AREHNA | Engineering, Inc.

REPORT OF GEOTECHNICAL EXPLORATION

I-75 & SR-70 FORCE MAIN REPLACEMENT
MANATEE COUNTY, FLORIDA

AREHNA PROJECT NO. B-19-017.05 Rev1
April 1, 2019
Revised Report: March 5, 2020

Prepared For:
Ayres & Associates, Inc.
8875 Hidden River Parkway, Suite 200
Tampa, FL 33637-1038

Prepared By:
AREHNA Engineering, Inc.
5012 West Lemon Street
Tampa, Florida 33609

AREHNA | Engineering, Inc.

5012 West Lemon Street
Tampa, Florida 33609
Ph 813.944.3464 | Fax 813.944.4959

April 1, 2019
Revised Report: March 5, 2020

Mr. Christopher Martin, P.E.
Ayres & Associates, Inc.
8875 Hidden River Parkway, Suite 200
Tampa, FL 33637-1038

MartinC@AyresAssociates.com

Subject: **Report of Geotechnical Exploration**
I-75 & SR-70 Force Main Replacement
Manatee County, Florida
Manatee County Project No. WW01710
AREHNA Project No. B-19-017.05 Rev1

Dear Mr. Martin,

AREHNA Engineering, Inc. (AREHNA) is pleased to submit this report of our geotechnical exploration for the proposed project. Services were conducted in general accordance with AREHNA Proposal B-18-159 dated December 28, 2018 and Proposal B.Prop-19-164.Rev dated December 6, 2019. The purpose of our geotechnical study was to obtain information on the general subsurface conditions for the proposed installation of approximately 670 linear feet of 16-inch diameter force main.

This report presents our understanding of the project, outlines our exploratory procedures, and documents the field data obtained.

AREHNA appreciates the opportunity to have assisted Ayres & Associates, Inc. on this project. Should you have any questions with regards to this report, or if we can be of any further assistance, please contact this office.

Best Regards,

AREHNA ENGINEERING, INC.
FLORIDA BOARD OF PROFESSIONAL ENGINEERS CERTIFICATE OF AUTHORIZATION NO. 28410

This item has been digitally signed and sealed by:
Digitally signed by Kristina S LaCava
Date: 2020.03.05 11:59:49 -05'00'

Kristina LaCava, P.E.
Geotechnical Engineer
Florida Registration 77594
on the date adjacent to the seal.
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Annabella C. Hullen. E.I.
Staff Geotechnical Engineer

Distribution: 1 – Electronic Submittal
1 – File

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APPENDIX

1.0 PROJECT INFORMATION AND SCOPE OF WORK

1.1 SITE DESCRIPTION AND PROJECT CHARACTERISTICS

The project consists of the installation of approximately 670 linear feet of 16-inch diameter force main downstream of the Master Lift Station (MLS) 39-A (RTU 428), under I-75, where a hydraulic bottleneck exists. The project site is located at I-75 and 41st Avenue E/Lena Road in Bradenton, Florida; as indicated on the **Project Location Map, Figure 1** in the **Appendix**. The project will use horizontal directional drilling (HDD) installation methods.

1.2 SCOPE OF WORK

The purpose of our geotechnical study was to obtain information on the general subsurface conditions at the proposed project site. The subsurface materials encountered were evaluated with respect to the available project characteristics. The following services were performed:

- Requested utility location services from Sunshine811.
- Performed three Standard Penetration Test (SPT) borings to depths 30 feet. Samples were collected, and Standard Penetration Test resistances were measured at approximate intervals of two feet for the top ten feet, and five feet thereafter. The upper four feet were manually augered to avoid any possible conflicts with buried utilities.
- Visually classified and stratified the soil samples in the laboratory using the Unified Soil Classification System.
- Reported the results of the field exploration and engineering analysis. The results of the subsurface exploration are presented in this report signed and sealed by a professional engineer specializing in geotechnical engineering.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

Based on email communication dated November 11, 2019 the SPT borings needed to be extended to a minimum of 30 feet. Our original scope included performing three Standard Penetration Test (SPT) borings extending to depths of approximately 15 feet.

The SPT borings were performed with the use of a Power Drill Rig using Bentonite "Mud" drilling procedures. Samples were collected and Standard Penetration Test resistances were measured at approximate intervals of two feet for the top ten feet and at approximate intervals of five feet thereafter. The soil sampling was performed in general accordance with ASTM Test Designation D-1586, entitled "Penetration Test and Split-Barrel Sampling of Soils."

Representative portions of these soil samples were sealed in glass jars, labeled and transferred to AREHNA's Tampa office for appropriate classification by a Geotechnical Engineer.

The SPT boring locations are indicated on the **Field Exploration Location Plans, Figure 2** in the **Appendix** of this report**.** The SPT borings were located in the field by measuring off of existing features and GPS Coordinates.

2.2 LABORATORY TESTING

The laboratory testing program consisted of natural moisture content, percent fines, and Atterberg limits performed on representative samples. The results are presented in **Table 1** in the **Appendix.**

3.0 SUBSURFACE CONDITIONS

3.1 USGS TOPOGRAPHIC DATA

The topographic survey map published by the United States Geological Survey and the existing survey information of the site was reviewed for ground surface features at the proposed project location (**Figure 3**). Based on this review, natural ground surface elevations at the project site range between approximately +25 to +30 feet.

3.2 USDA NATURAL RESOURCES CONSERVATION SERVICE DATA

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) survey for Manatee County indicates that the soils at the project site consist of the following soil units:

Soil Unit Number	Soil Name	Depth to High Water Table (feet)
20	EauGallie fine sand, 0 to 2 percent slopes	0.5 – 1.5
26	Floridana – Immokalee – Okeelanta association	+2 – 0

The soil survey also indicates that the average annual precipitation is 42 to 58 inches. The soils encountered in our SPT borings are generally consistent with the soil units listed above. The USDA Soil Survey map for the project site is attached as **Figure 4** in the **Appendix.**

3.3 SUBSURFACE CONDITIONS

The Boring Profiles on **Figure 5** in the **Appendix** should be consulted for a detailed description of the subsurface conditions encountered at each boring location. When reviewing the boring records and the subsurface profiles, it should be understood that soil conditions may vary between and away from boring locations.

The SPT borings generally encountered very loose to dense fine sands (SP, SP-SM, SM, SC) from the existing ground surface to the termination depths of 30 feet. Boring B-02 encountered stiff sandy clay (CL) from 13 feet a depth of 15 feet. Trace shell, limerock and phosphate fragments were occasionally encountered in the SPT borings. Standard Penetration Test resistances (N-Values) ranged between 1 and 34 blows per foot for the sandy soils and an N-value of 11 blows per foot was recorded for the clay soil in boring B-02.

3.4 GROUNDWATER CONDITIONS

The groundwater level was encountered in the SPT borings at depths between 3.5 to 5 feet. Fluctuation in ground water levels should be expected due to seasonal climatic changes, tidal changes, construction activity, rainfall variations, surface water runoff, and other site-specific factors. Since ground water level variations are anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based on the assumption that variations will occur.

3.5 ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL

Based on the mapping performed by the USDA, soils information obtained from the site and our experience in the area, we estimate that the seasonal high groundwater level will be encountered at an approximate depth of 1.5 feet below the existing ground surface.

4.0 GENERAL SITE PREPARATION

4.1 GENERAL

Site preparation includes stripping, excavation, backfilling, and compaction.

The HDD installation operation is the responsibility of the specialty contractor (i.e. the selection of HDD equipment and operation procedures are the choices of the specialty contractor). We have provided generic guidelines for HDD operation below. Our generic installation recommendations have been based on the site conditions encountered during our geotechnical investigation. AREHNA should be notified is the site conditions are different then stated in this report, so we may modify or amend our recommendations.

Soil parameters for each soil layer encountered in each SPT boring performed are shown on **Table 2** in the **Appendix**. These soil parameters should be used in the HDD design.

4.2 ON-SITE SOIL SUITABILITY

The borings indicate that sandy soils classified as SP-SM based on the Unified Soil Classification System are present at the site to depths of up to 13 feet and are suitable for use as backfill material. The clay (CL) soils encountered at a depth of 13 to 15 feet in boring B-02 are not suitable for use as backfill.

Suitable structural fill materials should consist of fine to medium sand with less than 12 percent passing the No. 200 sieve and be free of rubble, organics, clay, debris, and other unsuitable material. Any off-site materials used as fill should be approved by AREHNA prior to acquisition.

4.3 HORIZONTAL DIRECTIONAL DRILLING

Based on the SPT borings performed, the subsurface materials generally consist of very loose to dense fine sands (SP, SP-SM, SM, SC). Stiff sandy clay (CL) was also encountered at a depth of 13 feet in boring B-02. The encountered sandy soils have a potential for caving. Soil parameters for use in the HDD design software are presented on **Table 1** in the **Appendix**.

Drilling Fluid - Drilling fluid should be used during drilling and back-reaming operations. Due to the sandy soils encountered during our investigation it is recommended that the drilling fluid be composed of clean water and bentonite. Other appropriate additives should be added at the discretion of the specialty contractor. The drilling fluid should be mixed thoroughly and be absent of any clumps or clods. Further, the drilling fluid should not be recycled and should be hauled off the site.

Heaving Potential - The soils encountered in our investigation have a low heaving potential. However, heaving may occur when attempting to back-ream too large of a hole. To minimize heaving, reaming process should be completed leaving the bored hole at full design diameter during pullback. The pullback barrel reamer should be no larger than the design bored diameter. The pullback rate should minimize

overcutting of the borehole so that excessive voids are reduced and post installation settlement may be minimized.

Monitoring – The drilling and installation operations should be monitored continuously by experienced personnel trained in all aspects of directional drilling process. These procedures include accurate monitoring and control system to track the progress and exact location of the drilling head at all times. The drilling operator should maintain record on drilling fluid pumping rates, pressures, viscosity and density, etc. throughout the entire course of drilling activities.

Horizontal and vertical adjustments should be made throughout the procedure so that the drilling profile matches the planned profile. The specific weight of the drilling fluid should be adjusted throughout the process to maintain hydrological stability. Jetting pressures should be limited to avoid drilling fluid release during drilling. However, should release of drilling fluid in the project area occur, operations should stop immediately and measures should be taken to contain release. Generic measures may include the following:

- If release is detected, the drilling crew should take immediate corrective action to contain the release and to prevent migration offsite.
- Pits and/or berms should be constructed around the borehole entry point to contain drilling fluid and return.
- Containment equipment, including earth moving equipment, portable pumps, hand tools, sandbags, hay bales, silt fencing, lumber, and vacuum trucks, should be stored and readily available at the drilling site.
- Any drilling seepage should be removed using a vacuum truck and then transported to an approved disposal site.

4.4 EXCAVATION AND BACKFILL

Excavations, whether they be utility trenches, basement excavations, or footing excavations, should be constructed in accordance with the new OSHA guidelines. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in all local, state, and federal safety-regulations.

The soils encountered are consistent with AASHTO Class C soils and will not stand vertically in an open excavation below the ground water level. Soil should not be stockpiled adjacent to excavations unless the stockpile has been included in the analyses of the excavation stability.

Excavations below the groundwater level will likely require a combination of sanded wellpoints and pumping from filtered sumps.

Any and all excavations should be backfilled with compacted fill. Fill should generally consist of dry fine sand with less than 12 percent passing the No. 200 sieve and be free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition. Approved sand fill should be placed in loose lifts not exceeding 12 inches in thickness and should be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). Prior to beginning compaction, soil moisture contents should be adjusted in order to facilitate proper compaction. A moisture content within 2 percentage points of the optimum indicated by the Modified Proctor Test (ASTM D-1557) is recommended prior to compaction of the fill.

4.5 DEWATERING

Construction activities should be accomplished in the "dry" with ground water levels maintained at least 1 foot below the deepest portion of any excavation. The groundwater level was encountered at depths between 3.5 and 5 feet in the SPT borings performed. Therefore, depending on the time of year construction is performed, dewatering may be required for excavations deeper than 3 feet. Dewatering can be accomplished using a sanded wellpoint system supplemented by a gravel bottom layer and pumping from a sump. Actual dewatering means and methods should be the responsibility of the contractor.

Groundwater fluctuations will likely occur due to seasonal variations, runoff, and other factors and should be considered when planning earthwork activities. The impact of runoff from adjacent properties, nearby water bodies, and other site-specific conditions which may affect groundwater recharge are beyond the scope of this exploration and should be considered when planning and designing a dewatering system.

4.6 PIPELINE BEDDING

We recommend the pipeline be supported on a bedding layer consisting of at least 6 inches of granular soils meeting the previous requirements for structural fill. Any utilities 3 feet or greater in diameter should be supported on at least 12 inches of structural fill/granular soils. The bedding layer should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557).

4.7 GENERAL CONSTRUCTION MONITORING AND TESTING GUIDELINES

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable exposed in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils and to determine if the fill material is acceptable.

A representative number of in-place field density testes should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained. We recommend that at least one density test be performed for every lift of backfill and for every 100 lineal feet of trench.

5.0 BASIS FOR RECOMMENDATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the location indicated. Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions across site will be different from those encountered where the boring was drilled, and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process itself may alter soil conditions. AREHNA is not responsible for the conclusions, opinions or recommendations made by others based on the data presented in this report.

APPENDIX

Project Site Location Map – Figure 1
Field Exploration Location Plan – Figure 2
USGS Topographic Survey – Figure 3
USDA Soil Survey - Figure 4
Soil Profiles – Figure 5
Summary of Laboratory Test Results – Table 1
Summary of Soil Parameters – Table 2
Field and Laboratory Procedures

PROJECT SITE LOCATION MAP

AREHNA | Engineering, Inc.
5012 West Lemon Street, Tampa, FL 33609
Phone 813.944.3464 | Fax 813.944.4959
Certificate of Authorization No. 28410

DATE	PROJECT NAME	PROJECT NO.	FIG NO.
03/2019	MANATEE COUNTY POTABLE WATER I-75 and S.R. 70 BRADENTON, FLORIDA	B-19-017.005	1

FIELD EXPLORATION LOCATION PLAN

0 150'

APPROXIMATE PLAN SCALE

LEGEND

B-X Approximate Location of SPT Boring

REVISIONS			
NO.	DATE	DESCRIPTIONS	APPROVED

PREPARED BY:

AREHNA | Engineering, Inc.
5012 West Lemon Street, Tampa, FL 33609
Phone 813.944.3464 | Fax 813.944.4959
Certificate of Authorization No. 28410

	NAME	DATE
DESIGNED BY:	BRH	03/2019
DRAWN BY:	BRH	03/2019
CHECKED BY:	AC	03/2019
SUPERVISED BY:	Kristina LaCava, P.E.	

PROJECT NAME	PROJECT NO.	FIGURE NO.
MANATEE COUNTY POTABLE WATER I-75 and S.R. 70 BRADENTON, FLORIDA	B-19-017.005	2

USGS TOPOGRAPHIC SURVEY

0 N.T.S.

APPROXIMATE PLAN SCALE

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Phone 813.944.3464 | Fax 813.944.4959
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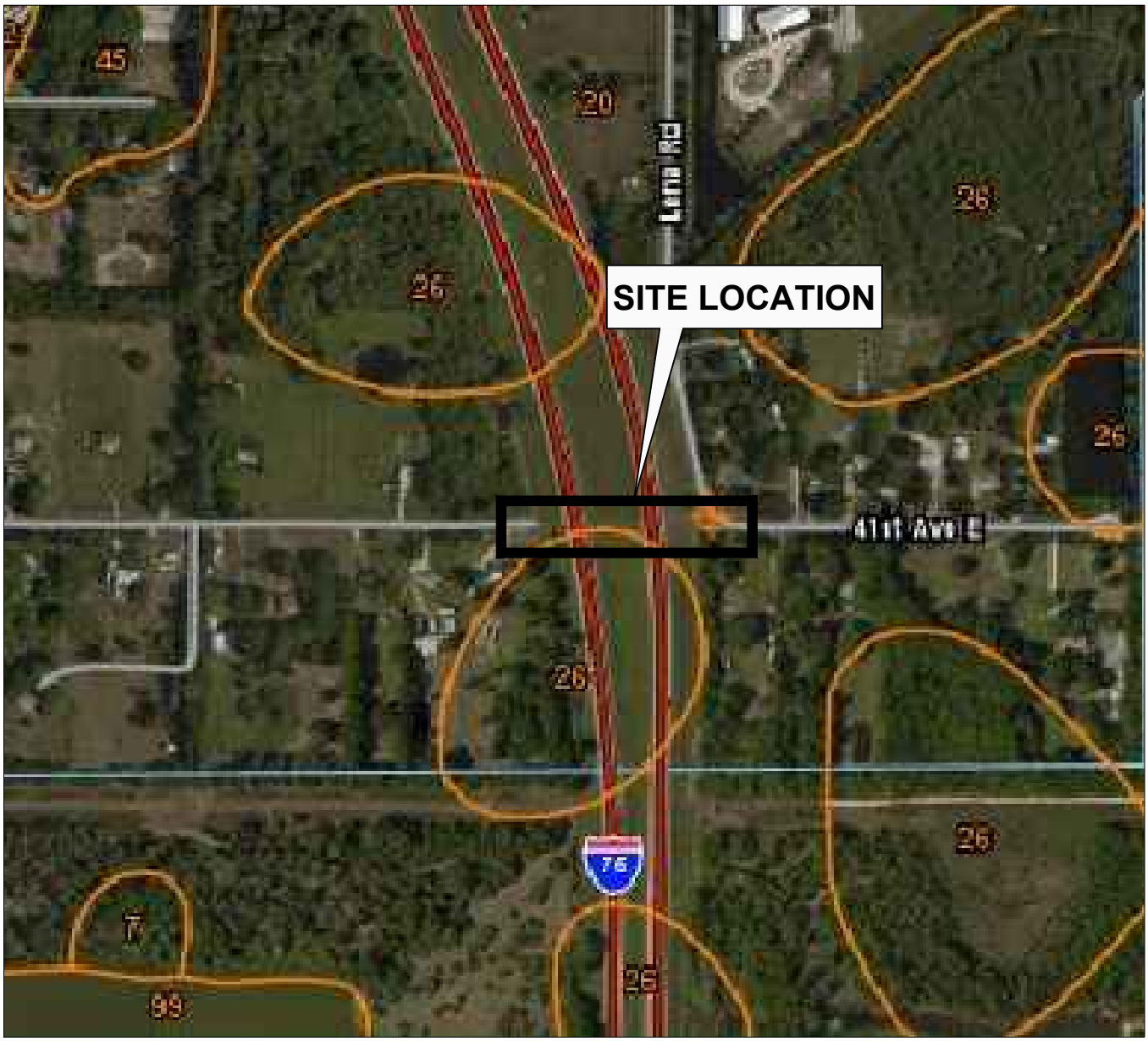
DATE	PROJECT NAME	PROJECT NO.	FIG NO.
03/2019	MANATEE COUNTY POTABLE WATER I-75 and S.R. 70 BRADENTON, FLORIDA	B-19-017.005	3

USDA SOIL SURVEY

0 N.T.S.

APPROXIMATE PLAN SCALE



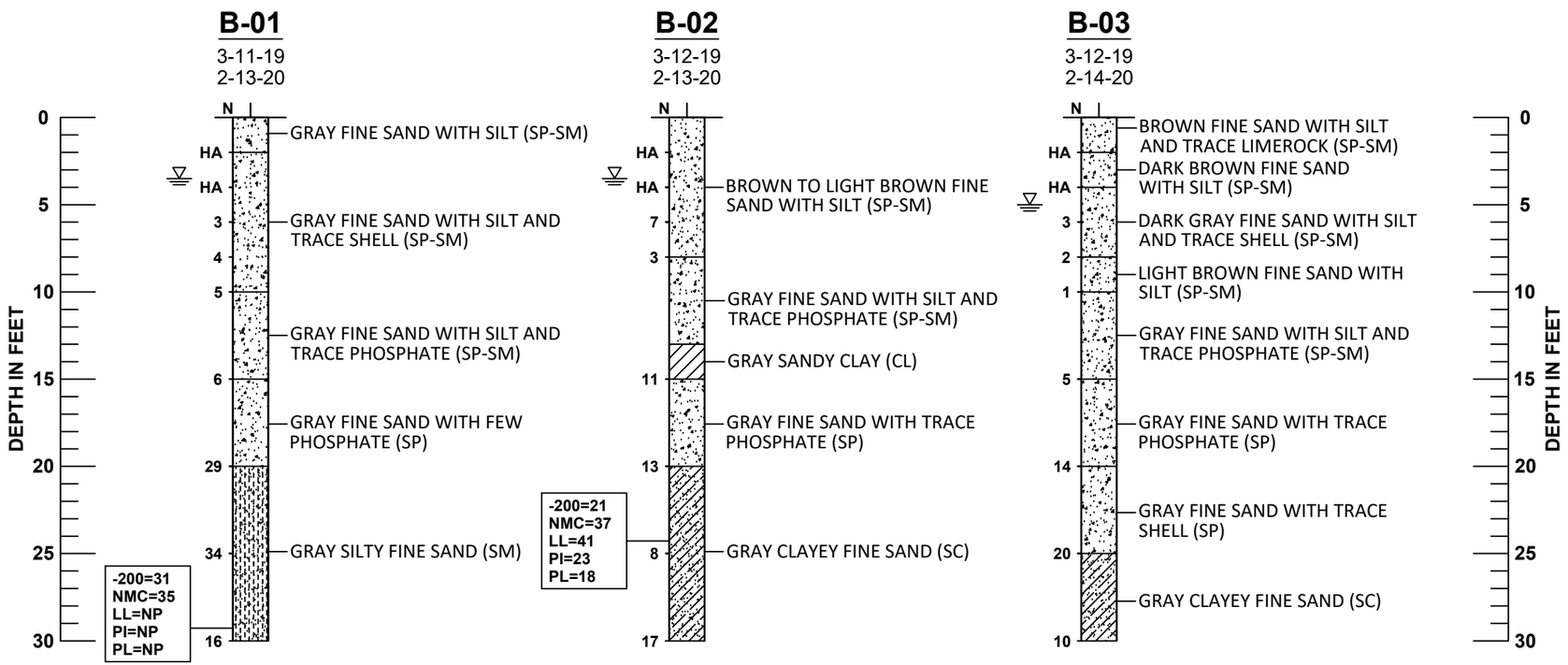
SOIL MAPPING UNITS

20—EauGallie fine sand, 0 to 2 percent slopes
26—Floridana-Immokalee-Okeelanta association

AREHNA | Engineering, Inc.
5012 West Lemon Street, Tampa, FL 33609
Phone 813.944.3464 | Fax 813.944.4959
Certificate of Authorization No. 28410

DATE	PROJECT NAME	PROJECT NO.	FIG NO.
03/2019	MANATEE COUNTY POTABLE WATER I-75 and S.R. 70 BRADENTON, FLORIDA	B-19-017.005	4

SOIL PROFILES



LEGEND

- FINE SAND (SP/SP-SM)
- SILTY SAND (SM)
- CLAY (CL)
- CLAYEY SAND (SC)

SP	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2488) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND/OR LABORATORY TESTING
▽	GROUNDWATER TABLE AT THE TIME OF DRILLING
N	SPT N-VALUE IN BLOWS/FOOT FOR 12 INCHES OF PENETRATION UTILIZING AUTOMATIC HAMMER (UNLESS OTHERWISE NOTED)
HA	HAND AUGERED TO AVOID UTILITY CONFLICTS AND SAFETY REASONS
-200	FINES PASSING THE #200 STANDARD SIEVE (%)
NMC	NATURAL MOISTURE CONTENT (%)
LL	LIQUID LIMIT (%)
PI	PLASTICITY INDEX (%)
PL	PLASTICITY LIMITS (%)
NP	NON PLASTIC

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM DENSE	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	16 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24
LIMESTONE CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
SOFT	LESS THAN 20	LESS THAN 17
MEDIUM	20 to 50	17 to 41
HARD	51 to 50/3"	42 to 50/6"
VERY HARD	GREATER THAN 50/3"	GREATER THAN 50/6"

Soil Profile Notes:

1. The profiles depicted are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The soil profiles include soil description, stratifications and penetration resistances. The stratifications shown on the boring profiles represent the conditions only at the actual boring location. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual.
2. Groundwater levels generally fluctuate during periods of prolonged drought and extended rainfall and may be affected by man-made influences. In addition, a seasonal effect will also occur in which higher groundwater levels or temporary perched conditions are normally recorded in rainy seasons.
3. The Boring Locations Presented are Approximate and Based on Hand Held GPS with an Accuracy of +/- 10 Feet.

REVISIONS			
NO.	DATE	DESCRIPTIONS	APPROVED

PREPARED BY:
AREHNA | Engineering, Inc.
5012 West Lemon Street, Tampa, FL 33609
Phone 813.944.3464 | Fax 813.944.4959
Certificate of Authorization No. 28410

	NAME	DATE
DESIGNED BY:	BRH	03/2019
DRAWN BY:	BRH	03/2019
CHECKED BY:	AC	03/2019
SUPERVISED BY:	Kristina LaCava, P.E.	

BORING PROFILE	PROJECT NO.	FIGURE NO.
MANATEE COUNTY POTABLE WATER I-75 and S.R. 70 BRADENTON, FLORIDA	B-19-017.005	5

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS
I-75 & SR-70 Force Main Replacement
Manatee County, Florida
AREHNA Project No. B-19-017-.005 Rev1

Boring No.	Sample Depth (feet)	#200	Atterberg Limits (%)			Natural Moisture Content (%)
			LL	PL	Plasticity Index	
B-01	28.5 - 30.0	31	NP	NP	NP	35
B-02	23.5 - 25.0	21	41	18	23	37

TABLE 2
SUMMARY OF SOIL SOIL PARAMETERS
I-75 & SR-7 Force Main Replacement
Manatee County, Florida
AREHNA Project B-19-017.005 Rev1

BORING NUMBER	DEPTH (FEET)	SPT "N" AVERAGE	SOIL CLASSIFICATION	APPROXIMATE SOIL UNIT WEIGHT (PCF)		COHESION (PSF)	SOIL ANGLE OF FRICTION (DEGREES)	EARTH PRESSURE COEFFICIENT		SHEAR MODULUS G (ksi)
				γ SAT	γ SUB			Ka	Kp	
B-01	0 - 15	4	SP-SM	100	37.6	-	29	0.35	2.86	0.25
	15 - 30	26	SP, SP-SM	115	52.6	-	33	0.29	3.42	0.92
B-02	0 - 13	4	SP-SM	100	37.6	-	29	0.35	2.86	0.27
	13 - 15	11	CL	115	52.6	1375	-	1.00	1.00	1.78
	15 - 30	13	SP, SM	105	42.6	-	31	0.33	3.07	0.46
B-03	0 - 15	3	SP-SM	100	37.6	-	28.6	0.35	2.84	0.19
	15 - 30	15	SP, SC	105	42.6	-	31	0.32	3.12	0.53

FIELD PROCEDURES

Standard Penetration Test (SPT) Borings

The SPT borings are performed in general accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils." A rotary drilling process is used and bentonite drilling fluid is circulated in the boreholes to stabilize the sides and flush the cuttings. At regular intervals, the drilling tools are removed and soil samples are obtained with a standard 2-feet long, 2-inch diameter split-tube sampler. The sampler is first seated 6 inches and then driven an additional foot with blows of a 140-pound hammer falling under its own weight a distance of 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance." The penetration resistance, when properly interpreted, is an index to the soil strength and density.

LABORATORY PROCEDURES

Water Content

The water content is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the solid particles. This test is conducted in general accordance with FM 1-T265.

Percent Organics (Organic Loss on Ignition)

The amount of organic material in a sample is determined in this test. The sample is first dried and weighed, then ignited and reweighed. The amount of organic material is expressed as a percentage of the total dry weight of the sample prior to ignition. This test is conducted in general accordance with FM 1-T267.

Atterberg Limits (Plasticity)

A soil's Plasticity Index (PI) is the numerical difference between the Liquid Limit (LL) and the Plastic limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in general accordance with ASTM D-4318. The PL is the moisture content at which the soil begins to crumble when rolled into a small thread and is also determined in general accordance with FM 1-T 90.

Fines Content

In this test, the sample is dried and then washed over a No. 200 mesh sieve. The percentage of soil by weight passing the sieve is the percentage of fines or portion of the sample in the silt and clay size range. This test is conducted in general accordance with ASTM D-1140.