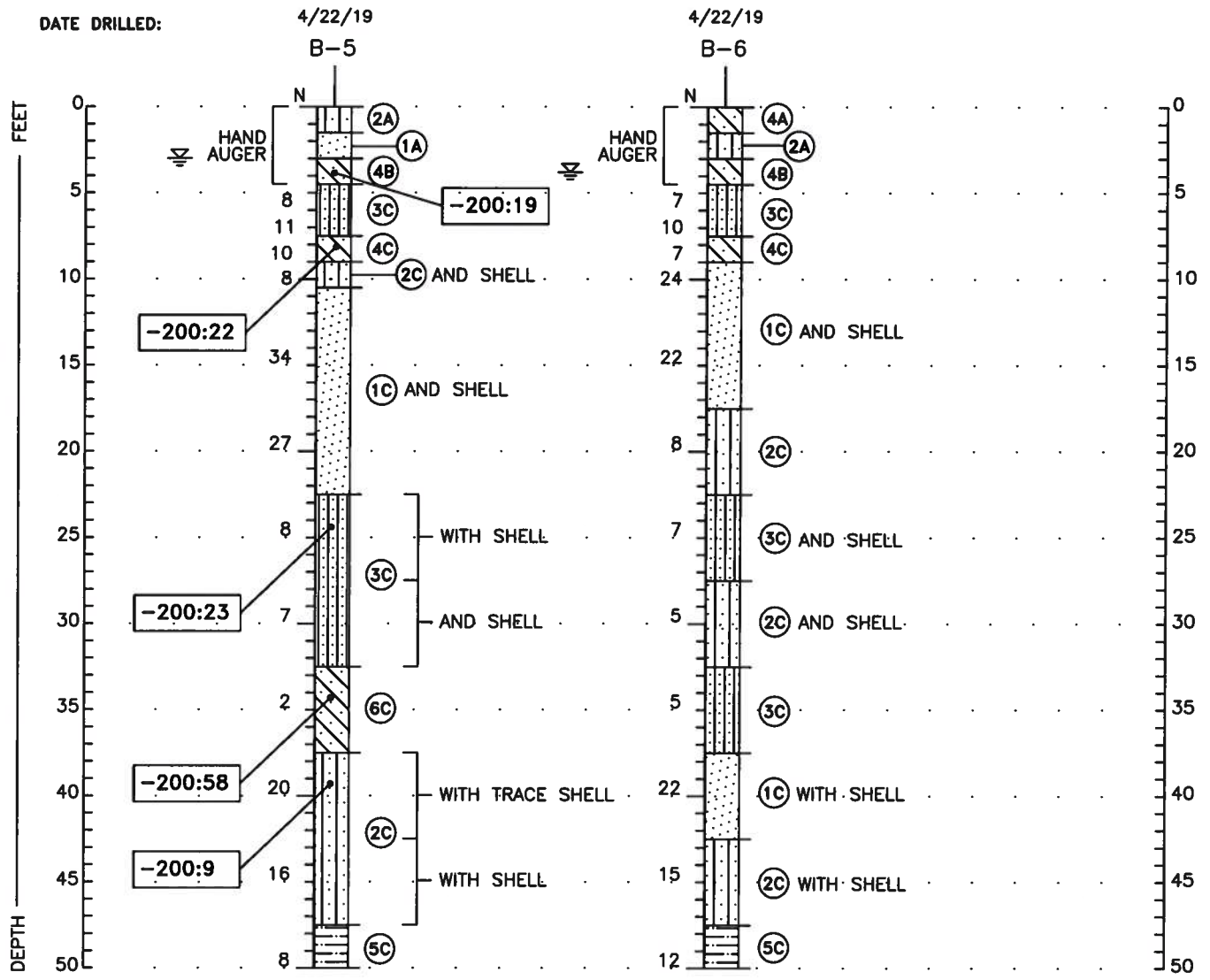

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE:

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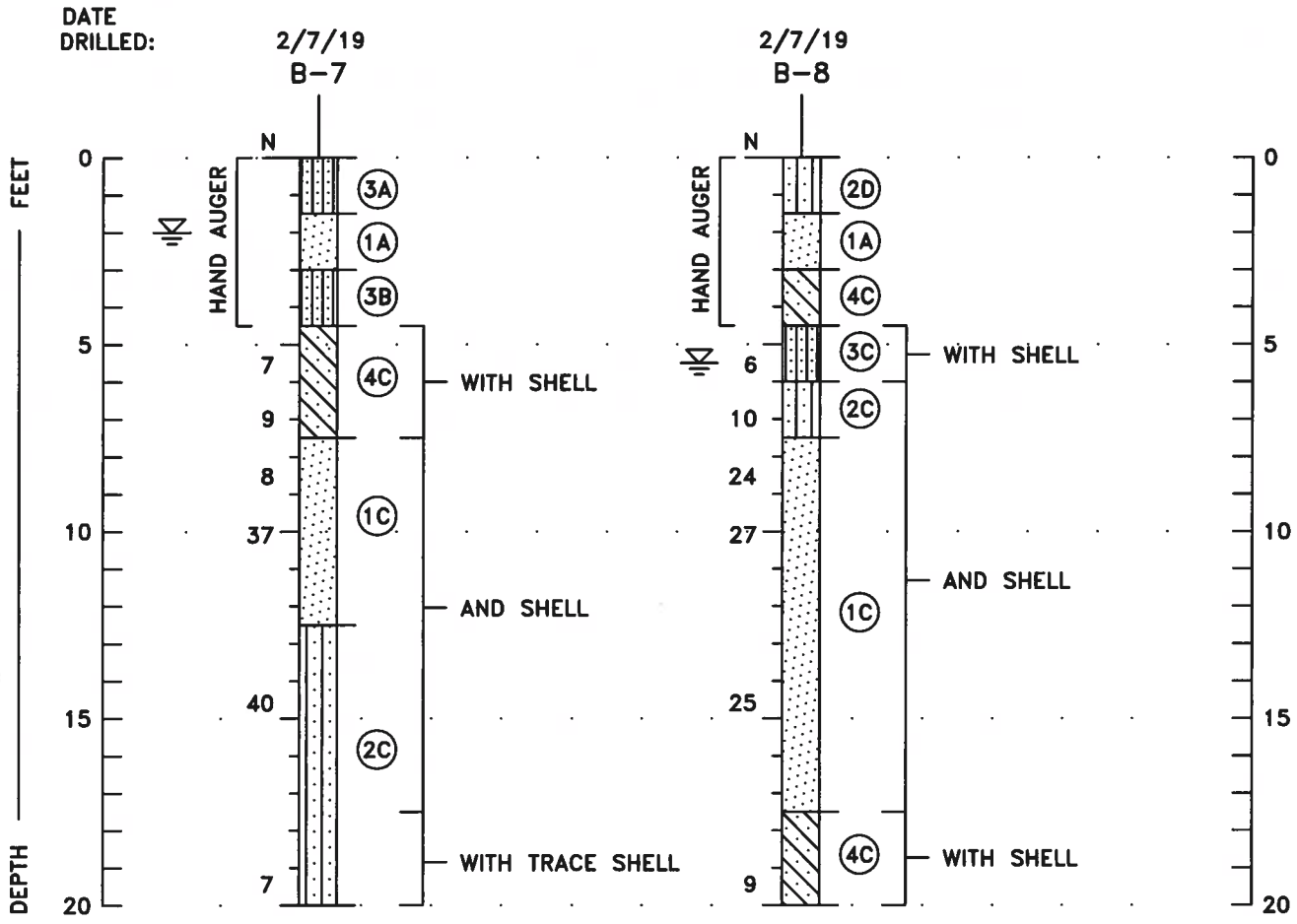

SOIL BORING PROFILES

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SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

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FILE NO. 18-5319	APPROVED BY:	FIGURE:

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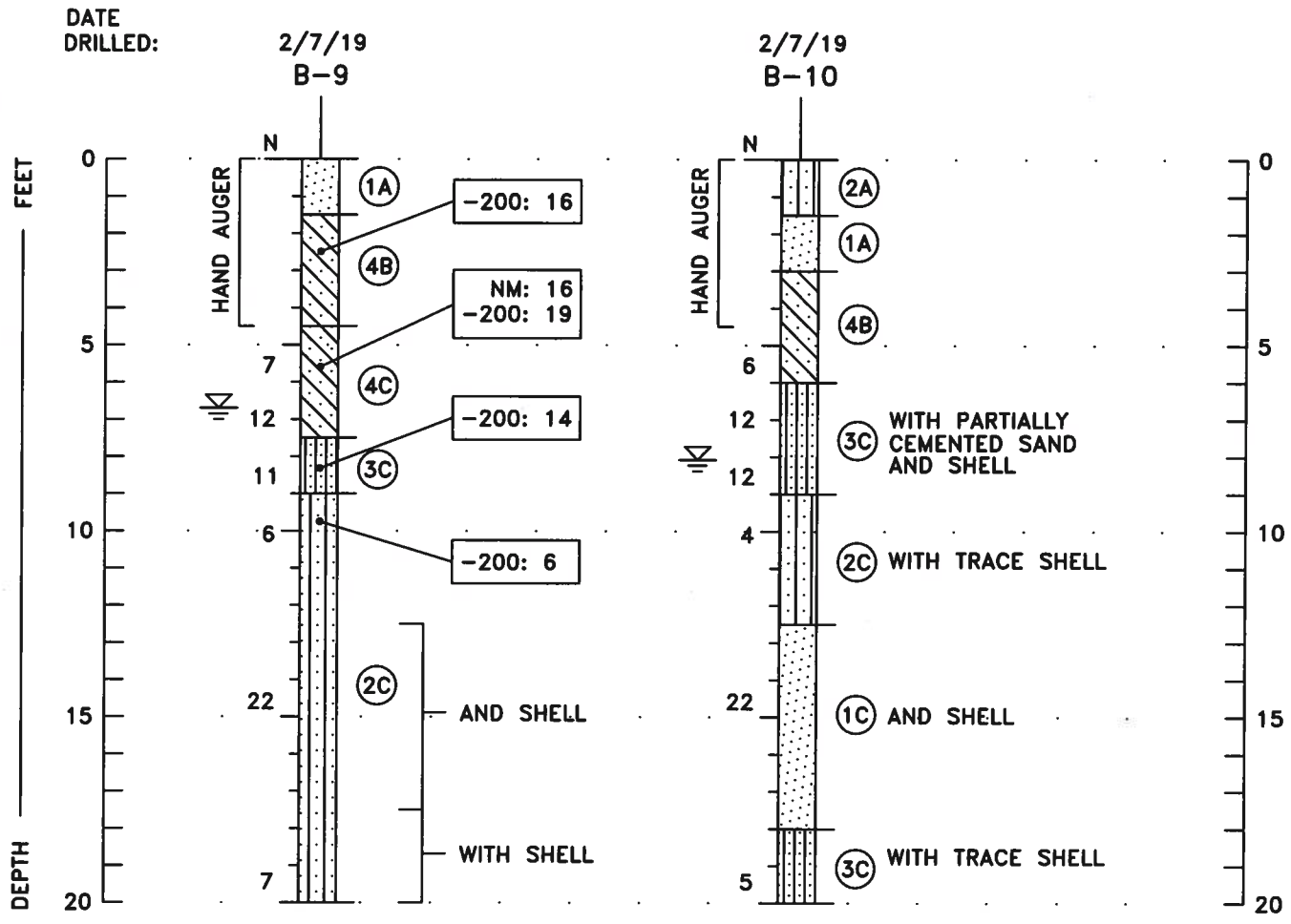

SOIL BORING PROFILES

Ardaman & Associates, Inc.
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SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

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FILE NO. 18-5319	APPROVED BY:	FIGURE:

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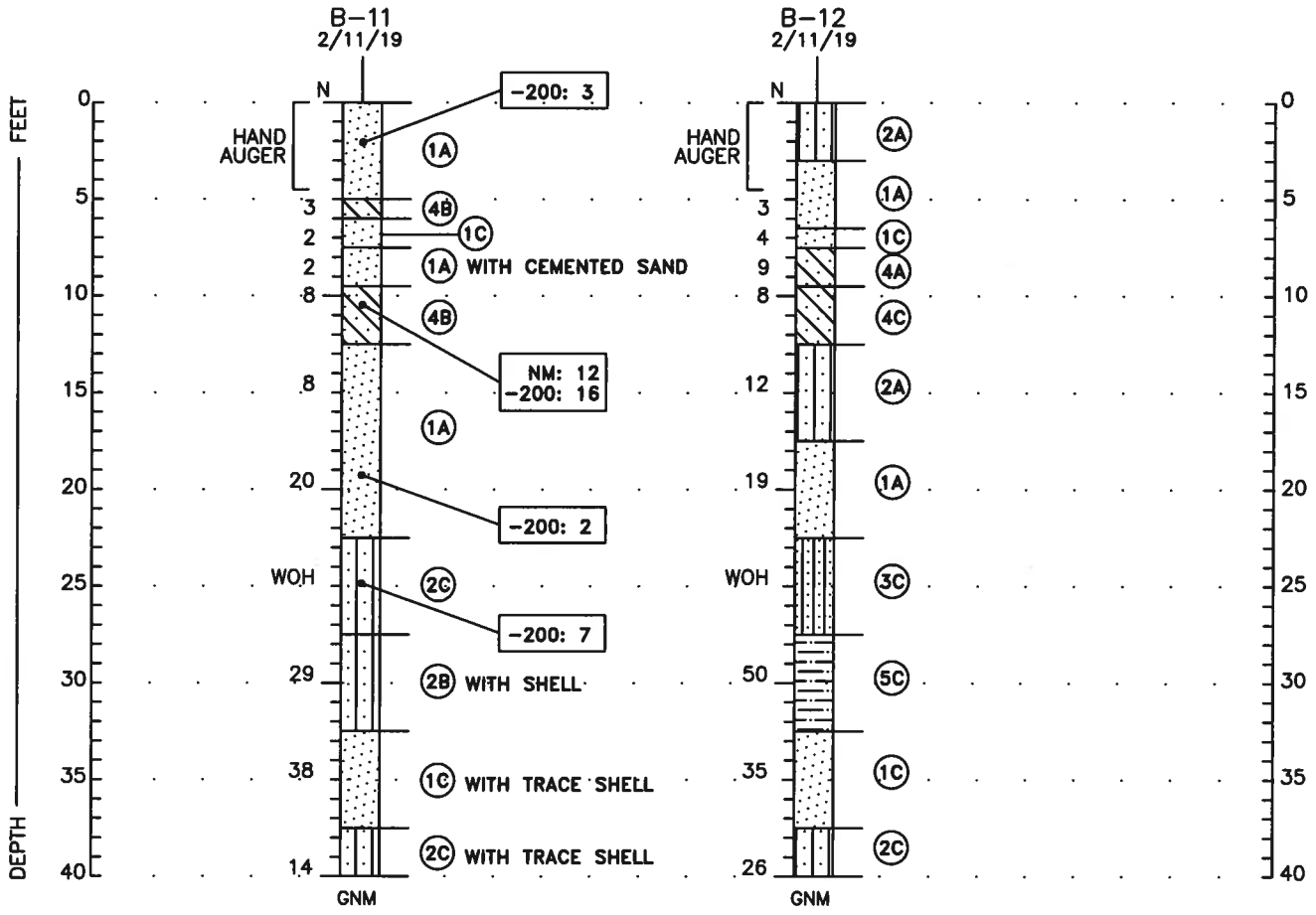

SOIL BORING PROFILES

Ardaman & Associates, Inc.
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SUBSURFACE SOIL EXPLORATION
CRANE CREEK/M-1 CANAL
FLOW RESTORATION
BREVARD COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/27/19
FILE NO. 18-5319	APPROVED BY:	FIGURE:

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APPENDIX III

Soil Parameters Table – Sheet Pile Design

Soil Parameter Table
Sheet Pile System – M-1 Canal Flow Diversion Structure
Crane Creek / M-1 Canal Flow Restoration Project
Brevard County, Florida

Boring	Depth Below Ground Surface (feet)	Soil Type	Average SPT N	Unit Weight (pcf)		Angle of Internal Friction (degrees)	Cohesion (psf)
				γ_{Moist}	γ_{Sat}		
B-1	0 – 4.5	SP, SP-SM	--[1]	101	108	29	--
	4.5 – 6	SC	6	105	112	29	--
	6 – 7.5	SP-SM	5	102	109	29	--
	7.5 – 9	SM	3	104	111	28	--
	9 – 12.5	SC	8	106	113	29	--
	12.5 – 17.5	SP-SM	46	114	121	35	--
	17.5 – 22.5	SP-SM	17	105	112	31	--
	22.5 – 27.5	SM	12	107	114	30	--
	27.5 – 30	SP	16	103	110	31	--

1. The top 4.5 feet of the boring was drilled with a 3-inch diameter, hand-held bucket auger. Therefore, no SPT N values were obtained over this depth range.

Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
M-1 Discharge System Project
West Melbourne, Florida

Ardaman & Associates, Inc.

CORPORATE HEADQUARTERS

8008 S. Orange Avenue, Orlando, FL 32809 - Phone: (407) 855-3860 Fax: (407) 859-8121

Branch Office Locations

Florida: Bartow, Cocoa, Fort Myers, Miami, Orlando, Port St. Lucie, Sarasota, Tallahassee, Tampa, West Palm Beach
Louisiana: Baton Rouge, Monroe, New Orleans, Shreveport

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

March 17, 2022
File No. 21-23-5318

Jones Edmunds
3910 S. Washington Avenue, Suite 210
Titusville, Florida 32780

Attention: Mr. Rich Koller, P.E.

Subject: Subsurface Soil Exploration and
Geotechnical Engineering Evaluation
M-1 Discharge System Project
West Melbourne, Florida

Dear Mr. Koller:

As requested, we have completed a subsurface soil exploration for the subject project. The purpose of performing this exploration was to determine if the soil characteristics are suitable to construct the proposed pipeline and structures. In addition, we have provided soil parameters to be used by others for design. This report documents our field exploration and presents our engineering recommendations.

SITE LOCATION AND PROPOSED CONSTRUCTION

The project site is located within the right of way area along the north side of US Highway 192 from the intersection with St. Johns Heritage Parkway on the east end to approximately 4,800 feet west along US Highway 192, and within the right of way area along the west side of St. Johns Heritage Parkway from the intersection with US Highway 192 on the south end to approximately 2,500 feet north along St. Johns Heritage Parkway in Melbourne, Florida (Sections 3,4, and 34, Townships 27 and 28 South, Range 36 East). The general site location is shown superimposed on the Melbourne West, Florida USGS quadrangle map presented on Figure 1.

Based on our review of information provided by Jones Edmunds, the project includes approximately 7,250 lineal feet of 24-inch diameter force main pipes that will be installed using a combination of the open cut and directional drill methods. The pipeline will have approximately 3 feet of cover in the open cut areas. The depth to the bottom of the pipe in the directional drill installation areas will not exceed approximately 10 to 12 feet below existing ground surface.

Additionally, a West Pump Station facility and stormwater discharge structure will be installed on the project site. The proposed West Pump Station facility located on the north end of the site will include a nearby intake structure and a concrete wet well structure that will not exceed approximately 15 feet and 25 feet in depth, respectively. We have assumed that the proposed wet well structure will be installed using the conventional braced excavation method. The proposed stormwater discharge structure located on the west end of the site will not exceed approximately 15 feet in depth.

REVIEW OF SOIL SURVEY MAPS

Based on the 1977 Soil Survey of Volusia County, Florida prepared by the U.S. Department of Agriculture Soil Conservation Service, the project site is located in an area mapped as the “Eau Gallie sand”, “Felda sand”, “Floridana sand”, and “Pineda sand” soil series. A description of these soil types, as obtained from the Soil Survey, is provided below.

Eau Gallie sand (Eg):

Eau Gallie sand is a nearly level, poorly drained soil on broad low ridges in the flatwoods. A representative profile consists of sand to a depth of about 50 inches underlain by sandy clay loam and loamy sand to a depth of 84 inches. In most years the water table is within a depth of 10 inches for 1 to 4 months and between 10 and 40 inches for more than 6 months. In dry seasons it is below a depth of 40 inches. The soil is flooded for 7 days to a month once in 5 years to 20.

Felda sand (Fa):

Felda sand is a nearly level, poorly drained soil on broad, low flats and in sloughs, depressions, and poorly defined drainageways. In a representative profile the surface layer is sand about 5 inches thick. Below this is 10 inches of dark gray sand that has common mottles and 15 inches of mottled grayish-brown sand. The next layer between depths of 30 and 41 inches is dark gray sandy loam that has mottles and streaks. Below this layer to 62 inches is gray sandy loam with mottles. Permeability is rapid in the sandy layers and moderate to moderately rapid in the loamy layers. The water table is within a depth of 10 inches for 2 to 6 months in most years and is typically between 10 and 40 inches for the rest of the year. Water rises above the surface for 2 to 7 days in 1 to 3 months of each year.

Floridana sand (Fn):

“Floridana sand” is a nearly level, very poorly drained soil in marshy depressions and on broad flood plains and broad flats. A representative soil profile consists of about 12 inches of black sand underlain by about 17 inches of grayish-brown sand that has a few mottles. The subsoil between depths of 29 and 43 inches is dark gray sandy clay loam that is mottled. Below this to a depth of 62 inches is gray sandy loam. The water table is within a depth of 10 inches for 6 to 9 months in most years and is typically between 10 and 30 inches for the rest of the year. Water rises above the surface for 2 to 7 days in 1 to 6 months of each year.

Pineda sand (Pn):

“Pineda sand” is a nearly level, poorly drained sandy soil on broad hammocks and in low sloughs. A representative soil profile consists of a surface layer of 5 inches of black sand followed by 8 inches of dark gray sand. Below this is 6 inches of light brownish-gray sand. The subsoil extends to a depth of 60 inches and includes sandy soil in the top 35 inches and loamy soils between 35 and 60 inches. The water table is within 10 inches of the surface for 1 to 2 months in most years and is between depths of 10 and 40 inches for more than 6 months. In dry periods, it is at a depth of more than 40 inches. The soil is flooded for 2 to 7 days once in 1 to 5 years.

FIELD EXPLORATION PROGRAM

SPT and Auger Borings

The field exploration program included performing two Standard Penetration Test (SPT) borings (TH-1 and TH-2) at the proposed lift station location, three SPT borings (TH-3 through TH-5) at the proposed intake structure and discharge structure locations, seven SPT borings (TH-6 through TH-12) at proposed force main pipeline directional drill locations, and twelve auger borings (AB-1 through AB-12) at the proposed force main pipeline open cut locations and existing access berms. Due to the potential presence of underground utilities, the top 4.5 feet of SPT borings TH-6 through TH-11 were drilled with a 3-inch diameter, hand-held bucket auger. Below 4.5 feet, the SPT borings were advanced to a depth ranging from 15 to 30 feet below the ground surface using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The field exploration program included performing twelve auger borings (AB-1 through AB-12) within the proposed pipeline open cut areas and existing access berms. The auger borings were drilled using a 3-inch diameter, hand-held bucket auger to a depth of 6 feet below the ground surface. Representative soil samples were recovered from the auger borings and transported to our laboratory for further analysis.

The groundwater level at each of the boring locations was measured during drilling. Upon completion, the borings were backfilled with soil cuttings.

Test Locations

The approximate locations of the borings are shown on aerial photograph plans included as Figures 2 and 3. These locations were determined in the field by estimating distances from existing site features and should be considered accurate only to the degree implied by the method of measurement used.

LABORATORY PROGRAM

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profiles presented in Appendix II.

In addition, we conducted nine percent fines analyses (ASTM D1140) on select soil samples obtained from the borings. The results of these tests are presented adjacent to the sample depth on the boring profiles in Appendix II.

GENERAL SUBSURFACE CONDITIONS

General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profiles presented in Appendix II. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The soils encountered in the SPT borings (TH-1 through TH-12) consisted of very loose to very dense fine sand (Unified Soil Classification SP), fine sand with silt (SP-SM), and clayey fine sand (SC) to a depth of approximately 9 feet below the existing ground surface. These soils were underlain by very loose to medium dense fine sand (SP), fine sand with silt (SP-SM), clayey fine sand (SC), and partially cemented sand and shell. Soft clay (CL) was encountered in Boring TH-4 at a depth of approximately 17.5 to 20 feet below existing ground surface. The soils encountered in the auger borings consisted of fine sand (SP), fine sand with silt (SP-SM), clayey fine sand (SC), and clay (CL) to the termination depth of the borings, 6 feet. These soil profiles are outlined in general terms only. Please refer to Appendix II for soil profile details.

Groundwater Level

The groundwater level was measured in the boreholes on the day drilled. As shown in Appendix II, the existing groundwater level was encountered at depths ranging from approximately 5 to 10.5 feet below ground surface on the date drilled. Fluctuations in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted.

The absence of groundwater data at some of the borings indicates that groundwater was not encountered within the vertical reach of the boring on the date drilled. For Borings TH-5 through TH-9, and TH-11 referenced “GNM” at the bottom of the boring profiles in Appendix II, groundwater was not encountered within the top 10.5 feet (and could not be measured below a depth of 10.5 feet due to the mudded condition of the boreholes). However, this does not necessarily mean that groundwater would not be encountered within the top 10.5 feet of the borings at some other time.

NORMAL SEASONAL HIGH GROUNDWATER LEVEL

The normal seasonal high groundwater level each year is the level in the August-September period at the end of the rainy season during a year of normal (average) rainfall. The water table elevations associated with a higher than normal rainfall and in the extreme case, flood, would be higher to much higher than the normal seasonal high groundwater level. The normal high-water levels would more approximate the normal seasonal high groundwater levels.

The seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, the land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

In addition to evaluating the conditions above, we have reviewed annual precipitation data available from the Melbourne Office of the National Weather Service. Based on this data, the rainfall to date in Brevard County is approximately 2.2 inches, which is approximately 3.5 inches below normal for this time of year.

Based on our interpretation of the site conditions using our boring logs, we estimate the normal seasonal high groundwater level at the boring locations to be approximately 2 to 2½ feet above the groundwater levels measured in the borings at the time of our field exploration. The groundwater level may temporarily perch higher due to the presence of shallow clayey fine sand.

ENGINEERING EVALUATION AND RECOMMENDATIONS

Lift Station Wet Well and Intake and Discharge Structures

Braced Excavation Installation Method

The results of our exploration indicate that the existing soils are suitable for supporting the proposed structures. A mat foundation should provide adequate support for the wet well structure and intake and discharge structures.

A positive head should be maintained in the wet well excavation to prevent a quick condition from occurring in the excavation bottom. A quick condition is defined as a condition where the soil in the bottom of the excavation has zero contact stress between the soil particles due to an overwhelming upward hydraulic gradient, and the soil structure breaks up. The bottom of the excavation can fail by heaving under this condition. In addition, “sinkholes” could occur around the perimeter of the excavation if a quick condition occurs in the bottom of the excavation. We note that if a quick condition occurs during structure installation, the soil parameter estimates beginning on Page 9 of this report may not be valid.

The following are our recommendations for overall site preparation, and structure foundation support, which we feel is best suited for the proposed construction based on the soil conditions encountered. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project’s specifications.

Excavation and Backfilling

The bottom of the structure excavations should be compacted to achieve a density of at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value for a depth 1 foot below the bottom of the excavation. Any over excavated areas should be backfilled with suitable fill soil as outlined below in the “Suitable Fill Material and Compaction of Fill Soils” section of this report.

Excavation and backfilling should be performed “in the dry”. Therefore, extensive dewatering will be necessary to lower the groundwater level 2 to 3 feet below the bottom of the excavation and compaction surfaces. Dewatering of the excavation is discussed in a subsequent section of this report.

The excavation should be safely braced to prevent injury to personnel or damage to equipment. Temporary safe slopes should be cut at a minimum in accordance with OSHA, 29 CFR Part 1926

Final Rule, Excavations Requirements. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations and spoil piles adjacent to excavations should be sloped no steeper than 2.0H to 1.0V. Provisions for maintaining workman safety within excavations is the sole responsibility of the Contractor.

Suitable Fill Material and the Compaction of Fill Soils

All fill soil should be free of organic materials, such as roots and vegetation. We recommend using fill with less than 12 percent by dry weight of material passing the U.S. Standard No. 200 sieve size. The fine sand and fine sand with silt (Strata Nos. 1 and 2, as shown in Appendix II) are suitable for use as fill soil and, with proper moisture control, should densify using conventional compaction methods. Soils with more than 12 percent passing the No. 200 sieve (Stratum No. 3), can be used in some applications but will be more difficult to compact due to their inherent nature to retain soil moisture. The clay (Stratum No. 4) should not be used as fill soil.

We note that partially cemented sand and shell soil and soils containing high shell content, identified with the term “and shell” in Appendix II, were encountered in Borings TH-1 through TH-5 at depths ranging from approximately 12.5 feet to 30 feet below existing ground surface. These soils are possibly coquina-type soils. Partially cemented soils can be problematic for several reasons. First, partially cemented soils can be difficult to excavate, often requiring special equipment; especially in confined excavations such as utility trenches, footings, etc. Excavated partially cemented soils are often boulder-size chunks of cemented soils which are not easily broken down for re-use as structural fill. In addition, when pulverized into fragments that can be compacted to an adequately dense matrix, the in-place soil often fails the relative compaction test because the laboratory test continues to pulverize the soil into smaller particles resulting in a denser laboratory matrix than that which occurs in the field. Alternative acceptance criteria may need to be used for partially cemented soils used as fill. This criteria would need to be developed on a site specific basis after observing the contractor’s earthwork methodology and the nature and condition of the compacted partially cemented soils.

All structural fill should be placed in level lifts not to exceed 12 inches in uncompacted thickness. Each lift should be compacted to at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value. The filling and compaction operations should continue in lifts until the desired elevation(s) is achieved. If hand-held compaction equipment is used, the lift thickness should be reduced to no more than 6 inches.

Backfill placed adjacent to the structure walls should consist of granular soils that are free draining and relatively free of fines. The backfill within 5 feet of the structure walls should be placed in lifts and compacted with hand-held compactors to between 95 and 98 percent of the modified Proctor (ASTM D-1557) maximum dry density value. Overcompaction of the backfill should be avoided since it could cause excessively large earth pressures to develop against the walls. Heavy equipment should be kept at least 5 feet away from the walls.

Foundation Support by Shallow Foundations and Foundation Compaction Criteria

Excavate the foundation to the proposed bottom of footing elevation and, thereafter, verify the in-place compaction for a depth of 1 foot below the footing bottom. If necessary, compact the soils at the bottom of the excavation to at least 95 percent of the modified Proctor maximum dry density

(ASTM D-1557) for a depth of 1 foot below the footing bottom. Based on the existing soil conditions and, assuming the above outlined compaction criteria are implemented, an allowable soil bearing pressure of 1,500 pounds per square foot (psf) may be used in the design of the structure foundation. This bearing pressure should result in foundation settlement within tolerable limits (i.e., 1 inch or less).

Dewatering

If the control of groundwater is required to achieve the necessary excavation, filling, compaction, and any other earthwork, site work, and/or foundation subgrade preparation operations required for the project, the actual method(s) of dewatering should be determined by the contractor. Dewatering should be performed to lower the groundwater level to depths that are adequately below excavations and compaction surfaces. Adequate groundwater level depths below excavations and compaction surfaces vary depending on soil type and construction method and are usually 2 feet or more. Dewatering solely with sump pumps may not achieve the desired results. We note that significant volumes of water may be encountered as cemented sand and shell and soils with high shell content, designated as “and shell”, are encountered in the excavations. The contractor should be prepared to handle the large water volumes.

Stormwater Pipeline

General

The results of our exploration indicate that the existing soils are suitable for supporting the proposed pipeline and associated structures. In addition, the encountered fine sand and fine sand with silt (Strata Nos. 1 and 2, as shown in Appendix II) are suitable for use as pipe/structure backfill. Soils with more than 12 percent passing the No. 200 sieve (Stratum No. 3, as shown in Appendix II), may be used in some applications but will be more difficult to compact due to their inherent nature to retain soil moisture.

The following are our recommendations for overall site preparation, pipeline and structure foundation support, which we feel is best suited for the proposed construction based on the soil conditions encountered in the borings. The recommendations are made as a guide for the design engineer, parts of which should be incorporated into the project’s specifications.

Directional Drilling Installations

Borings TH-6 through TH-12 were drilled in areas where pipelines may be installed using the directional drilling procedure. The soils encountered in these borings consisted of loose to very dense fine sand (SP), fine sand with silt (SP-SM), and clayey fine sand (SC) (Strata Nos. 1 through 3, as shown in Appendix II). The soils encountered in Borings TH-6 through TH-12 should be suitable for the directional drilling procedure. Difficult drilling may be encountered when penetrating the dense to very dense soils encountered in Borings Th-9 through TH-12 at depths ranging from approximately 5 to 9 feet below existing ground surface.

Excavation

Auger Borings AB-1 through AB-8 were drilled within areas where pipelines may be installed using the open cut pipe installation procedure. Based on the soil conditions encountered during the field exploration, we anticipate that the soils encountered in these borings and presented in Appendix

II can be excavated with standard earth moving equipment (i.e., front-end loaders and backhoes).

The soils below the bottom of the excavations should not be disturbed by the excavation process. If soils become disturbed and difficult to compact below the bottom of the initial excavation, they should be over excavated to a depth necessary to remove all disturbed soils. Over excavated areas should be replaced with compacted backfill meeting the “Suitable Backfill Material and Compaction Criteria” presented in a following section of this report.

The excavation should be safely braced to prevent injury to personnel or to equipment. Temporary safe slopes should be cut at a minimum in accordance with OSHA, 29 CFR Part 1926 Final Rule, Excavation Requirements. Flatter slopes should be used if deemed necessary. Surcharge loads should be kept at least 5 feet from excavations and spoil banks adjacent to excavations should be sloped no steeper than 2.0H to 1.0V. Provisions for maintaining workman safety within excavations is the sole responsibility of the Contractor.

Suitable Backfill Material and Compaction Criteria

As a general guide to aid the Contractor, we recommend using backfill with less than 12 percent by dry weight of material passing the U.S. Standard No. 200 sieve size. Soils with more than 12 percent passing the No. 200 sieve will be more difficult to compact due to their inherent nature to retain soil moisture. Based on the soil samples obtained during our subsurface investigation, the fine sand and fine sand with silt (Strata Nos. 1 and 2, as shown in Appendix II) are suitable for use as backfill soil and, with proper moisture control, should densify using conventional compaction methods. The clayey fine sand (Stratum No. 3) is not recommended as backfill material, as it contains more than 12 percent passing the No. 200 sieve and will be more difficult to compact due to the material’s inherent nature to retain soil moisture. Material removed from below the groundwater table will be wet and will require time to dry sufficiently.

The backfill soils must extend all the way to the excavation walls and should be placed in level lifts not exceeding 12 inches. Each lift should be compacted to at least 95 percent of the maximum dry density, as determined by the Modified Proctor test (ASTM D-1557, AASHTO T-180). Care should be taken not to damage any buried structure by compacting where there is insufficient cover material present. Minimum cover criteria should be in accordance with the pipe manufacturer’s and design engineer’s recommendations.

Dewatering

If the control of groundwater is required to achieve the necessary stripping, excavation, filling, backfilling, compaction, and any other earthwork, sitework, and/or foundation subgrade preparation operations required for the project, the actual method(s) of dewatering should be determined by the contractor. Dewatering should be performed to lower the groundwater level to depths that are adequately below excavations and compaction surfaces. Adequate groundwater level depths below excavations and compaction surfaces vary depending on soil type and construction method and are usually 2 feet or more. Dewatering solely with sump pumps may not achieve the desired results.

Pipeline Bedding

Pipe bedding material should be compacted as necessary to achieve a density equivalent to 95 percent of the maximum dry density, as determined by the Modified Proctor test (ASTM D-1557, AASHTO T-180), to a minimum depth of 6 inches below the bottom of the pipe. Compact deeper

if recommended by the pipe manufacturer.

It is our recommendation that the bedding for the pipe be preshaped by means of a template, prior to placement of the pipe, to ensure that the upward reaction on the bottom of the pipe will be well distributed over the width of the bedding contact. Based on the cost involved with pre-shaping the bedding material, and the construction time requirements, an alternative procedure may be to utilize a level bed for the pipe and require a higher pipe strength class which will adequately carry the load on a lower class of bedding. It would be prudent to perform an economic analysis of the two alternatives, or specify both design conditions within the contract documents, and allow the contractor to decide the most efficient method.

If level bedding is utilized, it will be necessary to place and compact the haunching backfill (backfill between the bedding and the centerline of the pipe) to the centerline of the pipe. This material should be placed in simultaneous layers on each side of the pipe and must be compacted in such a manner as to ensure intimate contact with the sides of the pipe. Do not use blocking to raise the pipe to grade. Provide bell holes at each joint to permit the joint to be assembled while maintaining uniform pipe support.

SOIL PARAMETERS

Presented below are our recommendations for various soil parameters that may be used for pipeline, wet well, and intake and discharge structure design. We note that if a quick condition occurs during construction/installation, the soil parameter estimates presented below may not be valid. A quick condition is defined as a condition where the soil in the bottom of the excavation has loss of contact stress between the soil particles due to an overwhelming upward hydraulic gradient, and the soil structure breaks up. The bottom of the excavation can fail by heaving under this condition.

Resistance to Horizontal Forces on Pipeline Structures

Horizontal forces which act on structures (such as thrust blocks or anchor blocks) can be resisted to some extent by the earth pressures that develop in contact with the buried vertical face (bearing vertical face is perpendicular and in front of the applied horizontal load) of the structure and by shearing resistance mobilized along the base of the structure and subgrade interface. Allowable earth pressure resistance may be determined using an equivalent fluid density of 90 pounds per cubic foot (pcf) for moist soil and 50 pcf for submerged soils below the water table[1]. The passive earth pressures are developed from ground surface to the bottom of the structure (assuming there is no excavation in the vicinity of the structure that would reduce the available passive pressure).

---

[1]Equivalent fluid density (moist soil) = $K_p \gamma_m$/S.F. = 90 pcf
Equivalent fluid density (submerged soil) = $K_p(\gamma_s-\gamma_w)$/S.F. = 50 pcf

Where:

K_p = effective coefficient of passive earth pressure = 2.7
S.F. = safety factor = (values given below)
γ_m= unit weight of moist soil = 100 pcf
γ_s = unit weight of saturated soils = 110 pcf
γ_w = unit weight of water = 62 pcf

The values presented above presume that the structure is surrounded by well compacted sand backfill extending at least 5 feet horizontally beyond the vertical bearing face. In addition, it is presumed that the structure can withstand horizontal movements on the order of one-quarter (¼) to three-eighths (⅜) inch before mobilizing full passive resistance. The factors of safety assumed in the above recommendations are 2.5 for passive pressure with submerged conditions, and 3.0 for passive pressure without submerged conditions.

The shearing resistance mobilized along the base of the structure may be determined by the following formula:

Shearing Resisting Force, $P=V \tan(2/3\Phi)$

Where:

P = Shearing Resistance Force (pounds)
V = Net Vertical Force (total weight of structure and soil overlying the structure minus uplift forces including buoyancy forces) (pounds)
Φ = Angle of Internal Friction of Soil = 32 degrees

The vertical earth pressures developed by the overburden weight of soil can be calculated using the following unit weights:

- Compacted moist soil = 100 pcf
- Saturated soil = 110 pcf

For design, an appropriate safety factor should be applied to the shearing resistance force calculated using the preceding Shearing Resisting Force equation. Vertical pressure distributions in accordance with the above do not take into account vertical forces from construction equipment, wheel loads or other surcharge loads.

At-Rest Earth Pressures Acting on Embedded/Buried Structures

At-rest pressures acting on embedded or buried structures include lateral loading due to soil, water and surcharge, if any. The lateral earth pressure will be a function of both the soil unit weight (submerged) and the depth below the ground surface. The following equation can be used to determine the lateral at-rest earth pressure:

$P_h = K_o \gamma h$

Where:

P_h = lateral at-rest earth pressure (psf)
K_o = coefficient of at-rest earth pressure (0.5) (this value assumes that the backfill is lightly compacted yet not overcompacted)
γ = unit weight of soil (γ_m for moist soil above the water table and γ_b for saturated soil below the water table)
γ_m = effective moist unit weight of soil = 110 pcf for compact moist soil above the water table

γ_b = buoyant unit weight of soil = 60 pcf for compacted saturated soil below the water table
h = depth (feet) below grade at which lateral earth pressure is determined

For design, an appropriate safety factor should be applied to the lateral at-rest earth pressure determined in accordance with the above equation. In addition, lateral pressure distributions determined in accordance with the above equation do not include hydrostatic pressures or surcharge loads. Where applicable, they should be incorporated in the design.

Earth Pressure on Shoring and Bracing

If temporary shoring and bracing is required for any excavations, the system should be designed to resist lateral earth pressure. The design earth pressure will be a function of the flexibility of the shoring and bracing system. For a flexible system restrained laterally by braces placed as the excavation proceeds, the design earth pressure for shoring and bracing can be computed using a uniform earth pressure distribution with depth. It is recommended that soils be de-watered around the excavations. For such de-watered excavations, we recommend using the following uniform pressure distribution over the full braced height as follows:

Uniform Soil Pressure Distribution, $P = 0.65K_a\gamma_m h$

where:

P = uniform pressure distribution for design of braced excavation
K_a = coefficient of active earth pressure = 0.33
γ_m = moist weight of soils = 100 pcf
h = depth of excavation

An appropriate factor of safety should be applied for the design of the braced excavations.

Lateral pressure distributions determined in accordance with the above do not take hydrostatic pressures or surcharge loads into account. To the extent that such pressures and forces may act on the walls, they should be included in the design.

Construction equipment and excavated fill should be kept a minimum distance of 5 feet from the edge of the braced or shored excavation. Backfill material placed adjacent to (maintaining a minimum 5-foot horizontal clearance) the braced or shored excavation should have a minimum slope of 2H:1V, or flatter if required by site specific conditions and/or to meet OSHA requirements.

Means and methods of excavation and bracing should be the responsibility of the Contractor. However, excavation and/or bracing should at a minimum adhere to the requirements of the Occupational Safety Health Administration (OSHA).

Buoyancy/Uplift Resistance

Permanent structures submerged below the water table will be subject to uplift forces caused by buoyancy. The components resisting this buoyancy include: 1) the total weight of the structure divided by an appropriate factor of safety, 2) the buoyant weight of soil overlying the structure, and 3) the shearing forces that act on shear planes that radiate vertically upward from the edges of the structure to the ground surface. The allowable unit shearing resistance may be determined by the following formula:

Allowable Unit Shearing Resistance (above groundwater table):

$$P=K_o\gamma_m h(2/3\ \tan\Phi)/S.F.$$

Allowable Unit Shearing Resistance (below groundwater table):

$$P=K_o[\gamma_m h_w+ \gamma_b(h-h_w)]\ (2/3\ \tan\Phi)/S.F.$$

Where:

P = unit shearing resistance (psf)
K_o = coefficient of at-rest earth pressure (0.5)
γ_m = unit weight of moist compacted soil = 100 pcf
γ_b = buoyant unit weight of compacted soil = 48 pcf
h = vertical depth (feet) below grade at which shearing resistance is determined
h_w = vertical depth (feet) below grade to groundwater table
Φ = angle of internal friction of the soil = 32 degrees
S.F. = safety factor = 2

The values given for the above parameters assume that the sides of the structure are in intimate contact with the surrounding soil, and that the ground level within 15 feet of the structure is relatively flat.

QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation and pipeline and structure foundation construction is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

In-situ density tests should be conducted during backfilling activities, and below and around all buried pipes and structures to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered. Finally, we recommend inspecting and testing the construction materials for the foundations and other structural components.

IN-PLACE DENSITY TESTING FREQUENCY

In Central Florida, earthwork testing is typically performed on an on-call basis when the contractor has completed a portion of the work. The test result from a specific location is only representative of a larger area if the contractor has used consistent means and methods and the soils are practically uniform throughout. The frequency of testing can be increased, and full-time construction inspection can be provided to account for variations. We recommend that the following minimum testing frequencies be utilized.

Pipeline backfill should be tested at a minimum frequency of one in-place density test for each 12-inch lift for each 200 linear feet of pipe. Additional tests should be performed in backfill for

manholes and other structures. The structures should be tested at a minimum frequency of one in-place density test for each 12-inch lift of fill.

Representative samples of the various natural ground and backfill soils should be obtained and transported to our laboratory for Proctor compaction tests. These tests will determine the maximum dry density and optimum moisture content for the materials tested and will be used in conjunction with the results of the in-place density tests to determine the degree of compaction achieved.

CLOSURE

The analyses and conclusions submitted herein are based on the data obtained from the soil borings presented on Figure 2 and 3 and in Appendix II. This report does not reflect any variations which may occur adjacent to or between the borings. The nature and extent of the variations between the borings may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations in this report after performing on-site observations during the construction period and noting the characteristics of any variations.

This report has been prepared for the exclusive use of Jones Edmunds. in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. In the event any changes occur in the design, nature, or location of the proposed utility improvements, we should review the applicability of conclusions in this report.

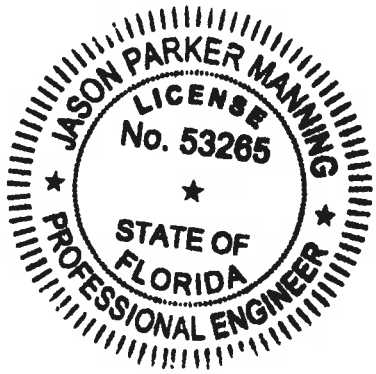
We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

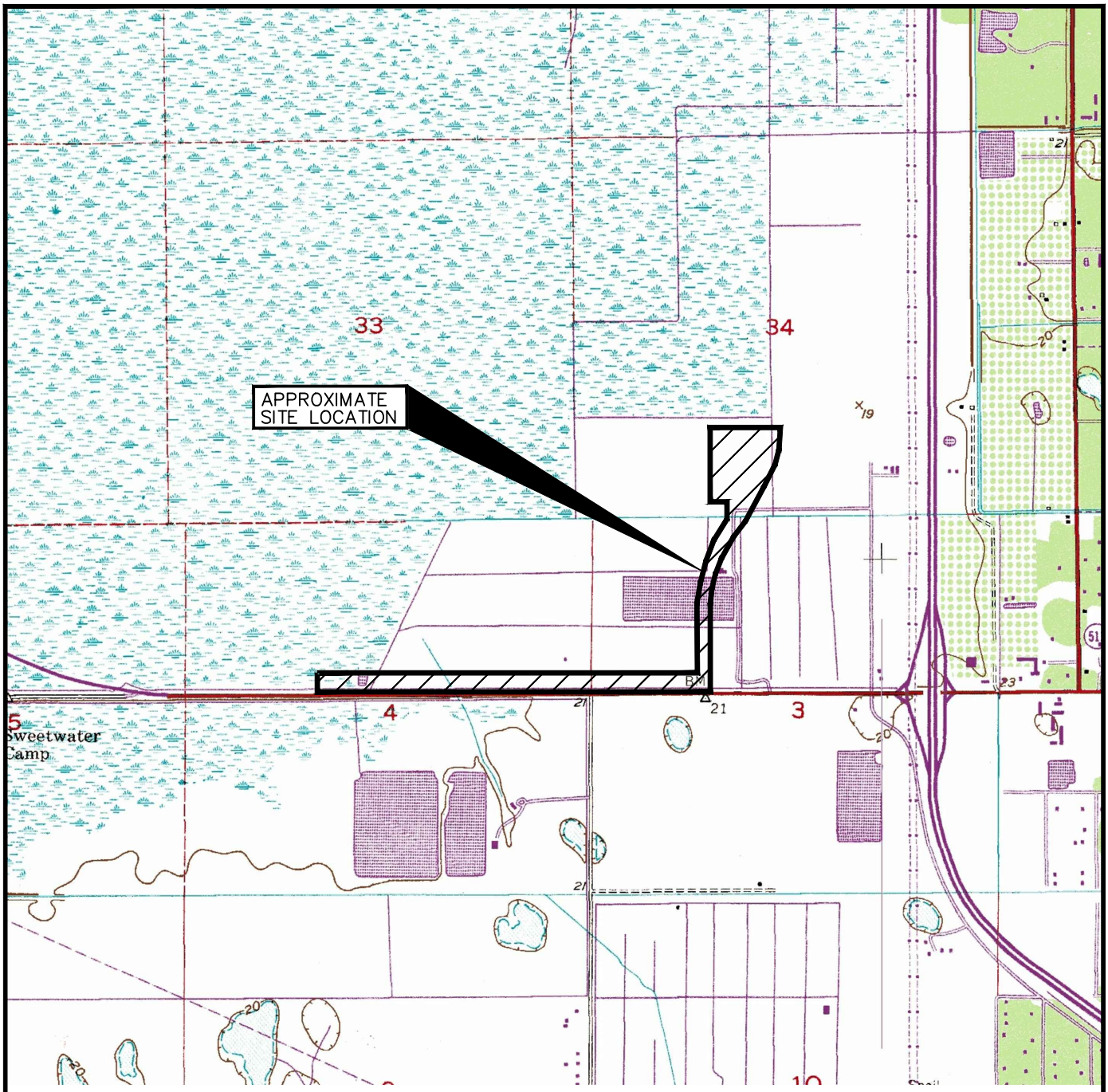
Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5950

Janie C. Ross
Assistant Project Engineer

Jason P. Manning, P.E. 3/17/22
Branch Manager
Florida License No. 53265

JCR/JPM/dk





SECTIONS 3,4,34
TOWNSHIPS 27,28 SOUTH
RANGE 36 EAST

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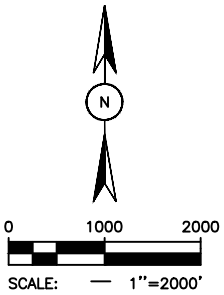

QUADRANGLE LOCATION

SITE LOCATION MAP

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SUBSURFACE SOIL EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION
M-1 DISCHARGE SYSTEM PROJECT
WEST MELBOURNE, FLORIDA

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N

0 100 200

SCALE: — 1"=200'

LEGEND

TH STANDARD PENETRATION TEST (SPT) BORING LOCATION

AB AUGER BORING LOCATION

BORING LOCATION PLAN

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N

0 100 200

SCALE: 1"=200'

LEGEND

TH STANDARD PENETRATION TEST (SPT) BORING LOCATION

AB AUGER BORING LOCATION

BORING LOCATION PLAN

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APPENDIX I

Standard Penetration Test

STANDARD PENETRATION TEST

The standard penetration test is a widely accepted test method of *in situ* testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, NX-size flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid.

Representative split-spoon samples from the soils at every 5 feet of drilled depth and from every different stratum are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for 30 days prior to being discarded. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed, if necessary, and backfilled.

APPENDIX II

Soil Boring Profiles

LEGEND

SOIL DESCRIPTIONS

1. FINE SAND (SP)
2. FINE SAND WITH SILT (SP–SM)
3. CLAYEY FINE SAND (SC)
4. CLAY (CL,CH)
5. PARTIALLY CEMENTED SAND AND SHELL

COLORS

A. LIGHT BROWN TO BROWN

B. GRAYISH–BROWN

C. LIGHT GRAY TO GRAY

TH	STANDARD PENETRATION TEST (SPT) BORING
AB	AUGER BORING
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
–200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D–1140)
▽	GROUNDWATER LEVEL MEASURED ON DATE DRILLED
GNM	GROUNDWATER NOT MEASURED ABOVE 10.5 FEET ON DATE DRILLED
SP,SP–SM SM,SC,CH	UNIFIED SOIL CLASSIFICATION SYSTEM

ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

SOIL PROFILES LEGEND

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M–1 DISCHARGE SYSTEM PROJECT
WEST MELBOURNE, FLORIDA

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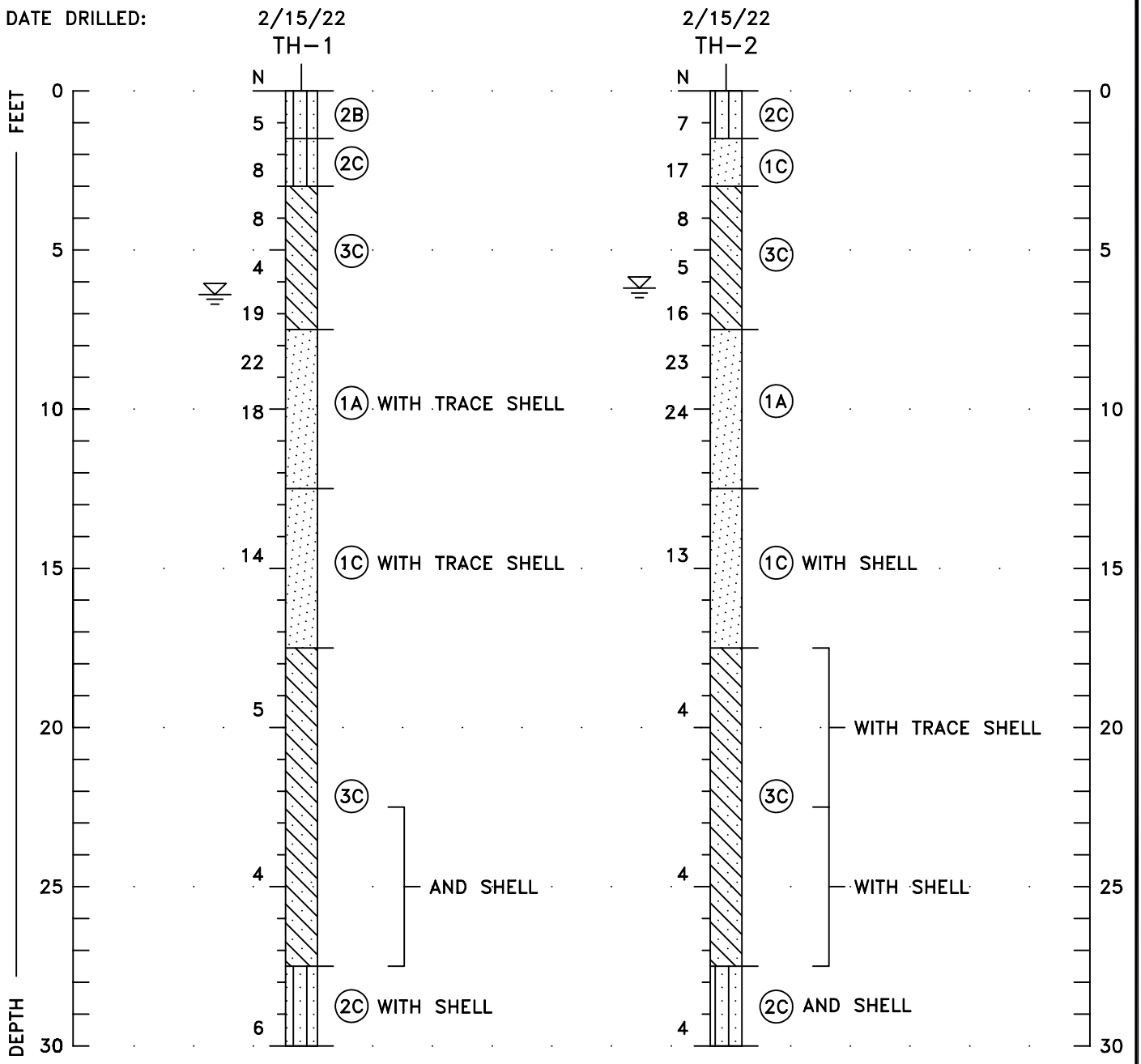

SOIL BORING PROFILES

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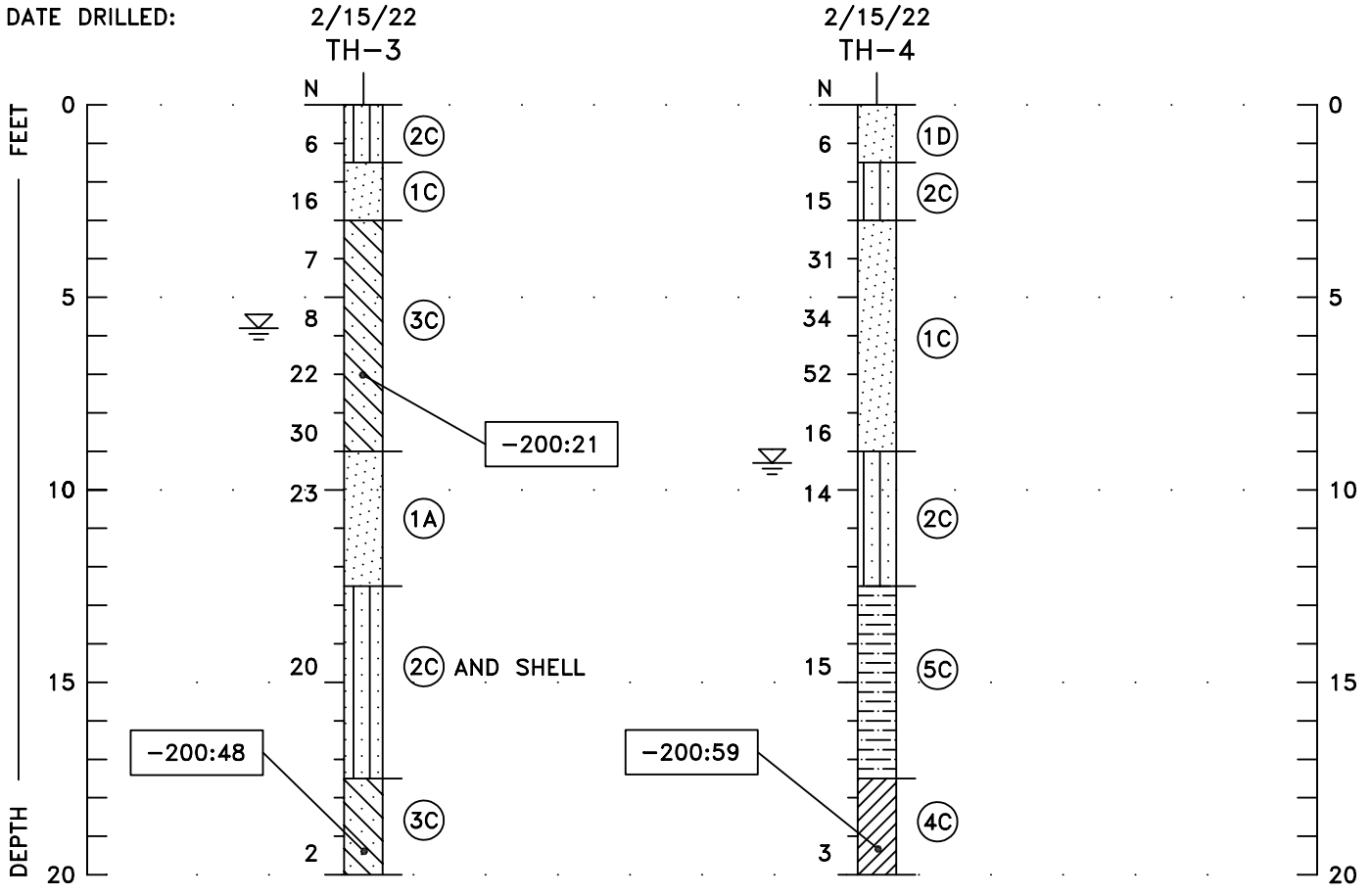

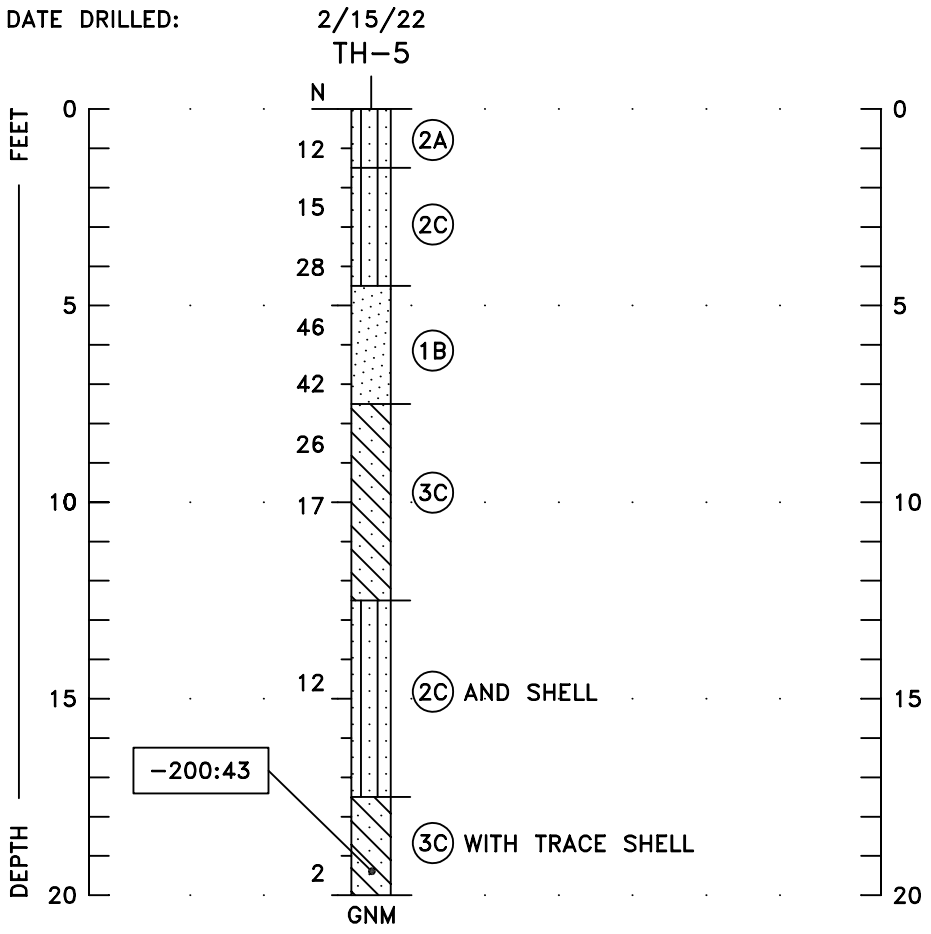

SOIL BORING PROFILES

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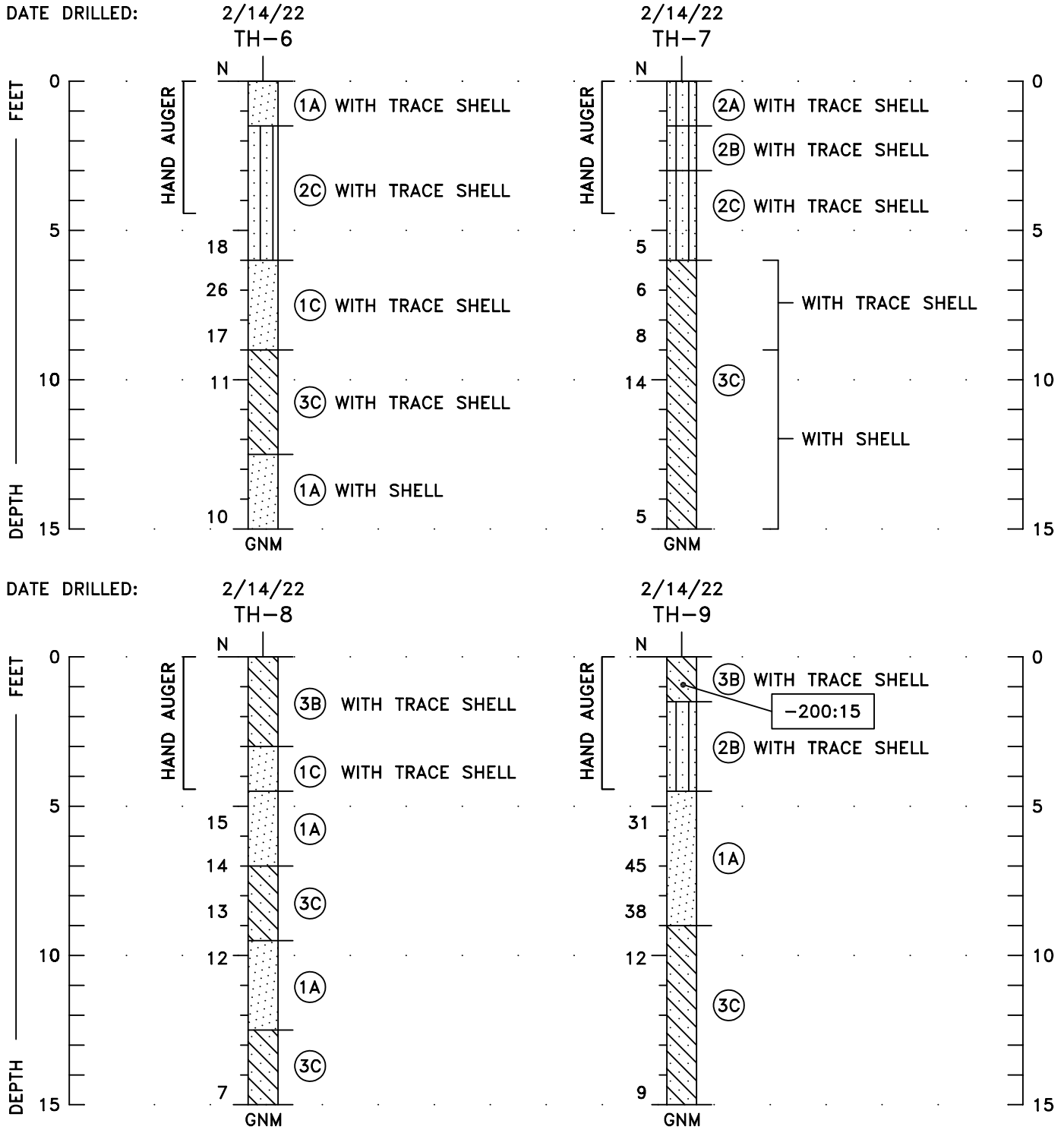

SOIL BORING PROFILES

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SUBSURFACE SOIL EXPLORATION AND
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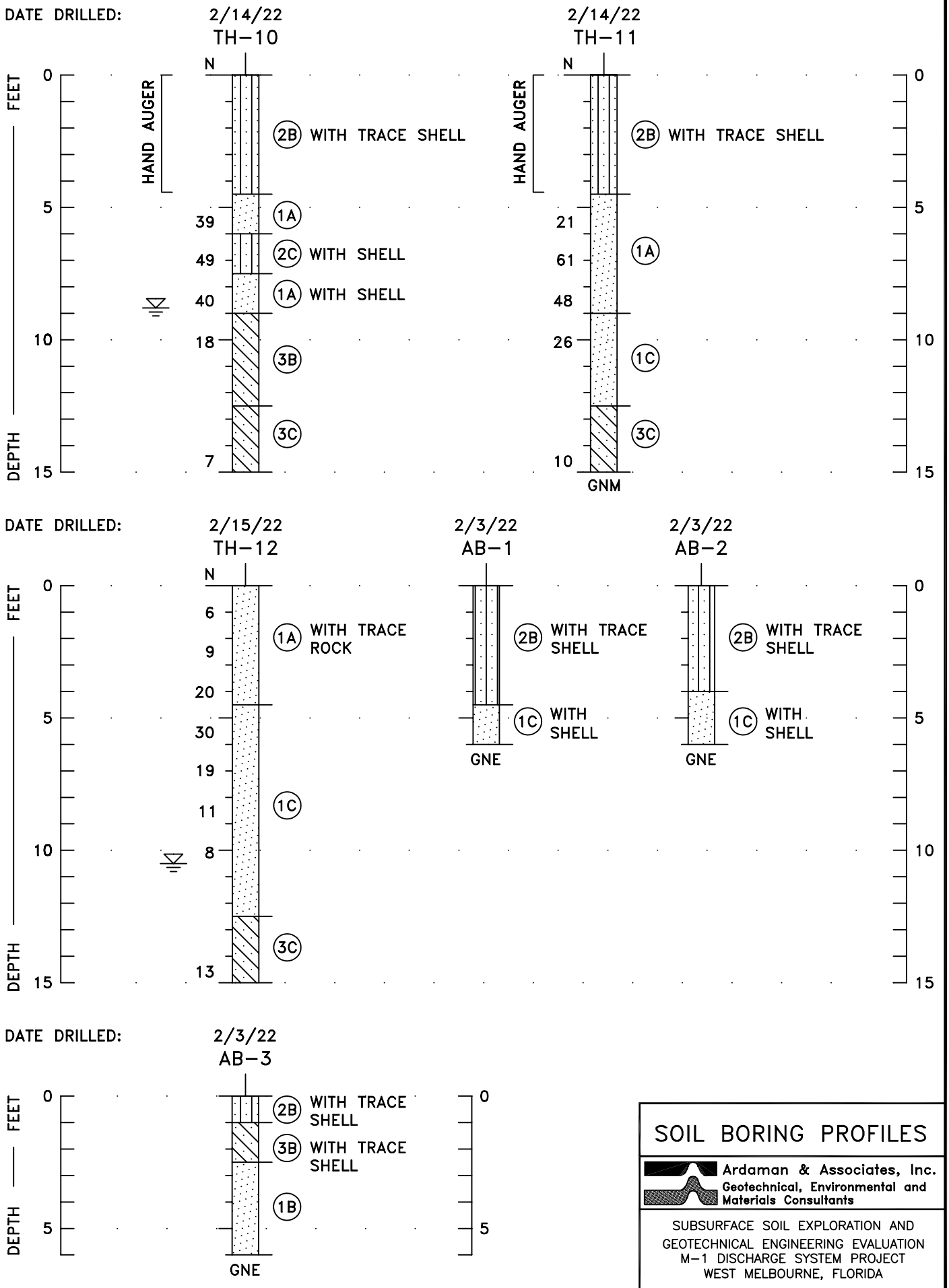

SOIL BORING PROFILES

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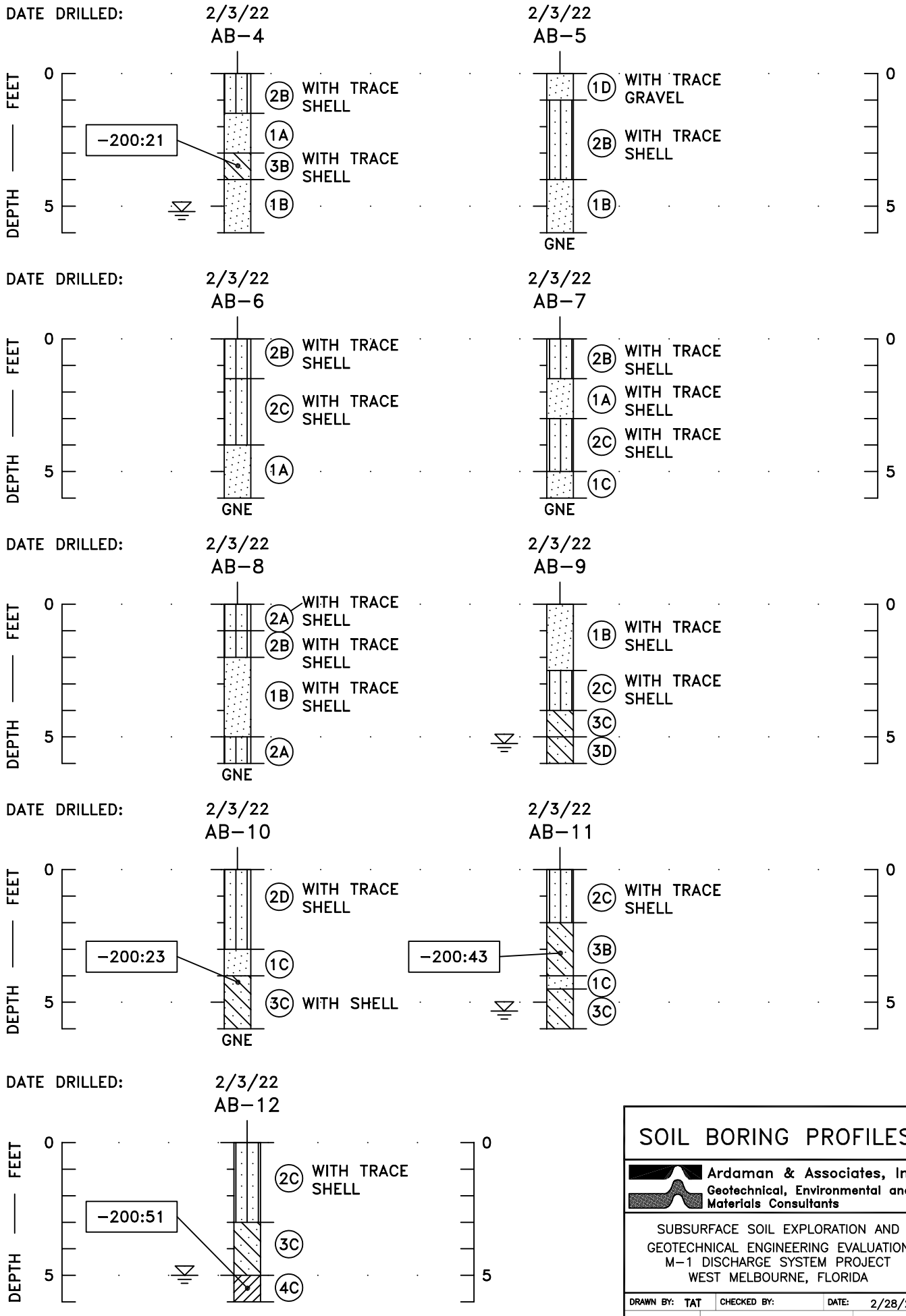
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION AND
GEOTECHNICAL ENGINEERING EVALUATION
M-1 DISCHARGE SYSTEM PROJECT
WEST MELBOURNE, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 2/28/22
FILE NO. 21-5318	APPROVED BY:	FIGURE:



SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SUBSURFACE SOIL EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION
M-1 DISCHARGE SYSTEM PROJECT
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APPENDIX B

TEST HOLE DATA REPORT

Date:	6/14-17/2022	Test Hole Data Report	Crew Members:	JM, AA, CW
ECHO Project #:	21-269	4803 George Road, Ste. 350 Tampa, Florida 33634 400 SR 434, Ste. 1024 Oviedo, Florida 32765	City, State:	WEST MELBOURNE, FL
Financial Project #:	N/A	ECHO UTILITY ENGINEERING & SURVEY	General Location:	US 192
Truck No.:	D2-T1	ECHO UES, Inc. www.echoues.com 888.778.ECHO - GROW, INSPIRE, MAKE A DIFFERENCE-	Coordinate Unit of Measure:	US Survey Feet

Utility Type		Utility Material		Identified By:	Abbreviations	Offset Measured From:
BE = Buried Electrical	RCW = Reclaimed Water	AC = Transite	GALV = Galvanized Pipe	HUB = Survey Hub	N/A = Not Applicable	EP= Edge of Pavement
GM = Gas Main	TS = Traffic Signal	CI= Cast Iron	HDPE = High Density Polyethylene Pipe	IRC = Iron Rod & Cap "ECHO TEST HOLE"	NAD = North American Datum	BC = Back of Curb
BT = Buried Telephone	SL = Street Light	CP = Concrete Pipe	PE = Polyethylene Pipe	NL = Nail & Disk "ECHO TEST HOLE"		BL = Baseline of Survey
FOC = Fiber Optic Cable	IRR = Irrigation Line	DBC = Direct Buried Cable	PVC = Polyvinyl Chloride	SLEEVE = Sleeve	NAVD = North American Vertical Datum	COORD = Survey Coordinates
WM = Water Main	GS = Gas Service	CMP = Corrugated Metal Pipe	STL = Steel	X = "X" in Concrete		CL = Centerline
SAN = Sanitary Sewer	WS = Water Service	CONC = Concrete	VCP = Vitrified Clay Pipe	**Surface Type**	UNK = Unknown	HUB = Survey Hub
STM = Storm Sewer	UNK = Unknown Utility	CPP = Corrugated Plastic Pipe	PCCP = Prestressed Cylinder Concrete Pipe	ASPH = Asphalt	CL = Cement Line	RW = Right of Way
CATV = Cable Television	BED = Buried Electrical Duct	DCT = Duct		CONC = Concrete	OIL = Oil Line	ST = Swing Ties
FM = Force Main	BTD = Buried Telephone Duct	DIP = Ductile Iron Pipe	RCP = Reinforced Concrete Pipe	NG = Natural Ground	ETH = Ethanol Fuel	X = "X" in Concrete

Test Hole	Utility Type	Utility Material	Utility Size Outside Diameter inches	Utility Manual Depth feet	Cross Sectional View	Utility Direction (N)	Identified By	Surface Type	Surface Thickness inches	Apparent Utility Owner	Datums: Horizontal: NAD83/11 Vertical: NAVD88 Northing	Datums: Easting	Ground Elevation	Utility Elevation
1-1	BT	DBC	1.00"	2.15'	⬭	E-W	IRC	NG	N/A	AT&T	1361481.69	743159.80	19.57'	17.42'
1-1A	FOC	DBC	0.50"	3.60'	○	E-W	IRC	NG	N/A	AT&T	1361470.99	743161.09	21.73'	18.13'
1-2	BT	DBC	1.00"	1.95'	⬭	E-W	IRC	NG	N/A	AT&T	1361486.02	744920.32	18.97'	17.02'
1-2A	FOC	DBC	0.50"	3.35'	○	E-W	IRC	NG	N/A	AT&T	1361479.57	744920.01	20.99'	17.64'
1-3	BT	DBC	1.00"	3.05'	⬭	E-W	IRC	NG	N/A	AT&T	1361498.87	746739.74	20.26'	17.21'
1-4	BT	DBC	1.00"	3.59'	⬭	E-W	IRC	NG	N/A	AT&T	1361507.54	747794.29	20.60'	17.01'
1-5	BE	HDPE	6.00"	2.90'	◯	NW-SE	IRC	NG	N/A	FP&L	1361510.10	747801.89	20.19'	17.29'
1-6	FOC	PVC	UNK	5.90'	N/A	NW-SE	IRC	NG	N/A	AT&T	1361512.66	747818.75	22.17'	16.27'
1-8	WM	HDPE	16.00"	3.80'	◯	N-S	IRC	NG	N/A	CITY OF WEST MELBOURNE	1361666.07	747836.82	22.14'	18.34'
1-9	EXP	N/A	N/A	N/A	N/A	N/A	IRC	NG	N/A	N/A	1361536.80	747841.34	23.45'	N/A

Notes: TH 1-6: UNABLE TO OBTAIN SIZING DUE TO GROUND WATER.

TH 1-8: UNABLE TO VERIFY WATERMAIN AT THE REQUESTED LOCATION .MOVED LOCATION NORTH TO SURVEYED POSTION; PER DEPTHS OF PROVIDED BORE PROFILE WM IS APPROXIMATLEY 15' DEEP.

TH 1-9: EXPLORATORY- VACUUMED 7.00'; PROBED 10.00'; UNABLE TO PROBE FURTHER DUE TO ROCKS COVERING UTILITY; POSSIBLE FOC; SEE SURVEY

Prepared by: CB	***Date: 6/27/2022***
Checked by: KK	***Date: 06/29/2022***

Date:	6/14-17/2022	**Test Hole Data Report**		**Crew Members:**	JM, AA, CW
ECHO Project #:	21-269	4803 George Road, Ste. 350 Tampa, Florida 33634 400 SR 434, Ste. 1024 Oviedo, Florida 32765	**ECHO UES, Inc.** **www.echoues.com** **888.778.ECHO** - GROW, INSPIRE, MAKE A DIFFERENCE-	**City, State:**	WEST MELBOURNE, FL
Financial Project #:	N/A	ECHO UTILITY ENGINEERING & SURVEY		**General Location:**	US 192
Truck No.:	D2-T1			**Coordinate Unit of Measure:**	US Survey Feet

Utility Type		**Utility Material**		**Identified By:**	**Abbreviations**	**Offset Measured From:**
BE = Buried Electrical	RCW = Reclaimed Water	AC = Transite	GALV = Galvanized Pipe	HUB = Survey Hub	N/A = Not Applicable	EP= Edge of Pavement
GM = Gas Main	TS = Traffic Signal	CI= Cast Iron	HDPE = High Density Polyethylene Pipe	IRC = Iron Rod & Cap "ECHO TEST HOLE"	NAD = North American Datum	BC = Back of Curb
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Test Hole	Utility Type	Utility Material	Utility Size Outside Diameter inches	Utility Manual Depth feet	Cross Sectional View	Utility Direction (N)	Identified By	Surface Type	Surface Thickness inches	Apparent Utility Owner	**Datums:** Northing	**Horizontal:** NAD83/11 **Vertical:** NAVD88 Easting	Ground Elevation	Utility Elevation
1-10	FM	PVC	UNK	5.15'	N/A	N-S	IRC	NG	N/A	CITY OF WEST MELBOURNE	1361554.34	747828.71	20.76'	15.61'
1-11	WM	PVC	16.00"	5.00'	◯	NE-SW	IRC	NG	N/A	CITY OF WEST MELBOURNE	1362238.86	747836.77	23.22'	18.22'
1-12	FM	PVC	16.00"	4.60'	◯	N-S	IRC	NG	N/A	CITY OF WEST MELBOURNE	1362261.60	747833.84	22.91'	18.31'
1-13	WM	PVC	16.00"	3.60'	◯	N-S	IRC	NG	N/A	CITY OF WEST MELBOURNE	1362470.24	747849.23	22.86'	19.26'
1-14	FM	PVC	16.00"	3.75'	◯	N-S	IRC	NG	N/A	CITY OF WEST MELBOURNE	1362469.59	747832.83	21.73'	17.98'
1-17	STM	UNK	UNK	6.45'	N/A	NE-SW	IRC	NG	N/A	UNKNOWN	1363742.40	748123.24	23.49'	17.04'
1-18	STM	UNK	UNK	12.12'	N/A	NW-SE	IRC	NG	N/A	UNKNOWN	1363797.38	748151.08	23.28'	11.16'
1-19	FM	PVC	16.00"	4.30'	◯	NE-SW	IRC	NG	N/A	CITY OF WEST MELBOURNE	1363826.24	748159.81	22.48'	18.18'
1-20	WM	PVC	16.00"	3.60'	◯	NE-SW	IRC	NG	N/A	CITY OF WEST MELBOURNE	1363819.96	748173.51	23.22'	19.62'

Notes: TH 1-10: UNABLE TO OBTAIN SIZING DUE TO WATER TABLE

TH 1-17 & 1-18: UNABLE TO OBTAIN SIZING AND MATERIAL DUE TO DEPTH AND WATER TABLE

Prepared by: CB	***Date: 6/27/2022***
Checked by: KK	***Date: 06/29/2022***

Subsurface Utility Engineering Test Hole Report

Test Hole: 1 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	COLUMBIA RD.						
Road Name:	COLUMBIA RD.				Utility Owner:	AT&T	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/16/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	CLEAR	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: DRY	Crew Number:	2	

Requested Utility Info

Utility Type:	COMMUNICATION	Utility Material:	DIRECT BURIED CABLE	Size (OD):	1.5	X	1.5
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	1.5	Width (in):	1.5
Top of Pipe:	3.25						
Utility Note:							

Profile View: TOP OF GROUND

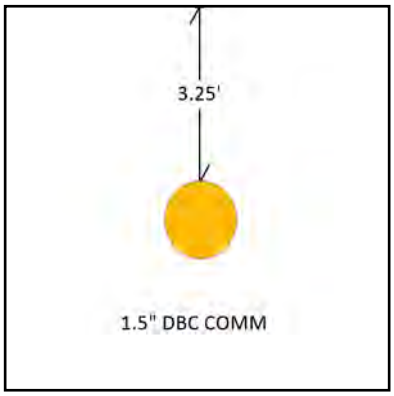
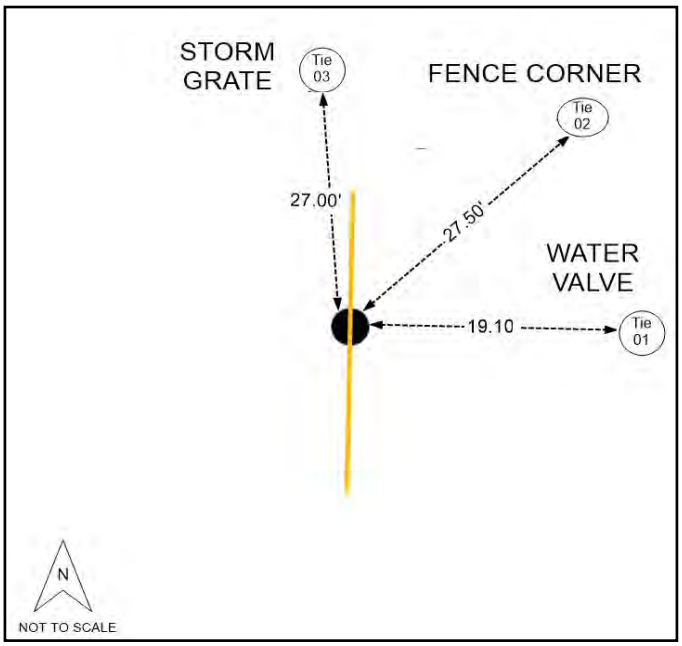


Image is not to scale

Tie	Description	Distance (Ft)	Distance (m)
01	VALVE, WATER	19.1	5.821
02	CORNER OF FENCE	27.5	8.382
03	STORM GRATE	27	8.229

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 1 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): VALVE, WATER

Tie 02 (From Test Hole): CORNER OF FENCE

Tie 03 (From Test Hole): STORM GRATE

Subsurface Utility Engineering Test Hole Report

Test Hole: 2 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

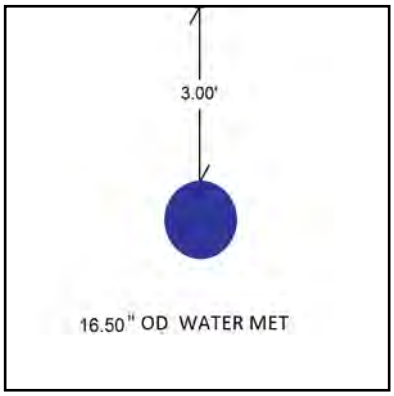
Site Data

Project Name: SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION
Location: EAST SIDE OF 95
Road Name: EVANS RD. Utility Owner: BREVARD COUNTY
WO Number: W102325 Job Number: J052783 Task WO #: N/A City: MELBOURNE
Client Number: C05025 FPN #: N/A County: BREVARD
Station: Offset:
Collection Date: 9/16/2019 PM: MSS Ground Cover: DIRT Utility Chief: KYYA
Weather: SUNNY Soil Type: DIRT Utility Crew: KEMU
Time: N/A Soil Condition: DRY Crew Number: 2

Requested Utility Info

Utility Type: WATER Utility Material: DIP-DUCTILE IRON Size (OD): 16.5 X 16.5
Utility Condition: FAIR Testhole Marker: HUB, LATH, NAIL AND DISK Height (in): 16.5 Width (in): 16.5
Top of Pipe: 3
Utility Note:

Profile View: TOP OF GROUND



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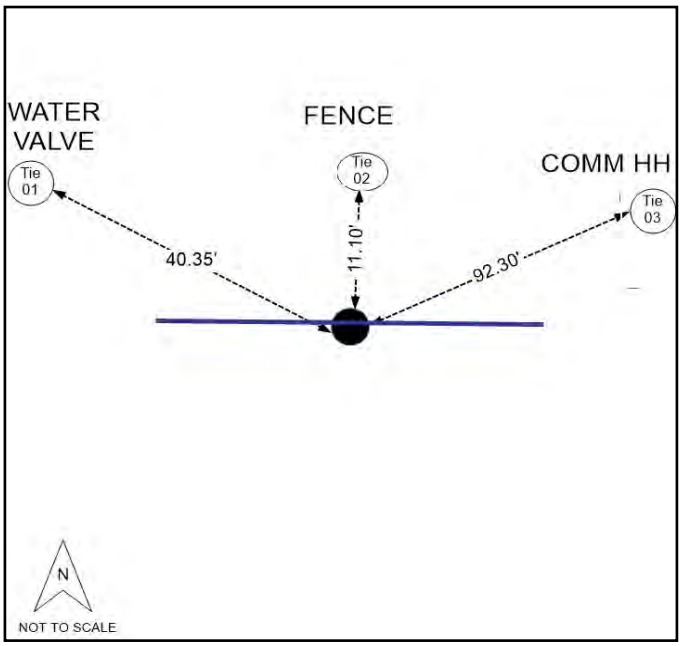
Tie	Description	Distance (Ft)	Distance (m)
01	VALVE, WATER	40.35	12.298
02	FENCE	11.1	3.383
03	HANDHOLE, COMMUNICATIONS	92.3	28.133

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 2 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): VALVE, WATER

Tie 02 (From Test Hole): FENCE

Tie 03 (From Test Hole): HANDHOLE, COMMUNICATIONS

Subsurface Utility Engineering Test Hole Report

Test Hole: 3 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

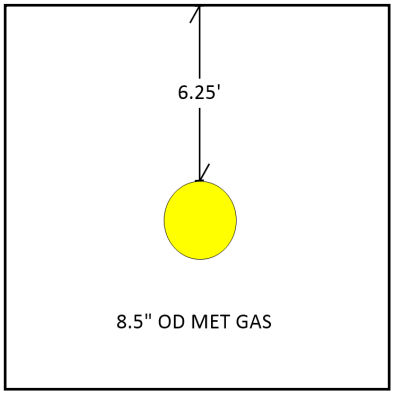
Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	EAST SIDE OF 95						
Road Name:	EVANS RD.				Utility Owner:	ENERGY TRANSFER	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/16/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	SUNNY	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: DRY	Crew Number:	2	

Requested Utility Info

Utility Type:	GAS	Utility Material:	METAL	Size (OD):	8.5	X	8.5
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	8.5	Width (in):	8.5
Top of Pipe:	6.25						
Utility Note:							

Profile View: TOP OF GROUND



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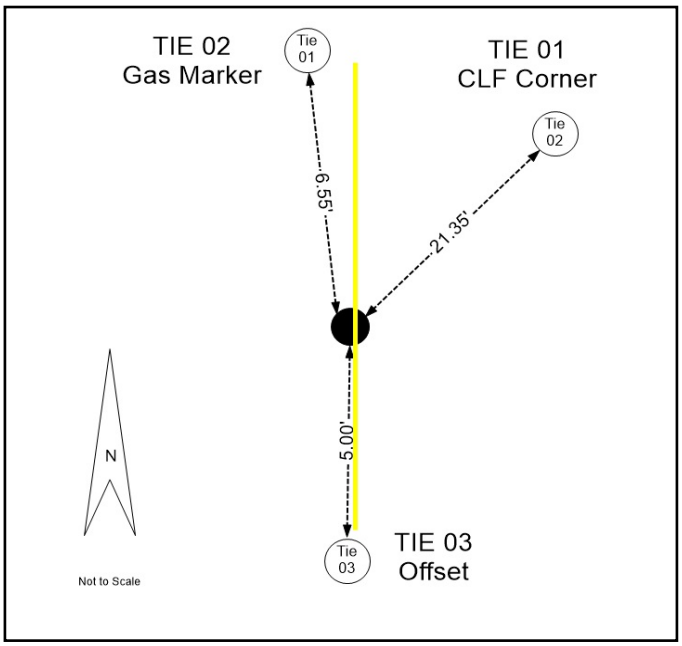
Tie	Description	Distance (Ft)	Distance (m)
01	CORNER OF FENCE	21.35	6.507
02	GAS MARKER	6.55	1.996
03	OFFSET	5	1.524

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 3 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): CORNER OF FENCE

Tie 02 (From Test Hole): GAS MARKER

Tie 03 (From Test Hole): OFFSET

Subsurface Utility Engineering Test Hole Report

Test Hole: 4 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

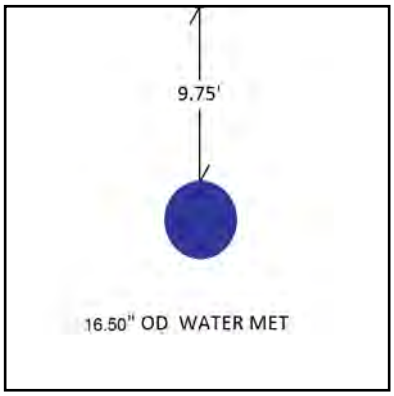
Site Data

Project Name: SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION
Location: EAST SIDE OF 95
Road Name: EVANS RD
Utility Owner: BREVARD COUNTY
WO Number: W102325
Job Number: J052783
Task WO #: N/A
City: MELBOURNE
Client Number: C05025
FPN #: N/A
County: BREVARD
Station:
Offset:
Collection Date: 9/16/2019
PM: MSS
Ground Cover: DIRT
Utility Chief: KYYA
Weather: CLEAR
Soil Type: DIRT
Utility Crew: KEMU
Time: N/A
Soil Condition: DRY
Crew Number: 2

Requested Utility Info

Utility Type: WATER
Utility Material: METAL
Size (OD): 16.5 X 16.5
Utility Condition: FAIR
Testhole Marker: HUB, LATH, NAIL AND DISK
Height (in): 16.5 Width (in): 16.5
Top of Pipe: 9.75
Utility Note: TAPPED THE TOP AS FAR AS WE COULD TRACE IT OUT.

Profile View: TOP OF GROUND



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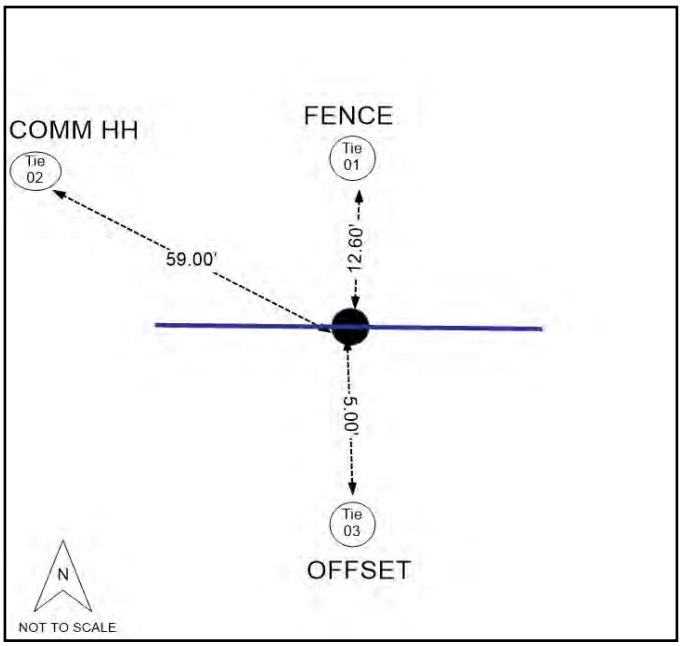
Tie	Description	Distance (Ft)	Distance (m)
01	FENCE	12.6	3.84
02	COMM HH	59	17.983
03	OFFSET	5	1.524

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 4 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): FENCE

Tie 02 (From Test Hole): COMM HH

Tie 03 (From Test Hole): OFFSET

Subsurface Utility Engineering Test Hole Report

Test Hole: 5 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

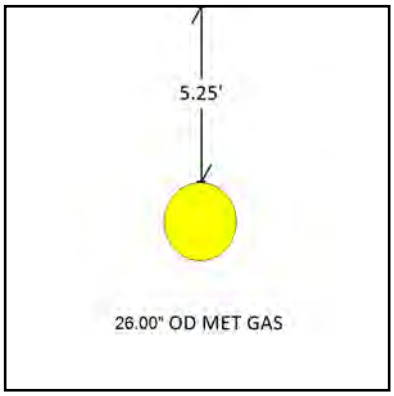
Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	EAST SIDE OF 95						
Road Name:	EVANS RD				Utility Owner:	ENERGY TRANSFER	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/16/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	SUNNY	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: SOFT-WET	Crew Number:	2	

Requested Utility Info

Utility Type:	GAS	Utility Material:	METAL	Size (OD):	26	X	26
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	26	Width (in):	26
Top of Pipe:	5.25						
Utility Note:							

Profile View: TOP OF GROUND



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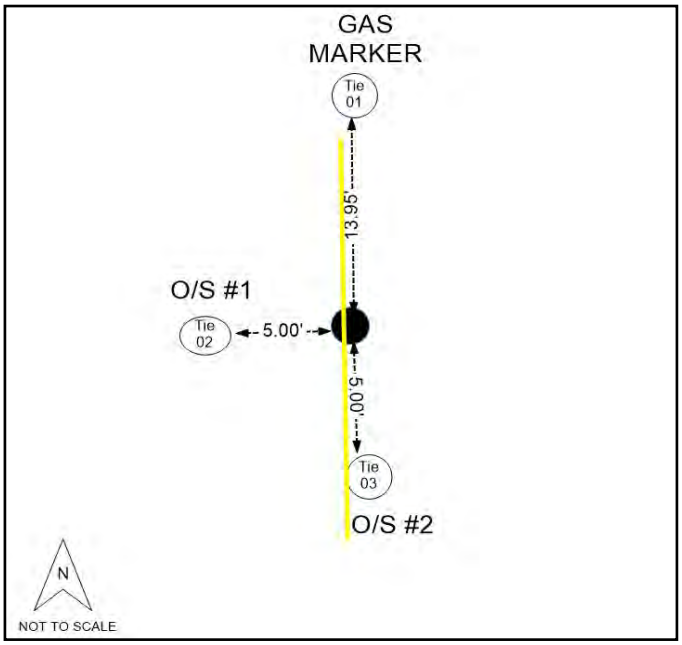
Tie	Description	Distance (Ft)	Distance (m)
01	GAS MARKER	13.95	4.251
02	OFFSET 1	5	1.524
03	OFFSET 2	5	1.524

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 5 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): GAS MARKER

Tie 02 (From Test Hole): OFFSET 1

Tie 03 (From Test Hole): OFFSET 2

Subsurface Utility Engineering Test Hole Report

Test Hole: 6 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	WEST SIDE OF 95						
Road Name:	DIKE RD.				Utility Owner:	BREVARD COUNTY	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/17/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	SUNNY	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: DRY	Crew Number:	2	

Requested Utility Info

Utility Type:	WATER	Utility Material:	HDPE-HIGH DENSITY POLYETHYLENE	Size (OD):	16.5	X	16.5
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	16.5	Width (in):	16.5
Top of Pipe:	3.5						
Utility Note:							

Profile View: TOP OF GROUND

Image is not to scale

Tie	Description	Distance (Ft)	Distance (m)
01	UTILITY MARKER, COMMUNICATIONS	8.95	2.727
02	VALVE, WATER	39.7	12.1
03	FENCE	13.7	4.175

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:

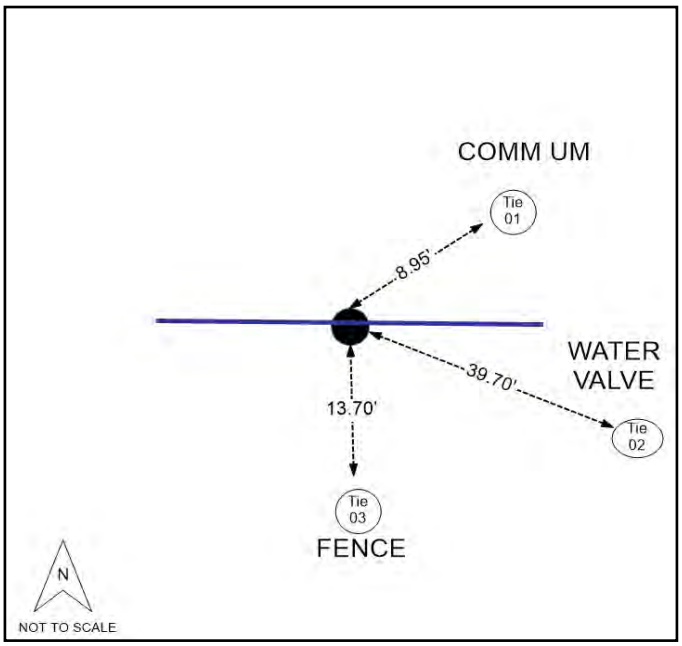


Image is not to scale

TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 6 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): UTILITY MARKER, COMMUNICATIONS

Tie 02 (From Test Hole): VALVE, WATER

Tie 03 (From Test Hole): FENCE

Subsurface Utility Engineering Test Hole Report

Test Hole: 7 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	WEST SIDE FOF 95						
Road Name:	DIKE RD.				Utility Owner:	BREVARD COUNTY	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/17/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	SUNNY	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: DRY	Crew Number:	2	

Requested Utility Info

Utility Type:	WATER	Utility Material:	HDPE-HIGH DENSITY POLYETHYLENE	Size (OD):	16.5	X	16.5
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	16.5	Width (in):	16.5
Top of Pipe:	3.1						
Utility Note:							

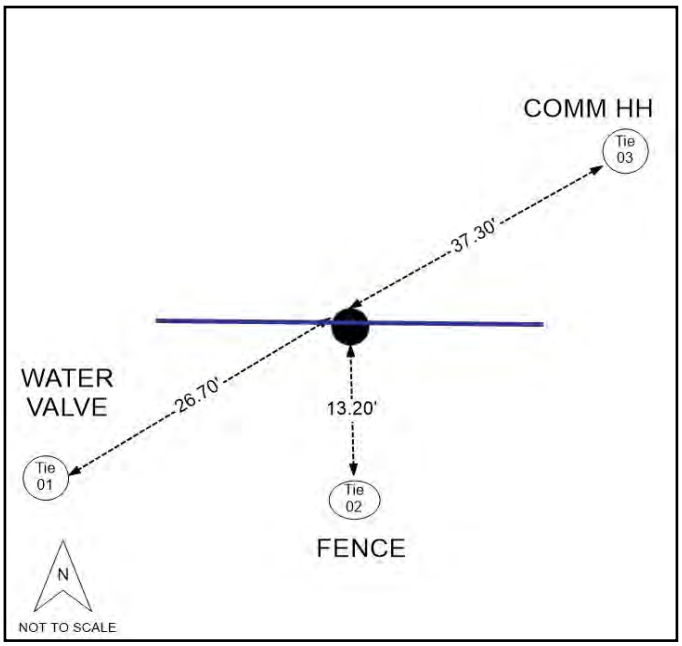
Profile View: TOP OF GROUND

Image is not to scale

Tie	Description	Distance (Ft)	Distance (m)
01	VALVE, WATER	26.7	8.138
02	FENCE	13.2	4.023
03	HANDHOLE, COMMUNICATIONS	37.3	11.369

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 7 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): VALVE, WATER

Tie 02 (From Test Hole): FENCE

Tie 03 (From Test Hole): HANDHOLE, COMMUNICATIONS

Subsurface Utility Engineering Test Hole Report

Test Hole: 8 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Site Data

Project Name:	SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION						
Location:	DIKE RD.						
Road Name:	DIKE RD.				Utility Owner:	BREVARD COUNTY	
WO Number:	W102325	Job Number:	J052783	Task WO #: N/A	City:	MELBOURNE	
Client Number:	C05025	FPN #:	N/A		County:	BREVARD	
Station:		Offset:					
Collection Date:	9/17/2019	PM:	MSS	Ground Cover: DIRT	Utility Chief:	KYYA	
		Weather:	CLEAR	Soil Type: DIRT	Utility Crew:	KEMU	
		Time:	N/A	Soil Condition: DRY	Crew Number:	2	

Requested Utility Info

Utility Type:	WATER	Utility Material:	HDPE-HIGH DENSITY POLYETHYLENE	Size (OD):	16.5	X	16.5
Utility Condition:	FAIR	Testhole Marker:	HUB, LATH, NAIL AND DISK	Height (in):	16.5	Width (in):	16.5
Top of Pipe:	3.75						
Utility Note:							

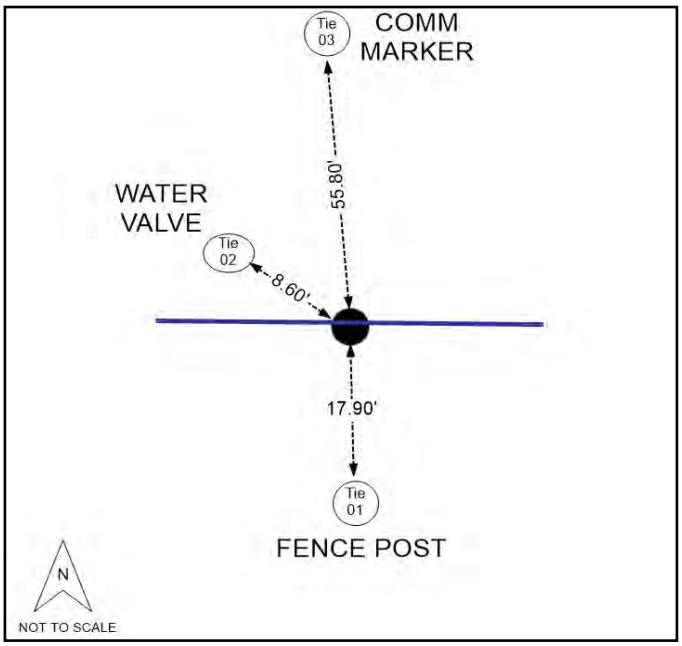
Profile View: TOP OF GROUND

Image is not to scale

Tie	Description	Distance (Ft)	Distance (m)
01	FENCE POST	17.9	5.455
02	VALVE, WATER	8.6	2.621
03	UTILITY MARKER, COMMUINCATION	55.8	17.007

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 8 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): FENCE POST

Tie 02 (From Test Hole): VALVE, WATER

Tie 03 (From Test Hole): UTILITY MARKER, COMMUINCATION

Subsurface Utility Engineering Test Hole Report

Test Hole: 9 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

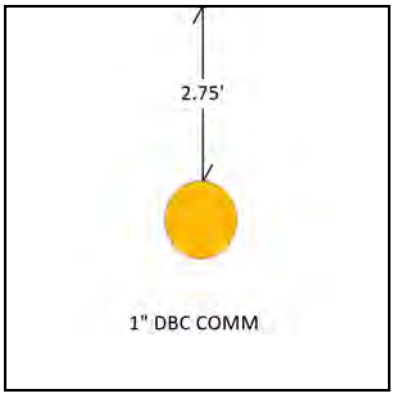
Site Data

Project Name: SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION
Location: DIKE RD
Road Name: DIKE RD
Utility Owner: AT&T
WO Number: W102325
Job Number: J052783
Task WO #: N/A
City: MELBOURNE
Client Number: C05025
FPN #: N/A
County: BREVARD
Station:
Offset:
Collection Date: 9/17/2019
PM: MSS
Ground Cover: DIRT
Utility Chief: KYYA
Weather: CLEAR
Soil Type: DIRT
Utility Crew: KEMU
Time: N/A
Soil Condition: DRY
Crew Number: 2

Requested Utility Info

Utility Type: COMMUNICATION
Utility Material: DIRECT BURIED CABLE
Size (OD): 1 X 1
Utility Condition: FAIR
Testhole Marker: HUB, LATH, NAIL AND DISK
Height (in): 1 Width (in): 1
Top of Pipe: 2.75
Utility Note:

Profile View: TOP OF GROUND



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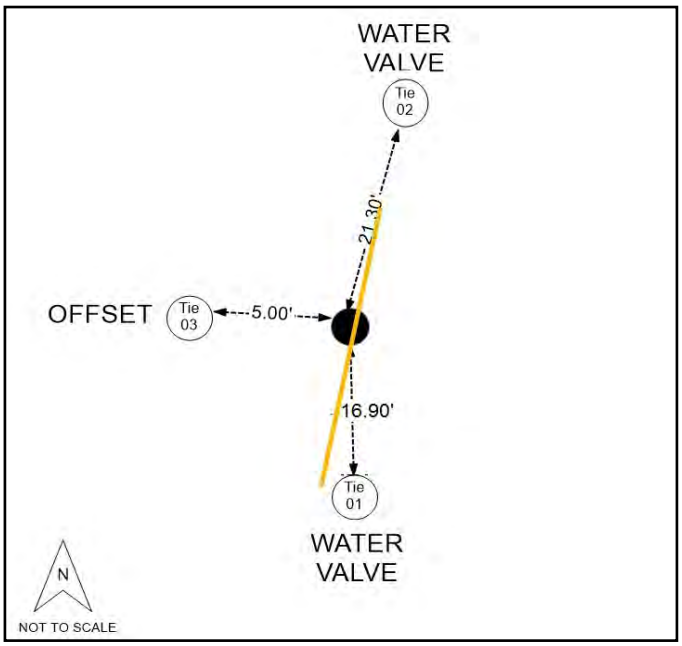
Tie	Description	Distance (Ft)	Distance (m)
01	SOUTH VALVE, WATER	16.9	5.151
02	NORTH VALVE, WATER	21.3	6.492
03	OFFSET	5	1.524

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 9 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): SOUTH VALVE, WATER

Tie 02 (From Test Hole): NORTH VALVE, WATER

Tie 03 (From Test Hole): OFFSET

Subsurface Utility Engineering Test Hole Report

Test Hole: 10 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Site Data

Project Name: SJRWMD-CRANE CREEK/M-1 CANAL FLOW RESTORATION
Location: DIKE RD.
Road Name: DIKE RD. Utility Owner: BREVARD COUNTY
WO Number: W102325 Job Number: J052783 Task WO #: N/A City: MELBOURNE
Client Number: C05025 FPN #: N/A County: BREVARD
Station: Offset:
Collection Date: 9/17/2019 PM: MSS Ground Cover: DIRT Utility Chief: KYYA
Weather: CLEAR Soil Type: DIRT Utility Crew: KEMU
Time: N/A Soil Condition: DRY Crew Number: 2

Requested Utility Info

Utility Type: WATER Utility Material: HDPE-HIGH DENSITY POLYETHYLENE Size (OD): 16.5 X 16.5
Utility Condition: FAIR Testhole Marker: HUB, LATH, NAIL AND DISK Height (in): 16.5 Width (in): 16.5
Top of Pipe: 4.15
Utility Note:

Profile View: TOP OF GROUND

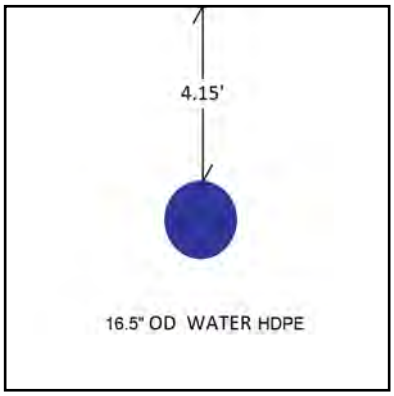
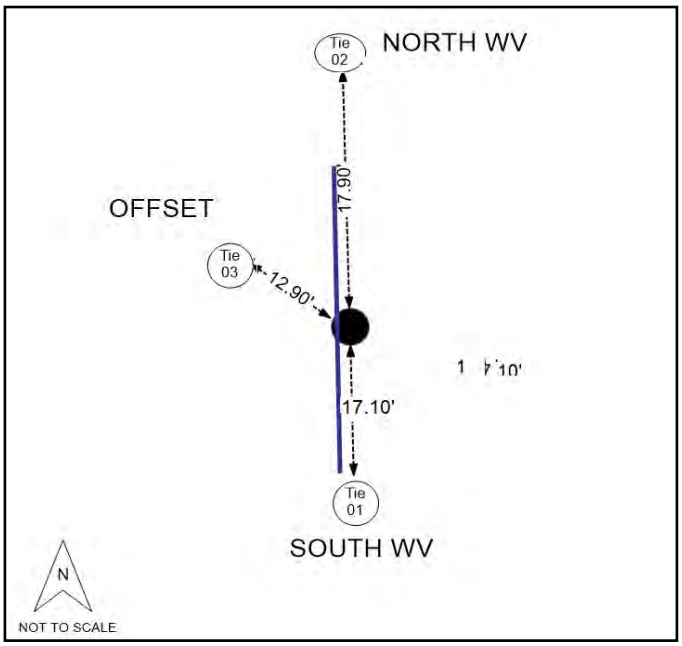


Image is not to scale

Tie	Description	Distance (Ft)	Distance (m)
01	SOUTH VALVE, WATER	17.1	5.212
02	NORTH VALVE, WATER	17.9	5.455
03	OFFSET	12.9	3.931

Additional Lines Found	Top of Pipe (ft)	Bottom of Pipe (ft)	Height (in)	Width (in)
Additional Utility 01	0	0	0	0
Additional Utility 02	0	0	0	0
Additional Utility 03	0	0	0	0

Plan View:



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TestHole Location (Main Image):

Southeastern Surveying and Mapping Corp.

Subsurface Utility Engineering Test Hole Report

Test Hole: 10 **Produced For:** JONES, EDMUNDS & ASSOCIATES, INC.

Tie 01 (From Test Hole): SOUTH VALVE, WATER

Tie 02 (From Test Hole): NORTH VALVE, WATER

Tie 03 (From Test Hole): OFFSET