EAC CONSULTING, INC

Vogel Marine Park Facility
North Bay Village
Miami-Dade County, FL
GCES Project No. G10201005-2

Geotechnical Engineering Services

Report of Subsurface Exploration

GCES ENGINEERING SERVICES, LLC
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March 19, 2021
(Rev May 12, 2021)

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March 19, 2021 (Revised May 12, 2021)

Evelyn Rodriguez, P.E., ENV SP
Assistant Project Manager
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Miami, FL 33126

Subject: Geotechnical Engineering Services
Report of Subsurface Exploration
Vogel Marine Park Facility
North Bay Village, Miami-Dade County, FL
GCES Project Number G10201005-2

Dear Evelyn:

GCES Engineering Services, LLC (GCES) has completed the Geotechnical Report for the North Bay Village Vogel Marine Park Facility Assessment for the above referenced project. This work was performed as authorized in our agreement with EAC Consulting, Inc.

The report presents the results of our field exploration and laboratory testing programs along with our geotechnical data for use in design of the proposed seawalls.

We appreciate the opportunity to provide our services on this project. If you have any questions concerning the information provided, please do not hesitate to contact our office.

GCES ENGINEERING SERVICES, LLC

Dhayana Chacon
Engineering Staff

Alejandro R. Montenegro, P.E.
Senior Geotechnical Engineer
Florida PE # 59426

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5/12/21

C:\G10201005 - North Bay Village – Vogel Marine Park Facility Assessment

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1.0 INTRODUCTION

1.1 GENERAL

GCES Engineering Services. LLC, (GCES) has completed the subsurface exploration for the proposed police boat dock and Kayak at Vogel Marine Park in North Bay Village, Miami-Dade County, Florida.

This report describes the subsurface conditions encountered in the boring, analyzes and evaluates the field and laboratory test data, and provides geotechnical information for the design of the proposed police boat dock and Kayak.

1.2 PROJECT LOCATION

The subject sites is located at 7920 West Dr in North Bay Village, FL. We have appended a project Vicinity Map, Figure 1, which identifies the location of each study area. This map is presented in Appendix A.

1.3 PROJECT DESCRIPTION

GCES understands that the project consists of a police boat dock and a new kayak launch at Vogal Park. We have assumed the police boat dock and the kayak launch will be a permanent concrete platform structure on the water supported by piles. Ground surface and mud elevations at the boat dock and kayak locations were provided by EAC and prepared by Sea Diversified Inc, dated March 2021. Based on the elevations shown on the drawings, the ground surface elevation at the boring location is approximately at El. +4.5 (NAVD 88).

If any of our understandings is not correct or if the structure differs from the characterization we have provided in this report, please inform us immediately so that we may re-evaluate our analyses.

2.0 SCOPE OF SERVICES

Our services for this project consisted of providing the following geotechnical engineering services:

- Conducted a field reconnaissance prior to the subsurface exploration.

- Assessed conditions with respect to the drilling equipment access, general topographic site conditions, property restrictions, overhead utilities, and utility underground.

- Marked the boring location in the field by GCES personnel using layout procedures.

- Coordinated with utility locating service to locate utilities within rights-of-ways and easements for the boring.

- Reviewed of available subsurface test data, such as the "Soil Survey of Miami-Dade County, Florida" published by the United States Department of Agriculture (USDA).

- Performed one Standard Penetration Test (SPT) boring withing the existing park to a depth of 40 feet deep below existing grades.

- Visually classified soil samples using the Unified Soil Classification System (USCS) and performed laboratory tests on selected representative samples to evaluate the physical and engineering properties of the strata observed.

- Provide estimated soil design parameters (i.e. unit weights, angle of friction and earth pressure coefficients) for use in pile design.

- Reviewed field and laboratory data, then prepared an engineering report summarizing our field and laboratory testing, subsurface soil and groundwater conditions for design of the proposed structure.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 STANDARD PENETRATION TEST (SPT)

GCES's field exploration consisted of performing one (1) Standard Penetration Test (SPT) boring, B-1 to a depth of 40 feet below existing grade for the proposed seawalls. The field exploration was conducted on March 11, 2021.

The boring was performed in an area accessible to our drilling equipment and in area that was not conflicting with existing underground utilities.

The SPT boring was performed using a truck-mounted drill rig equipped with a calibrated automatic hammer. The borehole was advanced using drilling mud techniques and casing. The boring was performed in general accordance with ASTM Standard D-1586.

The SPT boring was continuously sampled in the upper 10 feet. Thereafter, the sampling interval was every 5 feet. The boring was logged by the on-site personnel during the field exploration. Disturbed soil samples were placed in glass jars or sealed plastic bags and returned to our laboratory for additional visual classification by a GCES Engineer. Upon completion of the SPT boring, the borehole was backfilled with cement grout, the surface restored (with cold mix asphalt where applicable), and the site cleaned as required.

The results of the SPT tests are presented on the boing log included in Appendix B. The boring log represent an interpretation of the field log and includes modifications based on a geotechnical engineer's visual classification of the samples returned to the laboratory.

A brief description of the field exploration procedures employed in our subsurface investigation is provided in Appendix C of this report.

3.2 WATER LEVEL MEASUREMENTS

Water level depths were obtained during the test boring operations. In relatively previous soils, such as sandy (granular) soils, the indicated depths are usually groundwater levels. Seasonal variations, tidal conditions, temperature, land use, and recent rainfall conditions may influence the depths of the groundwater.

3.3 LABORATORY TESTING

Representative samples collected from the SPT boring were visually reviewed in the laboratory by a geotechnical engineer to confirm the field classifications. The descriptions of the soils indicated in the boring log are in general accordance with the enclosed General Notes, Unified Soil Classification System (USCS), and American Society of Testing and materials (ASTM-2488).

The classification was based on visual observations, texture, and consistency with the aids of laboratory testing. The tests were performed on selected samples believed to be representative of the materials encountered. Designated group symbols according to the Unified Soil Classification System are given on the boring log.

A summary of the laboratory test results are provided in the Table below.

Summary of Laboratory Tests

TEST BORING #	SAMPLE DESCRIPTION	SAMPLE DEPTH INTERVAL (FEET)	NO. 200 SIEVE PERCENT PASSING (%)	ORGANIC CONTENT (%)	MOISTURE CONTENT (%)	USCS CLASSIFICATION
B-1	Fine SAND, Trace Limerock Fragments	6 -8	9	-	17	SP, FILL
B-1	ORGANIC Silty Fine SAND, Trace Limestone and Shell Fragments	13 -15	-	5	37	OL
B-1	Silty Fine SAND, Trace Limestone Fragments	38 –40	17	-	24	SM

A brief description of the USCS classification system is attached to this report, Appendix C. A brief description of the laboratory testing procedure employed in our subsurface investigation is provided in Appendix C of this report.

4.0 SITE AND SUBSURFACE CONDITIONS

4.1 SITE CONDITIONS

Our understanding of the existing site conditions is based on the information provided to us by EAC Consulting and our observations during the field exploration.

The area where the boring was performed was covered by grass and it appears relatively level. Biscayne bay is situated to the west of the park. The areas adjacent are generally developed and include residential\commercial\office activities.

4.2 SOIL SURVEY

The Soil Surveys of Miami-Dade County, Florida, as prepared by the U.S. Department of Agriculture, Soil Conservation Service (later renamed the Natural Resource Conservation Service), dated 1967, identifies one soil type at and near the subject site as follows:

15 - Urban Land. This map unit is in areas where more than 85 percent of the surface is covered by shopping centers, parking lots, streets, sidewalks, airports, large buildings, houses, and other structures. The natural soil cannot be observed. The soils in open areas, mostly lawns, vacant lots, playgrounds, and parks, are mainly Udorthents.

These soils generally have been altered by land grading and shaping or have been covered with about 18 inches of extremely stony, loamy fill material. Areas of these soils are so small that mapping them separately is impractical. We note that the maximum depth of the survey is six feet.

The soil survey of Miami-Dade County, Florida from 1947 as prepared by the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) was also reviewed. Based on our review, the survey revealed that at the time the survey was conducted, the soils were described as Made Land. This land type was built up from dredging from the bay bottoms in the vicinity of Miami and Miami Beach. Made land is used mainly as building sites for homes, hotels and business establishments.

A USDA Soil Survey Map of the site, Figure 3, is included in Appendix A.

It should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate.

4.3 SUBSURFACE CONDITIONS

4.3.1 REGIONAL GEOLOGY

Miami-Dade County is located in the Coastal Lowlands region of the Florida peninsula. The coastal lowlands consist of nearly level plains, and within Dade County the land surface is generally below Elevation +25 MSL. The surficial soils are comprised of pockets and remnants of Pamlico Sands. The sands are underlain by Miami Limestone (oolitic limestone) followed by limestone and/or sandstone and sand lenses of the Fort Thompson and Tamiami Formations.

The Pamlico Formation is composed of non-fossiliferous, unconsolidated quartz fine sand. Except where outcrops of limestone and man-made fills occur, this formation covers the Miami Limestone. Miami Limestone can be found at or near the surface in the Miami-Dade area. This formation is an oolitic limestone that is generally less than 40 feet thick. It characteristically contains large quantities of ooliths, which are small, spherical particles formed when calcite or aragonite was deposited in concentric layers around a nucleus of some type.

This formation contains solution channels in the limestone which may be up to several feet in diameter at some locations and are filled with quartz fine sand and uncemented calcareous materials. The limestone varies in both thickness and competency within the investigated area. The degree of cementation, and therefore the competency of the rock, was influenced by both the abundance and the type of calcareous material in the original deposit.

The Fort Thompson Formation, which consists of interbedded limestone, sand, and shells, is one of the most productive units within the Biscayne aquifer. It averages 50 to 70 feet in thickness. It typically consists of alternating freshwater and marine sediments, which generally are permeable. The limestone beds in the Fort Thompson Formation can be cavernous and interconnected, thus providing channels through which water can flow.

The Fort Thompson Formation is composed of sediments of variable lithologies. The lithologies include non-fossilferous quartz fine sand, fossilferous quartz sandy limestone, coralline limestone, freshwater limestone and quartz sandstone. These lithologies alternate abruptly in thickness and lateral extent.

4.3.2 STANDARD PENETRATION TEST (SPT)

Our understanding of the subsurface conditions at the project site is derived by performing subsurface explorations, our understanding of geological conditions at the project site, and laboratory testing performed on samples recovered from the project site.

Soil stratification is based on an examination of the recovered soil samples, the laboratory testing, and interpretation of field boring log by a geotechnical engineer or geologist. The stratification lines represent the approximate boundaries between soil types of significantly different engineering properties. The actual transition may be gradual.

In some cases, small variations in properties not considered pertinent to our engineering evaluation may have been abbreviated or omitted for clarity. The logs represent the conditions at the boring location only and variations may occur among the boring.

The stratigraphy generally consists of three (3) distinct strata consisting of an upper layer of granular fill; a middle layer of organic silty sand, which is associated with marine sediments deposited on the former sea floor; and a lower layer consisting of alternating layers of limestone, interbedded limestone/sand, and silty sands. The strata are generalized as shown on the following table:

Generalized Site Stratigraphy

STRATUM	SOIL DESCRIPTION	USCS SOIL CLASSIFICATION
0	TOPSOIL	-
1	Granular FILL comprised of LIMEROCK/SAND/SAND WITH LIMEROCK FRAGMENTS	FILL/SP
2	ORGANIC SILTY SAND	OL
3	LIMESTONE with Fine Sand	
4	SILTY SAND	SM

Standard Penetration Values (N-values) within the upper fill material, Stratum 1, varied from 8 to 18 blows per foot (bpf). A single N-value of 3 bpf was recorded in the in the organic silty fine sand. N values within the Limestone formation, Stratum 3, ranged from 7 to 28 blows For Stratum 4, the sand recorded a single N-value of 8 bpf.

For a more detailed description of the subsurface conditions encountered, please refer to the boring log in Appendix B.

4.4 GROUNDWATER CONDITIONS

Groundwater levels were measured while drilling for the presence and level of groundwater. Groundwater levels observed at these times are indicated on the boring log. During the subsurface exploration, groundwater was observed in each of the soil boring at a depth of about 6 feet (el -1.5) below the existing ground surface.

These groundwater level observations provide an approximate indication of the groundwater conditions existing on the site at the time the boring was drilled. It should be noted that fluctuations in the groundwater table can occur due to seasonal variations, tidal conditions, recent rainfall conditions and other site specific conditions.

5.0 EVALUATIONS AND RECOMMENDATIONS

Based on the results of our study, the subsurface conditions appear to be suitable for the proposed police boat dock and kayak to be constructed at Vogel Marine Park in North Bay Village. We have assumed that the proposed police boat dock and kayak platform will be a concrete platform supported by driven piles.

Based on the information provided in our soil boring, the boring found the presence of very soft buried organic silty sand soils (OL) at a depth of about 12 feet (el – 7.5) and extending to a depth of 15 feet (-10.5) below existing ground surface. Organic content measured in the organic silty sand soils was about 5 percent.

Based on the laboratory results, these organic soils demonstrate very poor engineering characteristics, most notably low strength and high compressibility and are considered unsuitable. The presence of these unsuitable soils should be taken into consideration in the design of the piles.

The transition between the very soft organic silty soils to a limestone formation may be to some extent abrupt. The pile contractor should be ready to perform predrilling at the limestone formation immediately below the organic silty soils in order to achieve the design target depth.

The following sections provide discussions regarding geotechnical recommendations for the construction of a police boat dock and a new kayak.

5.1 PILE SYSTEMS

Driven Precast Concrete Piles may be used to support the lateral and compression load for the proposed police boat dock and kayak platform. The driven piles to support the proposed dock and kayak platform should be installed using a barge to provide access to the pile locations. In order to install the driven piles, predrilling of the medium cemented limestone may be needed.

An evaluation of the field data collected was conducted and geotechnical design parameters were obtained based on the empirical correlations and our experiences. Geotechnical parameters for pile evaluation are provided in the next section of the report

5.2 GEOTECHNICAL DESIGN PARAMETERS

Geotechnical parameters for pile evaluation shown in the table below were derived empirically using established relationships between the SPT "N" values, soil/rock properties, literature review and our local experience. The following strata encountered during the performance of the field exploration program have been assigned geotechnical parameters. The table below presents a summary of the geotechnical parameters for use in pile analysis and design.

SUMMARY OF GEOTECHNICAL DESIGN SOIL/ROCK PARAMETERS

Stratum	Material Type	Approximate Layer Thickness (feet) (*)	Unit Weight (pcf) Total γ	Unit Weight (pcf) Eff. γ'	Friction Angle (Degrees)	Allowable Side Shear, fs (tsf)	Wall Friction Angle, δ (Degrees)	Earth Pressure Coefficients Active Ka	Earth Pressure Coefficients Passive Kp	Earth Pressure Coefficients At-Rest Ko
1	FILL	13.5	115	53	31	-	23	0.32	3.12	0.48
2	ORGANIC SILTY SAND	2	80	18	-	-	-	-	-	-
3	LIIMESTONE	20	120	58	37	(*) 0.5 – 1.0	28	0.25	4.02	0.40
4	SAND	5	108	46	30	0.5	23	0.33	3.00	0.50

Notes:

Depths measured from existing grade at time of boring.
Groundwater shall be assumed at the ground surface for calculation design purposes
Refer to the boring log for Complete Soil Description
At rest earth pressure, K_O, is calculated as 1 - sin Ø for sands.
Friction angle between concrete and soil should be taken as d = 3/4 Ø (NAVFAC DM-7.2)
Limestone layers modeled as sand to sandy gravel for estimation of friction angle, Ø. Friction Angle, φ = N/4 + 33.
Strata 0 is topsoil. This top layer should be ignored for calculation purposes.
(*) Use lower shear value for the weakly limestone layer (22 ft to 28 ft from ground surface level)

6.0 CONSTRUCTION CONSIDERATIONS

The following are our suggestions for the installation of the proposed piles based on the results of the test boring.

It should be noted that pile refusal may occur on a random and unpredictable basis since zones of dense rock/soils may be encountered. In this case, we recommend that predrilling be considered prior to the installation of the piles. Predrilling is required in order to prevent refusal conditions, damage of the structural section of the pile and minimize vibrations-induced settlements to nearby structures. Following predrilling. the piles should be set in place and driven to the required tip elevations.

The pile installation equipment will produce vibration and noise levels that may be considered disturbing to people and can produce vibrations noticeable in structures. The potential for damage to any adjacent structures during the pile installations will be dependent on the distance from the adjacent structures to the location of the piles installation, the subsurface conditions, and the level of sensitivity of the structure to any type of vibration. The recommendations provided in Section 455-1.1 in the latest version of the FDOT Standard Specifications for Road and Bridge Construction should be followed for the protection of the existing structures during sheet piling operations. All those structures and or utilities located adjacent to the proposed excavation shall be surveyed as well as monitored for vibrations and settlements in accordance with Section 455-1.1 of the latest version of the FDOT Standard Specifications for Road and Bridge Construction

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that GCES is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

7.0 ADDITIONAL CONSTRUCTION CONSIDERATIONS

7.1 QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all foundation construction is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by GCES. In-situ density tests should be conducted during backfilling activities to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

8.0 LIMITATIONS

The evaluations presented in this Report of Geotechnical Exploration were prepared for exclusive use of EAC Consulting, Inc. for specific application of the proposed police boat dock and kayak at Vogel Marine Park Facility in North Bay Village, Miami-Dade County, FL. The scope of investigation was intended to specifically evaluate subsurface conditions within the influence of the proposed structures mentioned herein. These evaluations and recommendations were prepared using generally accepted standards of geotechnical engineering practices. No other warranty is expressed or implied.

Our geotechnical engineering evaluation of the site and subsurface conditions with respect to structures submittal and our recommendations are based upon the following: 1) site observations; 2) the field exploratory test data obtained during this phase of the study, and 3) our understanding of the project information as presented in this report.

Since this is an exploration, further consultation with GCES during the design process will be required so that these recommendations can be adjusted to the actual design. Furthermore, upon the discovery of any site or subsurface condition during construction which appears to deviate from the data presented and documented herein, please contact us immediately so that we may visit the site, observe the differing conditions, and thus evaluate this new information concerning these recommendations.

The recommendations presented represent design information that GCES believes are both applicable and feasible for the planned construction and as noted above, it is based on the information provided to GCES as summarized.

Involvement of the geotechnical engineer during the design process and subsequently with the construction process is vitally important to ensure the project is constructed in accordance with the recommendations from the geotechnical report. Should subsurface changes be encountered, early involvement of the geotechnical engineer can hasten subsequent recommendations. In addition, if varying subsurface conditions are encountered, resolutions can be obtained more quickly.

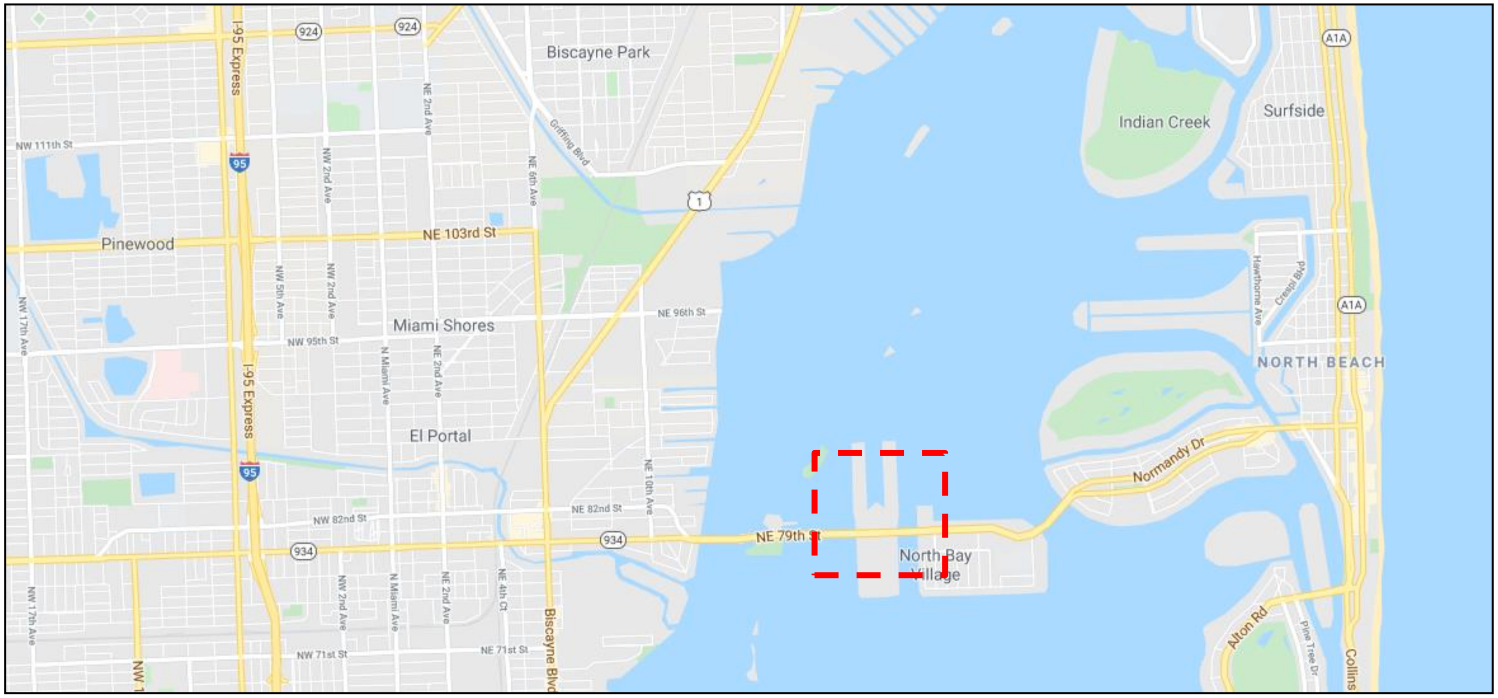
The assessment of site environmental conditions for the presence of contaminants in the soil, rock, surface, or groundwater of the site was beyond the scope of this exploration.

APPENDIX A

VICINITY MAP – FIGURE 1

BORING LOCATION PLAN – FIGURE 2

SOIL SURVEY MAP – FIGURE 3



N

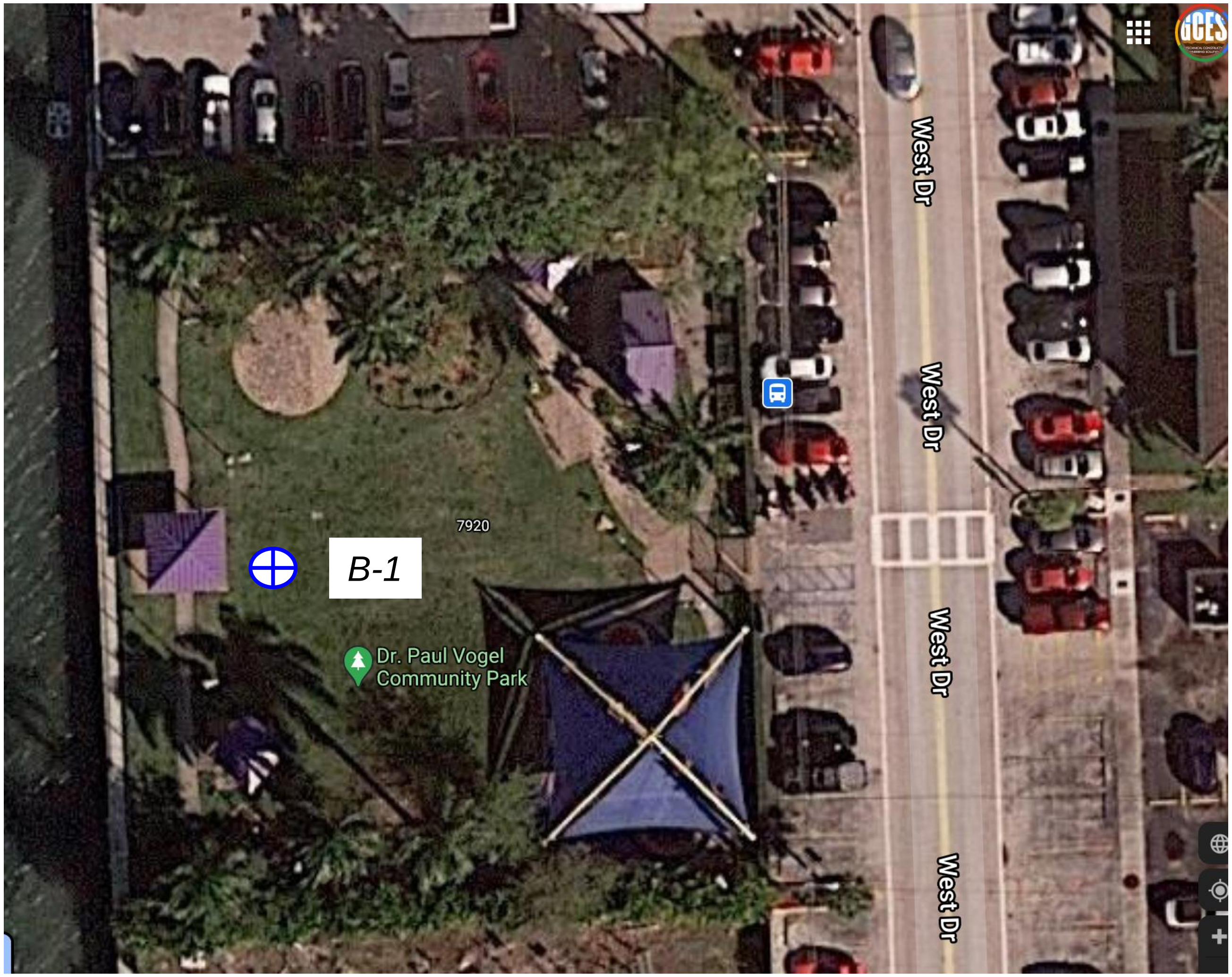
VICINITY MAP

Reference: http://www.googlemap.com

LEGEND

Subject Sites

Project Manager: ARM	Project No. G10201005-2	GCES GEOTECHNICAL CONSTRUCTION & ENGINEERING SOLUTIONS	**VICINITY MAP**	FIG
Drawn by: DC	Scale: N.T.S.		Geotechnical Engineering Services Vogel Marine Park Facility North Bay Village, Miami Dade County, FL	1
Checked by: ARM	File Name:			
Approved by: ARM	Date: 03/19/2021			



N

LEGEND

Approximate Boring Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

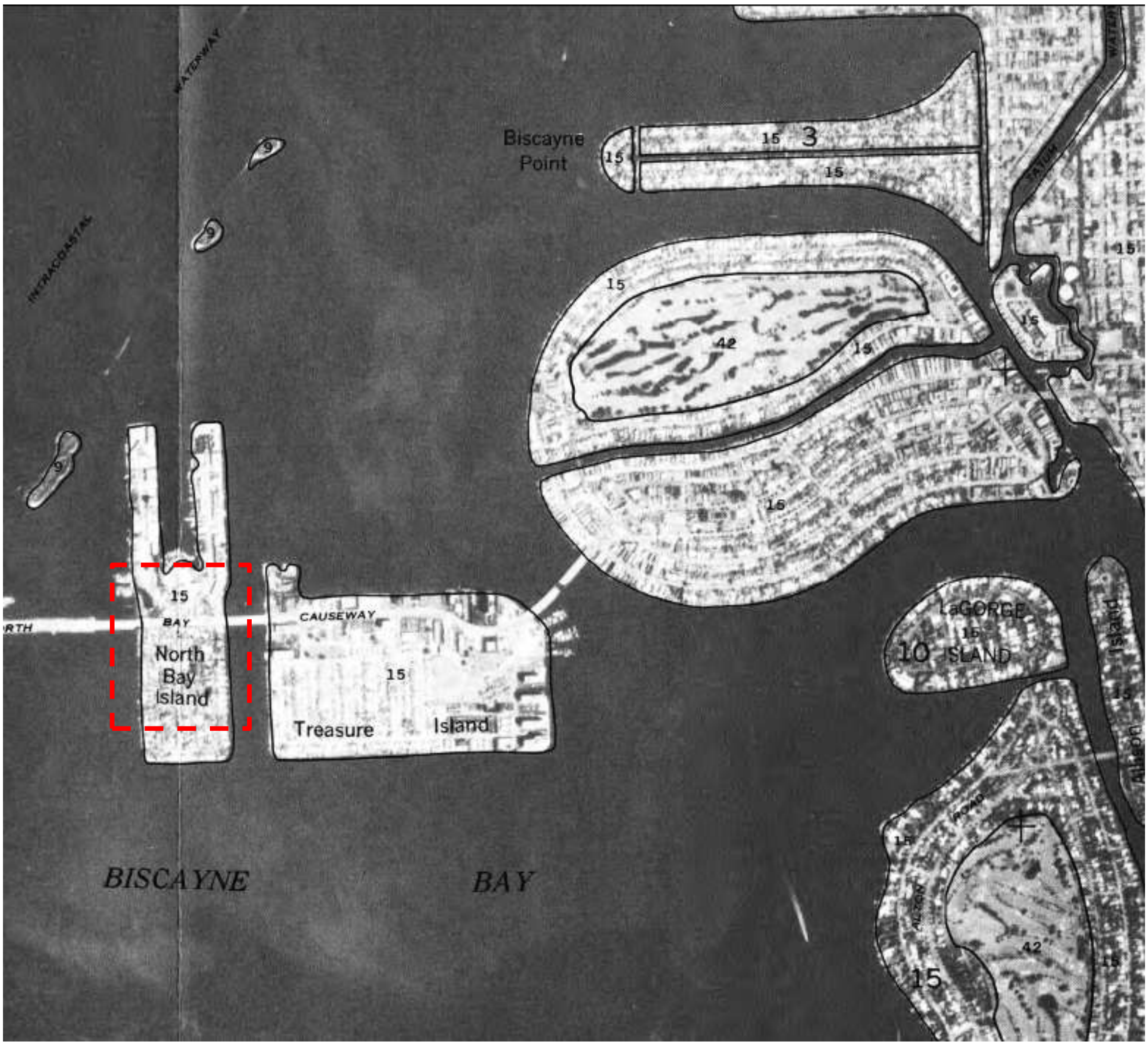
Project Manager: ARM	Project No. G10201005-2
Drawn by: DC	Scale: N.T.S.
Checked by: ARM	File Name:
Approved by: ARM	Date: 03/19/2021

GCES
GEOTECHNICAL CONSTRUCTION & ENGINEERING SOLUTIONS

BORING LOCATION PLAN

Geotechnical Engineering Services
Vogel Marine Park Facility
North Bay Village, Miami Dade County, FL

FIG
2



SOIL SURVEY MAP

From U.S. Department of Agriculture, Soil Conservation Service (later renamed the Natural Resource Conservation Service), dated 1967

LEGEND

SUBJECT SITE

15 - Urban Land Complex

Site Boundaries Are Approximate

Project Manager: ARM	Project No. G10201005-2	GCES GEOTECHNICAL CONSTRUCTION & ENGINEERING SOLUTIONS	**FIG. No. 3** Geotechnical Engineering Services Vogel Marine Park Facility North Bay Village Miami Dade County, FL
Drawn By: DC	Scale: N.T.S.		
Checked By: ARM	Date: 03/19/2021		

APPENDIX B

Boring Log – (B-1)

10860 NW 138th Street, Unit 4
Hialeah Gardens, FL 33018
P: 305.964.0669/954.440.8623

GEOTECHNICAL CONSTRUCTION & ENGINEERING SOLUTIONS

BORING NUMBER B- 1

PROJECT NUMBER G10201004A

CLIENT EAC Consulting, Inc.
PROJECT NAME Vogel Marine Park Facility
PROJECT LOCATION 7920 West Drive, North Bay Village, FL 33141
DATE STARTED 3/11/2021 **COMPLETED** 3/11/2021
SURFACE ELEVATION REFERENCE Same as road crown
DRILLING METHOD Standard Penetration Boring
LOGGED BY L.T. **CHECKED BY** ARM
GROUND WATER LEVELS AT TIME OF DRILLING 6 feet
APPROXIMATE LOCATION OF BORING See site plan

DEPTH		ELEVATION	GRAPHIC LOG	MATERIAL DESCRIPTION [redacted]	SAMPLE TYPE NUMBER	BLOWS	N-VALUE
		3.5		TOPSOIL - Dark Brown Fine SAND, Medium Dense (FILL) Light Brown to Brown Fine SAND with Limerock Fragments, Trace Silt, Loose to Medium Dense (FILL - SP)	SS 1	10 9 7 8	16
		2.5					
		1.5			SS 2	2 1 1 1	2
		0.5					
5		-0.5			SS 3	1 1 2 1	3
		-1.5					
		-2.5			SS 4	2 3 4 5	7
		-3.5					
		-4.5			SS 5	2 1 1 3	2
10		-5.5					
		-6.5					
	12	-7.5					
		-8.5		Gray ORGANIC SILTY Fine SAND with Shell, Trace Limestone Fragments, Very Loose (SM)	SS 6	2 1 4 7	5
		-9.5					
15		-10.5					
		-11.5					
	17	-12.5					
		-13.5		Tan LIMESTONE with Silt, Trace Fine Sand			
		-14.5			SS 7	12 19 11 18	30
20		-15.5					
				Continue Next Page			

▲ SPT N VALUE ▲ 10 20 30 40 50
PL MC LL 20 40 60 80
FINES CONTENT %

Disclaimer: GCES Engineering Services, LLC. , accepts no Liability for the consequences of the independent interpretation of drilling logs by others

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GEOTECHNICAL CONSTRUCTION & ENGINEERING SOLUTIONS

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Hialeah Gardens, FL 33018
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BORING NUMBER B- 1

PROJECT NUMBER G10201004A

CLIENT EAC Consulting, Inc.

PROJECT NAME Vogel Marine Park Facility

PROJECT LOCATION 7920 West Drive, North Bay Village, FL 33141

DATE STARTED 3/11/2021 **COMPLETED** 3/11/2021

SURFACE ELEVATION REFERENCE Same as road crown

DRILLING METHOD Standard Penetration Boring

LOGGED BY L.T. **CHECKED BY** ARM

GROUND WATER LEVELS AT TIME OF DRILLING 6 feet

APPROXIMATE LOCATION OF BORING See site plan

DEPTH		ELEVATION	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS	N-VALUE	SPT N VALUE (10 20 30 40 50) / PL MC LL (20 40 60 80) / FINES CONTENT %
		-16.5	Tan LIMESTONE with Silt, Trace Fine Sand				
		-17.5					
		-18.5					
		-19.5		SS 8	5 4 2 3	6	▲
25		-20.5					
		-21.5					
		-22.5					
		-23.5					
		-24.5		SS 9	10 18 19 10	37	▲
30		-25.5					
		-26.5					
	32	-27.5					
		-28.5	Light Gray LIMESTONE with Silt, Trace Fine Sand				
		-29.5		SS 10	3 4 22 19	26	▲
35		-30.5					
	36	-31.5					
		-32.5	Light Green SILTY Fine SAND, Loose (SM)				
		-33.5					
		-34.5		SS 11	3 4 6 5	10	▲
40		-35.5					

Continue Next Page

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APPENDIX C

GENERAL NOTES

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD EXPLORATORY DESCRIPTION

LABORATORY TESTING DESCRIPTION

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-^{3}/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the “Standard Penetration” or “N-value”. For 3” O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as “blows per foot,” and is not considered equivalent to the “Standard Penetration”or “N-value”.

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

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

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	<2	Very Soft
500 – 1,000	2-3	Soft
1,001 – 2,000	4-6	Medium Stiff
2,001 – 4,000	7-12	Stiff
4,001 – 8,000	13-26	Very Stiff
8,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
50+	99+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

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

RELATIVE PROPORTIONS OF FINES

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

GRAIN SIZE TERMINOLOGY

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

PLASTICITY DESCRIPTION

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

UNIFIED SOIL CLASSIFICATION SYSTEM

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

[A] Based on the material passing the 3-in. (75-mm) sieve

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

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

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

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

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

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

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

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

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

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

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

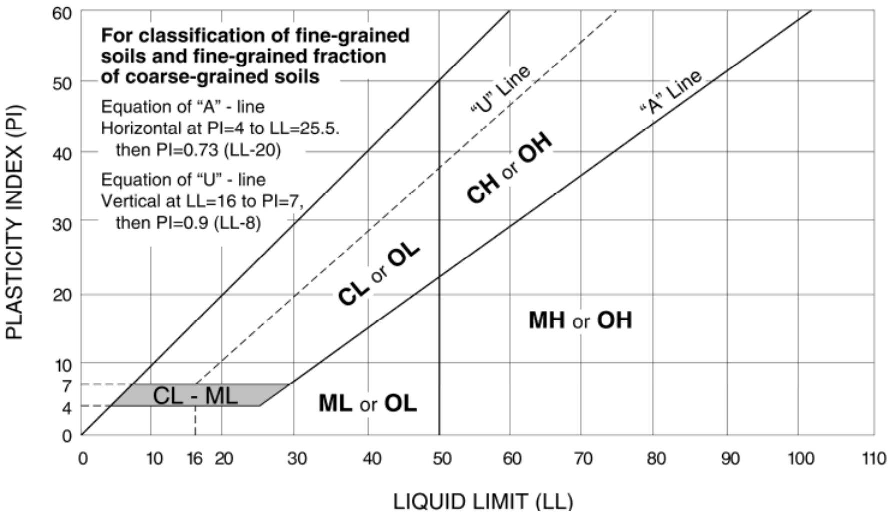
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

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

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

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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FIELD EXPLORATORY DESCRIPTION

Standard Penetration Test (SPT)

Soil samples were obtained by the split spoon sampling procedure in general accordance with the Standard Penetration Test (SPT) procedure ASTM Standard D-1586. The SPT procedure consists of driving a split-barrel sampler to obtain a soil sample and to measure the resistance (N-value) of the soil to penetration of the sampler. In the split barrel sampling procedure, the number of blows required to advance a standard 2 inch O.D. split barrel sampler the last 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration by means of a 140 pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N).

The N-values provide a measure of the relative density of cohesionless soils (sands) and the consistency of cohesive soils (clays) sampled during drilling. Engineering properties of the soils are inferred from SPT N-values and index property soil classification, based on published empirical correlations.

The N-values also provide a general indication of hardness for rock formations such as the limestone commonly encountered in the Southeast Florida area. Where limestone is encountered, the Standard Penetration Test is used as a general indication of hardness. Where low blows per foot are encountered, it is assumed that solution cavities filled with loose sands or soft silt soils are present within the limestone formation.

LABORATORY TESTING PROCEDURE

Percent Passing No. 200 Sieve

The grain size analysis were conducted in general accordance with FDOT test Designation (FM-1-T88 (ASTM Designation D-422, tilted "Particle Side Analysis of Soils"). The grain-size analysis test measures the percentage passing the No. 200 Sieve. In this manner, the grain-size distribution of a soil is measured. The percentage by weight passing the No. 200 Sieve is the amount of silt and clay sized particles. Other samples were analyzed for fines content only by measuring the percentage by weight of dry soil sample passing a U.S. standard No. 200 sieve in general accordance with ASTM-D1140.

Moisture Content

In order to determine the moisture content of soil samples, test specimens were dried in an oven to constant mass in general accordance with ASTM-D2216. The water content is then calculated using the mass of the water and the mass of the dry specimen. The water content is used to express the phase relationship of air, water, and solid in a given volume of material. In fine grained soils, the consistency of a given soil type depends on its water content.

Organic Content

In order to determine the compressibility of soil over time, organic content tests were performed on soil sample collected from soil layers suspected of containing significant amounts of organic materials. Organic content is determined by methods similar to those employed to find water content. The dry test specimen is burnt in a hot oven until it reaches a constant mass. The loss of mass due to burning is considered to be organic materials in the soil. The organic soil content is then calculated using the mass of the organics and the mass of the burnt specimen.