Final Report of Geotechnical Exploration
For

JEA District 2 Pump Station and Flow Rerouting

MAE Project No. 0011-0017
November 5, 2018

Prepared for:

CDM Smith

8381 Dix Ellis Trail, Suite 400
Jacksonville, FL 32256

JEA
Building Community®

Prepared by:

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical ▾ Environmental ▾ Inspection ▾ Testing

8936 Western Way, Suite 12
Jacksonville, Florida 32256
Phone (904) 519-6990
Fax (904) 519-6992

TEN YEARS
MAE
Meskel & Associates Engineering
Geotechnical · Environmental
Inspection · Testing

November 5, 2018

CDM Smith, Inc.
8381 Dix Ellis Trail, Suite 400
Jacksonville, FL 32256

Attention: Mr. Yanni Polematidis, P.E.

Reference: Final Report of Geotechnical Exploration
JEA District 2 Pump Station and Flow Rerouting
Jacksonville, Florida
MAE Project No. 0011-0017

Dear Mr. Polematidis:

Meskel & Associates Engineering, PLLC (MAE) has completed a geotechnical exploration for the subject project. Our work was performed in general accordance with our revised proposal dated September 14, 2017. The geotechnical exploration was performed to evaluate the general subsurface conditions within the areas of the three proposed pump station locations (Robena Road, Pulaski Road, and Harts Road), and to provide recommendations for foundation support and design, pond design, and site preparation. This report has been revised from its original version dated June 21, 2018 to include comments received from CDM Smith.

Provided the sites are prepared with the recommendations included in this report, it is our opinion that the proposed pump stations at Pulaski Road and Robena Road, and the proposed Electrical Building at Harts Road, can be supported on conventional shallow foundation systems.

We appreciate this opportunity to be of service as your geotechnical consultant on this phase of the project. If you have any questions, or if we may be of any further service, please contact us.

Sincerely,
MESKEL & ASSOCIATES ENGINEERING, PLLC
MAE FL Certificate of Authorization No. 28142

P. Rodney Mank, State of Florida, Professional Engineer, License No. 41986. This item has been electronically signed and sealed by P. Rodney Mank, P.E. on 11/05/2018 using a Digital Signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Philip R Mank Digitally signed by Philip R Mank Date: 2018.11.05 14:36:00 -05'00'

W. Josh Mele, E.I.
Staff Engineer

P. Rodney Mank, P.E.
Principal Engineer
Licensed, Florida No. 41986

Distribution: Mr. Yanni Polematidis, P.E. – CDM Smith, Inc. 1 pdf

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 PROJECT INFORMATION

1.1 General

Project information was provided to us by Mr. Yanni Polematidis, P.E., with CDM Smith, Inc. For our review and reference, we were provided with the following *JEA Cedar Bay (District II) Pumping Stations and Flow Rerouting Project* documents:

- Figures 1 and 2, Robena Road Pump Station - Existing Site Survey and Yard Piping Plan, Sheets C-1 and C-2 (respectively); developed by CDM Smith, dated August 2017.
- Figures 3 and 4, Pulaski Road Pump Station - Existing Site Survey and Yard Piping Plan, Sheets C-3 and C-4 (respectively); developed by CDM Smith, dated August 2017.
- Figure 5, Harts Road Pump Station - Site Layout, Sheet C-5; developed by CDM Smith, dated June 2017.

1.2 Project Description

The sites for the subject project are located in Jacksonville, Florida. The general site locations are shown on Figures 1A through 1C.

Based on the provided information and our discussions with Mr. Polematidis, it is our understanding the proposed project includes the construction of two new pumping stations, one south of Robena Road near its intersection with Verde Gardens Road, and the other east of Pulaski Road just north of its intersection with Noah Road, and a new electrical building at the existing Harts Road Pump Station site. The new pumping stations will each include a submersible booster pump station with three primary pumps (2 duty and 1 standby) and two jockey pumps (1 duty and 1 standby), an electrical building, generator, fuel tank, a stormwater management pond, and associated drive and parking areas. We have assumed that the depth of the wet wells will be 15 to 20 feet below existing grades. In addition, the proposed force main piping at the two planned pump stations will be 20-inch polyvinyl chloride (PVC) pipe.

From our observation of the provided plans, we understand the proposed electrical buildings will be prefabricated metal buildings, each approximately 27 feet by 12 feet in “footprint” plan dimensions and supported on a monolithic, turned-down-edge slab-on-grade. Although detailed information has not been provided, we have assumed the wall and floor loads will not exceed 2 kips per linear foot (klf) and 100 pounds per square foot (psf), respectively. Furthermore, we except the planned generators and fuel tanks will be supported on monolithic slab-on-grade foundations. Grading plans were not provided at the time of our evaluation; however, we have assumed the building and pavement areas will be supported on less than 2 to 3 feet of fill above the presently existing ground surface.

If actual project information varies from these conditions, then the recommendations in this report may need to be re-evaluated. Any changes in these conditions should be provided so the need for re-evaluation of our recommendations can be assessed prior to final design.

1.3 Site Conditions

Prior to the start of this project, a site visit was conducted at the Pulaski Road and Robena Road sites by our field crew on September 13, 2017. Recent rains had caused both sites to be flooded, particularly within the wetland areas as designated on the site plans, thus causing them to be inaccessible with our

All-Terrain Vehicle (ATV) drilling equipment. Our previous experience with similar site conditions has shown that saturated surficial sandy soils will rut while traversing the site, thus causing our ATV to get stuck. Therefore, it was decided that both sites would be accessed using our portable, tripod-mounted, drilling equipment. This equipment would be carried to each boring location and setup on pallets to stabilize the tripod.

At the time of our field exploration at the Robena Road site (October 2017), it was observed that much of the site was still covered with standing water. Groundwater levels at the boring locations were at the ground surface. This resulted in soft surficial soil conditions. Most of the site was heavily wooded as well.

The Pulaski Road site did not contain many areas of standing water at the time of our field exploration (April 2018). However, the surface soils were generally wet, soft, organic topsoils that were difficult to travel across. This site was also mostly heavily wooded.

2.0 FIELD EXPLORATION

Three separate field explorations were performed for this project; one for each site. The Harts Road Pump Station exploration was performed on August 17, 2017, the Robena Road site was explored during the period of October 10 through 12, 2017, and the Pulaski Road site was explored during the period of April 5 through 13, 2018. Copies of the plans provided to us, which show the approximate boring locations, are included as the *Boring Location Plan*, Figures 2A through 2C. The boring locations were provided by you, and then GPS coordinates were obtained by overlaying the provided plans in Google Earth. Our field personnel then located each boring location using a Garmin GPSMAP 78 hand-held GPS receiver; therefore, the boring locations should be considered accurate only to the degree implied by the method of measurement used.

2.1 SPT Borings

To explore the subsurface conditions within the areas of the proposed Pump Stations at Robena Road and Pulaski Road, and the Electrical Building at the Harts Road site, we located and performed 11 Standard Penetration Test (SPT) borings, each drilled to depths of approximately 15, 25 and 35 feet below the existing ground surface. Our truck mounted CME 55 drill rig was used to perform the Harts Road boring; However, due to the saturated soil conditions as described in Section 1.3 above, the Robena Road site was accessed using our portable, tripod-mounted drilling equipment. This equipment was carried to each location and set up on pallets for stabilization. In addition, due to the dense tree vegetation at the Pulaski Road site, the boring locations were accessed using our ATV-mounted CME 45. All the borings were performed in general accordance with the methodology outlined in ASTM D 1586. Split-spoon soil samples recovered during performance of the borings were visually described in the field and representative portions of the samples were transported to our laboratory for further evaluation.

3.0 LABORATORY TESTING

3.1 Visual Classification

Representative soil samples obtained during our field exploration were visually classified by a geotechnical engineer using the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. A *Key to the Soil Classification System* is included in Appendix A.

3.2 Index Tests

Quantitative laboratory testing was performed on selected samples of the soils encountered during the field exploration to better define the composition of the soils encountered and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the Atterberg limits, natural moisture, percent passing a Number 200 U.S. sieve (percent fines), and organic contents of selected soil samples. The results of the laboratory testing are shown in the *Summary of Laboratory Test Results* included in Appendix B. Also, these results are shown on the *Generalized Soil Profiles* on Figures 3 through 7, and on the *Log of Boring* records at the respective depths from which the tested samples were recovered.

3.3 Corrosion Series Tests

Composite soil samples from the Robena Road and Pulaski Road sites were selected for corrosion potential testing. These samples were obtained from borings located near the proposed Booster Pump Stations (B-3 and B-8) at depths from 2 to 8 feet below the existing ground surface. The testing included soil pH, resistivity, and chloride and sulfate contents. The test results are discussed in Section 5.8 and Section 6.8 below, and are presented on the *Summary of Laboratory Corrosivity Tests Results* in Appendix C.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

Graphical presentation of the generalized subsurface conditions is presented on Figures 3 through 7. Detailed boring records are included in Appendix A. When reviewing these records, it should be understood that the soil conditions will vary between the boring locations.

4.1.1 Robena Road

In general, the borings encountered very loose fine sands with silt (SP-SM) containing few to some amounts of organic fines to a depth of about 2 to 6 feet, underlain by loose to dense clayey fine sands (SC) and silty fine sands (SM) to depths ranging from about 13.5 feet to 18.5 feet. Following these sandy soils, the borings encountered soft to stiff clays (CL, CH) continuing to depths ranging from 22 feet to 33.5 feet, underlain by clayey fine sands (SC) and silty fine sands (SM) to their termination depths of up to approximately 35 feet below the existing ground surface.

4.1.2 Pulaski Road

In general, the borings encountered a surficial layer of organic material (e.g., pine needles, small root clusters, moss, etc.) 8 to 9 inches thick, underlain by fine sands (SP), fine sands with silt (SP-SM) and silty fine sands (SM) to their termination depths of up to 35 feet below the existing ground surface. The relative densities of the soils encountered ranged from very loose to very dense and typically increased with depth. The near surface soils often contained trace amounts of root fragments and organic fines, and soils containing trace clay constituents were frequently encountered throughout the depths explored.

4.1.3 Harts Road

In general, the boring encountered a surficial topsoil layer 6 inches thick, underlain by loose fine sand with silt (SP-SM) containing trace clay nodules to a depth of about 2 feet, followed by medium dense to loose clayey fine sands (SC) to a depth of about 13.5 feet. Following these clayey sand soils, the boring encountered medium dense silty fine sands (SM) and fine sands with silt (SP-SM) to a depth of about 24.5 feet, underlain by very loose (weight-of-hammer) clayey fine sands to a depth of about 28.5 feet. Following the very loose clayey sand soils, the boring encountered loose silty fine sands (SM) to a depth of about 34.5 feet and then terminated in medium dense clayey fine sands (SC) at a depth of approximately 35 feet below the existing ground surface.

4.2 Groundwater Level

The groundwater level was encountered at each of the boring locations and recorded at the time of drilling. The table below shows the variation in depths below the existing ground surface at each site. However, it should be anticipated that the groundwater levels will fluctuate seasonally and with changes in climate. As such, we recommend that the water table be re-measured prior to construction. Measured groundwater levels are shown the boring profiles and boring logs.

Project Site	Variation in Depths Below the Existing Ground Surface
Robena Road	At existing ground surface
Pulaski Road	1 foot to 2 feet 8 inches
Harts Road	11 inches

4.3 Review of the USDA Web Soil Survey Map

The results of a review of the USDA Soil Survey Conservation Service (SSCS) Web Soil Survey of Duval County are shown in the table below. The soil drainage class, hydrological group, and estimated seasonal high groundwater levels reported in the Soil Survey are as follows:

Project Site	Map Unit Symbol	Map Unit Name	Drainage Class	Hydrologic Group	Depth to the Water Table[1] (inches)
Robena Road	51	Pelham fine sand, 0 to 2 percent slopes	Poorly Drained	B/D	6 to 12
Robena Road	66	Surrency loamy fine sand, depressional, 0 to 2 percent slopes	Very Poorly Drained	B/D	0
Pulaski Road	63	Sapelo fine sand, 0 to 2 percent slopes	Poorly Drained	B/D	8 to 18
Harts Road	74	Pelham-Urban land complex, 0 to 2 percent slopes	Poorly Drained	B/D	0 to 12

[1] The “Water Table” above refers to a saturated zone in the soil which occurs during specified months, typically the summer wet season. Estimates of the upper limit shown in the Web Soil Survey are based mainly on observations

of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

(2) The term "complex", as defined by the USDA, refers to a map unit consisting of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the map.

4.4 Seasonal High Groundwater Level

In estimating seasonal high groundwater level, a number of factors are taken into consideration including antecedent rainfall, soil redoximorphic features (i.e., soil mottling), stratigraphy (including presence of hydraulically restrictive layers), vegetative indicators, effects of development, and relief points such as drainage ditches, low-lying areas, etc.

Based on our observation of the site conditions over time, and our interpretation of the boring logs and review of published data, we estimate the seasonal high groundwater levels at all three sites to be at the existing ground surface. However, the drainage engineer should be consulted to determine if higher groundwater levels are likely due to offsite drainage patterns that may be influencing the groundwater levels at these sites.

For all three sites, it is possible that higher groundwater levels may exceed the estimated seasonal high groundwater level as a result of significant or prolonged rains. Therefore, we recommend that design drawings and specifications account for the possibility of groundwater level variations, and construction planning should be based on the assumption that such variations will occur.

5.0 ROBENA ROAD FOUNDATION DESIGN RECOMMENDATIONS

5.1 General

The following evaluation and recommendations are based on the provided project information as presented in this report, the results of the field exploration and laboratory testing performed, and the construction techniques recommended in Section 9.0 below. If the described project conditions are incorrect or changed after this report, or if subsurface conditions encountered during construction are different from those reported, MAE should be notified so these recommendations can be re-evaluated and revised, if necessary. We recommend that MAE review the foundation plans and earthwork specifications to verify that the recommendations in this report have been properly interpreted and implemented.

5.2 Pump Station Foundation Recommendations

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed pump station equipment on monolithic slab-on-grade designed for a modulus of subgrade reaction of 200 pci, provided that the surficial topsoil is removed from within the construction area and replaced with suitable fill material as outlined in Section 9.0.

5.2.1 Bearing Pressure

The maximum allowable net soil bearing pressure for use in monolithic slab-on-grade design should not exceed 2,000 psf. Due to the clay layers encountered between depths of approximately 13.5 feet to up to 34 feet, the maximum allowable net soil bearing pressure for the wet well base slab should not exceed 500 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the effective overburden pressure at that level. The slab-on-grade and wet well base slab foundations should be designed based on the maximum load that could be imposed by all loading conditions.

5.2.2 Bearing Depth

The turned down edges of the monolithic slabs-on-grade supporting surface equipment should bear at a depth of at least 12 inches below the exterior final grades. It is recommended that stormwater be diverted away from these slabs to reduce the possibility of erosion beneath the slabs.

5.2.3 Bearing Material

The subgrade soils below the monolithic slabs-on-grades or the wet well slabs should consist of suitable on-site or import structural fill soils. The fine sands (SP) and fine sands with silt (SP-SM) as encountered in the borings are considered suitable onsite soils. These soils should be compacted to at least 95 percent of the soil's modified Proctor Maximum Dry Density (ASTM D-1557) to a depth of at least one foot below the slab bearing levels. Control of the soil's moisture content, particularly for the subgrade soils below the wet well slab, will be necessary to achieve the required level of compaction.

The clay (CL, CH) soils as encountered at the boring locations are not considered suitable bearing soils for the wet well slab. These soils should be excavated to a depth of at least 12 inches below the planned bearing depth and within the full lateral extent of the slab, plus a margin of 3 feet outside the limits of the slab. We recommend the clay soils at the bottom of the excavation be overlain by a filter fabric to act as a separation layer between the clay soils and the subgrade backfill. The fabric should continue up the sides of the excavation to separate the soil backfill from the adjacent clay soils. The excavated clays at the subgrade level should be replaced with a graded aggregate such as ASTM C33 Gradation 67 stone as specified in the JEA Water/Wastewater Standards, as discussed in Section 9.5 below.

5.3 Electrical Building Foundation Design Recommendations

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structure when constructed on a properly designed shallow foundation system. Provided the site preparation and earthwork construction recommendations outlined in Section 9.0 of this report are performed, the following parameters may be used for foundation design.

5.3.1 Bearing Pressure

The maximum allowable net soil bearing pressure to be applied to the foundations subgrade soils by the turned-down edge footings of the monolithic slab should not exceed 2,500 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the effective overburden pressure at that level. The foundations should be designed based on the maximum load that could be imposed by all loading conditions.

5.3.2 Bearing Depth

The turned down edges of the monolithic slabs-on-grade supporting surface equipment should bear at a depth of at least 12 inches below the exterior final grades. It is recommended that stormwater be diverted away from these slabs to reduce the possibility of erosion beneath the slabs.

5.3.3 Bearing Material

The foundations may bear in either the compacted suitable natural soils or compacted structural fill. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least one foot below the foundation bearing levels.

5.3.4 Floor Slab

The floor slab for the electrical building can be constructed as a slab-on-ground designed for a modulus of subgrade reaction of 200 pci, provided unsuitable material is removed and replaced with compacted structural fill as outlined in Section 9.0. It is recommended that the floor slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil thick plastic membrane is commonly used for this purpose. Care should be exercised not to tear large sections of the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of 2 feet be maintained between the finished floor levels and the estimated normal seasonal high groundwater level.

5.4 Settlement Estimates

Post-construction settlements of the structure will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) footing size, bearing level, applied loads, and resulting bearing pressures beneath the foundations; and (3) site preparation and earthwork construction techniques used by the contractor. Our settlement estimates for the structure are based on the use of site preparation/earthwork construction techniques as recommended in Section 9.0 of this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the structure.

Due to the sandy nature of the near-surface soils, we expect the majority of settlement to occur in an elastic manner and fairly rapidly during construction. Using the recommended maximum bearing pressure, the supplied/assumed maximum structural loads, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that total settlements of the structure could be on the order of one inch or less.

Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions and the recommended site preparation and earthwork construction techniques outlined in Section 9.0, we estimate differential settlement of the structure to be on the order of one-half inch or less.

5.5 Pavement Considerations

Based on the results of our exploration, we consider the subsurface conditions at the site favorable for support of a flexible pavement section, when constructed on properly prepared subgrade soils as outlined in Section 9.0 of this report. Pavement design and construction should conform to the *City of Jacksonville Standard Asphaltic Concrete Driveway*, Plate P-204, for a Class II Commercial driveway.

5.5.1 Wearing Surface

The wearing surface should consist of Florida Department of Transportation (FDOT) Type S asphaltic concrete having a minimum Marshall Stability of 1,500 lbs. Concrete pavement should have a minimum

28-day strength of 3,000 psi. Specific requirements for Type S asphaltic concrete wearing surface are outlined in the latest edition of the *Florida Department of Transportation, Standard Specifications for Road and Bridge Construction.*

5.5.2 Base and Subgrade

Due to the typical soil saturation and wetland areas at the project site, it is unlikely that an appropriate separation between a limerock base course and the estimated seasonal high groundwater table will be able to be maintained. As an alternative to the more partly soluble limerock material, a Graded Aggregate Base (GAB) such as crushed concrete may be used. The GAB should meet FDOT criteria or be from a FDOT-certified source and compacted to the same level as would a limerock material.

The subgrade material should have a minimum LBR of 40 and be compacted to 98 percent of the modified Proctor maximum dry density (AASHTO T-180) value.

5.5.3 Underdrains

Satisfactory pavement life is dependent on dry/strong pavement support provided by the base and subgrade courses. Accordingly, a minimum clearance of 2 feet must be maintained between the estimated seasonal high groundwater table and the bottom of the limerock base layer, or 2.5 feet below the pavement surface. If a GAB is used as the base material, then the minimum clearances may be reduced to one foot and 1.5 feet, respectively. Depending on final pavement grades, subsurface drains may be required to maintain dry base and subgrade materials. Once the final paving and drainage plans are prepared, we would be pleased to review them and the need for underdrains.

5.6 Below Grade Structures Design Recommendations

Based on the results of the subsurface explorations, laboratory testing, and provided information, as included in this report, we consider the subsurface conditions at the site adaptable for supporting the proposed PVC pipeline and pump station wet well when constructed upon properly prepared subgrade soils.

As noted in Section 4.0 above, clays (CL, CH) were encountered at some boring locations within the expected bearing level of the planned wet well slabs. Due to the plasticity of these soils and their affinity for moisture, we consider these soils unsuitable for use as bedding and backfill material for the associated piping and wet well structures. We recommend that the clay soils at the bearing depth be overexcavated a minimum of 12 inches below the planned bearing depth and within the full lateral extent of the pipeline or structure slab plus a margin of 3 feet. The clay soils at the bottom of the excavation should be overlain by a filter fabric material to act as a separation layer between the clay soils and the subgrade backfill. The fabric should continue up the sides of the excavation to separate the soil backfill from the adjacent clay soils. The excavated clays at the subgrade level should be replaced with a graded aggregate such as ASTM C33 Gradation 67 stone as specified in the JEA Water/Wastewater Standards, as discussed in Section 9.5 and 9.6 below.

Backfill placed for the pipeline and against the sides of the wet well structure should consist of fine sands and fine sands with silt as recommended in Section 9.6 below. The fine sands with silt (SP-M) as encountered in the soil borings are suitable for use as structural backfill. However, the silty fine sands (SM) and the clayey fine sands (SC), as well as the soils containing varying amounts of root fragments, as encountered in the borings, are considered unsuitable for use as backfill material.

Provided the site preparation and earthwork construction recommendations outlined in Section 9.0 of this report are performed, the following parameters may be used for design of the below-grade structures.

5.6.1 Lateral Pressure Design Parameters

In general, below grade structures that have adjacent compacted fill will be subjected to lateral earth pressures. Structures that are restrained at the top and bottom will be subjected to at-rest soil pressures, while structures that are not restrained at the top, and where sufficient movement is anticipated, will be subjected to active earth pressures. Surcharge effects for sloped backfill, point or area loads behind the walls, and adequate drainage provisions should be incorporated in the structure design. Passive resistance, resulting from footing embedment at the wall toe, could be neglected for safer design. The following soil parameters can be used for the project where suitable fill soils, as described in Section 9.6, are placed adjacent to the structure:

- Backfill Soil Unit Weight, Saturated (γ_{sat}) = 115 pcf
- Backfill Soil Unit Weight, Moist (γ_m) = 110 pcf
- Backfill Soil Angle of Internal Friction (ϕ) = 30 degrees
- Coefficient of Active Earth Pressure, k_a = 0.33
- Coefficient of At-Rest Earth Pressure, k_o = 0.5
- Coefficient of Passive Earth Pressure, k_p = 3.0
- Foundation Soil (Gravel) Unit Weight, Saturated (γ_{sat}) = 110 pcf
- Foundation Soil Angle of Internal Friction (ϕ) = 35 degrees

The above parameters are based on sand backfill (SP, SP-SM) placed and compacted behind the structures as discussed in Section 9.6, and on compaction of the structure foundation soils as discussed in Section 9.5. A coefficient of friction for poured in-place concrete of 0.45 may be used in the wall design. The wet well structure should be designed to include all temporary construction and permanent traffic and surcharge loads acting on the walls.

5.6.2 Hydrostatic Uplift Resistance

It is anticipated that buried structures will exert little or no net downward pressure on the soils, rather, the structure may be subject to hydrostatic uplift pressure when empty. Below grade structures should be designed to resist hydrostatic uplift pressures appropriate for their depth below existing grade and the seasonal high groundwater table. Hydrostatic uplift forces can be resisted in several ways including:

- Addition of dead weight to the structure.
- Mobilizing the dead weight of the soil surrounding the structure through extension of the bottom slab outside the perimeter of the structure.

A moist compacted soil unit weight of 110 lb/ft^3 may be used in designing the wet well structure to resist buoyancy.

5.7 Reuse of Onsite Soils

Based on the boring results and classification of the soil samples, the fine sands with silt (SP-SM) as encountered at the boring locations, are considered suitable for use as fill and backfill soil. The silty fine sand and silty fine sand with trace amounts of clay (SM) and the clayey fine sand (SC) soils (i.e., soils with more than 10 to 12 percent passing the No. 200 sieve) will be more difficult to compact due to their natural tendency to retain soil moisture Therefore, these soils are considered unsuitable for use as fill or backfill material. The clay soils (CL, CH) and the soils containing surficial organic material (e.g., topsoil) will require removal and are considered unsuitable for use as structural fill. The organic soils could be used in landscape berms.

Due to the typically high groundwater levels at this site, it should be anticipated the soils will have moisture contents in excess of the modified Proctor optimum moisture content and will require stockpiling or spreading to bring the moisture content within 2 percent of the soil's optimum moisture content corresponding to the required degree of compaction.

5.8 Environmental Classification

One soil corrosion series test from the Robena Road site was performed on composite soil samples obtained at the boring performed within the planned Submersible Booster Pump Station area to determine the environmental classification of the soils. The samples were classified in accordance with FDOT procedures contained in Chapter 1.3.2.1 of the January 2018 edition of the FDOT *Structures Design Guidelines*. Based on the results of these tests, the encountered soils were classified as Extremely Aggressive. Sample location and test results are included in Appendix C.

6.0 PULASKI ROAD DESIGN RECOMMENDATIONS

6.1 General

The following evaluation and recommendations are based on the provided project information as presented in this report, results of the field exploration and laboratory testing performed, and the construction techniques recommended in Section 9.0 below. If the described project conditions are incorrect or changed after this report, or subsurface conditions encountered during construction are different from those reported, MAE should be notified so these recommendations can be re-evaluated and revised, if necessary. We recommend that MAE review the foundation plans and earthwork specifications to verify that the recommendations in this report have been properly interpreted and implemented.

6.2 Pump Station Foundations Recommendations

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed pump station equipment on monolithic slab-on-grade designed for a modulus of subgrade reaction of 200 pci, provided that the surficial topsoil is removed from within the construction area and replaced with suitable fill material as outlined in Section 9.0.

6.2.1 Bearing Pressure

The maximum allowable net soil bearing pressure for use in monolithic slab-on-grade design should not exceed 2,500 psf. The maximum allowable net soil bearing pressure for the wet well base slab should not exceed 1,000 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the effective overburden pressure at that level. The slab-on-grade and wet well base slab foundations should be designed based on the maximum load that could be imposed by all loading conditions.

6.2.2 Bearing Depth

The turned down edges of the monolithic slabs-on-grade supporting surface equipment should bear at a depth of at least 12 inches below the exterior final grades. It is recommended that stormwater be diverted away from these slabs to reduce the possibility of erosion beneath the slabs.

6.2.3 Bearing Material

The subgrade soils below the monolithic slabs-on-grades or the wet well slabs should consist of suitable on-site or import structural fill soils. The fine sands (SP) and fine sands with silt (SP-SM) as encountered in the borings are considered suitable onsite soils. These soils should be compacted to at least 95 percent of the soil's modified Proctor Maximum Dry Density (ASTM D-1557) to a depth of at least one foot below the slab bearing levels. Control of the soil's moisture content, particularly for the subgrade soils below the wet well slab, will be necessary to achieve the required level of compaction.

6.3 Electrical Building Foundation Design Recommendations

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structures when constructed on a properly designed shallow foundation system. Provided the site preparation and earthwork construction recommendations outlined in Section 9.0 of this report are performed, including removal of any near surface organic-containing soils and replacement with compacted structural fill, the following parameters may be used for foundation design.

6.3.1 Bearing Pressure

The maximum allowable net soil bearing pressure to be applied to the foundations subgrade soils by the turned-down edge footings of the monolithic slab should not exceed 2,500 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the effective overburden pressure at that level. The foundations should be designed based on the maximum load that could be imposed by all loading conditions.

6.3.2 Bearing Depth

The turned down edges of the monolithic slabs-on-grade supporting surface equipment should bear at a depth of at least 12 inches below the exterior final grades. It is recommended that stormwater be diverted away from these slabs to reduce the possibility of erosion beneath the slabs.

6.3.3 Bearing Material

The foundations may bear in either the compacted suitable natural soils or compacted structural fill. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least one foot below the foundation bearing levels.

6.3.4 Floor Slab

The floor slab for the electrical building can be constructed as a slab-on-ground designed for a modulus of subgrade reaction of 200 pci, provided unsuitable material is removed and replaced with compacted structural fill as outlined in Section 9.0. It is recommended that the floor slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil thick plastic membrane is commonly used for this purpose. Care should be exercised not to tear large sections of the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of 2 feet be maintained between the finished floor levels and the estimated normal seasonal high groundwater level.

6.4 Settlement Estimates

Post-construction settlements of the structure will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) footing size, bearing level, applied loads, and resulting bearing pressures beneath the foundations; and (3) site preparation and earthwork construction techniques used by the contractor. Our settlement estimates for the structure are based on the use of site preparation/earthwork construction techniques as recommended in Section 9.0 of this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the structure.

Due to the sandy nature of the near-surface soils, we expect the majority of settlement to occur in an elastic manner and fairly rapidly during construction. Using the recommended maximum bearing pressure, the supplied/assumed maximum structural loads, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that total settlements of the structure could be on the order of one inch or less.

Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions and the recommended site preparation and earthwork construction techniques outlined in Section 9.0, we estimate differential settlement of the structure to be on the order of one-half inch or less.

6.5 Pavement Considerations

Based on the results of our exploration, we consider the subsurface conditions at the site favorable for support of a flexible pavement section, when constructed on properly prepared subgrade soils as outlined in Section 9.0 of this report. Pavement design and construction should conform to the *City of Jacksonville Standard Asphaltic Concrete Driveway*, Plate P-204, for a Class II Commercial driveway.

6.5.1 Wearing Surface

The wearing surface should consist of Florida Department of Transportation (FDOT) Type S asphaltic concrete having a minimum Marshall Stability of 1,500 lbs. Concrete pavement should have a minimum 28-day strength of 3,000 psi. Specific requirements for Type S asphaltic concrete wearing surface are outlined in the latest edition of the *Florida Department of Transportation, Standard Specifications for Road and Bridge Construction.*

6.5.2 Base and Subgrade

Due to the typical soil saturation and wetland areas at the project site, it is unlikely that an appropriate separation between a limerock base course and the estimated seasonal high groundwater table will be able to be maintained. As an alternative to the more partly soluble limerock material, a Graded Aggregate Base (GAB) such as crushed concrete may be used. The GAB should meet FDOT criteria or be from a FDOT-certified source and compacted to the same level as would a limerock material.

The subgrade material should have a minimum LBR of 40 and be compacted to 98 percent of the modified

Proctor maximum dry density (AASHTO T-180) value.

6.5.3 Underdrains

Satisfactory pavement life is dependent on dry/strong pavement support provided by the base and subgrade courses. Accordingly, a minimum clearance of 2 feet must be maintained between the estimated seasonal high groundwater table and the bottom of the limerock base layer, or 2.5 feet below the pavement surface. If a GAB is used as the base material, then the minimum clearances may be reduced to one foot and 1.5 feet, respectively. Depending on final pavement grades, subsurface drains may be required to maintain dry base and subgrade materials. Once the final paving and drainage plans are prepared, we would be pleased to review them and the need for underdrains.

6.6 Below Grade Structures Design Recommendations

Based on the results of the subsurface explorations, laboratory testing, and provided information, as included in this report, we consider the subsurface conditions at the site adaptable for supporting the proposed PVC pipeline and pump station wet well when constructed upon properly prepared subgrade soils. Provided the site preparation and earthwork construction recommendations outlined in Section 9.0 of this report are performed, the following parameters may be used for design of below-grade utilities.

6.6.1 Lateral Pressure Design Parameters

In general, below grade structures that have adjacent compacted fill will be subjected to lateral earth pressures. Structures that are restrained at the top and bottom will be subjected to at-rest soil pressures, while structures that are not restrained at the top, and where sufficient movement is anticipated, will be subjected to active earth pressures. Surcharge effects for sloped backfill, point or area loads behind the structures, and adequate drainage provisions should be incorporated in the structure design. Passive resistance, resulting from footing embedment, could be neglected for safer design. The following soil parameters can be used for the project where suitable fill soils, as described in Section 9.6, are placed adjacent to the structure:

- Backfill Soil Unit Weight, Saturated (γ_{sat}) = 115 pcf
- Backfill Soil Unit Weight, Moist (γ_m) = 110 pcf
- Backfill Soil Angle of Internal Friction (ϕ) = 30 degrees
- Coefficient of Active Earth Pressure, k_a = 0.33
- Coefficient of At-Rest Earth Pressure, k_o = 0.5
- Coefficient of Passive Earth Pressure, k_p = 3.0
- Foundation Soil Unit Weight, Saturated (γ_{sat}) = 120 pcf
- Foundation Soil Angle of Internal Friction (ϕ) = 30 degrees

The above parameters are based on sand backfill (SP, SP-SM) placed and compacted behind the structures as discussed in Section 9.6, and on compaction of the structure foundation soils as discussed in Section 9.5. A coefficient of friction for poured in-place concrete of 0.45 may be used in the structure design. The wet well structure should be designed to include all temporary construction and permanent traffic and surcharge loads acting on the walls.

6.6.2 Hydrostatic Uplift Resistance

It is anticipated that the buried structure will exert little or no net downward pressure on the soils, rather, the structure may be subject to hydrostatic uplift pressure when empty. Below grade structures should be designed to resist hydrostatic uplift pressures appropriate for their depth below existing grade and the seasonal high groundwater table. Hydrostatic uplift forces can be resisted in several ways including:

- Addition of dead weight to the structure.
- Mobilizing the dead weight of the soil surrounding the structure through extension of the bottom slab outside the perimeter of the structure.

A moist compacted soil unit weight of 110 lb/ft^3 may be used in designing the wet well structure to resist buoyancy.

6.7 Reuse of Onsite Soils

Based on the boring results and classification of the soil samples, the fine sands, fine sands with silt, and silty fine sands (SP, SP-SM, SM) as encountered at the boring locations, are considered suitable for use as fill soil. However, it should be noted that the SM soils (i.e., soils with more than 10 to 12 percent passing the No. 200 sieve) will be more difficult to compact due to their natural tendency to retain soil moisture and will require drying. It should be anticipated that if the SM soils are not properly dewatered prior to excavation, drying of these soils to obtain the proper moisture content for compaction may take approximately 2 to 3 weeks, if weather permits. Depending on the anticipated time for completing the site work portion of the project and the drying time required to preclude pumping and yielding of these soils during placement and compaction operations, these soils may be considered unsuitable for use as fill material. The soils containing surficial organic material (e.g., pine needles, small root clusters, moss, and topsoils) will require removal and are considered unsuitable for use as structural fill. The organic soils could be used in landscape berms.

Due to the typically high groundwater levels at this site, it should be anticipated the soils will have moisture contents in excess of the modified Proctor optimum moisture content and will require stockpiling or spreading to bring the moisture content within 2 percent of the soil's optimum moisture content corresponding to the required degree of compaction.

6.8 Environmental Classification

One soil corrosion series tests from the Pulaski Road site was performed on composite soil samples obtained at the boring performed within the planned Submersible Booster Pump Station area to determine the environmental classification of the soils. The samples were classified in accordance with FDOT procedures contained in Chapter 1.3.2.1 of the January 2018 edition of the FDOT *Structures Design Guidelines*. Based on the results of these tests, the encountered soils were classified as Extremely Aggressive and Moderately Aggressive. Sample location and test results are included in Appendix C.

7.0 HARTS ROAD DESIGN RECOMMENDATIONS

7.1 General

The following evaluation and recommendations are based on the provided project information as presented in this report, results of the field exploration and laboratory testing performed, and the construction techniques recommended in Section 9.0 below. If the described project conditions are incorrect or changed after this report, or subsurface conditions encountered during construction are different from those reported, MAE should be notified so these recommendations can be re-evaluated and revised, if necessary. We recommend that MAE review the foundation plans and earthwork specifications to verify that the recommendations in this report have been properly interpreted and implemented.

7.2 Electrical Building Foundation Design Recommendations

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structures when constructed on a properly designed shallow foundation system. Provided the site preparation and earthwork construction recommendations outlined in Section 9.0 of this report are performed, the following parameters may be used for foundation design.

7.2.1 Bearing Pressure

The maximum allowable net soil bearing pressure to be applied to the foundations subgrade soils by the turned-down edge footings of the monolithic slab should not exceed 2,500 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the effective overburden pressure at that level. The foundations should be designed based on the maximum load that could be imposed by all loading conditions.

7.2.2 Bearing Depth

The exterior foundations should bear at a depth of at least 12 inches below the exterior final grades, and the interior foundations should bear at a depth of at least 12 inches below the finish floor elevation to provide confinement to the bearing level soils. It is recommended that stormwater be diverted away from the building exterior to reduce the possibility of erosion beneath the exterior footings.

7.2.3 Bearing Material

The foundations may bear in either the compacted suitable natural soils or compacted structural fill. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least one foot below the foundation bearing levels.

7.2.4 Floor Slab

The floor slab for the electrical building can be constructed as a slab-on-ground designed for a modulus of subgrade reaction of 200 pci, provided unsuitable material is removed and replaced with compacted structural fill as outlined in Section 9.0. It is recommended that the floor slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil thick plastic membrane is commonly used for this purpose. Care should be exercised not to tear large sections of the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of 2 feet be maintained between the finished floor levels and the estimated normal seasonal high groundwater level.

7.3 Settlement Estimates

Post-construction settlements of the structure will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) footing size, bearing level, applied loads, and resulting bearing pressures beneath the foundations; and (3) site preparation and earthwork construction techniques used by the contractor. Our settlement estimates for the structure are based on the use of site preparation/earthwork construction techniques as recommended in Section 6.0 of this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the structure.

Due to the sandy nature of the near-surface soils, we expect the majority of settlement to occur in an elastic manner and fairly rapidly during construction. Using the recommended maximum bearing pressure, the supplied/assumed maximum structural loads, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that total settlements of the structure could be on the order of one inch or less.

Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions and the recommended site preparation and earthwork construction techniques outlined in Section 9.0, we estimate differential settlement of the structure to be one-half inch or less.

7.4 Reuse of Onsite Soils

Based on the boring results and classification of the soil samples, the fine sands, fine sands with silt, silty fine sands, and silty fine sands with clay (SP, SP-SM, SM) as encountered at the boring locations, are considered suitable for use as fill soil. However, it should be noted that the SM soils (i.e., soils with more than 10 to 12 percent passing the No. 200 sieve) will be more difficult to compact due to their natural tendency to retain soil moisture and will require drying. It should be anticipated that if the SM soils are not properly dewatered prior to excavation, drying of these soils to obtain the proper moisture content for compaction may take approximately 2 to 3 weeks, if weather permits. Depending on the anticipated time for completing the site work portion of the project and the drying time required to preclude pumping and yielding of these soils during placement and compaction operations, these soils may be considered unsuitable for use as fill material. The clayey soils (SC) and soils containing surficial organic material (topsoil) will require removal and are considered unsuitable for use as structural fill. The organic soils could be used in landscape berms.

8.0 SITE SEISMIC CLASSIFICATION

For all three sites, the 2018 International Building Code (IBC), Section 1613 Earthquake Loads indicates that the Maximum Considered Earthquake Ground Motion Response Acceleration Contours of Spectral Response vary across Florida as follows:

> **0.2-Second Period Spectral Response Acceleration:** (Figure 1613.2.1(1)): Contour 5 (South Florida) to Contour 10 (Northern Florida)
>
> **1-Second Period Spectral Response Acceleration** (Figure 1613.2.1(2)): Contour 2 (South Florida) to Contour 6 (Northern Florida/Southern Georgia)

For these project sites, based on a review of the 2018 IBC, Section 1613, the seismic classifications for the subsurface materials as encountered at the boring locations were estimated as shown below.

Site Classification: For the Pulaski and Harts Road Sites, Site Class D based on the average N-value between 15 and 50. For the Robena Road site, Site Class E due to the soft clay soil encountered between depths of approximately 15 and 35 feet.[1]

1 IBC, 2018: Section 1613.2.2 referring to Chapter 20, ASCE 7 Table 20.3-1 Site Classification

Earthquake Spectral Response Acceleration at Short Periods: S_s = 10%g (as determined in Section 1613.5.1) [2]

Earthquake Spectral Response Acceleration at 1-second Period: S_l = 6%g (as determined in Section 1613.5.1) [3]

9.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

Site preparation as outlined in this section should be performed to provide more uniform foundation bearing conditions, to reduce the potential for post-construction settlements of the planned structures and to maintain the integrity of a flexible pavement section.

9.1 Clearing and Stripping

Prior to construction, the location of existing underground utility lines within the construction area should be established. Provisions should then be made to relocate interfering utilities to appropriate locations. It should be noted that, if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying structures.

The "footprint" of the proposed structures plus a minimum additional margin of 5 feet, and of the hardscape areas (parking/driveway) plus a minimum additional margin of 3 feet, should be stripped of all surface vegetation, stumps, organic topsoil, or other deleterious materials. During grubbing operations, roots with a diameter greater than 0.5-inch, stumps, or small roots in a concentrated state, should be grubbed and completely removed.

Based on the results of our field exploration, it should be anticipated that 6 to 12 inches of topsoil and soils containing significant amounts of organic materials may be encountered across the sites. The actual depths of unsuitable soils and materials should be determined by Meskel & Associates Engineering using visual observation and judgment during earthwork operations. Any topsoils removed from the structure and parking/drive areas can be stockpiled and used subsequently in areas to be grassed.

9.2 Temporary Groundwater Control

Because of the need for densification of the soils within the upper 2 feet below the stripped surface, temporary groundwater control measures may be required if the groundwater level is within 2 feet below the stripped and grubbed surface at the time of construction. Should groundwater control measures become necessary, dewatering methods should be determined by the contractor. We recommend the groundwater control measures, if necessary, remain in place until compaction of the existing soils is completed. The dewatering method should be maintained until backfilling has reached a height of 2 feet above the groundwater level at the time of construction. The site should be graded to direct surface water runoff from the construction area.

Note that discharge of produced groundwater to surface waters of the state from dewatering operations or other site activities is regulated and requires a permit from the State of Florida Department of Environmental Protection (FDEP). This permit is termed a *Generic Permit for the Discharge of Produced*

2 IBC, 2018: Figure 1613.2.1(1) – 0.2 second response acceleration (5% of critical damping)
3 IBC, 2006: Figure 1613.2.1(2) – 1.0 second response acceleration (5% of critical damping)

Groundwater From Any Non-Contaminated Site Activity. If discharge of produced groundwater is anticipated, we recommend sampling and testing of the groundwater early in the site design phase to prevent project delays during construction. MAE can provide the sampling, testing, and professional consulting required to evaluate compliance with the regulations.

9.3 Surface Compaction

The exposed surface areas outside of the excavation should be compacted with a vibratory drum roller having a minimum static, at-drum weight, on the order of 3 tons. Typically, the material should exhibit moisture contents within ±2 percent of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within the upper 2 feet of the compacted natural soils at the sites. Prior to compaction, proof-rolling of these areas with a loaded dump truck is recommended to locate any unforeseen soft areas or unsuitable surface or near-surface soils.

Should the surface soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated. The disturbed soils should be removed and backfilled with dry structural fill soils, which are then compacted, or the excess moisture content within the disturbed soils should be allowed to dissipate before recompacting.

Care should be exercised to avoid damaging any nearby structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified, and the existing conditions of the structures should be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures, and Meskel & Associates Engineering should be contacted immediately. It is recommended that the vibratory roller remain a minimum of 50 feet from existing structures. Within this zone, use of a track-mounted bulldozer or a vibratory roller, operating in the static mode, is recommended.

9.4 Preparation of Pipe Bedding Soils

As discussed earlier in the repot, the fine sand (SP) and fine sand with silt (SP-SM) soils as encountered in the borings are suitable for support of the proposed pipeline. Silty (SM) and clayey (SC) sand soils as encountered in the borings are not considered suitable for pipe bedding. These soils should be removed to a depth of at least 12 inches below the pipe bottom. A filter fabric material should be placed at the excavation bottom to act as a separation layer between the clay soils and the subgrade backfill. The fabric should continue up the sides of the excavation to separate the soil backfill from the adjacent clay soils. The excavated clays at the subgrade level should be replaced with a graded aggregate such as ASTM C33 Gradation 67 stone as specified in the JEA Water/Wastewater Standards. The aggregate should be placed in compacted lifts of 6 inches or less.

9.5 Compaction of Excavation Bottom, Pipe Bedding and Backfilling

Once the clearing and stripping has been completed, excavation for the wet well structure may commence. The excavation should extend at least 3 feet in all directions outside the lateral dimensions of the structure. Once the wet well excavation has achieved the target depth, backfill placement can commence. The temporary dewatering method should remain in-place to facilitate compaction of the bottom soils for the wet well slabs, and to facilitate the backfilling operation. The bottom soils for the wet well slabs should be compacted to 95 percent of their modified Proctor maximum dry density for a depth of 12 inches below subgrade elevation. If clayey soils, as encountered at the Robena Road site, are encountered at the wet well slab subgrade elevation, then we recommend the excavation continue at least an additional 12 inches and be backfilled with a graded aggregate such as ASTM C33 Gradation 67 stone as specified in the JEA Water/Wastewater Standards. The excavation bottom soils should be overlain with a filter fabric to act as a separation layer between the clay soils and the stone backfill. The fabric should continue up the sides of the excavation to separate the soil backfill from the adjacent clay soils. The stone should be placed in 2 lifts of equal thickness, with each lift compacted to form a stable working surface.

Backfill soil placed against the sides of the structure above the subgrade stone should consist of sand soils as defined in Section 9.6 below. The backfill should be placed in maximum 6-inch lifts, with each lift compacted with hand-held equipment as defined in Section 9.6. Backfill placed more than 10 feet away from the structure walls may be placed in lifts up to 12 inches in thickness, with each lift compacted with appropriate compaction equipment to achieve the same level of compaction. Dewatering should remain in place until the level of backfill is at least 2 feet above the groundwater table at the time of construction.

9.6 Structural Backfill and Fill Soils

Any structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of the above described vibratory drum roller. The lift thickness should be reduced to 8 inches if the roller operates in the static mode or if track-mounted compaction equipment is used. If hand-held compaction equipment is used, the lift thickness should be further reduced to 6 inches.

Structural fill is defined as a non-plastic, inorganic, granular soil having less than 10 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sand and slightly silty or clayey fine sand, without roots, as encountered in the borings, are suitable as fill materials and, with proper moisture control, should densify using conventional compaction methods. It should be noted that soils with more than 10 to 12 percent passing the No. 200 sieve will be more difficult to compact, due to their nature to retain soil moisture, and may require drying. Typically, the material should exhibit moisture contents within ±2 percent of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within each lift of the compacted structural fill.

It should be noted that we recommend the clay soils at the Robena Road pump station wet well bearing depth be overlain by a geo-fabric material, and the excavated clays be replaced with a graded aggregate such as ASTM C33 Gradation 67 stone as specified in the JEA Water/Wastewater Standards. The aggregate should be placed in 6-inch lifts, with each lift compacted to form a stable working surface.

Because the clayey soils (SC, CL, CH) have excessive fines contents, and a tendency to retain moisture which makes these soils very difficult to dry and compact, we consider these soils unsuitable for use as structural backfill.

We recommend that material excavated from the wet well pits and pipeline trenches, which will be reused as backfill, be stockpiled a safe distance from the excavations and in such a manner that promotes runoff away from the open trenches and limits saturation of the materials.

9.7 Foundation Areas

The foundation bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of one foot below the bearing level. For confined areas, such as the footing excavations, any additional compaction operations can probably best be performed by the use of a lightweight vibratory sled or roller having a total weight on the order of 500 to 2000 pounds.

9.8 Pavement Areas

After completing the clearing/stripping operations in the pavement areas, any underlying clayey sands as encountered in the borings that are within 2 feet of the bottom of the pavement base should be over-excavated from within the pavement areas. Structural backfill and fill required to achieve the finish pavement grades then can be placed and compacted as described Section 9.3 above. As an exception, densities of at least 98 percent of the modified Proctor maximum dry density (ASTM D1557) should be obtained within the upper one foot of the materials immediately below the proposed base course.

9.9 Excavation Protection

Excavation work for the pump station construction will be required to meet OSHA Excavation Standard Subpart P regulations for Type C Soils. The use of excavation support systems will be necessary where there is not sufficient space to allow the side slopes of the excavation to be laidback to at least 2H:1V (2 horizontal to 1 vertical) to provide a safe and stable working area and to facilitate adequate compaction along the sides of the excavation.

The method of excavation support should be determined by the contractor but can consist of a trench box, drilled-in soldier piles with lagging, interlocking steel sheeting or other methods. The support structure should be designed according to OSHA sheeting and bracing requirements by a Florida registered Professional Engineer.

10.0 QUALITY CONTROL TESTING

A representative number of field in-place density tests should be made in the upper 2 feet of compacted natural soils, in each lift of compacted backfill and fill, and in the upper 12 inches below the bearing levels in the footing excavations. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed as listed below:

- one location for every 5,000 square feet of slab foundation areas
- one test per lift of backfill placed against the wet well walls
- one test per 100 feet of pipe length
- one location for every 10,000 square feet of pavement area

11.0 REPORT LIMITATIONS

This report has been prepared for the exclusive use of CDM, Inc. and the JEA for specific application to the design and construction of the JEA District 2 Pump Station and Flow Rerouting project. An electronically signed and sealed version, and a version of our report that is signed and sealed in blue ink, may be considered an original of the report. Copies of an original should not be relied on unless specifically allowed by MAE in writing. Our work for this project was performed in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made.

The analyses and recommendations contained in this report are based on the data obtained from this project. This testing indicates subsurface conditions only at the specific locations and times, and only to the depths explored. These results do not reflect subsurface variations that may exist away from the boring locations and/or at depths below the boring termination depths. Subsurface conditions and water levels at other locations may differ from conditions occurring at the tested locations. In addition, it should be understood that the passage of time may result in a change in the conditions at the tested locations. If variations in subsurface conditions from those described in this report are observed during construction, the recommendations in this report must be re-evaluated.

The scope of our services did not include any environmental assessment or testing for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the subject site. Any statements made in this report, and/or notations made on the generalized soil profiles or boring logs, regarding odors or other potential environmental concerns are based on observations made during execution of our scope of services and as such are strictly for the information of our client. No opinion of any environmental concern of such observations is made or implied. Unless complete environmental information regarding the site is already available, an environmental assessment is recommended.

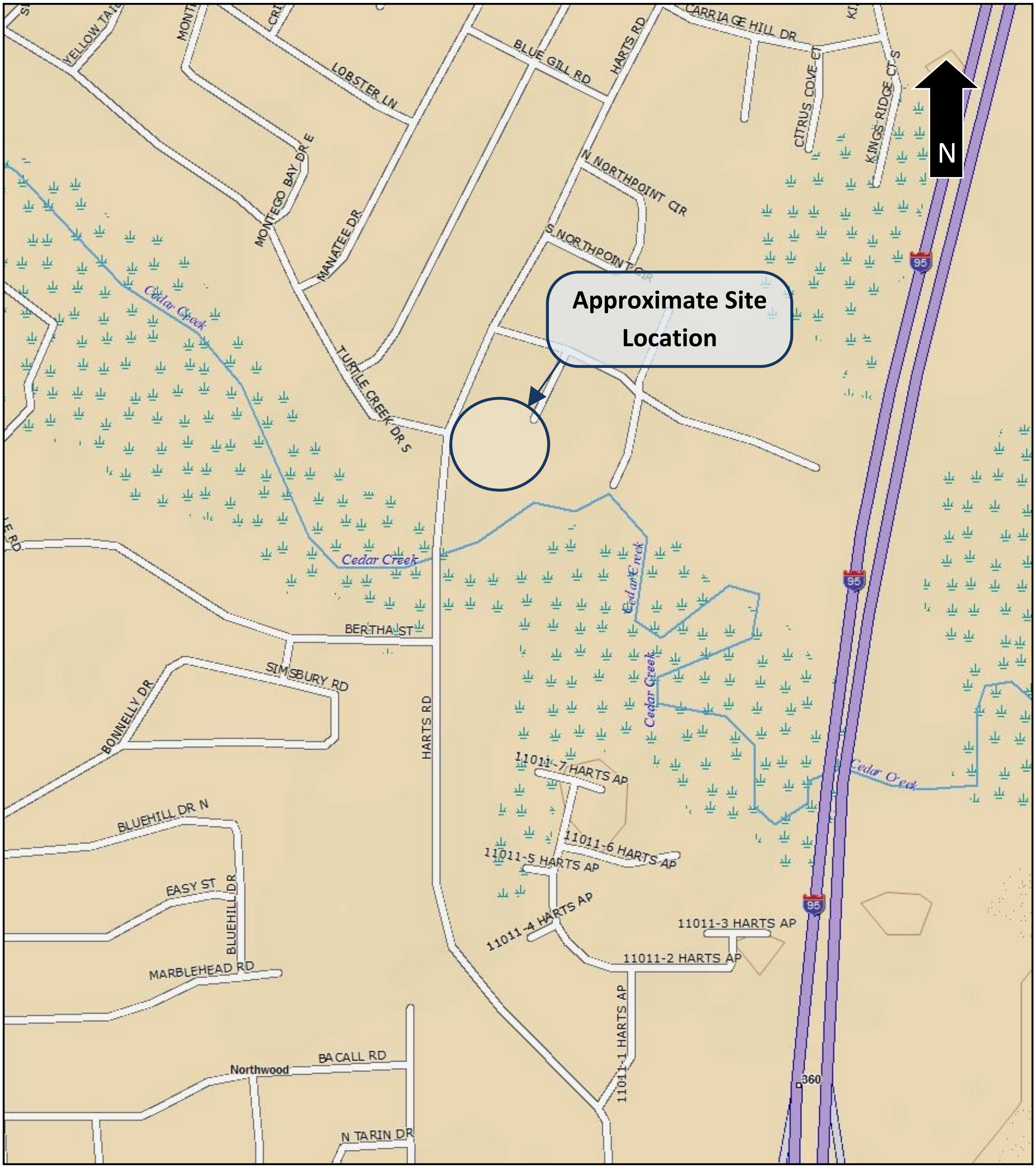
If changes in the design or location of the structures occur, the conclusions and recommendations contained in this report may need to be modified. We recommend that these changes be provided to us for our consideration. MAE is not responsible for conclusions, interpretations, opinions or recommendations made by others based on the data contained in this report.

Figures

Site Location Map

PREPARED BY	PROJECT NAME	
MAE Meskel & Associates Engineering Geotechnical • Environmental • Inspection • Testing	JEA District 2 New Pump Stations-Robena Road Jacksonville, Florida	
	REFEREERENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	FIGURE NO.
CDM Smith, Inc.	0011-0017	1A

Site Location Map			
PREPARED BY	PROJECT NAME		
Meskel & Associates Engineering Geotechnical · Environmental · Inspection · Testing	JEA District 2 New Pump Stations-Pulaski Road Jacksonville, Florida		
	REFEREENCE		SCALE
	Delorme XMap 7.0		NTS
PREPARED FOR	MAE PROJECT NO.		**FIGURE NO.**
CDM Smith, Inc.	0011-0017		1B



Site Location Map

PREPARED BY	PROJECT NAME	
MAE Meskel & Associates Engineering — Geotechnical · Environmental · Inspection · Testing	**JEA District 2 New Pump Stations-Harts Road Site Jacksonville, Florida**	
	REFEREENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	**FIGURE NO.**
CDM Smith, Inc.	0011-0017	1C

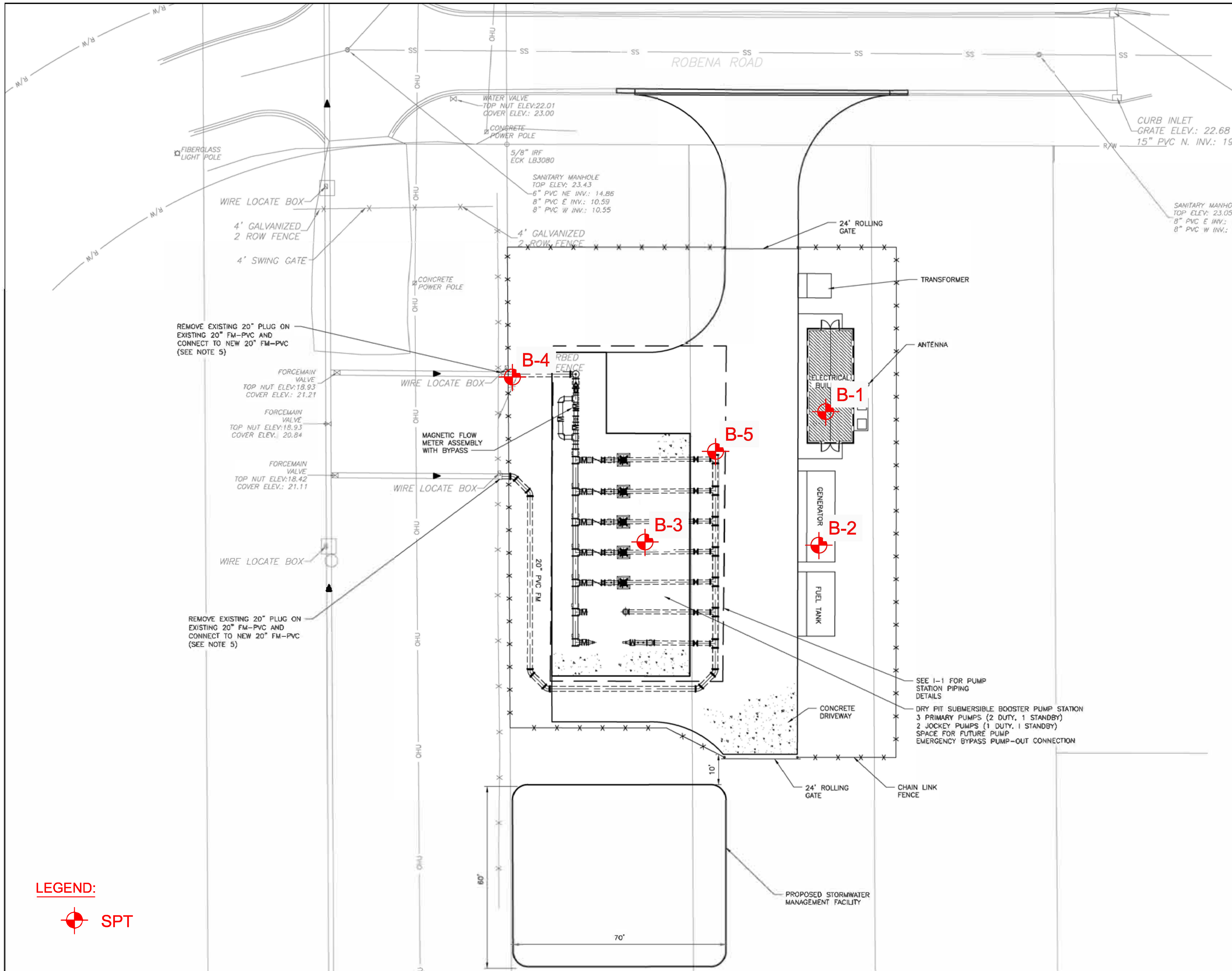


TABLE OF GEOTECHNICAL BORINGS, DOUBLE RING INFILTROMETER TESTS (DRI), AND GROUNDWATER TESTING

	NORTHING	EASTING	DEPTH, FT
B-1	2223949.83	432550.86	35
B-2	2223905.93	432548.55	35
B-3	2223907.03	432491.33	35
B-4	2223961.25	432447.61	15
B-5	2223936.82	432514.48	25
DRI-1	2223797.67	32481.51	N/A
STD-1	2223920.08	432491.23	N/A
STD-2	2223821.56	432492.67	N/A

NOTES:

1. ALL ABOVE GRADE PIPING SHALL BE FLANGED 316-SST.
2. ALL BELOW GRADE PIPING SHALL BE PVC WITH DUCTILE IRON FITTINGS.
3. ALL BELOW GRADE PIPING JOINTS, VALVES, AND FITTINGS SHALL BE RESTRAINED.
4. ALL BELOW GRADE VALVES SHALL BE INSTALLED WITH VALVE BOXES.
5. REFER TO SPECIFICATION 01014 FOR CONSTRUCTION SEQUENCE REQUIREMENTS.
6. COORDINATE FINAL ANTENNA LOCATION WITH ENGINEER AND OWNER.

NOTE: Robena Road Pump Station Yard Piping Plan dated August 2017 was provided by CDM Smith, Inc.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

MAE Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing

FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

CLIENT: CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/12/2018	0011-0017

SHEET TITLE: BORING LOCATION PLAN

PROJECT NAME: JEA District 2 New Pump Stations-Robena Road
Jacksonville, Florida

FIGURE NO. 2A

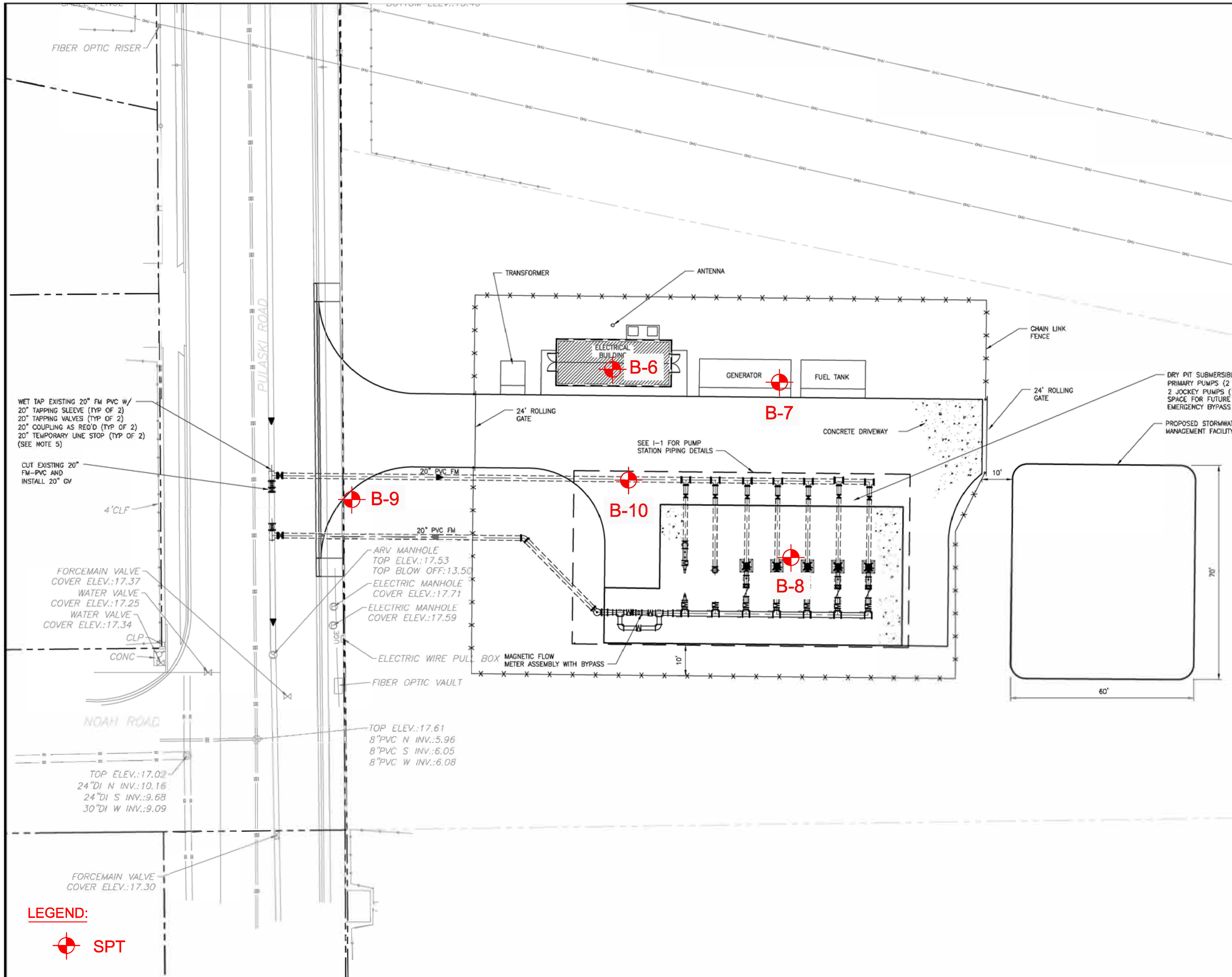


TABLE OF GEOTECHNICAL BORINGS, DOUBLE RING INFILTROMETER TESTS (DRI), AND GROUNDWATER TESTING

	NORTHING	EASTING	DEPTH, FT
B-6	2225872.95	463080.80	35
B-7	2225869.01	463134.08	35
B-8	2225809.74	463138.85	35
B-9	2225830.52	462994.49	15
B-10	2225836.16	463084.97	25
DRI-2	2225798.63	463245.23	N/A
STD-3	2225817.43	463119.02	N/A
STD-4	2225796.83	463216.18	N/A

NOTES:

1. ALL ABOVE GRADE PIPING SHALL BE FLANGED 316-SST.
2. ALL BELOW GRADE PIPING SHALL BE PVC WITH DUCTILE IRON FITTINGS.
3. ALL BELOW GRADE PIPING JOINTS, VALVES, AND FITTINGS SHALL BE RESTRAINED.
4. ALL BELOW GRADE VALVES SHALL BE INSTALLED WITH VALVE BOXES.
5. REFER TO SPECIFICATION 01014 FOR CONSTRUCTION SEQUENCE REQUIREMENTS.
6. COORDINATE FINAL ANTENNA LOCATION WITH ENGINEER AND OWNER.

NOTE: Pulaski Road Pump Station Yard Piping Plan dated August 2017 was provided by CDM Smith, Inc.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing

FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

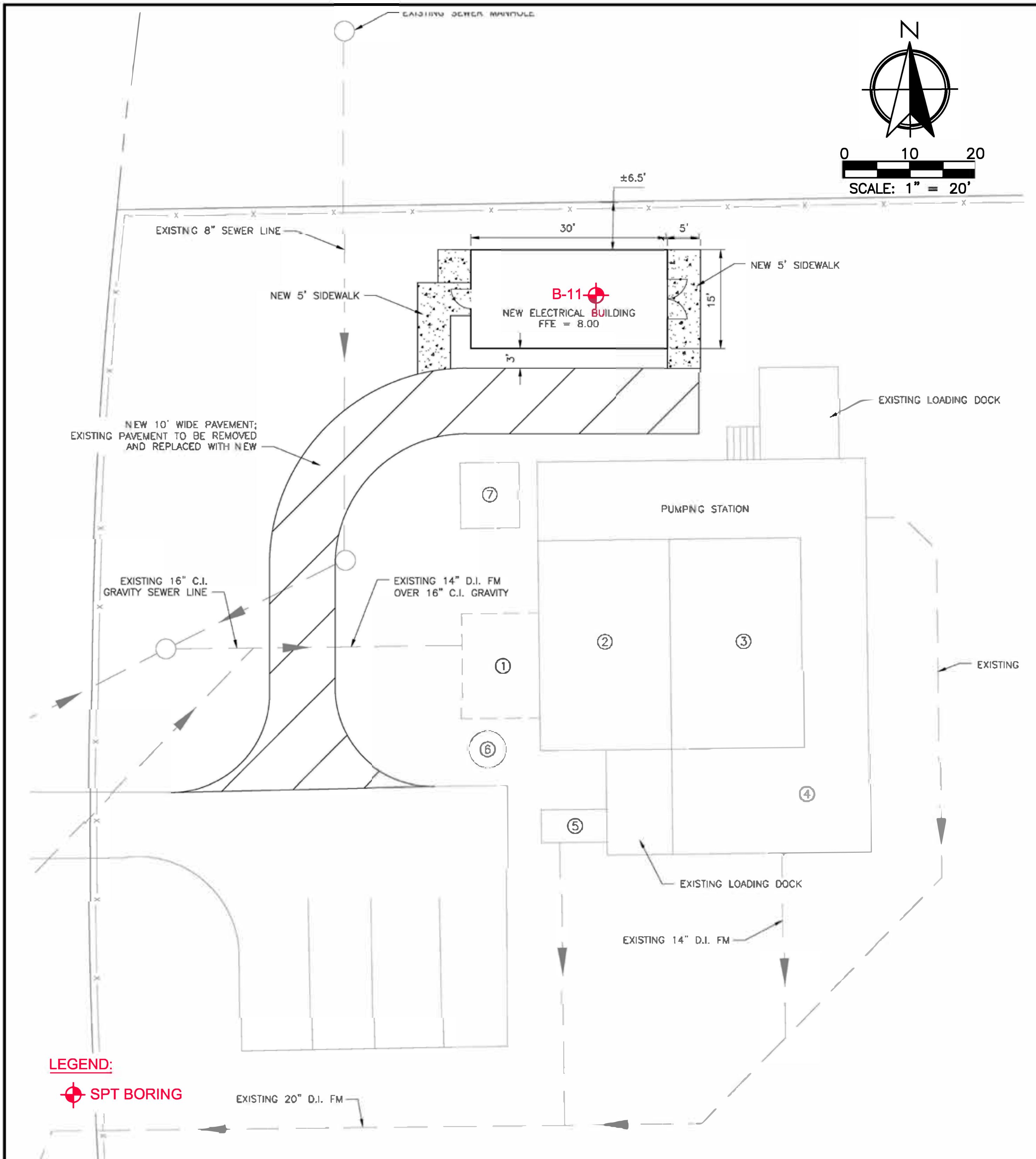
CLIENT: CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/12/2018	0011-0017

SHEET TITLE: BORING LOCATION PLAN

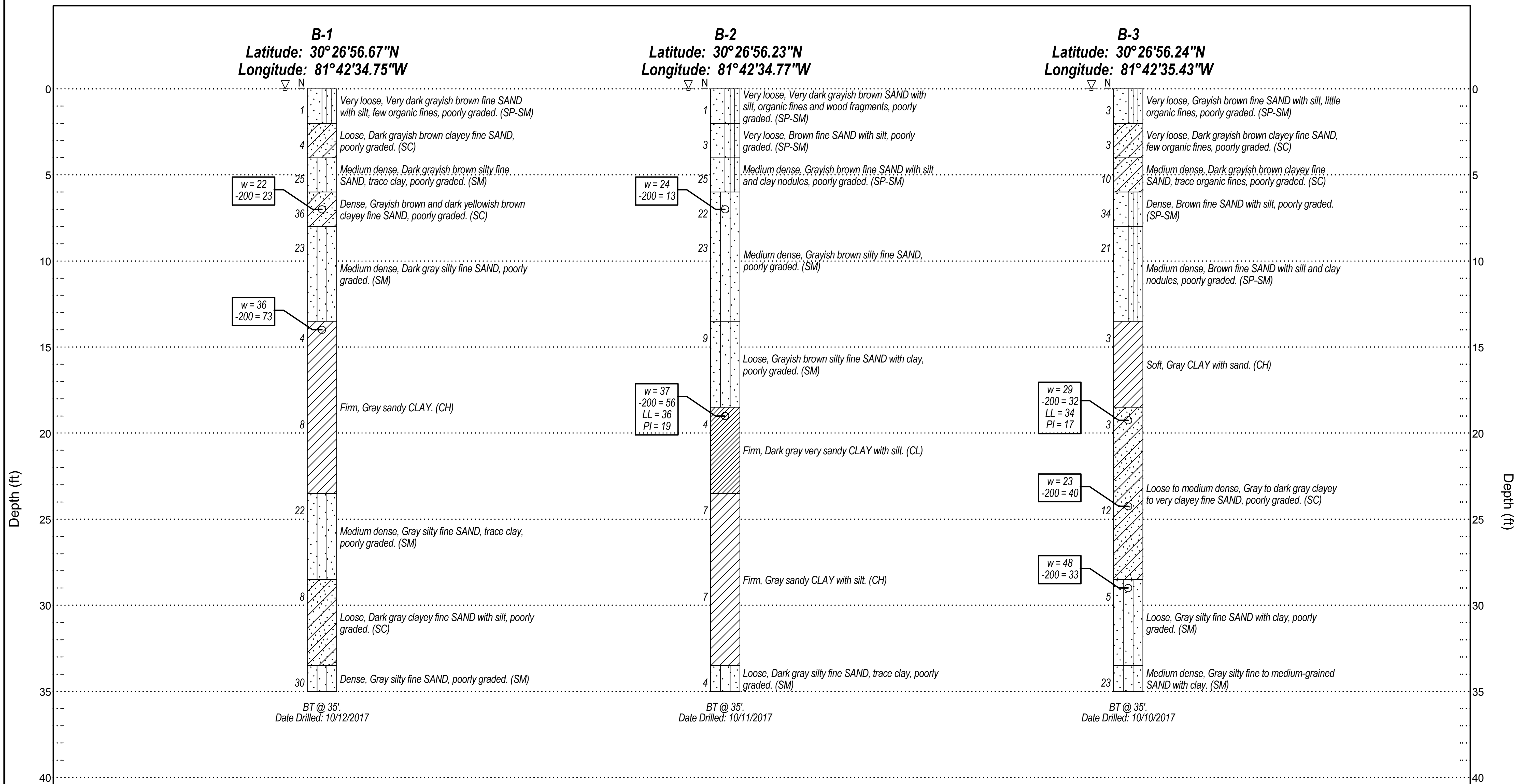
PROJECT NAME: JEA District 2 New Pump Stations-Pulaski Road
Jacksonville, Florida

FIGURE NO. 2B



Boring Location Plan

PREPARED BY	PROJECT NAME	
MAE Meskel & Associates Engineering Geotechnical • Environmental • Inspection • Testing FL Certificate of Authorization No. 28142 8936 Western Way, Suite 12, Jacksonville, FL 32256	JEA District 2 New Pump Stations-Harts Road Site Jacksonville, Florida	
	REFERENCE	SCALE
	SITE LAYOUT	NTS
PREPARED FOR	MAE PROJECT NO.	FIGURE NO.
CDM Smith, Inc.	0011-0017	2C



Legend

Fine Sand with Silt
Clay
Clayey Fine Sand
Silt
Silty Fine Sand
Very Sandy Clay

N Standard Penetration Resistance, Blows/Foot
BT Boring Terminated at Depth Below Existing Grade
(SP) Unified Soil Classification System (USCS)
∇ Depth to Groundwater at Time of Drilling
w Natural Moisture Content (%)
-200 % Passing No. 200 U.S. Standard Sieve
LL Liquid Limit
PI Plasticity Index

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

MAE
Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

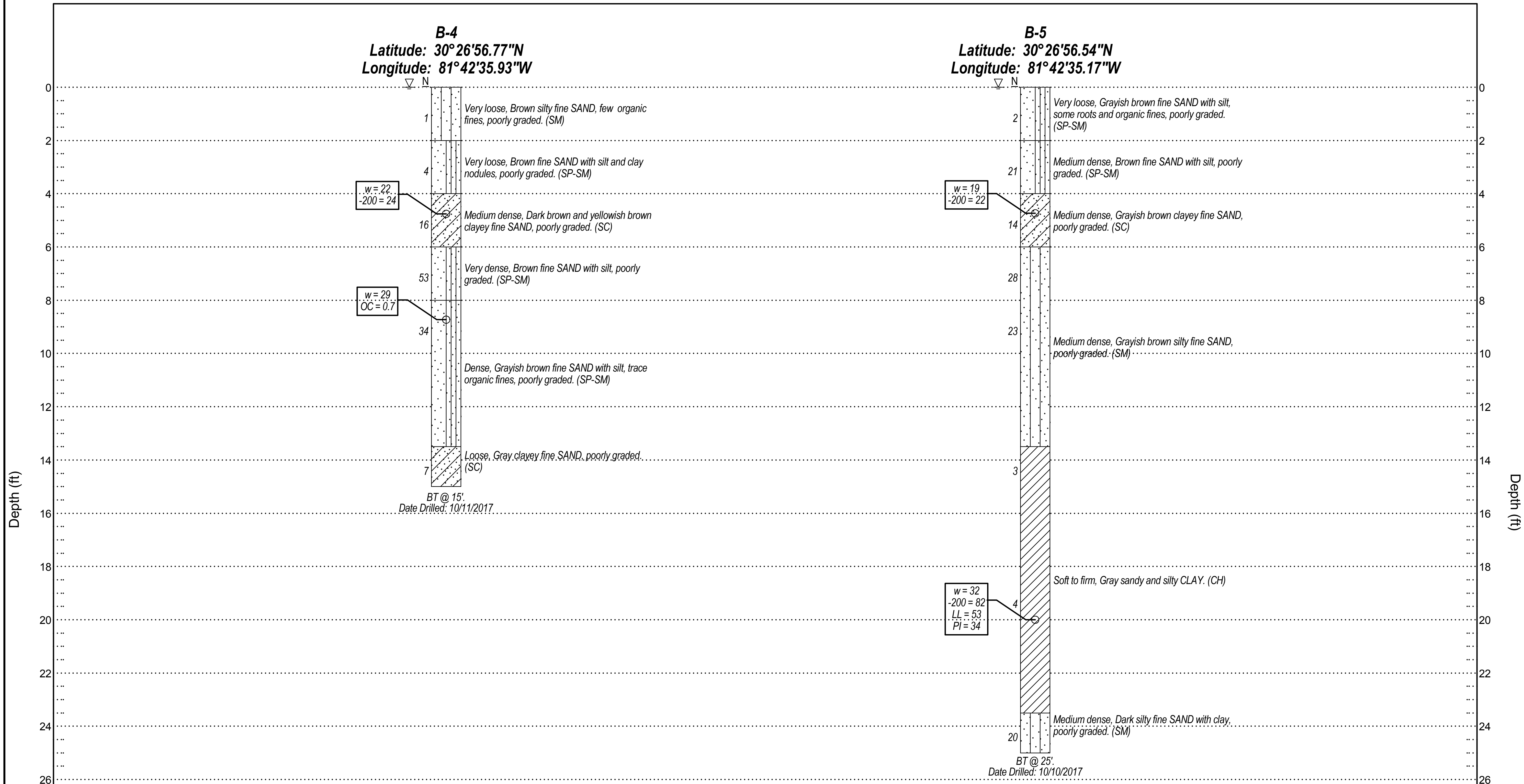
CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/20/2018	0011-0017

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA District 2 New Pump Stations-Robena Road
Jacksonville, Florida

FIGURE NO. 3



Legend

Silty Fine Sand	Fine Sand with Silt	Clayey Fine Sand	Clay

N	Standard Penetration Resistance, Blows/Foot	(SP)	Unified Soil Classification System (USCS)	w	Natural Moisture Content (%)	OC	Organic Content (%)
BT	Boring Terminated at Depth Below Existing Grade	∇	Depth to Groundwater at Time of Drilling	-200	% Passing No. 200 U.S. Standard Sieve	LL	Liquid Limit
						PI	Plasticity Index

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

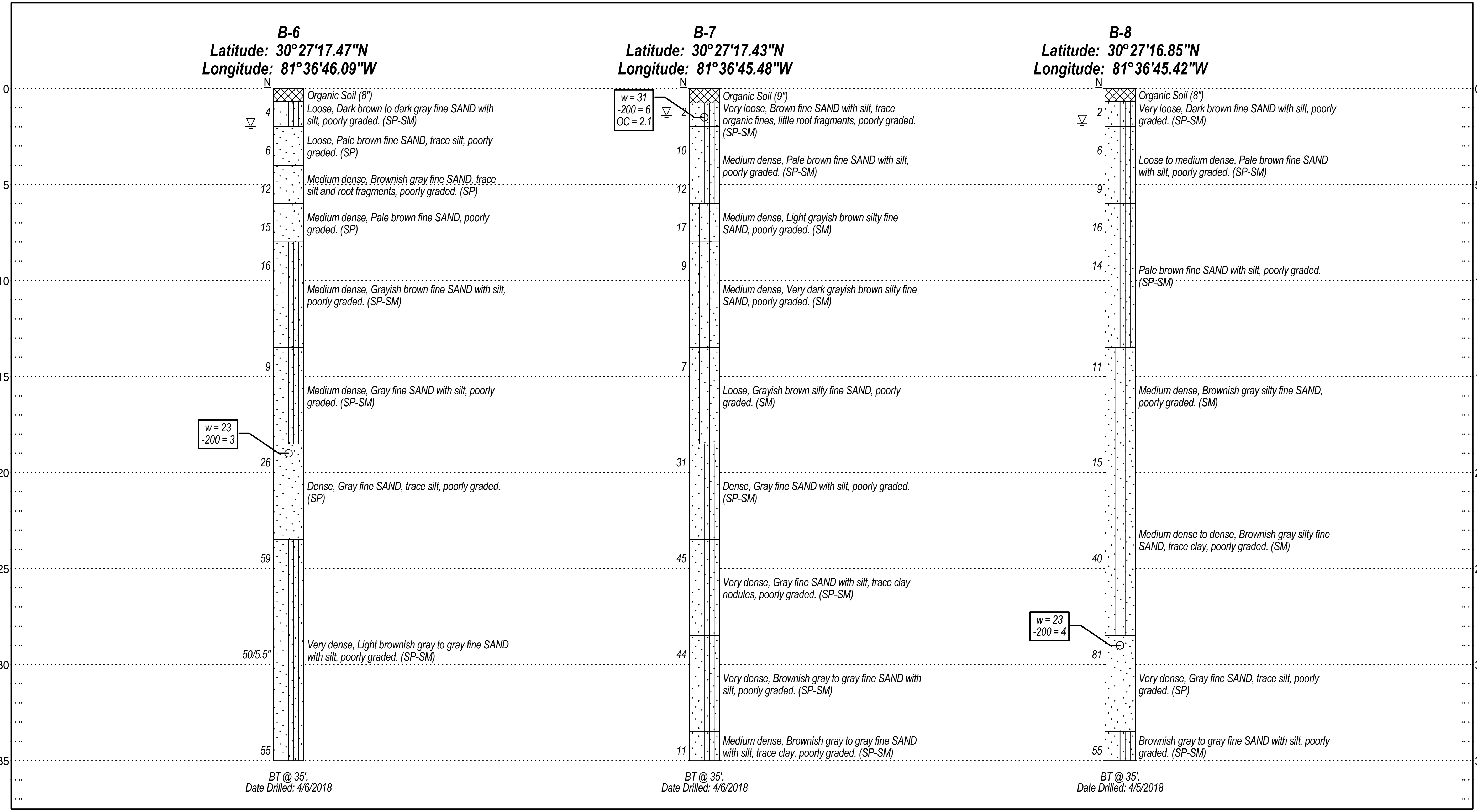
CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/20/2018	0011-0017

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA District 2 New Pump Stations-Robena Road
Jacksonville, Florida

FIGURE NO. 4



Legend

Organic Sand or Silt

Silty Fine Sand

Fine Sand with Silt

Fine Sand

N	Standard Penetration Resistance, Blows/Foot	(SP)	Unified Soil Classification System (USCS)	w	Natural Moisture Content (%)	50/5.5"	Indicates 50 Hammer blows drove split spoon sampler 5.5 inches.
BT	Boring Terminated at Depth Below Existing Grade	∇	Depth to Groundwater at Time of Drilling	-200	% Passing No. 200 U.S. Standard Sieve	OC	Organic Content (%)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

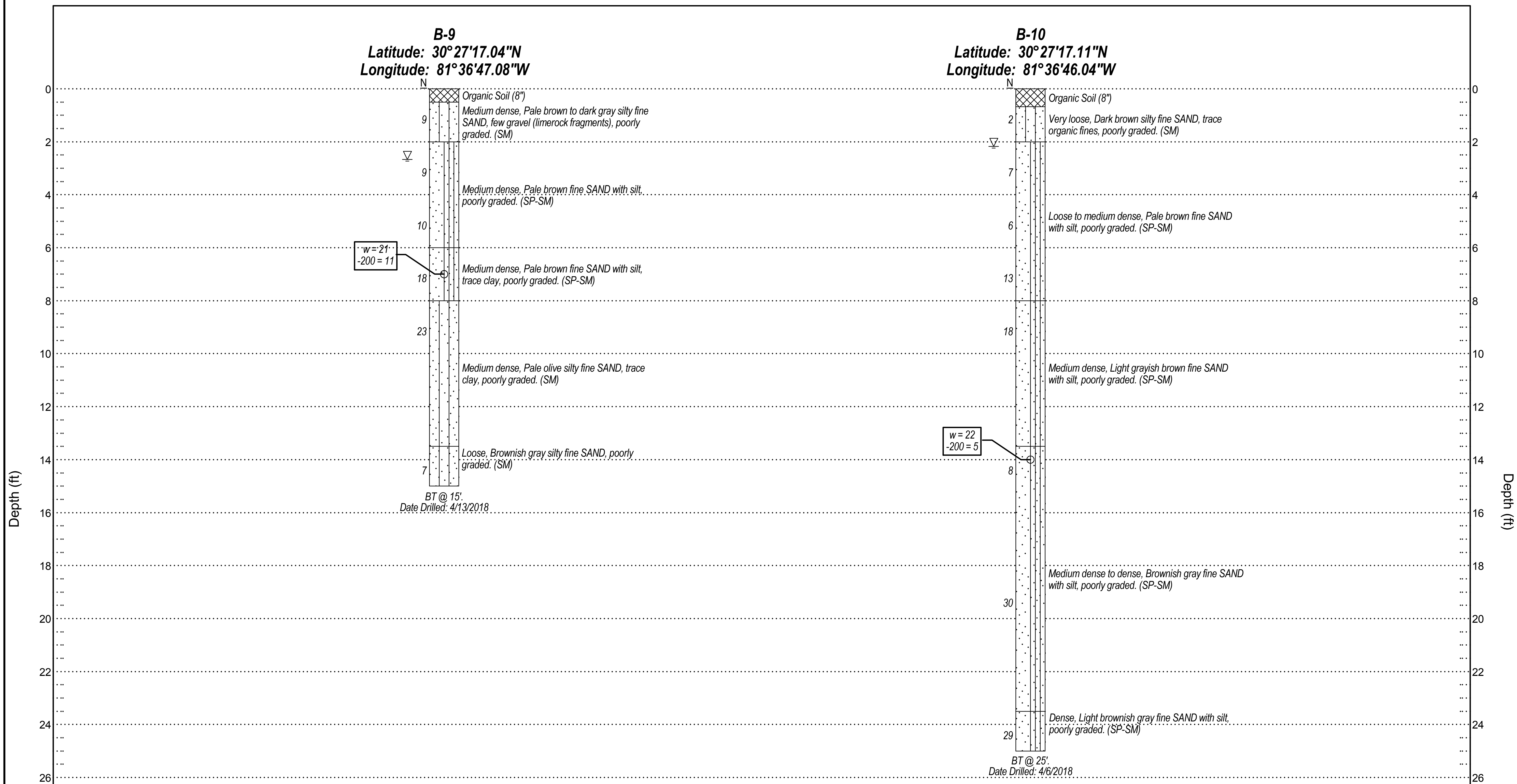
CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/12/2018	0011-0017

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA District 2 New Pump Stations-Pulaski Road
Jacksonville, Florida

FIGURE NO. 5



Legend

Organic Sand or Silt	
Silty Fine Sand	
Fine Sand with Silt	
N	Standard Penetration Resistance, Blows/Foot
BT	Boring Terminated at Depth Below Existing Grade
(SP)	Unified Soil Classification System (USCS)
∇	Depth to Groundwater at Time of Drilling
w	Natural Moisture Content (%)
-200	% Passing No. 200 U.S. Standard Sieve

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12, Jacksonville, FL 32256

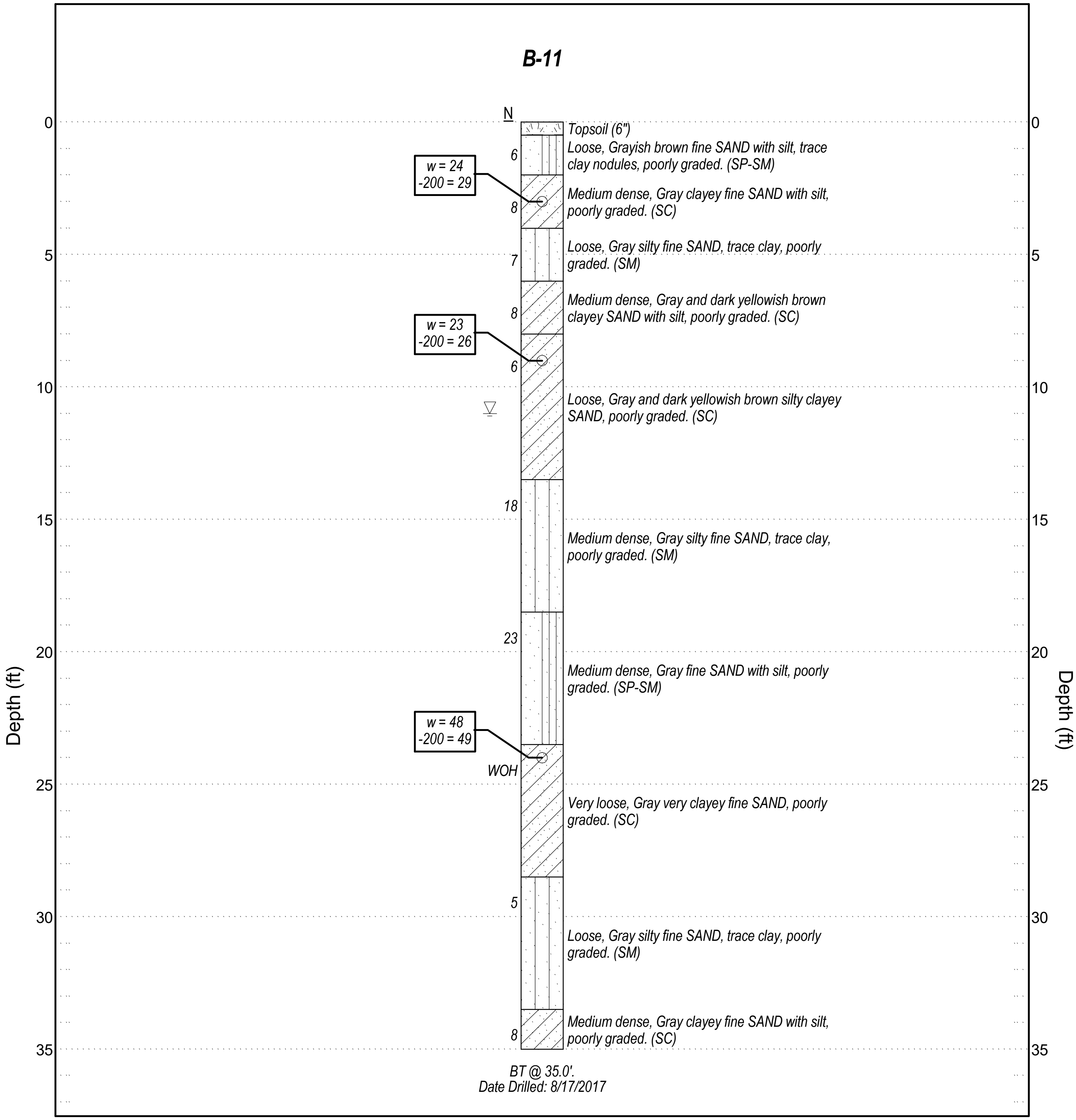
CDM Smith, Inc.

DATE:	MAE PROJECT NO.
6/12/2018	0011-0017

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA District 2 New Pump Stations-Pulaski Road
Jacksonville, Florida

FIGURE NO. 6



Legend

- Topsoil
- Clayey Fine Sand
- Fine Sand with Silt
- Silty Fine Sand
- N — Standard Penetration Resistance, Blows/Foot
- (SP) — Unified Soil Classification System
- BT — Boring Terminated at Depth Below Grade
- ∇ — Depth to Groundwater at Time of Drilling
- w — Natural Moisture Content (%)
- -200 — % Passing No. 200 U.S. Standard Sieve
- WOH — Sampler advanced by weight of hammer only.

P. RODNEY MANK, P.E. P.E. NO.: 41986 MAE Meskel & Associates Engineering Geotechnical • Environmental • Inspection • Testing FL Certificate of Authorization No. 28142 8936 Western Way, Suite 12 | Jacksonville, FL 32256	CDM Smith, Inc. DATE: 6/12/2018 MAE PROJECT NO.: 0011-0017	SHEET TITLE: Generalized Soil Profile PROJECT NAME: JEA District 2 New Pump Stations-Harts Road Site, Jacksonville, Florida FIGURE NO. 7

Appendix A

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-1

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DATE STARTED 10/12/17 **COMPLETED** 10/12/17 **LATITUDE** 30°26'56.67"N **LONGITUDE** 81°42'34.75"W

DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Safety

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0	1	Very loose, Very dark grayish brown fine SAND with silt, few organic fines, poorly graded.	SP-SM		1/12" ↓ 1 1	1								
	2	Loose, Dark grayish brown clayey fine SAND, poorly graded.	SC		4 3 1 1	4								
5	3	Medium dense, Dark grayish brown silty fine SAND, trace clay, poorly graded.	SM		6 9 16 21	25								
	4	Dense, Grayish brown and dark yellowish brown clayey fine SAND, poorly graded.	SC		11 18 18 21	36	22	23						
10	5	Medium dense, Dark gray silty fine SAND, poorly graded.	SM		9 11 12 13	23								
15	6	Firm, Gray sandy CLAY.	CH		1 2 2	4	36	73						
20	7				2 2 6	8								

NOTES 1/12" Indicates 1 hammer blow drove split spoon sampler 12 inches.

GROUND WATER LEVELS

AT TIME OF DRILLING 8" Above Surface — END OF DAY ---

(Continued Next Page)

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-1

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Firm, Gray sandy CLAY. *(continued)*	CH											
25	8	Medium dense, Gray silty fine SAND, trace clay, poorly graded.	SM		8 10 12	22								
30	9	Loose, Dark gray clayey fine SAND with silt, poorly graded.	SC		7 4 4	8								
35	10	Dense, Gray silty fine SAND, poorly graded.	SM		9 15 15	30								

Bottom of borehole at 35 feet.

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 8" Above Surface

END OF DAY ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-2

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 10/11/17 **COMPLETED** 10/11/17 **LATITUDE** 30°26'56.23"N **LONGITUDE** 81°42'34.77"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Safety

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0	1	Very loose, Very dark grayish brown SAND with silt, organic fines and wood fragments, poorly graded.	SP-SM		1/12" ↓ 1 1	1								
	2	Very loose, Brown fine SAND with silt, poorly graded.	SP-SM		3 2 1 1	3								
5	3	Medium dense, Grayish brown fine SAND with silt and clay nodules, poorly graded.	SP-SM		6 9 16 21	25								
	4	Medium dense, Grayish brown silty fine SAND, poorly graded.	SM		6 9 13 16	22	24	13						
10	5				8 11 12 13	23								
15	6	Loose, Grayish brown silty fine SAND with clay, poorly graded.	SM		10 5 4	9								
20	7	Firm, Dark gray very sandy CLAY with silt.	CL		2 2 2	4	37	56		36	19			

NOTES 1/12" Indicates 1 hammer blow drove split spoon sampler 12 inches.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 4" Above Surface *∇ **END OF DAY** ---

(Continued Next Page)

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-2

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Firm, Dark gray very sandy CLAY with silt. *(continued)*	CL											
25	8	Firm, Gray sandy CLAY with silt.	CH		5 3 4	7								
30	9				4 3 4	7								
35	10	Loose, Dark gray silty fine SAND, trace clay, poorly graded.	SM		2 2 2	4								
		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 4" Above Surface

END OF DAY ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-5

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 10/10/17 **COMPLETED** 10/10/17 **LATITUDE** 30°26'56.54"N **LONGITUDE** 81°42'35.17"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Safety

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0	1	Very loose, Grayish brown fine SAND with silt, some roots and organic fines, poorly graded.	SP-SM	1-1-1-2	2								
	2	Medium dense, Brown fine SAND with silt, poorly graded.	SP-SM	8-10-11-6	21								
5	3	Medium dense, Grayish brown clayey fine SAND, poorly graded.	SC	2-5-9-16	14	19	22						
	4	Medium dense, Grayish brown silty fine SAND, poorly graded.	SM	8-14-14-16	28								
10	5			9-9-14-18	23								
15	6	Soft to firm, Gray sandy and silty CLAY.	CH	1-2-1	3								
20	7			1-2-2	4	32	82		53	34			
25	8	Medium dense, Dark silty fine SAND with clay, poorly graded.	SM	29-9-11	20								

Bottom of borehole at 25 feet.

NOTES

GROUND WATER LEVELS
AT TIME OF DRILLING 12" Above Surface* END OF DAY ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-3

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
25	8	Loose to medium dense, Gray to dark gray clayey to very clayey fine SAND, poorly graded.	SC		4 4 8	12	23	40						
30	9				3 2 3	5	48	33						
		Loose, Gray silty fine SAND with clay, poorly graded.	SM											
35	10	Medium dense, Gray silty fine to medium-grained SAND with clay.	SM		4 11 12	23								

Bottom of borehole at 35 feet.

NOTES

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 10" Above Surface * ∇ **END OF DAY** ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-4

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 10/11/17 **COMPLETED** 10/11/17 **LATITUDE** 30°26'56.77"N **LONGITUDE** 81°42'35.93"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Safety

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0	1	Very loose, Brown silty fine SAND, few organic fines, poorly graded.	SM		WOH ↓ 1 2	1								
	2	Very loose, Brown fine SAND with silt and clay nodules, poorly graded.	SP-SM		1 2 2 3	4								
5	3	Medium dense, Dark brown and yellowish brown clayey fine SAND, poorly graded.	SC		6 8 8 19	16	22	24						
	4	Very dense, Brown fine SAND with silt, poorly graded.	SP-SM		20 30 23 14	53								
10	5	Dense, Grayish brown fine SAND with silt, trace organic fines, poorly graded.	SP-SM		12 15 19 21	34	29		0.7					
15	6	Loose, Gray clayey fine SAND, poorly graded.	SC		5 3 4	7								

Bottom of borehole at 15 feet.

NOTES WOH-Sampler advanced by weight of hammer only.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 8" Above Surface *∇ **END OF DAY** ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-5

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DATE STARTED 10/10/17 **COMPLETED** 10/10/17 **LATITUDE** 30°26'56.54"N **LONGITUDE** 81°42'35.17"W

DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Safety

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0	1	Very loose, Grayish brown fine SAND with silt, some roots and organic fines, poorly graded.	SP-SM		1 1 1 2	2								
	2	Medium dense, Brown fine SAND with silt, poorly graded.	SP-SM		8 10 11 6	21								
5	3	Medium dense, Grayish brown clayey fine SAND, poorly graded.	SC		2 5 9 16	14	19	22						
	4	Medium dense, Grayish brown silty fine SAND, poorly graded.	SM		8 14 14 16	28								
10	5				9 9 14 18	23								
15	6	Soft to firm, Gray sandy and silty CLAY.	CH		1 2 1	3								
20	7				1 2 2	4	32	82		53	34			
25	8	Medium dense, Dark silty fine SAND with clay, poorly graded.	SM		29 9 11	20								

Bottom of borehole at 25 feet.

NOTES

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 12" Above Surface * ∇ **END OF DAY** ---

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-6

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 4/6/18 **COMPLETED** 4/6/18 **LATITUDE** 30°27'17.47"N **LONGITUDE** 81°36'46.09"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Organic Soil (8")												
	1	Loose, Dark brown to dark gray fine SAND with silt, poorly graded.	SP-SM		1 2 2 2	4								
	2	Loose, Pale brown fine SAND, trace silt, poorly graded.	SP		2 2 4 4	6								
5	3	Medium dense, Brownish gray fine SAND, trace silt and root fragments, poorly graded.	SP		3 5 7 9	12								
	4	Medium dense, Pale brown fine SAND, poorly graded.	SP		3 6 9 13	15								
10	5	Medium dense, Grayish brown fine SAND with silt, poorly graded.	SP-SM		5 8 8 10	16								
15	6	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		1 4 5	9								
20	7	Dense, Gray fine SAND, trace silt, poorly graded.	SP		8 10 16	26	23	3						

NOTES

GROUND WATER LEVELS
AT TIME OF DRILLING 2 ft 0 in
*END OF DAY ---

(Continued Next Page)

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-6

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Dense, Gray fine SAND, trace silt, poorly graded. *(continued)*	SP											
25	8	Very dense, Light brownish gray to gray fine SAND with silt, poorly graded.	SP-SM		11 23 36	59								
30	9				20 50/5.5"	50/5.5"								
35	10				14 23 32	55								
		Bottom of borehole at 35 feet.												

NOTES 50/5.5" Indicates 50 hammer blows drove split spoon sampler 5.5 inches.

GROUND WATER LEVELS

AT TIME OF DRILLING 2 ft 0 in

*END OF DAY ---

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing

BORING B-7

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 4/6/18 **COMPLETED** 4/6/18 **LATITUDE** 30°27'17.43"N **LONGITUDE** 81°36'45.48"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Organic Soil (9")			1/12"									
	1	∇ Very loose, Brown fine SAND with silt, trace organic fines, little root fragments, poorly graded.	SP-SM		2 3	2	31	6	2.1					
	2	Medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		3 4 6 7	10								
5	3				3 5 7 4	12								
	4	Medium dense, Light grayish brown silty fine SAND, poorly graded.	SM		4 6 11 15	17								
10	5	Medium dense, Very dark grayish brown silty fine SAND, poorly graded.	SM		4 5 4 8	9								
15	6	Loose, Grayish brown silty fine SAND, poorly graded.	SM		7 2 5	7								
20	7	Dense, Gray fine SAND with silt, poorly graded.	SP-SM		6 13 18	31								

NOTES 1/12" Indicates 1 hammer blow drove split spoon sampler 12 inches.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 1 ft 5 in
*∇ **END OF DAY** ---

(Continued Next Page)

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-7

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Dense, Gray fine SAND with silt, poorly graded. *(continued)*	SP-SM											
25	8				7 19 26	45								
		Very dense, Gray fine SAND with silt, trace clay nodules, poorly graded.	SP-SM											
30	9				14 19 25	44								
		Very dense, Brownish gray to gray fine SAND with silt, poorly graded.	SP-SM											
35	10	Medium dense, Brownish gray to gray fine SAND with silt, trace clay, poorly graded.	SP-SM		2 3 8	11								
		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 1 ft 5 in *∇ **END OF DAY** ---

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical • Environmental • Inspection • Testing

BORING B-8

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 4/5/18 **COMPLETED** 4/5/18 **LATITUDE** 30°27'16.85"N **LONGITUDE** 81°36'45.42"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Organic Soil (8")												
	1	Very loose, Dark brown fine SAND with silt, poorly graded.	SP-SM		1/12" 2 3	2								
	2	Loose to medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		1 2 4 6	6								
5	3				2 4 5 7	9								
	4	Pale brown fine SAND with silt, poorly graded.	SP-SM		3 6 10 10	16								
10	5				5 6 8 10	14								
15	6	Medium dense, Brownish gray silty fine SAND, poorly graded.	SM		2 5 6	11								
20	7	Medium dense to dense, Brownish gray silty fine SAND, trace clay, poorly graded.	SM		7 4 11	15								

NOTES 1/12" Indicates 1 hammer blow drove split spoon sampler 12 inches.

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 1 ft 10 in *∇ **END OF DAY** ---

(Continued Next Page)

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-8

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
25	8	Medium dense to dense, Brownish gray silty fine SAND, trace clay, poorly graded. *(continued)*	SM		8 12 28	40								
30	9	Very dense, Gray fine SAND, trace silt, poorly graded.	SP		18 31 50	81	23	4						
35	10	Brownish gray to gray fine SAND with silt, poorly graded.	SP-SM		14 26 29	55								
		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 1 ft 10 in   * END OF DAY ---

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

BORING B-9

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DATE STARTED 4/13/18 **COMPLETED** 4/13/18 **LATITUDE** 30°27'17.04"N **LONGITUDE** 81°36'47.08"W

DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Organic Soil (8")												
	1	Medium dense, Pale brown to dark gray silty fine SAND, few gravel (limerock fragments), poorly graded.	SM		2-4-5-2	9								
	2	∇ Medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		3-4-5-7	9								
5	3				4-5-5-10	10								
	4	Medium dense, Pale brown fine SAND with silt, trace clay, poorly graded.	SP-SM		8-7-11-12	18	21	11						
10	5	Medium dense, Pale olive silty fine SAND, trace clay, poorly graded.	SM		8-10-13-12	23								
15	6	Loose, Brownish gray silty fine SAND, poorly graded.	SM		2-2-5	7								

Bottom of borehole at 15 feet.

NOTES

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 2 ft 8 in *∇ **END OF DAY** ---

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-10

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 4/6/18 **COMPLETED** 4/6/18 **LATITUDE** 30°27'17.11"N **LONGITUDE** 81°36'46.04"W
DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Organic Soil (8")												
	1	Very loose, Dark brown silty fine SAND, trace organic fines, poorly graded.	SM		1/12" 2 3	2								
	2	Loose to medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		1 2 5 7	7								
5	3				2 3 3 6	6								
	4				3 5 8 10	13								
	5	Medium dense, Light grayish brown fine SAND with silt, poorly graded.	SP-SM		6 9 9 9	18								
10														
	6	Medium dense to dense, Brownish gray fine SAND with silt, poorly graded.	SP-SM		1 3 5	8	22	5						
15														
	7				8 14 16	30								
20														

NOTES 1/12" Indicates 1 hammer blow drove split spoon sampler 12 inches.

GROUND WATER LEVELS
▽ **AT TIME OF DRILLING** 2 ft 2 in *▽ **END OF DAY** ---

(Continued Next Page)

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-10

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Medium dense to dense, Brownish gray fine SAND with silt, poorly graded. *(continued)*	SP-SM											
25	8	Dense, Light brownish gray fine SAND with silt, poorly graded.	SP-SM		17 13 16	29								

Bottom of borehole at 25 feet.

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 2 ft 2 in *END OF DAY ---

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-11

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Harts Road Site

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DATE STARTED 8/17/17 **COMPLETED** 8/17/17 **BORING LOCATION** See Boring Location Plan

DRILLING CONTRACTOR MAE, LLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY C.Morgan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (6")												
	1	Loose, Grayish brown fine SAND with silt, trace clay nodules, poorly graded.	SP-SM		1 3 3 5	6								
	2	Medium dense, Gray clayey fine SAND with silt, poorly graded.	SC		4 5 3 1	8	24	29						
5	3	Loose, Gray silty fine SAND, trace clay, poorly graded.	SM		3 3 4 5	7								
	4	Medium dense, Gray and dark yellowish brown clayey SAND with silt, poorly graded.	SC		4 3 5 6	8								
10	5	Loose, Gray and dark yellowish brown silty clayey SAND, poorly graded. ▽	SC		2 3 3 4	6	23	26						
15	6	Medium dense, Gray silty fine SAND, trace clay, poorly graded.	SM		5 8 10	18								
20	7	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		8 11 12	23								

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 11 ft 0 in

*▽ **END OF DAY** ---

(Continued Next Page)

Meskel & Associates Engineering, LLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

BORING B-11

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Harts Road Site

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM											
25	8	Very loose, Gray very clayey fine SAND, poorly graded.	SC		WOH ↓	WOH	48	49						
30	9	Loose, Gray silty fine SAND, trace clay, poorly graded.	SM		2 2 3	5								
35	10	Medium dense, Gray clayey fine SAND with silt, poorly graded.	SC		7 5 3	8								
		Bottom of borehole at 35 feet.												

NOTES WOH-Sampler advanced by weight of hammer only.

GROUND WATER LEVELS

AT TIME OF DRILLING 11 ft 0 in

END OF DAY ---

FIELD EXPLORATION PROCEDURES

Standard Penetration Test (SPT) Borings

The Standard Penetration Test (SPT) boring(s) were performed in general accordance with the latest revision of ASTM D 1586, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils." The borings were advanced by rotary drilling techniques. A split-barrel sampler was inserted to the borehole bottom and driven 18 to 24 inches into the soil using a 140-pound hammer falling an average of 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration (18" sample) or for the sum of the middle 12 inches of penetration (24" sample) is termed the "penetration resistance, blow count, or N-value." This value is an index to several in-situ geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler, it was retrieved from the borehole and representative samples of the material within the split-barrel were containerized and sealed. After completing the drilling operations, the samples for each boring were transported to the laboratory where they were examined by a geotechnical engineer to verify the field descriptions and classify the soil, and to select samples for laboratory testing.

FIELD EXPLORATION PROCEDURES

Standard Penetration Test (SPT) Borings Using Portable (Tripod) Equipment

The Standard Penetration Test (SPT) boring(s) were performed using portable equipment. This generally involves setting up a tripod metal frame with a cathead and motor attached to the frame to raise and lower the drill rod. This equipment is used when a conventional motorized drill rig cannot access the boring location(s). Due to the limitations of this equipment, rotary wash drilling techniques, normally used to advance the borehole, are not possible. Therefore, the borings were advanced between sampling intervals using a "wash and chop" drilling method. This method involves repeatedly raising and lowering the drill rod to break up, or "chop", the soil layers and using bentonite slurry to "wash" the cuttings to the surface, thus advancing the borehole.

Samples from the borings were obtained in general accordance with the latest revision of ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils". A split-barrel sampler was inserted to the borehole bottom and driven 18 to 24 inches into the soil using a 140-pound hammer dropped an average of 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration (18" sample) or for the sum of the middle 12 inches of penetration (24" sample) is termed the "penetration resistance, blow count, or N-value." This value is an index to several in-situ geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler, it was retrieved from the borehole and representative samples of the material within the split-barrel were containerized and sealed. After completing the drilling operations, the samples for each boring were transported to the laboratory where they were examined by our engineer in order to verify the field descriptions.

KEY TO BORING LOGS – USCS

Soil Classification

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

BORING LOG LEGEND

Symbol	Description
N	Standard Penetration Resistance, the number of blows required to advance a standard spoon sampler 12" when driven by a 140-lb hammer dropping 30".
WOR	Split Spoon sampler advanced under the weight of the drill rods
WOH	Split Spoon sampler advanced under the weight of the SPT hammer
50/2"	Indicates 50 hammer blows drove the split spoon 2 inches; 50 Hammer blows for less than 6-inches of split spoon driving is considered "Refusal".
(SP)	Unified Soil Classification System
-200	Fines content, % Passing No. 200 U.S. Standard Sieve
w	Natural Moisture Content (%)
OC	Organic Content (%)
LL	Liquid Limit
PI	Plasticity Index
NP	Non-Plastic
PP	Pocket Penetrometer in tons per square foot (tsf)

MODIFIERS

SECONDARY CONSTITUENTS (Sand, Silt or Clay)	
Trace	Less than 5%
With	5% to 12%
Sandy, Silty or Clayey	12% to 35%
Very Sandy, Very Silty or Very Clayey	35% to 50%

ORGANIC CONTENT	
Trace	Less than 5%
Organic Soils	5% to 20%
Highly Organic Soils (Muck)	20% to 75%
PEAT	Greater than 75%

MINOR COMPONENTS (Shell, Rock, Debris, Roots, etc.)	
Trace	Less than 5%
Few	5% to 10%
Little	15% to 25%
Some	30% to 45%

RELATIVE DENSITY (Coarse-Grained Soils)

Relative Density	N-Value *
Very Loose	Less than 3
Loose	3 to 8
Medium Dense	8 to 24
Dense	24 to 40
Very Dense	Greater than 40

CONSISTENCY (Fine-Grained Soils)

Consistency	N-Value *
Very Soft	Less than 1
Soft	1 to 3
Firm	3 to 6
Stiff	6 to 12
Very Stiff	12 to 24
Hard	Greater than 24

RELATIVE HARDNESS (Limestone)

Relative Hardness	N-Value *
Soft	Less than 50
Hard	Greater than 50

* Using Automatic Hammer

TEN YEARS 10 Meskel & Associates Engineering

KEY TO BORING LOGS – USCS

Soil Classification

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

BORING LOG LEGEND

Symbol	Description
N	Standard Penetration Resistance, the number of blows required to advance a standard spoon sampler 12" when driven by a 140-lb hammer dropping 30".
WOR	Split Spoon sampler advanced under the weight of the drill rods
WOH	Split Spoon sampler advanced under the weight of the SPT hammer
50/2”	Indicates 50 hammer blows drove the split spoon 2 inches; 50 Hammer blows for less than 6-inches of split spoon driving is considered “Refusal”.
(SP)	Unified Soil Classification System
-200	Fines content, % Passing No. 200 U.S. Standard Sieve
w	Natural Moisture Content (%)
OC	Organic Content (%)
LL	Liquid Limit
PI	Plasticity Index
NP	Non-Plastic
PP	Pocket Penetrometer in tons per square foot (tsf)

MODIFIERS

SECONDARY CONSTITUENTS (Sand, Silt or Clay)	
Trace	Less than 5%
With	5% to 12%
Sandy, Silty or Clayey	12% to 35%
Very Sandy, Very Silty or Very Clayey	35% to 50%

ORGANIC CONTENT	
Trace	2% or less
With	3% to 5%
Organic Soils	5% to 20%
Highly Organic Soils (Muck)	20% to 75%
PEAT	Greater than 75%

MINOR COMPONENTS (Shell, Rock, Debris, Roots, etc.)	
Trace	Less than 5%
Few	5% to 10%
Little	15% to 25%
Some	30% to 45%

RELATIVE DENSITY (Coarse-Grained Soils)

Relative Density	N-Value
Very Loose	Less than 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

CONSISTENCY (Fine-Grained Soils)

Consistency	N-Value
Very Soft	Less than 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very Stiff	15 to 30
Hard	Greater than 30

RELATIVE HARDNESS (Limestone)

Relative Hardness	N-Value
Soft	Less than 50
Hard	Greater than 50

* Using Safety Hammer

Unified Soil Classification System (USCS)
(from ASTM D 2487)

Major Divisions			*Group Symbol*	*Typical Names*
Coarse-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	**Gravels** 50% or more of coarse fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of coarse fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	**Silts and Clays** Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic
Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

Appendix B

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Robena Road **DATE.** 6/19/2018

PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.

Borehole	Sample No.	Approx. Depth (ft)	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification	Comments
B-1	4	7	23	22	---	---	---	---	SC	
B-1	6	14	73	36	---	---	---	---	CH	
B-2	4	7	13	24	---	---	---	---	SM	
B-2	7	7	56	37	---	36	17	19	CL	
B-3	7	18	32	29	---	34	17	17	SC	
B-3	8	24	40	23	---	---	---	---	SC	
B-3	9	29	33	48	---	---	---	---	SM	
B-4	3	5	24	22	---	---	---	---	SC	
B-4	9	9	---	29	0.7	---	---	---	SP-SM	
B-5	3	5	22	19	---	---	---	---	SC	
B-5	7	20	82	32	---	53	19	34	CH	

Note: "---" Untested Parameter

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Pulaski Road

DATE. 4/25/2018

PROJECT LOCATION Jacksonville, Florida

CLIENT CDM Smith, Inc.

Borehole	Sample No.	Approx. Depth (ft)	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification	Comments
B-10	7	14	5	22	---	---	---	---	SP-SM	
B-6	7	19	3	23	---	---	---	---	SP	
B-7	1	1	6	31	2.1	---	---	---	SP-SM	
B-8	9	29	4	23	---	---	---	---	SP	
B-9	4	7	11	21	---	---	---	---	SP-SM	

Note: "---" Untested Parameter

Meskel & Associates Engineering, PLLC
FL Certificate of Authorization No. 28142
8936 Western Way, Suite 12
Jacksonville, FL 32256
P: (904)519-6990 F: (904)519-6992

TEN YEARS MAE
Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0011-0017

PROJECT NAME JEA District 2 New Pump Stations-Harts Road Site

DATE. 8/24/2017

PROJECT LOCATION Jacksonville, Florida

CLIENT CDM Smith, Inc.

Borehole	Sample No.	Approx. Depth (ft)	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification	Comments
B-11	2	3	29	24	---	---	---	---	SC	
B-11	5	9	26	23	---	---	---	---	SC	
B-11	8	24	49	48	---	---	---	---	SC	

Note: "---" Untested Parameter

LABORATORY TEST PROCEDURES

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Natural Moisture Content

The water content of the tested sample was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of “pore” or “free” water in a given mass of material to the mass of solid material particles.

Atterberg Limits

The Atterberg Limits consist of the Liquid Limit (LL) and the Plastic Limit (PL). The LL and PL were determined in general accordance with the latest revision of ASTM D 4318. The LL is the water content of the material denoting the boundary between the liquid and plastic states. The PL is the water content denoting the boundary between the plastic and semi-solid states. The Plasticity Index (PI) is the range of water content over which a soil behaves plastically and is denoted numerically by the difference between the LL and the PL. The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ration of “pore” or “free” water in a given mass of material to the mass of solid material particles.

Organic Loss on Ignition (Percent Organics)

The organic loss on ignition or percent organic material in the sample tested was determined in general accordance with ASTM D 2974. The percent organics is the material, expressed as a percentage, which is burned off in a muffle furnace at 455±10 degrees Celsius.

Appendix C

Summary of Corrosion Series Test Results
JEA District 2 Pump Station and Flow Rerouting - Robena Road and Pulaski Road
Duval County, Florida
MAE Project No.: 0011-0017

Boring/Sample No.	GPS Coordinates Latitude/Longitude		Approximate Test Depth (ft)	pH	Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	Environmental Classification	
								Steel Substructure	Concrete Substructure
B-3/2,3,4*	30° 26'56.24" N	81° 42'35.42" W	2 to 8	4.57	6,600	45	51	Extremely Aggressive	Extremely Aggressive
B-8/2,3,4*	30° 27'16.85" N	81° 36'45.42" W	2 to 8	5.01	23,100	30	18	Extremely Aggressive	Moderately Aggressive

* Composite samples were tested

Meskel & Associates Engineering