Report of Additional Geotechnical Exploration
For

JEA Argyle Forest Boulevard
Pump Station Improvements – New 20-Inch Force Main
Jacksonville, Duval County, Florida

MAE Project No. 0011-0016A
September 16, 2016

Prepared for:

Prepared by:

Meskel & Associates Engineering
Geotechnical · Environmental · Inspection · Testing

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September 16, 2016

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 01/15/2016 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.

Mr. Jeremy A. O'Neal
CDM Smith, Inc.
8381 Dix Ellis Trail, Suite 400
Jacksonville, Florida 32256

Reference: Report of Additional Geotechnical Exploration
JEA Argyle Forest Boulevard
Pump Station Improvements – New 20-Inch Force Main
Jacksonville, Duval County, Florida
MAE Project No. 0011-0016A

Dear Mr. O'Neal:

Meskel & Associates Engineering, PLLC has completed a geotechnical exploration for the subject project. Our work was performed in general accordance with our proposal dated August 2, 2016. The purpose of the geotechnical exploration was to evaluate the general subsurface conditions within the area of the proposed PVC Force Main at the Argyle Forest Boulevard Pump Station site, and to provide recommendations for pipe bedding and backfilling and site preparation.

In summary, the soil borings encountered a surface layer of topsoil (6 inches thick) or gravel, underlain by loose to medium dense fine sands with silt (SP-SM) and silty fine sands (SM) to the terminating depths of the borings. The encountered soils appear to be adaptable for support of the proposed PVC Force Main. Site preparation recommendations include clearing and stripping of existing surficial organic topsoil and organic materials, compaction of the pipe bedding soils, and placement and compaction of pipe backfill in controlled lifts. The purpose of these recommendations is to provide a more uniform subgrade for pipe support, and to reduce the potential for settlement of any overlying pavements.

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

W. Josh Mele, E.I.
Staff Engineer

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

Distribution: Mr. Jeremy A. O'Neal – CDM Smith, Inc. 2 copies; 1 pdf

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1.0 PROJECT INFORMATION

1.1 Project Description

Project information was provided to us by Mr. Jeremy O'Neal and Mr. David Rasmussen, P.E of CDM Smith. The project site is located 8104 Argyle Forest Boulevard. The focus of this report is on the new PVC Force Main of the Pump Station Improvements project.

We understand the Force Main will be a 20-inch diameter PVC pipeline. We received a plan sheet showing the proposed pipeline route as well as the proposed boring locations. A previous field exploration included a soil boring (B-5) located along the western leg of the pipeline. This boring was included in our previous geotechnical report for the site, dated May 17, 2016. The boring log showing the subsurface conditions encountered at this boring location are included in this report.

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.

1.2 Site Observations

At the time of our field exploration, the site contained an existing pump station with a driveway to the west of the facility. The site area was several feet lower than the adjacent Argyle Forest Boulevard to the north. The site was heavily wooded to the south and east of the existing facility with adjacent wetlands. The surface soils in the area of the boring locations were observed to be generally loose and dry at the time of our field exploration.

2.0 FIELD EXPLORATION

A field exploration program consisting of a Standard Penetration Test (SPT) boring and a hand auger boring was performed on August 22, 2016. The boring locations were determined by CDM as shown on a marked up version of the Boring Location Plan from our previous exploration. The proposed boring location to the immediate east of the existing facility was not accessible to our ATV-mounted drilling equipment due to the density of the vegetation in the wetlands. Therefore, the boring was moved inside the facility near the fence line, and was changed to a shallow hand auger boring.

The borings were located in the field by our field crew using taped measurement from existing site features as shown on the plan provided by CDM. Once the borings were located, JEA was notified so that they could determine if there were any conflicts with existing utilities. The locations as shown on the *Boring Location Plan,* Figure 2, should be considered approximate.

2.1 SPT Boring

One (1) SPT boring was drilled to a depth of 25 feet to explore the subsurface conditions near the proposed pipeline route. The SPT boring was performed in general accordance with the methodology outlined in ASTM D 1586. Split-spoon soil samples recovered during performance of the boring were visually described in the field, and representative portions of the samples were transported to our laboratory for classification and testing. The boring was backfilled with native soils upon completion. A summary of the field procedures used for the SPT boring is included in Appendix A.

2.2 Hand Auger Boring

A second boring near the proposed pipeline route was located within the fenced-in portion of the existing pump station area. Due to limited access for our ATV-mounted drilling equipment, the boring was advanced by hand to a depth of approximately 6 feet below the existing ground surface. The boring was performed in general accordance with the methodology outlined in ASTM D 1452. Representative soil samples were recovered from the auger borings and returned to our laboratory for further evaluation. The boring was backfilled with native soils upon completion. A summary of the field procedures used for the hand auger boring is included in Appendix A.

3.0 LABORATORY TESTING

Representative soil samples obtained from the soil borings were visually classified by a geotechnical engineer in our laboratory utilizing 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.

Quantitative laboratory testing was performed on selected samples of the soils encountered during the field exploration. The purpose of the testing was to better define their composition, and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the following soil physical characteristics:

- The natural moisture content,
- The percent passing the US Sieve No. 200 (percent fines)

The results of the laboratory testing are shown in the *Summary of Laboratory Test Results* table included in Appendix B. Also, these test results are shown on the *Generalized Soil Profiles* (Figure 3), and on the soil boring logs included in Appendix A at the respective depths from which the samples were recovered.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

Graphical presentation of the generalized subsurface conditions is presented on the *Generalized Soil Profiles*, Figure 3. Detailed boring logs are included in Appendix A. Boring B-5 from our previous exploration was located near the proposed pipeline route, so it has been included on Figure 3 and the log included in Appendix A. When reviewing the Profiles and boring logs, it should be understood that the subsurface soil conditions will vary between the boring locations.

Generally, borings B-5 and HA-1 encountered a surficial layer of topsoil approximately 6 inches in thickness. Boring B-7, which was located near the end of the existing driveway into the site, encountered a layer of gravel at the surface, approximately 2 inches in thickness, underlain by apparent fill soils consisting of fine sands with silt and gravel (rock fragments). Below these surface layers and the fill soils at boring B-7, the SPT borings (B-5 and B-7) encountered loose to medium dense fine sands with silt (SP-SM) and silty fine sands (SM) to the terminating depths of the borings, or 25 feet below existing grade. The hand auger boring HA-1 encountered similar subsurface conditions to the terminating depth of 6 feet below existing grade.

4.2 Groundwater Level

The groundwater table was encountered and measured at all of the boring locations at the time of drilling. The boreholes were left open so that stabilized groundwater levels could be measured again at the end of the day. The groundwater level at boring location B-5 was measured at a depth of approximately 1.3 feet at the time of drilling (February 17, 2016), and at a depth of approximately one foot at the end of the day. The groundwater levels at borings B-7 and HA-1 were measured at the time of drilling at depths of approximately 4.9 feet and 3.5 feet, respectively. Boring HA-1 was left open and the groundwater level was measured at approximately 3 feet at the end of the day.

It should be anticipated that the groundwater level will fluctuate due to seasonal weather changes, surface water runoff patterns, construction operations, and other interrelated factors. The depths to the measured groundwater levels are shown on the attached *Generalized Soil Profiles* (Figure 3), and on the soil boring logs.

4.3 Review of the USDA Web Soil Survey Map

The results of a review of the USDA Soil Survey Conservation Service (SCS) Web Soil Survey of Duval County are shown in the table below. There are two predominant soil map units at the project sight: Arents, nearly level and Pamlico Muck. The soil drainage class, hydrological group, and estimated seasonal high groundwater levels reported in the Soil Survey are tabulated below.

Map Unit Symbol – Name	Drainage Class	Hydrologic Group	Depth to Water Table (1)
7 – Arents, nearly level	Somewhat Poorly Drained	A	18 to 36 inches
49 – Pamlico Muck	Very Poorly Drained	B/D, A/D	6 to 18 inches

(1) The "Water table" above refers to a saturated zone in the soil which occurs during specified months, typically during 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. The low value and a high value indicate the range of this attribute for the soil component.

4.4 Seasonal High Groundwater Level

In estimating the seasonal high groundwater level (SHGL) within the project area, 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 interpretation of the site conditions and the boring logs, we estimate the SHGL at the site to be approximately 6 inches to one foot below the existing ground surface at borings B-5 and HA-1. The SHGL at boring B-7 is likely to be deeper due to the apparent higher ground surface elevation and presence of fill soils at this location. Our estimate of the SHGL is based solely on our measured groundwater levels at the time of our exploration, the time of year during which these levels were measured, and the correlation of the encountered subsurface conditions with the soil map unit profile provided in the *USDA Web Soil Survey*. The site drainage engineer should be consulted to determine how much current site activity has affected the SHGL within the project area.

It is possible that groundwater levels may exceed the estimated SHGL 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 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 the construction techniques recommended in Section 6.0 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, then MAE should be notified so that 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 Below-Grade Utility Support Recommendations

Based on the results of the subsurface explorations and provided information, as included in this report, we consider the subsurface conditions at the site to be adaptable for supporting the proposed below-grade pipeline when constructed upon properly prepared subgrade soils.

Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for design of below-grade utilities.

5.2.1 Lateral Pressure Design Parameters

Below-grade walls that are backfilled on one side and restrained against rotation at the top, should be designed to resist lateral pressures from soil and groundwater based on the following equivalent fluid unit weights:

- Above Water Table - Equivalent Fluid Density 60 lb/ ft^3
- Below Water Table - Equivalent Fluid Density 90 lb/ ft^3

For the design of lateral loads on below-grade walls, we recommend that the groundwater level be assumed to be at the ground surface. Lateral pressure distributions in accordance with the above do not take into account forces from construction equipment, wheel loads or other surcharge loads. To account for this loading, a pressure equal to 0.5 times the anticipated surface surcharge should be applied over the full height of all walls.

5.2.2 Hydrostatic Uplift Resistance

It is anticipated that any buried pipeline access structures will exert little or no net downward pressure on the soils, rather, the structures 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

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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 footings outside the perimeter of the structure.

A soil unit weight of 120 lb/ft^3 may be used in designing structures to resist buoyancy.

6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

Site preparation as outlined in this section should be performed to provide more uniform bearing conditions and reduce the potential for post-construction settlements of any potential structures associated with the proposed Force Main pipeline.

6.1 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 pipeline area, plus a minimum additional margin of 5 feet, should be stripped of all surface vegetation, stumps, debris, 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 the soil borings, it should be anticipated that approximately 6 inches of soils containing topsoil and significant amounts of organic materials (roots, grasses) will be encountered across the project site. Boring B-7, located near the end of the existing driveway, encountered approximately 2 inches of gravel at the ground surface. The actual depths of unsuitable soils and materials should be determined by MAE using visual observation and judgment during earthwork operations. Organic materials removed from the structure areas can be stockpiled and used subsequently in areas to be grassed.

6.2 Temporary Groundwater Control

The groundwater level was encountered at depths of approximately 1 to 4.9 feet below existing grade at the project site, at the time of our explorations. Based on our understanding of the planned construction, the contractor should anticipate that control of groundwater will be necessary during pipe excavation. Should groundwater control measures become necessary, the dewatering method should be determined by the contractor. We recommend that the groundwater control measures, if necessary, maintain the groundwater level at least 2 feet below the compacted surface (pipe bedding or slab subgrade) and remain in place until compaction of the existing soils is completed. The site should be graded to direct surface water runoff away from the construction area.

6.3 Compaction of Excavation Bottom

After installing the temporary groundwater control measures and achieving the required depth of excavation, the pipe bedding soils should be compacted at least 98 percent of the modified Proctor

Maximum Dry Density (AASHTO T-180). Typically, the bedding soil should exhibit moisture contents within ±2 percent of the Optimum Moisture Content during the compaction operations.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated and the disturbed soils removed and backfilled with dry structural fill soils that are placed in 6-inch thick compacted lifts. Alternatively, a graded aggregate conforming to ASTM No. 67 stone as noted in the JEA Water/Wastewater Manual, latest edition, may be used. The gravel should be placed in equal lifts no more than 6 inches in thickness, and each lift should be compacted to form a stable working surface.

Care should be exercised to avoid damaging any nearby structures while the compaction operations are underway. Compaction should cease if deemed detrimental to adjacent structures.

6.4 Excavation Protection

Excavation work for pipeline 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 licensed Professional Engineer.

6.5 Structural Backfill and Compaction of Pipe Backfill

Structural backfill placed within the pipeline excavation, and in areas in which over-excavation of unsuitable soils is required below the pipeline invert elevation, should be placed in loose lifts not exceeding six inches in thickness and compacted by the use of hand-operated compaction equipment. This procedure should continue until the backfill elevation is 12 inches above the top of the pipe. At elevations greater than 12 inches above the top of pipe, structural backfill may be placed in loose lifts not exceeding 12 inches in thickness and compacted by hand-operated compaction equipment.

Structural backfill is defined as a non-plastic, granular soil having less than 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sands with silt (SP-SM), as encountered in the borings, may be used as backfill. It may be possible to use the silty soils (SM) as encountered as backfill as long as they can be dried to below its Optimum Moisture Content prior to placement and compaction. However, these soils are difficult to dry when excavated from below the groundwater table due to their significant fines content and their affinity for moisture. Alternatively, they can be blended with sandier soils (SP, SP-SM) to make them more workable.

The backfill soil should exhibit moisture contents within ±2 percent of the modified Proctor Optimum Moisture Content (AASHTO T-180) during the compaction operations. Compaction should continue until densities of at least 98 percent of the modified Proctor Maximum Dry Density (AASHTO T-180) have been achieved within each lift of compacted structural backfill.

We recommend that soil excavated from the pipeline trenches that 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 excavated soil.

7.0 QUALITY CONTROL TESTING

A representative number of field in-place density tests should be made in the upper 12 inches of pipe bedding below the pipeline invert, and in each lift of compacted pipe backfill soils. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed at a minimum of one location for every 200 feet of pipeline.

8.0 REPORT LIMITATIONS

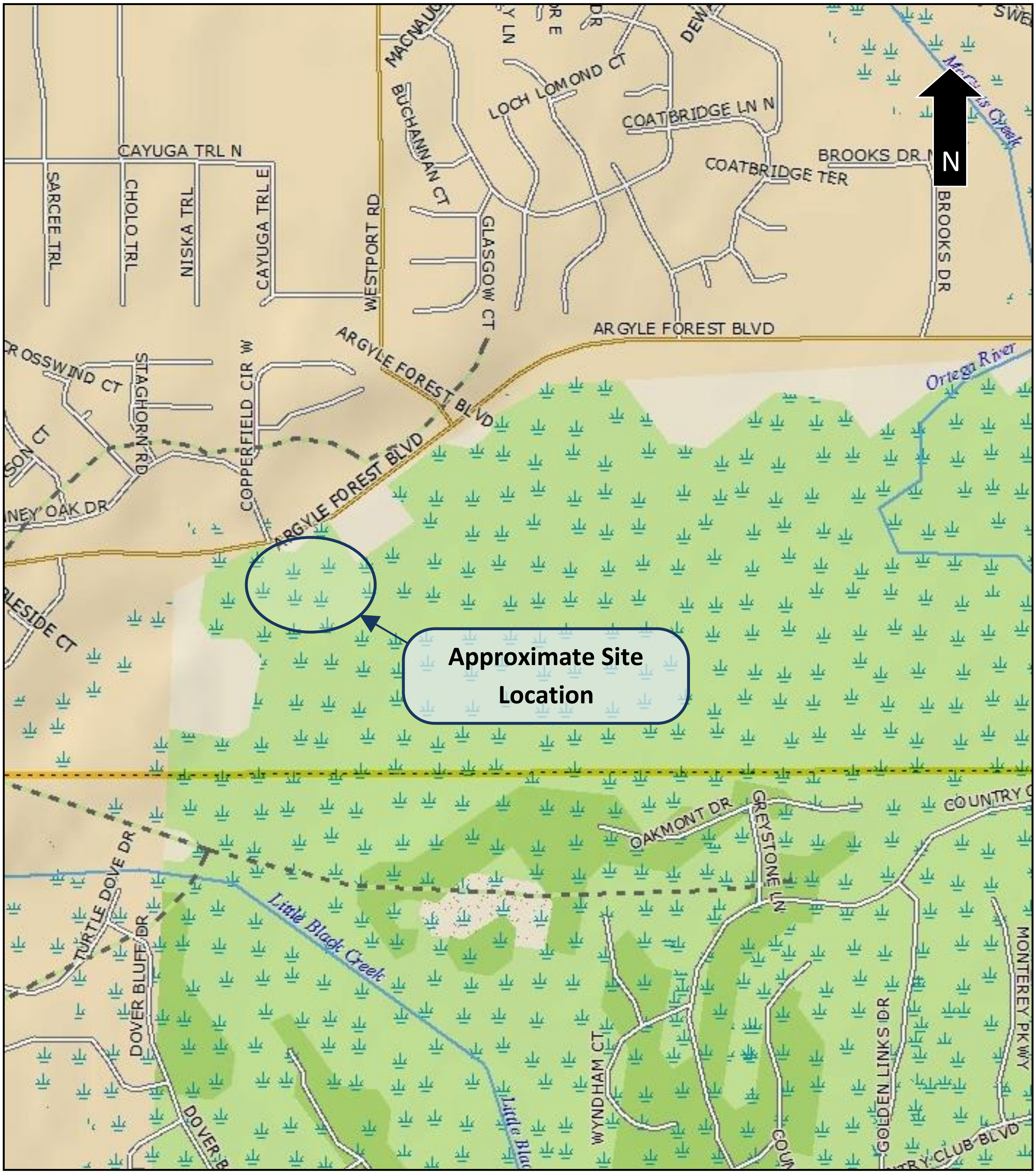
This report has been prepared for the exclusive use of CDM Smith and the JEA for specific application to the proposed 20-inch Force Main at the JEA Argyle Forest Boulevard Pump Station project. Our work for this project was performed in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made.

The analyses and recommendations contained in this report are based on the data obtained from the borings performed for this exploration and the boring located along the proposed pipeline route (B-5) from our previous exploration for the JEA Argyle Forest Pump Station project, reported May 17, 2016. 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 groundwater 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.

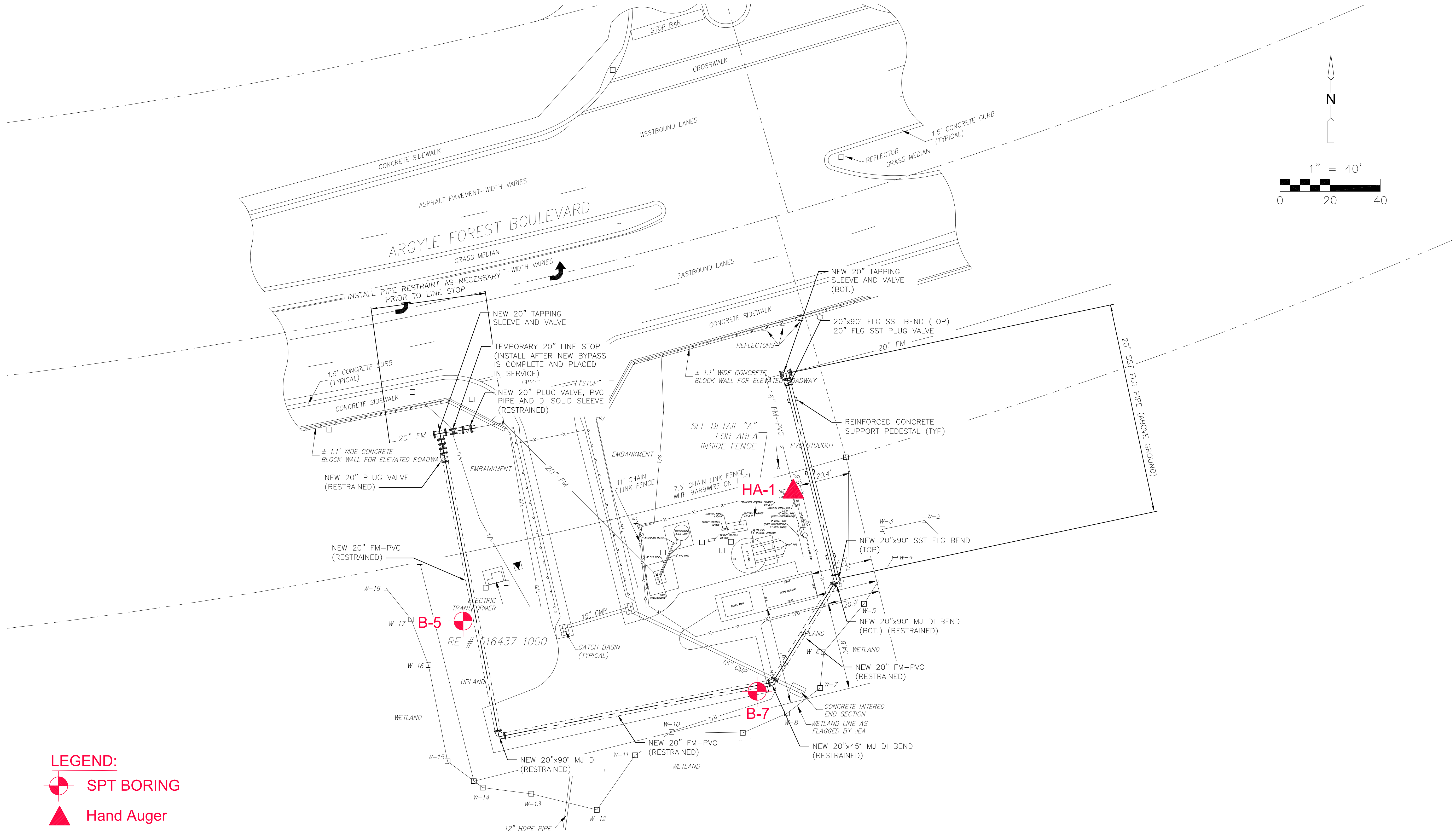
If changes in the design or location of the pipeline occur, the conclusions and recommendations contained in this report may need to be modified. We recommend that these changes be provided to us for our consideration. MAE is not responsible for conclusions, interpretations, opinions or recommendations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

Figures



Site Location Map

PREPARED BY	PROJECT NAME	
Meskel & Associates Engineering	JEA Argyle Forest Blvd. Pump Station Improvements Jacksonville, Florida	
	REFERERENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	FIGURE NO.
CDM Smith, Inc.	0011-0016A	1



Note: Drawing provided by CDM Smith, Inc.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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

MAE
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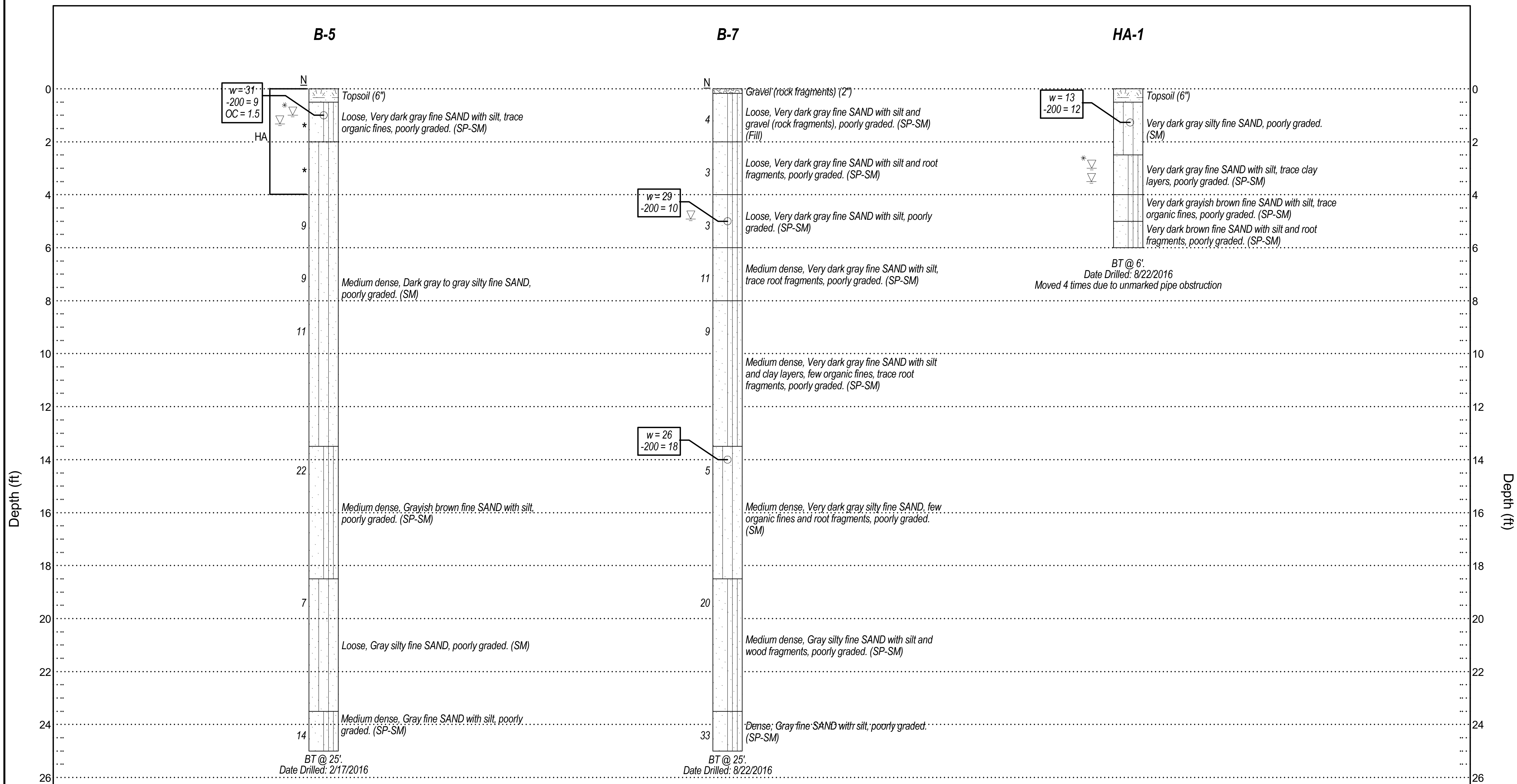
CLIENT: CDM Smith, Inc.

DATE:	MAE PROJECT NO.
8/30/2016	0011-0016A

SHEET TITLE: Boring Location Plan

PROJECT NAME: JEA Argyle Forest Blvd. Pump Station Improvements

FIGURE NO. 2



Legend

- Gravel
- Clayey Fine Sand
- Fine Sand with Silt
- Topsoil
- Silty Fine Sand

N Standard Penetration Resistance, Blows/Foot

BT Boring Terminated at Depth Below Existing Grade

(SP) Unified Soil Classification System

▽ Depth to Groundwater at Time of Drilling

*▽ Depth to Groundwater at End of Day

w Natural Moisture Content (%)

-200 % Passing No. 200 U.S. Standard Sieve

HA Boring Advanced by hand-held bucket auger due to possible underground utilities.

OC Organic Content (%)

* Hand Cone Static Penetrometer used to estimate soil relative density

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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CDM Smith, Inc.

DATE:	MAE PROJECT NO.
9/16/2016	0011-0016A

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA Argyle Forest Blvd. Pump Station Improvements
Jacksonville, Florida

FIGURE NO. 3

Appendix A

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Meskel & Associates Engineering

BORING B-5

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest Blvd. Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 2/17/16 **COMPLETED** 2/17/16 **BORING LOCATION** Argyle Forest (See Boring Location Plan)
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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")												* Hand Cone Penetrometer 0" - 6" : 1/6" 6" - 12" : 1/6" 12" - 18" : 3/6" 18" - 24" : 4/6" 24" - 30" : 4/6" 30" - 36" : 5/6" 36" - 42" : 6/6" 42" - 48" : 12/6"
	1	Loose, Very dark gray fine SAND with silt, trace organic fines, poorly graded.	SP-SM			*	31	9	1.5					
	2	Medium dense, Dark gray to gray silty fine SAND, poorly graded.	SM			*								
5	3				3 4 5 3	9								
	4				5 2 7 8	9								
10	5				3 4 7 7	11								
15	6	Medium dense, Grayish brown fine SAND with silt, poorly graded.	SP-SM		7 10 12	22								
20	7	Loose, Gray silty fine SAND, poorly graded.	SM		2 3 4	7								
25	8	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		6 8 6	14								

Bottom of borehole at 25 feet.

NOTES Boring Advanced by hand due to possible utility conflicts
* Hand Cone Static Penetrometer used to estimate soil relative density.

GROUND WATER LEVELS
AT TIME OF DRILLING 1 ft 4 in
* END OF DAY 1 ft 0 in

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BORING B-7

PROJECT NO. 0011-0016A

PROJECT NAME JEA Argyle Forest Blvd. Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 8/22/16 **COMPLETED** 8/22/16 **BORING LOCATION** See Boring Location Plan
DRILLING CONTRACTOR MAE, PLLC **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		Gravel (rock fragments) (2")												
	1	Loose, Very dark gray fine SAND with silt and gravel (rock fragments), poorly graded. (Fill)	SP-SM		2 2 2 3	4								
	2	Loose, Very dark gray fine SAND with silt and root fragments, poorly graded.	SP-SM		1 2 1 1	3								
5	3	∇ Loose, Very dark gray fine SAND with silt, poorly graded.	SP-SM		2 1 2 2	3	29	10						
	4	Medium dense, Very dark gray fine SAND with silt, trace root fragments, poorly graded.	SP-SM		1 4 7 8	11								
10	5	Medium dense, Very dark gray fine SAND with silt and clay layers, few organic fines, trace root fragments, poorly graded.	SP-SM		3 4 5 6	9								
15	6	Medium dense, Very dark gray silty fine SAND, few organic fines and root fragments, poorly graded.	SM		4 3 2	5	26	18						
20	7	Medium dense, Gray silty fine SAND with silt and wood fragments, poorly graded.	SP-SM		5 8 12	20								
25	8	Dense, Gray fine SAND with silt, poorly graded.	SP-SM		14 16 17	33								

Bottom of borehole at 25 feet.

NOTES

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 4 ft 11 in   *∇ **END OF DAY** ---

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Meskel & Associates Engineering

BORING HA-1

PAGE 1 OF 1

PROJECT NO. 0011-0016A

PROJECT NAME JEA Argyle Forest Blvd. Pump Station Improvements

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

DATE STARTED 8/22/16 **COMPLETED** 8/22/16 **BORING LOCATION** See Boring Location Plan

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Hand Auger

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

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
0.0		Topsoil (6")												
	1	Very dark gray silty fine SAND, poorly graded.	SM				13	12						
2.5	2	Very dark gray fine SAND with silt, trace clay layers, poorly graded.	SP-SM											
	3	Very dark grayish brown fine SAND with silt, trace organic fines, poorly graded.	SP-SM											
5.0	4	Very dark brown fine SAND with silt and root fragments, poorly graded.	SP-SM											
		Bottom of borehole at 6 feet. Moved 4 times due to unmarked pipe obstruction												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 3 ft 6 in

*END OF DAY 3 ft 0 in

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, "Penetration Test 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 our engineer in order to verify the field classification.

Hand Auger Boring

The auger boring(s) were performed manually by the use of a hand auger and in general accordance with the latest revision of ASTM D 1452, "Soil Investigation and Sampling by Auger Borings." Representative samples of the soils brought to the ground surface by the augering process were placed in sealed containers and transported to our laboratory where they were examined by our engineer to verify the driller's field classification.

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 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

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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%

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Appendix B

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Meskel & Associates Engineering

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0011-0016A

PROJECT NAME JEA Argyle Forest Pump Station Improvements

DATE. 8/30/2016

PROJECT LOCATION Jacksonville, Florida

CLIENT CDM Smith, Inc.

Borehole	Sample No	Approx. Depth	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification	Comments
B-7	3	5	10	29	---	---	---	---	SP-SM	
B-7	5	14	18	26	---	---	---	---	SM	
HA-1	1	1	12	13	---	---	---	---	SM	

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.

FINAL Report of Geotechnical Exploration
For

JEA Argyle Forest Boulevard
Pump Station Replacement
Jacksonville, Duval County, Florida

MAE Project No. 0011-0016
May 6, 2016

Prepared for:

JEA Building Community®

CDM Smith

Prepared by:

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

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May 6, 2016

Meskel & Associates Engineering
Geotechnical ◤ Environmental ◤ Inspection ◤ Testing

Mr. David A. Rasmussen, P.E.
CDM Smith, Inc.
8381 Dix Ellis Trail, Suite 400
Jacksonville, Florida 32256

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 05/06/2016 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.

Reference: DRAFT Report of Geotechnical Exploration
JEA Argyle Forest Boulevard
Pump Station Replacement
Jacksonville, Duval County, Florida
MAE Project No. 0011-0016

Dear Mr. Rasmussen:

Meskel & Associates Engineering, PLLC has completed a geotechnical exploration for the subject project. Our work was performed in general accordance with our revised proposal dated January 28, 2016. The purpose of the geotechnical exploration was to evaluate the general subsurface conditions within the area of the proposed structures at the Rampart Road and Argyle Forest Boulevard sites to provide recommendations for foundation support and design, and site preparation.

In summary, the soil borings encountered generally fine sands with silt (SP-SM) and silty fine sands (SM) throughout the depths of the borings. These encountered soils appear to be adaptable for support of the proposed structures. Site preparation recommendations include clearing and stripping of existing surficial organic materials, compaction of the underlying subgrade soils, and placement and compaction of suitable structural fill in controlled lifts. The purpose of these recommendations is to provide a more uniform subgrade for support of the structures, which reduces the potential for excessive settlement.

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, P.E.	Antoinette (Tina) D. Meskel, P.E.
Principal Engineer	Principal Engineer
Licensed, Florida No. 41986	Licensed, Florida No. 56999

Distribution: Mr. David Rasmussen, P.E. – CDM Smith, Inc. 2 copies; 1 pdf

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APPENDICES

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1.0 PROJECT INFORMATION

1.1 Project Description

Project information was provided to us by Mr. Jeremy O'Neal and Mr. David Rasmussen, P.E of CDM Smith. This information included the planned layout of the new construction and the existing site conditions.

The project is divided between two sites. The main site where most of the improvements will occur is at 7806 Rampart Road. The improvements at this site include a Booster Pump Station, an Electrical Building, a fuel tank pad, a transformer pad and a generator pad, along with new piping. We have assumed that the Booster Pump Station and the Electrical Building will be supported on cast-in-place concrete floor slabs, assumed to be 6 inches in thickness, with turned-down edges (i.e. monolithic slabs). We have also assumed that the generator pad will be supported on a concrete slab-on-grade, approximately 3 feet in thickness. A stormwater retention pond will also be constructed to the west of the structures. The second site is at 8104 Argyle Forest Boulevard and will consist of new piping to the existing pump station.

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.

1.2 Site Observations

At the time of our field exploration, the Rampart Road site was bisected by an existing gravel driveway running east-west across the site. The site sloped gradually downward away from Rampart Road. The site was moderately wooded to the north of the apparent driveway. The surface soils in the vicinity of the soil borings were generally dry and firm at the time of our field exploration with no standing water observed within the project area. A stormwater pond was observed to the south of the site.

The Argyle Forest Boulevard site contained an existing pump station with a driveway to the west of the facility. The site area was several feet lower than the adjacent Argyle Forest Boulevard. The site was heavily wooded to the south of the existing facility with adjacent wetlands. The surface soils in the area of the boring location were observed to be generally dry to moist at the time of our field exploration. An existing stormwater pond was located east of the well site.

2.0 REVIEW OF SOIL SURVEY MAP

Based on a report from the Web Soil Survey for Duval County Florida, as prepared by the U.S. Department of Agriculture Natural Resource Conservation Service, the predominate soil map units and their characteristics within the Rampart Road and Argyle Forest Boulevard sites are tabulated below.

Rampart Road Site:

Map Unit Symbol – Name	Drainage Class	Hydrologic Group	Depth to Water Table
22 – Evergreen–Wesconnett complex, depressional, 0 to 2 percent slopes	Very Poorly Drained	A/D	0 inches
38 - Mascotte fine sand, 0 to 2 percent slopes	Poorly Drained	C/D	6 to 18 inches
73 – Urban land-Mascotte-Sapelo complex, 0 to 2 percent slopes	Poorly Drained	C/D	6 to 18 inches

Argyle Forest Boulevard Site:

Map Unit Symbol – Name	Drainage Class	Hydrologic Group	Depth to Water Table
7 – Arents, nearly level	Somewhat Poorly Drained	A	18 to 36 inches
49 – Pamlico Muck	Very Poorly Drained	B/D, A/D	6 to 18 inches

The "Water table" above refers to a saturated zone in the soil which occurs during specified months, typically during 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. The low value and a high value indicate the range of this attribute for the soil component.

3.0 FIELD EXPLORATION

A field exploration program consisting of Standard Penetration Test (SPT) borings and a Double-Ring Infiltrometer (DRI) test was performed from February 15 to 18, 2016. The boring locations and DRI test location were determined by CDM as shown plan sheets received from them. The borings were located in the field by our field crew using taped measurement from existing site features as shown on the site plans. Once the borings were located, JEA was notified so that they could determine if there were any conflicts with existing utilities. A copy of the proposed site plan, last dated March 17, 2016, was used to show the boring locations at the Rampart Road site on the *Boring Location Plan – Rampart Road*, Figure 2. A yard piping plan, last dated March 18, 2016, was received from CDM to show the boring location on the *Boring Location Plan – Argyle Forest Blvd.*, Figure 2A. The locations as shown on Figure 2 and Figure 2A should be considered approximate.

3.1 SPT Borings

A total of five SPT borings were drilled for the project. Four of the borings (B-1 through B-4) were located at the Rampart Road site within or near the planned improvements. The fifth boring (B-5) was located at the Argyle Boulevard site near the location of the new piping.

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Borings B-1 through B-3 were located at the Booster Pump Station Pad, the generator pad and the Electrical Building, respectively, at the Rampart Road site. Each boring was advanced to a depth of 35 feet below existing grade. Boring B-4 was located near the proposed piping and was advanced to a depth of 15 feet. Boring B-5 was located near the proposed piping at the Argyle Boulevard site, and was advanced to a depth of 25 feet below the existing ground surface.

All of the SPT 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 classified in the field, and representative portions of the samples were transported to our laboratory for classification and testing. Each boring was backfilled with native soils upon completion. A summary of the field procedures used for the SPT borings is included in Appendix A.

3.2 Double-Ring Infiltrometer Test

The DRI test was located within the proposed stormwater retention pond area at the Rampart Road site. The test location is shown on the *Boring Location Plan-Rampart Road*, Figure 2. The test was performed in general accordance with the procedures outlined in the latest revision of ASTMD 3385, *Infiltration Rate of Soils in Field using Double Ring Infiltrometers*. The test location was initially cleared of all surface vegetation and topsoil, excavated to the test depth of 2 feet below existing grade, and then leveled. The outer ring, approximately 24 inches in diameter, was driven to a depth of 6 inches below the test depth. The inner ring, approximately 12 inches in diameter, was inserted inside the outer ring, centered, and driven to a depth of approximately 2 inches below the test depth. A thin layer of gravel was placed on the exposed soils inside the rings at the test level. The 2 rings were filled simultaneously with 4 inches of water.

The water level was maintained throughout the test period, with the required amount of water added to maintain this level in both rings recorded at time intervals of 5 minutes. After reaching a stabilized inflow volume of water, the test was continued for approximately 120 minutes. A summary of the field procedures used for the DRI test is included in Appendix C. The DRI test results are also included in Appendix C and are discussed in Section 5.2 below.

4.0 LABORATORY TESTING

Representative soil samples obtained from the soil borings were visually classified by a geotechnical engineer in our laboratory utilizing 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.

Quantitative laboratory testing was performed on selected samples of the soils encountered during the field exploration. The purpose of the testing was to better define their composition, and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the following soil physical characteristics:

- The natural moisture content,
- The percent passing the US Sieve No. 200 (percent fines)
- Organic Content, and
- Atterberg limits

The results of the laboratory testing are shown in the Summary of Laboratory Test Data table included in Appendix B. Also, these test results are shown on the *Generalized Soil Profiles* (Figures 3 and 4), and on the soil boring logs included in Appendix A at the respective depths from which the samples were recovered.

5.0 GENERAL SUBSURFACE CONDITIONS

5.1 General Soil Profile

Graphical presentation of the generalized subsurface conditions is presented on the *Generalized Soil Profiles*, Figures 3 and 4. Detailed boring logs are included in Appendix A. When reviewing the Profiles and boring logs, it should be understood that the subsurface soil conditions will vary between the boring locations.

Generally, the soil borings located at the Rampart Road site encountered a surficial layer consisting of gravel (rock fragments with asphalt fragments observed at boring B-1 location), grass and roots. This surficial layer ranged in thickness from approximately 3 to 6 inches. Below this layer, the borings encountered loose to medium dense fine sands (SP) and fine sands with silt (SP-SM) to depths of approximately 3.5 to 4.5 feet below the existing ground surface. This general sand stratum was underlain by loose to medium dense silty fine sands (SM) and clayey fine sands (SC) to a depth of approximately 18.5 feet below existing grade. Boring B-4 was terminated within these soils. These silty and clayey sands were underlain by medium dense to dense fine sands with silt approximately 28.5 feet, and were underlain by loose to medium dense clayey fine sands (SC) to the boring termination depth of 35 feet below existing grade.

The boring located at the Argyle Forest Boulevard site (Boring B-5) encountered a 6-inch topsoil layer, underlain by fine sands with silt (SP-SM) and silty fine sands (SM) to the boring termination depth of approximately 25 feet below existing grade. The relative density of these sands alternated between loose and medium dense throughout the depth of the boring.

5.2 DRI Test Results

The results of the DRI test showed an average vertical infiltration rate of 6.2 inches per hour, or 12.4 feet per day. The measured vertical infiltration rates should not be construed to represent the actual pond exfiltration rate. For dry pond recovery calculations, we recommend a factor of safety of at least 2 be applied to the above vertical infiltration rate value. A summary of the DRI test result is included in Appendix C.

5.3 Groundwater Level

The groundwater table was encountered at each of the boring locations at the Rampart Road site (Borings B-1 through B-4) and measured at the time of drilling between depths of approximately 6 and 7.8 feet below the existing ground surface. The boreholes were left open for a period of 48 hours to allow the groundwater level to stabilize within the boreholes. The 48-hour groundwater level varied between 4 and 7.3 feet below existing grade.

The groundwater table at the Argyle Forest Boulevard location (Boring B-5) was measured at a depth of approximately 1.3 feet below existing grade at the time of drilling. The borehole was left open several hours and was later measured that same day at a depth of approximately 1 foot below existing grade.

It should be anticipated that the groundwater level will fluctuate due to seasonal weather changes, surface water runoff patterns, construction operations, and other interrelated factors. The depths to the measured groundwater levels are shown on the attached *Generalized Soil Profiles* (Figures 3 and 4), and on the soil boring logs.

5.4 Seasonal High Groundwater Level

In estimating the seasonal high groundwater level (SHGL) within the project area, 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 interpretation of the current site conditions and the boring logs, we estimate the SHGL at the Rampart Road site project area to be generally 2 to 2.5 feet below the existing ground surface. We estimate the SHGL at the Argyle Forest Boulevard site to be approximately 6 inches below the existing ground surface. Our estimate of the SHGL at both sites is based solely on our measured groundwater levels at the time of our exploration, the time of year during which these levels were measured, and the correlation of the encountered subsurface conditions with the soil map unit profile provided in the Soil Survey. The site drainage engineer should be consulted to determine how much current site activity has affected the SHGL within both project areas.

It is possible that groundwater levels may exceed the estimated SHGL 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.

6.0 DESIGN RECOMMENDATIONS

6.1 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 6.0 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, then MAE should be notified so that 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 Rampart Road Structures Foundation Design Recommendations

Based on the results of our exploration, we consider the subsurface conditions to be adaptable for support of the proposed structures when each are constructed on properly designed shallow foundation systems. Provided the site preparation and earthwork construction recommendations outlined in Section 7.0 of this report are performed, the following parameters may be used for foundation design.

6.2.1 Bearing Pressure

The maximum allowable net soil bearing pressure for use in turned-down edge monolithic slab foundation design should not exceed 2,000 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the natural overburden pressure at that level. The foundations should be designed based on the maximum load that could be imposed by all loading conditions.

6.2.2 Foundation Size

The minimum width recommended for the turned down edge portion of a monolithic slab bearing on the subgrade soils is 16 inches. Even though the maximum allowable soil bearing pressure may not be achieved, these width recommendations should control the size of the foundations.

6.2.3 Bearing Depth

The exterior turned down edge of the monolithic slab or the thickened portion should bear at a depth of at least 12 inches below the adjacent final grades 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.

6.2.4 Bearing Material

The turned down edges of the monolithic slabs may bear within either the compacted suitable natural soils (i.e., the fine sand (SP) or fine sand with silt (SP-SM) soils as encountered in the borings), or within compacted structural fill. The bearing level soils for the turned down edges of the monolithic slabs, 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.

6.2.5 Settlement Estimates

Post-construction settlements of the structures 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 soils within the expected influence of the foundations, 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 structural details, 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 structures 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 6.0, we anticipate that differential settlements of the structures should be one-half inch or less.

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6.3 Slabs-On-Grade

The monolithic slabs for the proposed structures can be constructed as slabs-on-ground, provided unsuitable material is removed and replaced with compacted structural fill as outlined in Section 6.0. 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 SHGL.

A modulus of subgrade reaction of 150 pci can be used for concrete slab foundation design for sandy soils compacted to 95 percent of the modified Proctor maximum dry density (ASTM D 1557, AASHTO T-180) value.

These parameters are based on a clean sand subgrade (SP, SP-SM) with an average angle of internal friction (ϕ) of 30 degrees (cohesion = 0) and a total unit weight (γ) of 115 pounds per cubic foot (pcf). This assumes that the subgrade soils are compacted in accordance with the recommendations presented below.

6.4 Below-Grade Utility Support 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 Rampart Road and Argyle Forest Boulevard sites to be adaptable for supporting the proposed below-grade pipeline and associated manhole structures when constructed upon properly prepared subgrade soils.

As noted in Section 5.0 above, clayey fine sands (SC) were encountered at the Rampart Road site boring locations beginning at depths of 3.5 to 4.5 feet below existing grade. Due to the plasticity of these soils and their affinity for moisture, we consider these soils unsuitable for use as bedding material for proposed pipelines and as bearing material for the associated manhole structures. We recommend that where encountered at the pipe invert and manhole bearing elevations these unsuitable clayey soils be over-excavated and replaced with compacted suitable structural backfill soil or fine gravel in accordance with the recommendations presented in Section 7.0.

Provided the site preparation and earthwork construction recommendations outlined in Section 7.0 of this report are performed, the following parameters may be used for design of below-grade utilities.

6.4.1 Lateral Pressure Design Parameters

Below-grade walls that are backfilled on one side and restrained against rotation at the top, should be designed to resist lateral pressures from soil and groundwater based on the following equivalent fluid unit weights:

- Above Water Table - Equivalent Fluid Density 60 lb/ft3
- Below Water Table - Equivalent Fluid Density 90 lb/ft3

For the design of lateral loads on below-grade walls, we recommend that the groundwater level be assumed to be at the ground surface. Lateral pressure distributions in accordance with the above do not take into account forces from construction equipment, wheel loads or other surcharge loads. To account for this loading, a pressure equal to 0.5 times the anticipated surface surcharge should be applied over the full height of all walls.

6.4.2 Hydrostatic Uplift Resistance

It is anticipated that the buried structures will exert little or no net downward pressure on the soils, rather, the structures 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 normal 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 footings outside the perimeter of the structure.

A soil unit weight of 120 lb/ft^3 may be used in designing structures to resist buoyancy.

7.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

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

7.1 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, should be stripped of all surface vegetation, stumps, debris, 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 the soil borings, it should be anticipated that about 3 to 6 inches of soils containing significant amounts of gravel (rock, asphalt fragments) and organic materials (roots, grasses) will be encountered across the Rampart Road site, and up to 6 inches of topsoil at the Argyle Forest Boulevard site. The actual depths of unsuitable soils and materials should be determined by MAE using visual observation and judgment during earthwork operations. Organic materials removed from the structure areas can be stockpiled and used subsequently in areas to be grassed.

7.2 Temporary Groundwater Control

The stabilized groundwater level was encountered at the Rampart Road site at depths varying from approximately 4 to 7.3 feet below the existing ground surface at, and at 1 foot at the Argyle Forest Boulevard site, at the time of our exploration. Based on our understanding of the planned construction, it is likely that control of groundwater will be necessary during pipe excavation. Should groundwater control measures become necessary, the dewatering method should be determined by the contractor. We recommend that the groundwater control measures, if necessary, maintain the groundwater level at least 2 feet below the compacted surface (pipe bedding or slab subgrade) and remain in place until compaction of the existing soils is completed.

The site should be graded to direct surface water runoff from the construction area.

7.3 Compaction

After completing the clearing and stripping operations, and after installing the temporary groundwater control measures if required, the exposed structure surface area should be compacted with a vibratory drum roller having a minimum static, at-drum weight, on the order of 10 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 one foot of the compacted natural soils at the site for the proposed structures.

Should the bearing level 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 75 feet from existing structures. Within this zone, use of a track-mounted bulldozer or a vibratory roller, operating in the static mode, is recommended. If such methods are deemed necessary, then it may be necessary to excavate the top foot of soil subgrade, following site clearing, and compact the underlying soils to the specified level of compaction, followed by re-placement and compaction of the excavated soil.

7.4 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 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sands and fine sands with silt, 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 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.

7.5 Foundation Areas

After satisfactory placement and compaction of the required structural fill, the foundation areas may be excavated to the planned bearing levels. The bearing level soils for the turned-down edges for monolithic slabs, 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. The bearing level soils for the generator pad should exhibit densities of 98 percent of the modified Proctor maximum dry density following compaction, 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 2,000 pounds.

Should excessively wet or organic soils be encountered at the footing excavation bottom, we recommend that these soils be excavated an additional 12 inches and backfilled with structural fill as described in Section 7.4. Alternatively, a graded aggregate conforming to ASTM No. 67 stone as noted in the JEA Water/Wastewater Manual, latest edition, may be used. The gravel should be placed in maximum 6-inch lifts with each lift compacted to form a stable working surface.

7.6 Below-Grade Utility Construction Recommendations

7.6.1 Preparation of Foundation Soils

As noted in Section 5.0 above, clayey fine sands (SC) were encountered at the Rampart Road site boring locations beginning at depths of 3.5 to 4.5 feet below existing grade. Due to the plasticity of these soils and their affinity for moisture, we consider these soils unsuitable for use as bedding material for proposed pipelines and as bearing material for the associated manhole structures.

We recommend that where these clayey sands are encountered at the pipe invert and manhole bearing elevations, these unsuitable soils should be over-excavated an additional one foot minimum below the pipe invert elevation and 2 feet minimum below the manhole base. Similarly, if organic soils are encountered at the pipe invert and manhole bearing elevations, these unsuitable soils should be handled in the same manner. This over-excavation should be backfilled with suitable structural backfill as discussed in Section 7.6.4 below. Alternatively, a graded aggregate conforming to ASTM No. 67 stone as noted in the JEA Water/Wastewater Manual, latest edition, may be used and should be placed in compacted lifts of 6 inches or less to form a stable working surface.

7.6.2 Compaction of Excavation Bottom

After installing the temporary groundwater control measures and achieving the required depth of excavation, including over-excavating the excavation trench bottom if necessary as recommended in Section 7.6.1, the excavation should be backfilled with suitable structural fill as described in Section 7.6.4. Alternatively, a graded aggregate conforming to ASTM No. 67 stone as noted in the JEA Water/Wastewater Manual, latest edition, may be used and should be compacted to form a stable working surface. If structural fill soil is used, it should be placed in 6-inch lifts with each lift compacted at least 98 percent of the modified Proctor maximum dry density (AASHTO T-180). Typically, the backfill soil should exhibit moisture contents within ±2 percent of the Optimum Moisture Content during the compaction operations.

If the gravel is used as the backfill, then the material should be placed in equal lifts no more than 6 inches in thickness. Each lift should be compacted to form a stable working surface.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated and (1) the disturbed soils removed and backfilled with dry structural fill soils that are then compacted, or (2) the excess moisture content within the disturbed soils allowed to dissipate before recompacting.

Care should be exercised to avoid damaging any nearby structures while the compaction operations are underway. Compaction should cease if deemed detrimental to adjacent structures.

7.6.3 Excavation Protection

Excavation work for pipeline 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.

7.6.4 Structural Backfill and Compaction of Structural Backfill

Structural backfill placed within the pipeline excavation, and in areas in which over-excavation of unsuitable soils is required below the pipeline invert elevation, should be placed in loose lifts not exceeding six inches in thickness and compacted by the use of hand-operated compaction equipment. This procedure should continue until the backfill elevation is 12 inches above the top of the pipe. At elevations greater than 12 inches above the top of pipe, structural backfill may be placed in loose lifts not exceeding 12 inches in thickness and compacted by hand-operated compaction equipment.

Structural backfill is defined as a non-plastic, granular soil having less than 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sand and fine sand with silt soils (SP, SP-SM) meeting the properties given above, as encountered in the borings at both sites, may be used as backfill. It may be possible to use the silty soils (SM), as encountered at the Boring B-5 location at the Argyle Forest Boulevard site, as backfill as long as they are dried to below their Optimum Moisture Content prior to placement and compaction. However, these soils are difficult to dry when excavated from below the groundwater table due to their significant fines content and their affinity for moisture. Alternatively, they can be blended with sandier soils (SP, SP-SM) to make them more workable.

The backfill soil should exhibit moisture contents within ±2 percent of the modified Proctor Optimum Moisture Content (AASHTO T-180) during the compaction operations. Compaction should continue until densities of at least 98 percent of the modified Proctor maximum dry density (AASHTO T-180) have been achieved within each lift of compacted structural backfill.

We recommend that soil excavated from the pipeline trenches that 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 excavated soil.

8.0 QUALITY CONTROL TESTING

For all structures, a representative number of field in-place density tests should be made in the upper one foot of compacted natural soils, in each lift of compacted backfill and fill, in the upper 12 inches of compacted subgrade soil in the foundation areas. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed at one location for every 2,000 square feet of building or slab area, with a minimum of one location per structure.

For the pipe excavations, a representative number of field in-place density tests should be made in the upper 12 inches of pipe bedding below the pipeline invert, the subgrade soils below any manhole structures, and in each lift of compacted pipe and manhole structure backfill soils. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed at a minimum of one location for every 200 feet of pipeline, at one location within the manhole structure subgrade soil, and at 2 locations for each lift of manhole structure backfill.

9.0 REPORT LIMITATIONS

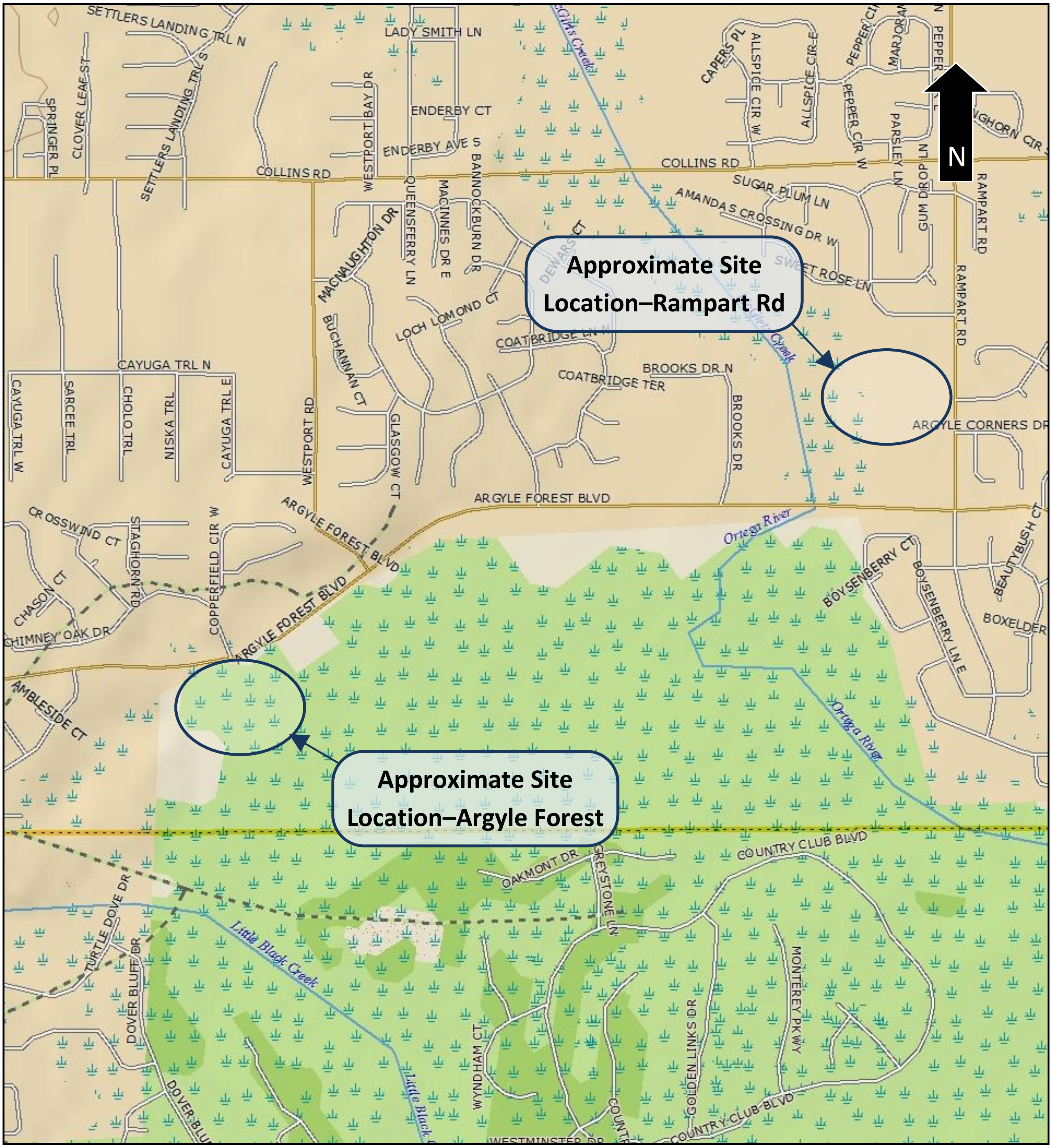
This report has been prepared for the exclusive use of CDM Smith and the JEA for specific application to the design and construction of the JEA Argyle Forest Boulevard Pump Station Replacement project. Our work for this project was performed in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made.

The analyses and recommendations contained in this report are based on the data obtained from the borings performed for the JEA Argyle Forest Pump Station Replacement 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 groundwater 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.

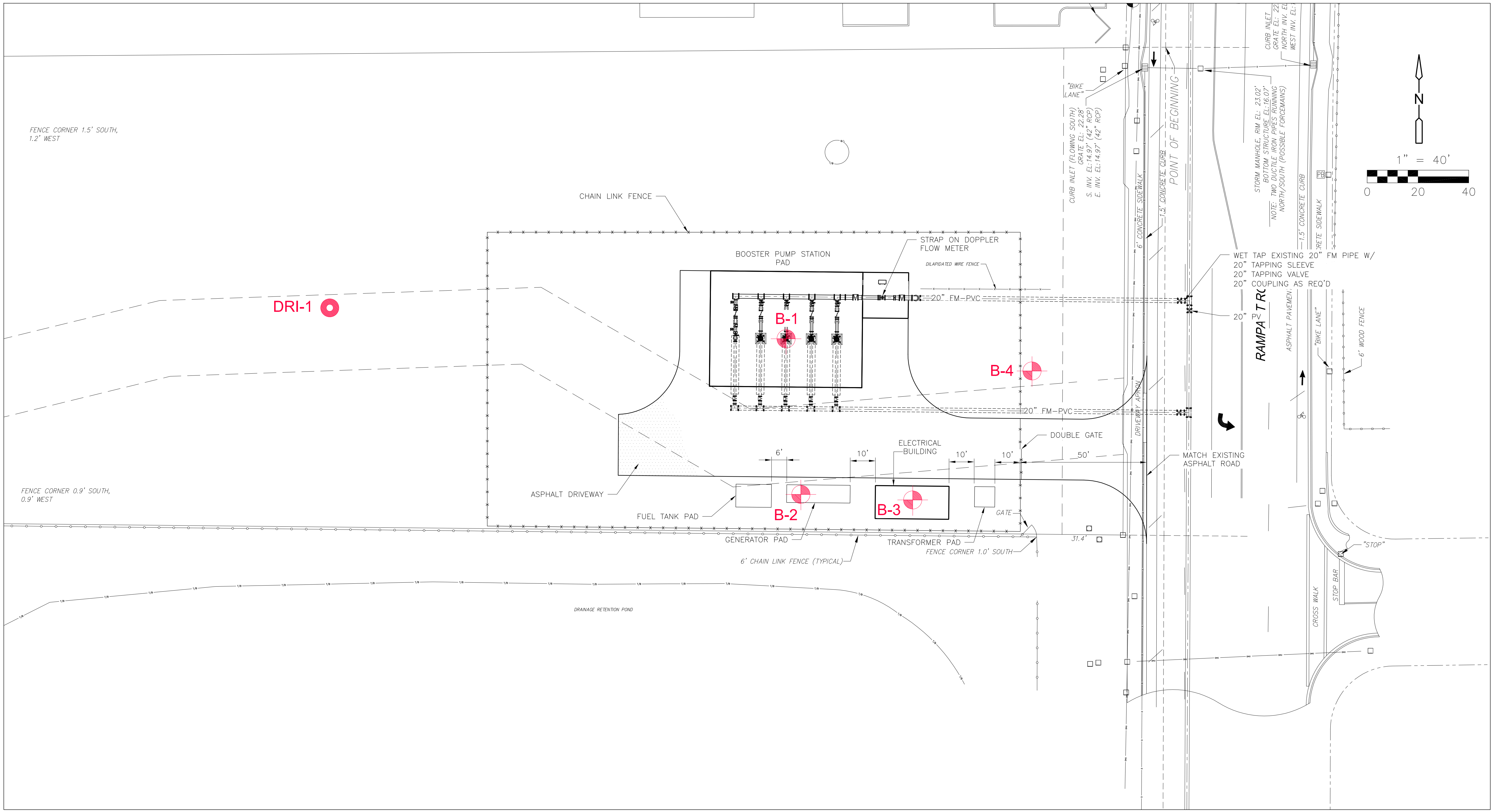
If changes in the design or location of the structures occur, the conclusions and recommendations contained in this report may need to be modified. We recommend that these changes be provided to us for our consideration. MAE is not responsible for conclusions, interpretations, opinions or recommendations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

Figures



Site Location Map

PREPARED BY	PROJECT NAME	
Meskel & Associates Engineering	JEA Argyle Forest, Rampart Road Pump Station Improvements Jacksonville, Florida	
	REFEREENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	FIGURE NO.
CDM Smith, Inc.	0011-0016	1



LEGEND:

- SPT BORING
- DRI LOCATION

Note: Drawing provided by CDM Smith, Inc.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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

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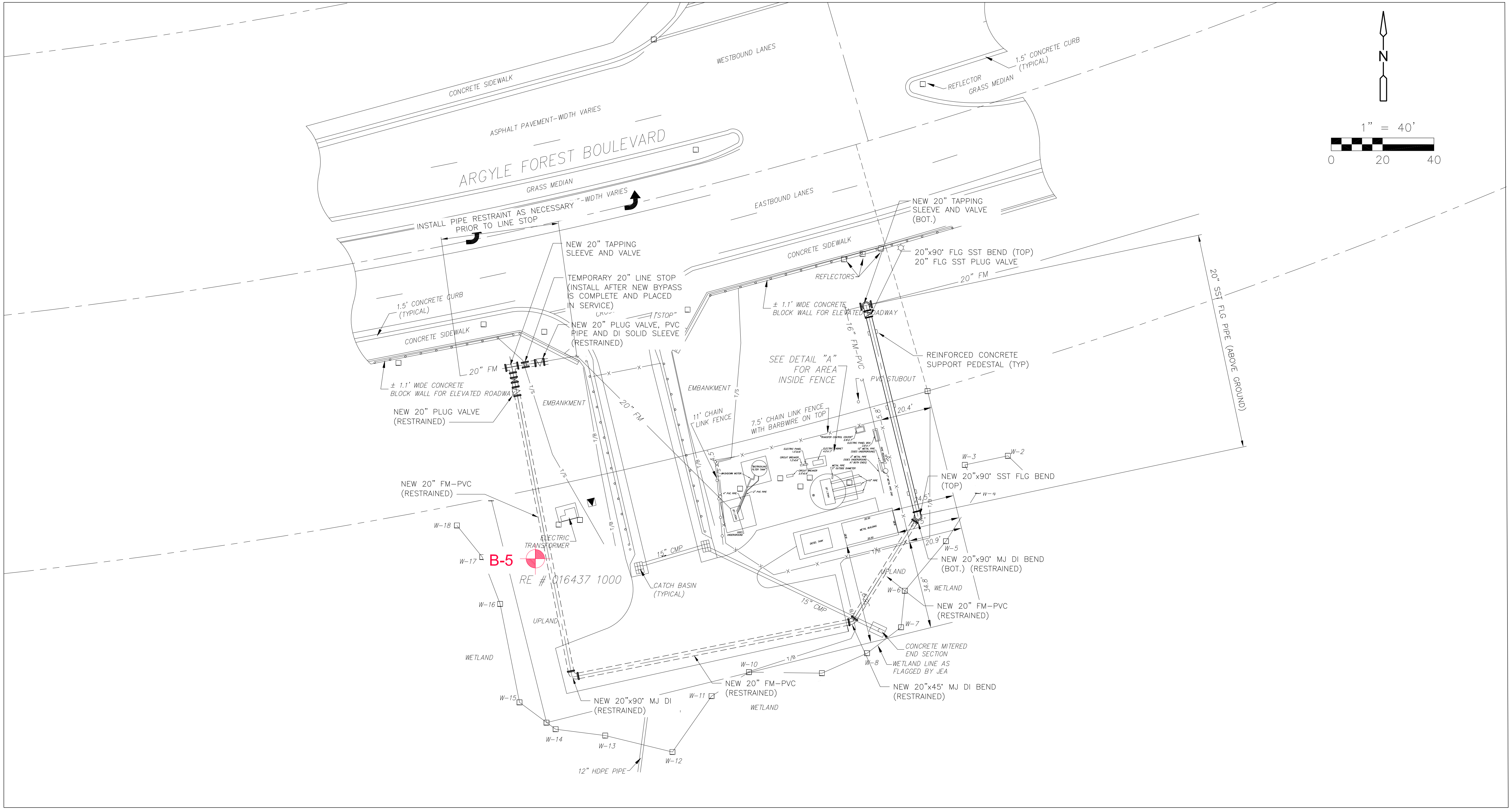
CLIENT:	
CDM Smith, Inc.	
DATE:	MAE PROJECT NO.
3/24/2016	0011-0016

SHEET TITLE: Boring Location Plan - Rampart Road

PROJECT NAME: JEA Argyle Forest, Rampart Road Pump Station Improvements

FIGURE NO. 2



LEGEND:

SPT BORING

Note: Drawing provided by CDM Smith, Inc.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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

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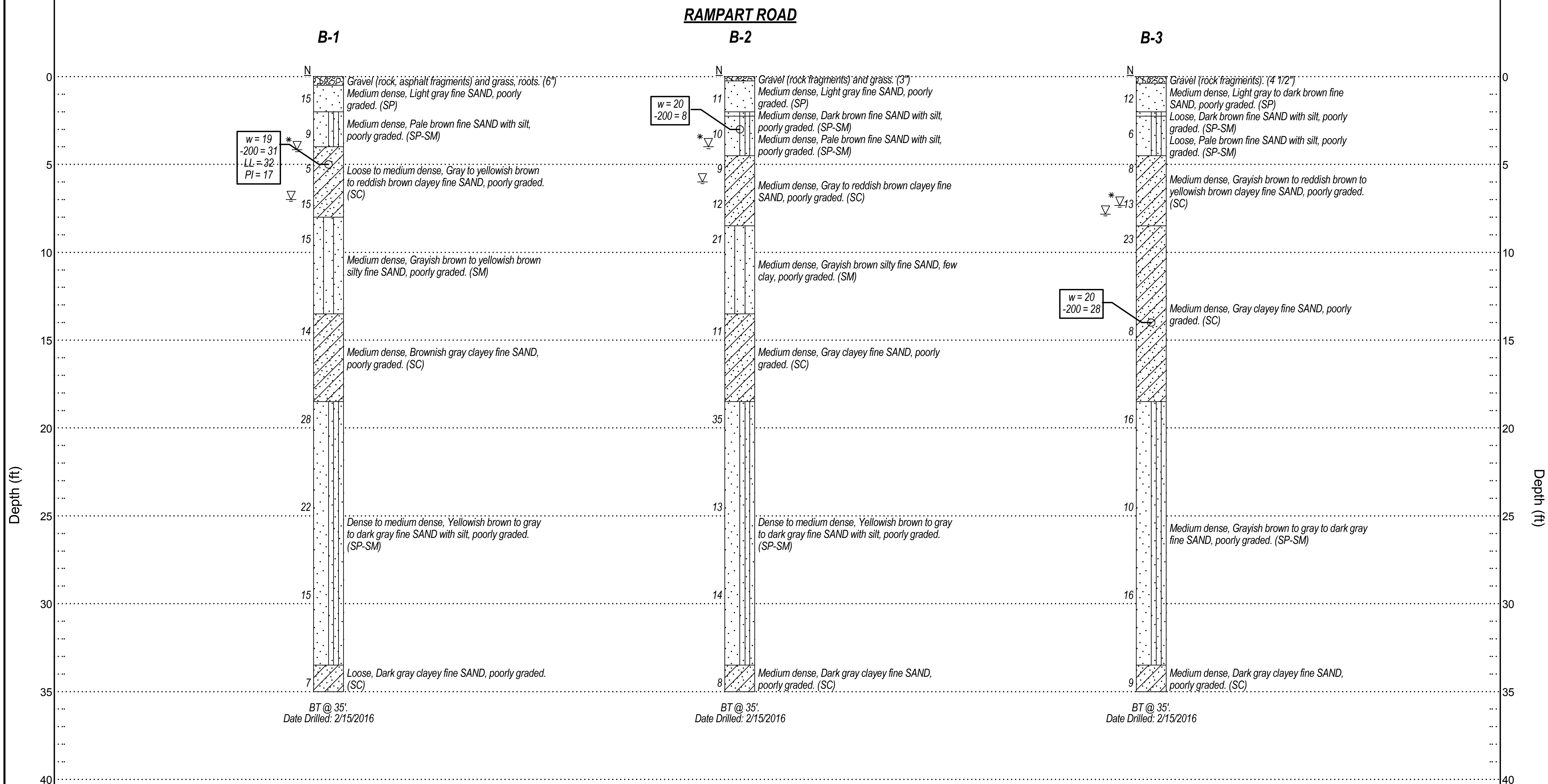
CLIENT:	
CDM Smith, Inc.	
DATE:	MAE PROJECT NO.
3/24/2016	0011-0016

SHEET TITLE: Boring Location Plan - Argyle Forest Blvd.

PROJECT NAME: JEA Argyle Forest, Rampart Road Pump Station Improvements

FIGURE NO. 2A



Legend

Gravel	Fine Sand	Fine Sand with Silt	
Clayey Fine Sand	Silty Fine Sand		

N	Standard Penetration Resistance, Blows/Foot	(SP)	Unified Soil Classification System	w	Natural Moisture Content (%)	LL	Liquid Limit
BT	Boring Terminated at Depth Below Existing Grade	∇	Depth to Groundwater at Time of Drilling	-200	% Passing No. 200 U.S. Standard Sieve	PI	Plasticity Index
		∇	Depth to Groundwater 48 Hrs After Drilling				

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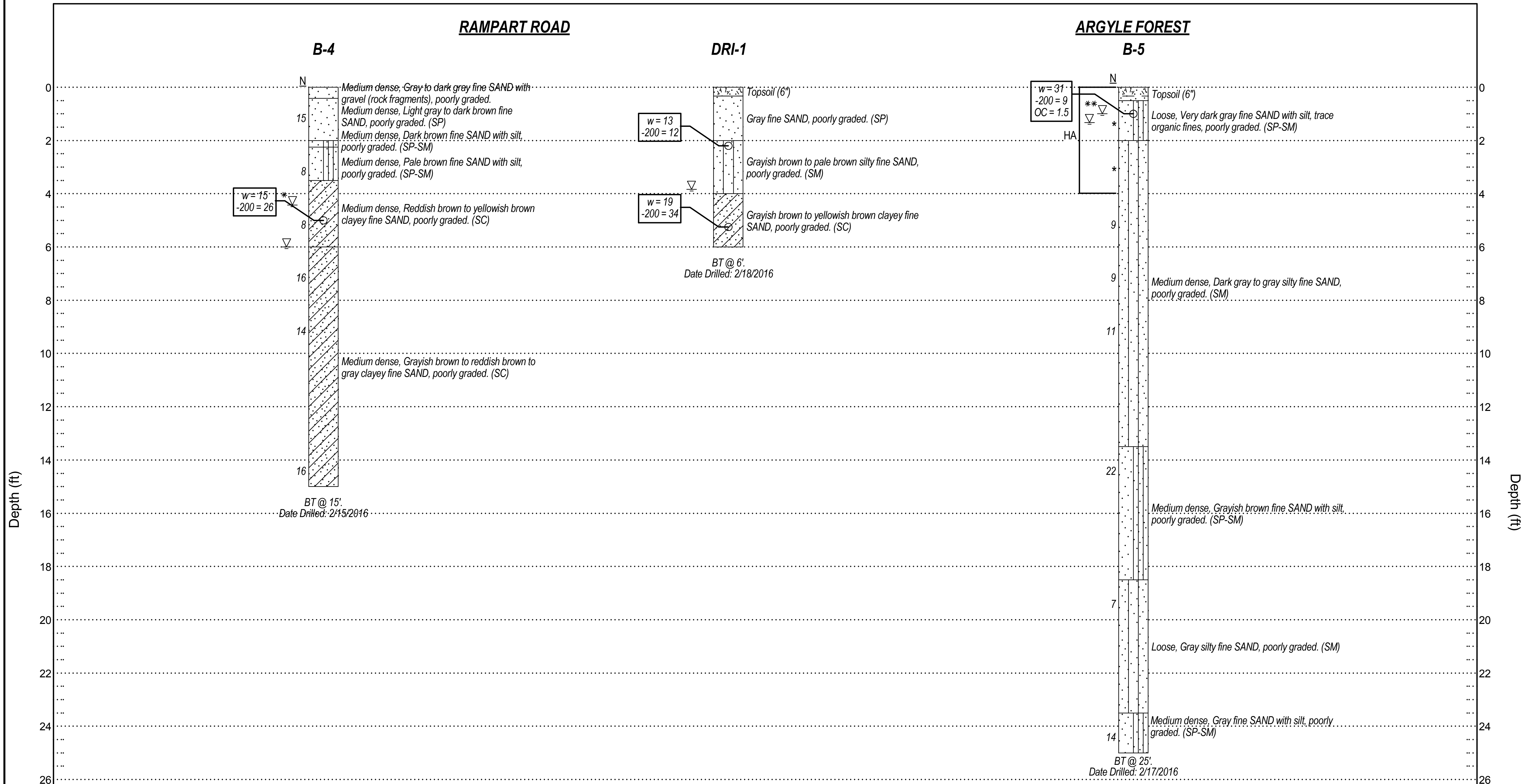
CDM Smith, Inc.

DATE:	MAE PROJECT NO.
3/28/2016	0011-0016

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA Argyle Forest, Rampart Road Pump Station Improvements Jacksonville, Florida

FIGURE NO. 3



Legend

Fine Sand	Clayey Fine Sand
Fine Sand with Silt	Topsoil
Silty Fine Sand	

N Standard Penetration Resistance, Blows/Foot

BT Boring Terminated at Depth Below Existing Grade

(SP) Unified Soil Classification System

▽ Depth to Groundwater at Time of Drilling

*▽ Depth to Groundwater 48 Hrs After Drilling

**▽ Depth to Groundwater at End of Day

w Natural Moisture Content (%)

-200 % Passing No. 200 U.S. Standard Sieve

HA Boring Advanced by hand-held bucket auger due to possible underground utilities.

OC Organic Content (%)

* Hand Cone Static Penetrometer used to estimate soil relative density

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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CDM Smith, Inc.

DATE:	MAE PROJECT NO.
3/28/2016	0011-0016

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: JEA Argyle Forest, Rampart Road Pump Station Improvements
Jacksonville, Florida

FIGURE NO. 4

Appendix A

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BORING B-1

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements

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

DATE STARTED 2/15/16 **COMPLETED** 2/15/16 **BORING LOCATION** Rampart Rd -Booster Pumps (See Boring Location Plan)

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

LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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		Gravel (rock, asphalt fragments) and grass, roots. (6")												
	1	Medium dense, Light gray fine SAND, poorly graded.	SP		4 6 9 9	15								
	2	Medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		3 4 5 6	9								
5	3	Loose to medium dense, Gray to yellowish brown to reddish brown clayey fine SAND, poorly graded.	SC		1 2 3 5	5	19	31		32	17			
	4				5 7 8 10	15								
10	5	Medium dense, Grayish brown to yellowish brown silty fine SAND, poorly graded.	SM		5 7 8 13	15								
15	6	Medium dense, Brownish gray clayey fine SAND, poorly graded.	SC		5 6 8	14								
20	7	Dense to medium dense, Yellowish brown to gray to dark gray fine SAND with silt, poorly graded.	SP-SM		7 12 16	28								

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 7 ft 0 in *▽ **48 Hrs AFTER** 4 ft 2 in

(Continued Next Page)

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BORING B-1

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements

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	Dense to medium dense, Yellowish brown to gray to dark gray fine SAND with silt, poorly graded.	SP-SM		4-9-13	22								
25–30	9				4-5-10	15								
30–35	10	Loose, Dark gray clayey fine SAND, poorly graded.	SC		1-2-5	7								
35		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 7 ft 0 in

*48 Hrs AFTER 4 ft 2 in

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BORING B-2

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 2/15/16 **COMPLETED** 2/15/16 **BORING LOCATION** Rampart Rd -Generator (See Boring Location Plan)
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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		Gravel (rock fragments) and grass. (3")												
	1	Medium dense, Light gray fine SAND, poorly graded.	SP		4 4 7 5	11								
		Medium dense, Dark brown fine SAND with silt, poorly graded.	SP-SM											
	2	Medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM		3 4 6 8	10	20	8						
5	3	Medium dense, Gray to reddish brown clayey fine SAND, poorly graded.	SC		3 4 5 7	9								
	4				3 5 7 8	12								
	5	Medium dense, Grayish brown silty fine SAND, few clay, poorly graded.	SM		7 9 12 13	21								
10														
	6	Medium dense, Gray clayey fine SAND, poorly graded.	SC		2 4 7	11								
15														
	7	Dense to medium dense, Yellowish brown to gray to dark gray fine SAND with silt, poorly graded.	SP-SM		6 13 22	35								
20														

NOTES

GROUND WATER LEVELS
AT TIME OF DRILLING 6 ft 0 in
*48 Hrs AFTER 4 ft 0 in

(Continued Next Page)

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BORING B-2

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements

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	Dense to medium dense, Yellowish brown to gray to dark gray fine SAND with silt, poorly graded.	SP-SM		4 5 8	13								
30	9				8 6 8	14								
35	10	Medium dense, Dark gray clayey fine SAND, poorly graded.	SC		2 3 5	8								
		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 6 ft 0 in

*48 Hrs AFTER 4 ft 0 in

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Meskel & Associates Engineering

BORING B-3

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 2/15/16 **COMPLETED** 2/15/16 **BORING LOCATION** Rampart Rd -Electrical Bldg. (See Boring Location Plan)
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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		Gravel (rock fragments) (4 1/2")												
	1	Medium dense, Light gray to dark brown fine SAND, poorly graded.	SP		5 6 6	12								
	2	Loose, Dark brown fine SAND with silt, poorly graded.	SP-SM		2 3 3 4	6								
		Loose, Pale brown fine SAND with silt, poorly graded.	SP-SM											
5	3	Medium dense, Grayish brown to reddish brown to yellowish brown clayey fine SAND, poorly graded.	SM		2 3 5 7	8								
	4	*▽ ▽			6 6 7 15	13								
	5	Medium dense, Gray clayey fine SAND, poorly graded.	SC		6 12 11 8	23								
10														
15	6				2 3 5	8	20	28						
20	7	Medium dense, Grayish brown to gray to dark gray fine SAND, poorly graded.	SP-SM		5 6 10	16								

NOTES

GROUND WATER LEVELS
▽ **AT TIME OF DRILLING** 7 ft 10 in
*▽ **48 Hrs AFTER** 7 ft 4 in

(Continued Next Page)

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BORING B-3

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements

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
20–33.5		Medium dense, Grayish brown to gray to dark gray fine SAND, poorly graded.	SP-SM											
25	8				7 3 7	10								
30	9				5 8 8	16								
35	10	Medium dense, Dark gray clayey fine SAND, poorly graded.	SC		3 4 5	9								
		Bottom of borehole at 35 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 7 ft 10 in

*48 Hrs AFTER 7 ft 4 in

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Meskel & Associates Engineering

BORING B-4

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 2/15/16 **COMPLETED** 2/15/16 **BORING LOCATION** Rampart Rd -Force Main (See Boring Location Plan)
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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	1	Medium dense, Gray to dark gray fine SAND with gravel (rock fragments), poorly graded. Medium dense, Light gray to dark brown fine SAND, poorly graded.	SP		3 5 10 10	15								
	2	Medium dense, Dark brown fine SAND with silt, poorly graded. Medium dense, Pale brown fine SAND with silt, poorly graded.	SP-SM SP-SM		5 4 4 4	8								
5	3	Medium dense, Reddish brown to yellowish brown clayey fine SAND, poorly graded.	SC		2 4 4 5	8	15	26						
	4	Medium dense, Grayish brown to reddish brown to gray clayey fine SAND, poorly graded.	SC		4 6 10 13	16								
10	5				4 8 6 4	14								
15	6				8 8 8	16								
		Bottom of borehole at 15 feet.												

NOTES

GROUND WATER LEVELS
AT TIME OF DRILLING 6 ft 0 in
*48 Hrs AFTER 4 ft 5 in

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BORING B-5

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements
PROJECT LOCATION Jacksonville, Florida **CLIENT** CDM Smith, Inc.
DATE STARTED 2/17/16 **COMPLETED** 2/17/16 **BORING LOCATION** Argyle Forest (See Boring Location Plan)
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **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")												Penetrometer Readings 1 1 3 4 4 5 6 12
	1	*▽ ▽ Loose, Very dark gray fine SAND with silt, trace organic fines, poorly graded.	SP-SM			*	31	9	1.5					
	2	Medium dense, Dark gray to gray silty fine SAND, poorly graded.	SM			*								
5	3				3 4 5 3	9								
	4				5 2 7 8	9								
10	5				3 4 7 7	11								
15	6	Medium dense, Grayish brown fine SAND with silt, poorly graded.	SP-SM		7 10 12	22								
20	7	Loose, Gray silty fine SAND, poorly graded.	SM		2 3 4	7								
25	8	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		6 8 6	14								

Bottom of borehole at 25 feet.

NOTES Boring Advanced by hand due to possible utility conflicts
* Hand Cone Static Penetrometer used to estimate soil relative density.

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 1 ft 4 in *▽ **END OF DAY** 1 ft 0 in

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BORING DRI-1

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements

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

DATE STARTED 2/18/16 **COMPLETED** 2/18/16 **BORING LOCATION** Rampart Rd (See Boring Location Plan)

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Hand Auger

LOGGED BY P.R.Young **CHECKED BY** P.R.Mank **GROUND ELEVATION** — **HAMMER TYPE** —

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
0.0		Topsoil (6")												
	1	Gray fine SAND, poorly graded.	SP											
2.5	2, 3	Grayish brown to pale brown fine SAND with silt, poorly graded. ▽	SP-SM				13	12						
5.0	4	Grayish brown to yellowish brown clayey fine SAND, poorly graded.	SC				19	34						
		Bottom of borehole at 6 feet.												

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 3 ft 10 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, "Penetration Test 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 our engineer in order to verify the field classification.

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 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

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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%

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Appendix B

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SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0011-0016

PROJECT NAME JEA Argyle Forest, Rampart Road Pump Station Improvements **DATE.** 3/1/2016

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

Borehole	Sample No	Approx. Depth	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification	Comments
B-1	3	5	31	19	---	32	15	17	SC	
B-2	2	3	8	20	---	---	---	---	SP-SM	
B-3	6	14	28	20	---	---	---	---	SC	
B-4	3	5	26	15	---	---	---	---	SC	
B-5	1	1	9	31	1.5	---	---	---	SP-SM	
DRI-1	2	2	12	13	---	---	---	---	SM	
DRI-1	4	5	34	19	---	---	---	---	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.

Appendix C

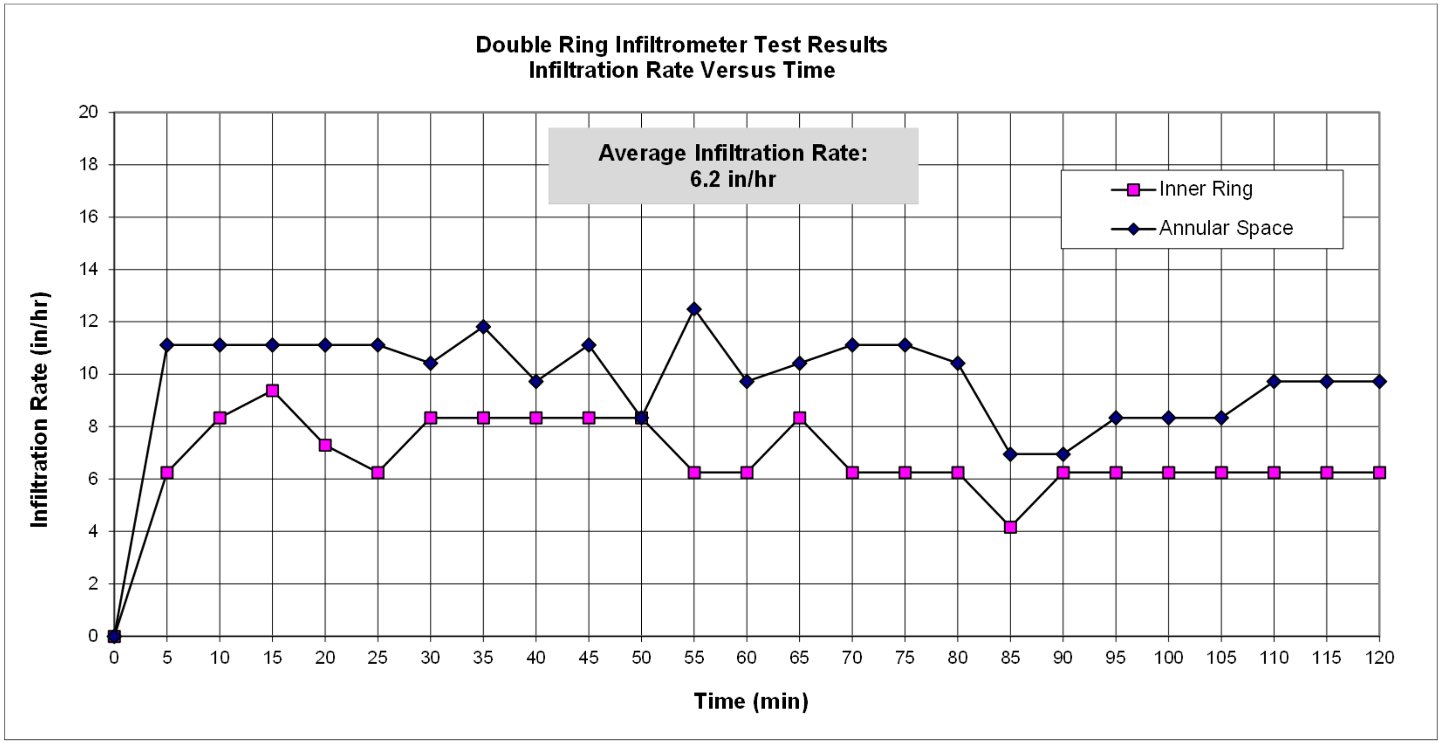
Double Ring Infiltrometer Test Summary Sheet

ASTM D3385

Project Name: **JEA Argyle Forest, Rampart Rd Pump Station Improvements**
Jacksonville, Florida

Test Location: **DRI-1**

			Test No.:	DRI-1
Groundwater Depth:	3.8'	feet	**Date Performed:**	2/18/2016
Test Depth:	2.0	feet	**Performed by:**	PR Young
Soil Description:	See Boring log DRI-1		**MAE Project No.:**	0011-0016



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FIELD EXPLORATION PROCEDURES

Double-Ring Infiltrometer Test

The Double-Ring Infiltrometer test was performed in the field in general accordance with the procedures outlined in the latest revision of ASTM D 3385, "Infiltration Rate of Soils in Field using Double-Ring Infiltrometers." The test location was initially cleared of all surface vegetation and topsoil, excavated to the desired test depth and then leveled. The outer ring, approximately 24 inches in diameter, was driven to a depth of 6 inches below the test depth. The inner ring, approximately 12 inches in diameter, was inserted inside the outer ring, centered, and driven to a depth of approximately 2 inches below the test depth. A thin layer of gravel was placed on the exposed soils inside the rings at the test level. The two rings were filled simultaneously with 4 inches of water.

This water level maintained throughout the test period, with the required amount of water added to maintain this level in both rings recorded at time intervals of five minutes. After reaching a stabilized inflow volume of water, the test was continued for approximately 120 minutes. To determine the infiltration rate, the volume of water used during the stabilized flow period for the inner ring, the annular space and both rings combined is converted to the depth of water per unit of time (e.g., in inches per hour).