NV5

Miami Office

GEOTECHNICAL ENGINEERING | FOUNDATION ENGINEERING | GEOTECHNICAL TESTING | SOIL BORINGS/MONITORING WELLS | CONSTRUCTION MATERIALS TESTING

December 1, 2016

Ms. Michelle Arana
TY Lin International
201 Alhambra Circle, Suite 900
Coral Gables, Florida 33134

Re: Report of Subsurface Exploration & Recommended Soil Parameters
Legions Park – Proposed Seawall
6447 NE 7th Avenue
Miami, Florida
NV5 Project No. 15499

Dear Ms. Arana:

NV5, Inc. submits this report in fulfillment of the scope of services described in our Proposal No. 16-0745 dated November 16, 2016. The work was authorized by acceptance of our Professional Services Agreement. This report describes our understanding of the project, presents the field and laboratory tests and a summary of the soil and rock parameters for design of the proposed seawall.

Sincerely,
NV5, Inc.

ALFREDO BUDIK LICENSE No. 43884 STATE OF FLORIDA PROFESSIONAL ENGINEER

Clyde L. Grey, P.E.
Project Manager
Florida License No. 80312

Alfredo Budik, P.E.
Senior Engineer
Florida License No. 43884

Enclosures/

Distribution: 2 Copies to Addressee via U.S. Mail
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NV5

1.0 SITE AND PROJECT INFORMATION

The project site is located at 6447 NE 7th Avenue in Miami, Florida. The site is bounded to the north by a vacant lot, to the south by NE 64th Street, to the east by Biscayne Bay and to the west by a 2-level structure. We received a Conceptual Site Plan prepared by TY Lin International, not dated. Based on the drawings the parking lot elevation is at +5 feet with respect to the 1929 National Geodetic Vertical Datum (NGVD).

The existing wood dock at the site is supported on precast prestressed concrete piles. We understand that the existing boat ramp will be replaced or modified and a new seawall is planned to the west of the existing riprap located north and south of the existing boat ramp. A new drainage system will be constructed in the middle of the parking lot.

2.0 PURPOSE AND SCOPE OF WORK

The purpose of our services on this project is to explore the subsurface conditions, provide geotechnical parameters required for the design of the proposed seawall and recommendations for the new piles for the wood dock should it be required. Specifically this report provides:

- Drawings showing boring locations, a graphic summary of the generalized subsurface conditions, and boring logs with detailed descriptions of the materials encountered.
- Discussion of generalized subsurface conditions at the site including groundwater levels and hydraulic conductivity.
- Soil parameters for the proposed seawall.
- Recommendations for possible new piles to support the new wood boat dock.

3.0 FIELD EXPLORATION

3.1 BORINGS

The subsurface conditions were explored with two (2) engineering test borings drilled to a depth of 50 feet below existing grade at the approximate locations shown on Drawing 1. The test locations were marked and identified in the field by NV5. The borings were drilled in accessible locations with a truck-mounted drill rig utilizing the rotary wash method. Samples of the subsurface materials were recovered at roughly 2-foot intervals within the upper 10 feet of the borings and at approximately 5-foot intervals thereafter using a Standard Penetration Test split-spoon sampler (SPT) in substantial accordance with ASTM D-1586, "Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils." This test procedure drives a 1.4-inch I.D. split-tube sampler into the subsurface profile using a 140-pound hammer falling 30 inches. The total number of blows required to drive the sampler the second and third six-inch increments is the SPT N-value, in blows per foot, and is an indication of material strength. Upon completion of the borings, the boreholes were backfilled with cement grout.

The soil/rock samples recovered from the borings were classified by a geotechnical engineer. The collected samples were later re-examined to confirm field classifications and to select specimens for laboratory testing. Visual soil classifications were also made in accordance with ASTM D2487 and ASTM

D2488. The results of the classification and consequent generalized stratification are shown in Drawing 2, the generalized subsurface profile, and in the records of test borings in Appendix A (sheets A-1 through A-6). Strata contacts shown on these drawings are approximate. The boring data reflect conditions at the specific test locations only, and at the time the borings were drilled.

3.1 FIELD PERMEABILITY TESTS

In addition to the borings, NV5 performed also a field permeability test to a depth of 15 feet at the location shown on Drawing 1. The test was performed in general accordance with the South Florida Water Management District's *Usual Open Hole Procedure,* and is presented in Appendix B (sheet B-1).

4.0 LOCAL GEOLOGY AND GEOLOGIC HAZARDS

4.1 LOCAL GEOLOGY

Miami-Dade County is located on the southern flank of a stable carbonate platform on which thick deposits of limestones, dolomites and evaporites have accumulated. The upper two hundred feet of the subsurface profile is composed predominantly of limestone and quartz sand. These sediments were deposited during several glacial and interglacial stages when the ocean was at elevations higher than present.

In many portions of Miami-Dade County, surface sand deposits of the Pamlico Formation are encountered. The Pamlico sands overlie the Miami Limestone. In western Miami-Dade County, portions of the Everglades Region interfinger with the Pamlico sand. The Everglades soil consists of peat and calcareous silt (marl).

The Miami Limestone is a soft to moderately hard, white, porous to very porous, sometimes sandy, oolitic calcareous cemented grainstone. The formation outcrops in portions of Miami-Dade County. The Miami Limestone has a maximum thickness of about 35 feet along the Atlantic Coastal Ridge and thins sharply near the coastline and more gradually in a westerly direction. The Miami Limestone was formed about 130,000 years ago at a time when the sea level was twenty-five feet higher than it is today. This environment facilitated formation of concentrically layered sand sized carbonate grains called oolites. These grains formed by repeated precipitation of calcium carbonate around the nucleus of a sand or shell grain.

The Miami Limestone can be separated into two facies: the barrier bar oolitic facies and the tidal shoal limestone facies. The barrier bar facies is characterized by lenses of oolitic limestone separated by intermittent, 1-inch thick or less, uncemented sand layers (cross-bedded limestone). Zones of higher porosity are characteristic and parallel the bedding planes of the cross-bedded limestone. The tidal shoal limestone facies is characterized by a distinct lack of bedding planes. In addition, burrowing organisms have churned previously deposited sediments, which have resulted in high porosity channels in the rock. These ancient channels give the rock an appearance of a hardened sponge in some areas.

The Fort Thompson Formation underlies the Miami Limestone, and includes sand, sandstone, and limestone. The upper zones of the Fort Thompson Formation consist of sand having a thickness ranging from 5 to 35 feet. The remainder of the formation consists of coralline limestone, quartz sandstone,

sandy limestone and freshwater limestone. The type of soils within the formation and the degree of cementation vary with lateral extent and depth.
The Fort Thompson Formation is underlain by the Tamiami Formation. The Tamiami Formation consists of sands, silts, clays, and sometime fossiliferous limestone. The upper portions of the Tamiami Formation are permeable and make up the lower reaches of the Biscayne Aquifer. This formation ranges in thickness from zero to 300 feet in South Florida.

4.2 GEOLOGIC HAZARDS

The South Florida area is relatively free of geologic hazards. The region is not considered seismically active. Consequently hazards such as ground shaking, liquefaction, lateral spreading, and ground rupture that are normally associated with earthquakes and other seismic activity are generally not a factor for the design of structure foundations in South Florida. Based on the 2012 International Building Code, a Site Class D classification is considered appropriate for this site.

Karst topography that is associated with the formation of sinkholes and other underground discontinuities in carbonate rock formations in the central and northern portions of Florida is generally not found in South Florida. Any discontinuities in the limestone due to solutioning of the rock are typically very limited in vertical and lateral extent and are usually not considered a factor in the design of foundations in the local practice.

5.0 SUBSURFACE CONDITIONS

5.1 BORINGS

In general, the subsurface conditions encountered in our borings are consistent with the geology described above. The detailed subsurface conditions are presented graphically in the attached generalized subsurface profile (Drawing 2) and in more detail on the records of test boring sheets in Appendix A.

5.2 FIELD PERMEABILITY

One open-hole field permeability (drainage) test was performed at 15 feet below grade at the location denoted as P-1 on Drawing 1. The result of the field permeability test performed at the site is presented in the table below:

Table 1 – Drainage Test Results

Location	Test Depth (ft)	Hydraulic Conductivity (cfs/ft^2-ft-head)
P-1	15	5.02E-04

It should be noted that this result is un-factored and represent the conditions at the test location at the time of the test. To account for potential variations in hydraulic conductivity across the site the designer should apply an appropriate safety factor to the reported values. The permeability test data is presented in Appendix B (sheet B-1).

6.0 RECOMMENDATIONS

6.1 GEOTECHNICAL PARAMETERS

The following table 2 summarizes the geotechnical design parameters for the design of the proposed Sheet pile wall for this project.

Table 2 – Wall Design Parameters

Soil Description	Depths Below Existing Grade (ft)	Total Unit Weight (pcf)	Angle of Internal Friction (deg)	Cohesion (psf)	Unfactored Coefficient of Active Earth Pressure	Unfactored Coefficient of At-Rest Earth Pressure	Unfactored Coefficient of Passive Earth Pressure
Upper Sand	0 - 12	105	30	-	0.33	0.50	3.00
Limestone	12 – 28	130	-	2000	-	-	-
Middle Sand	28 – 38	100	27	-	0.37	0.50	2.70
Limestone/Sandstone	38 – 43	130	-	3000	-	-	-
Lower Sand	43 -50+	130	32	-	0.31	0.47	3.25

6.2 PILES FOR DOCK

For the new wood or concrete piles under the marina dock we assumed that shore bottom elevation is at -8 feet NGVD. The piles were analyzed using the computer programs LPILE and FB-Deep for the lateral and axial resistance, respectively. The following table summarizes the output of different loading conditions for the selected pile for free head conditions at the top of the pile.

Table 3 – Summary of Axial Load Analysis

Pile Type	Pile Length (ft)	Allowable Compression (kips)	Allowable Tension (kips)
12-Inch-Diameter Wood	40	40	15
12-Inch-Squared Precast Prestressed Concrete	40	50	18

TABLE 4 – Summary of Lateral Deflections and Moments

Pile Type	Pile Lateral Load (kips)	Pile Head Deflection (inches)	Maximum Unfactored Bending Moment (in-kip)	Depth to Maximum Moment (ft. below top of pile)	Depth to Zero Moment (ft. below top of pile)
12-Inch Wood	1.0	2.10	180	17	20
12-Inch Concrete	2.0	1.35	380	17	20

Table-4 above considers a 15-foot pile stickup above the mudline. The minimum pile length is 40 feet (15-foot stickup and 25-foot embedment). Maximum bending moments shown above have not been factored. Designer must check maximum moments against pile selection moment capacity.

The prestressed concrete piles should have a minimum compressive strength of 4,000 pounds per square inch in 28 days. The piling contractor should submit proposed driving equipment for review and approval by NV5. NV5 should observe the pile installation to assure that the recommendations provided in this report are followed.

7.0 REPORT LIMITATIONS

This report has been prepared for the exclusive use of the Owner and other members of the design/construction team for the specific projects discussed in this report. This report has been prepared in accordance with generally accepted local geotechnical engineering practices; no other warranty is expressed or implied.

The evaluation and soil parameters submitted in this report are based in part upon the data collected from the field exploration. The nature or extent of variations throughout the subsurface profile may not become evident until the time of construction. In the event changes are made in the nature, design or locations of the proposed project construction, the parameters contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by NV5.

The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, sinkholes, chemically hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around the site.

We should be provided the opportunity to review final wall specifications in order to ascertain whether our soil parameters have been properly interpreted and implemented. If NV5. is not afforded the opportunity to review related aspects of wall installation as mentioned in this report, we can accept no responsibility for the interpretation of our data made in this report or for wall performance.

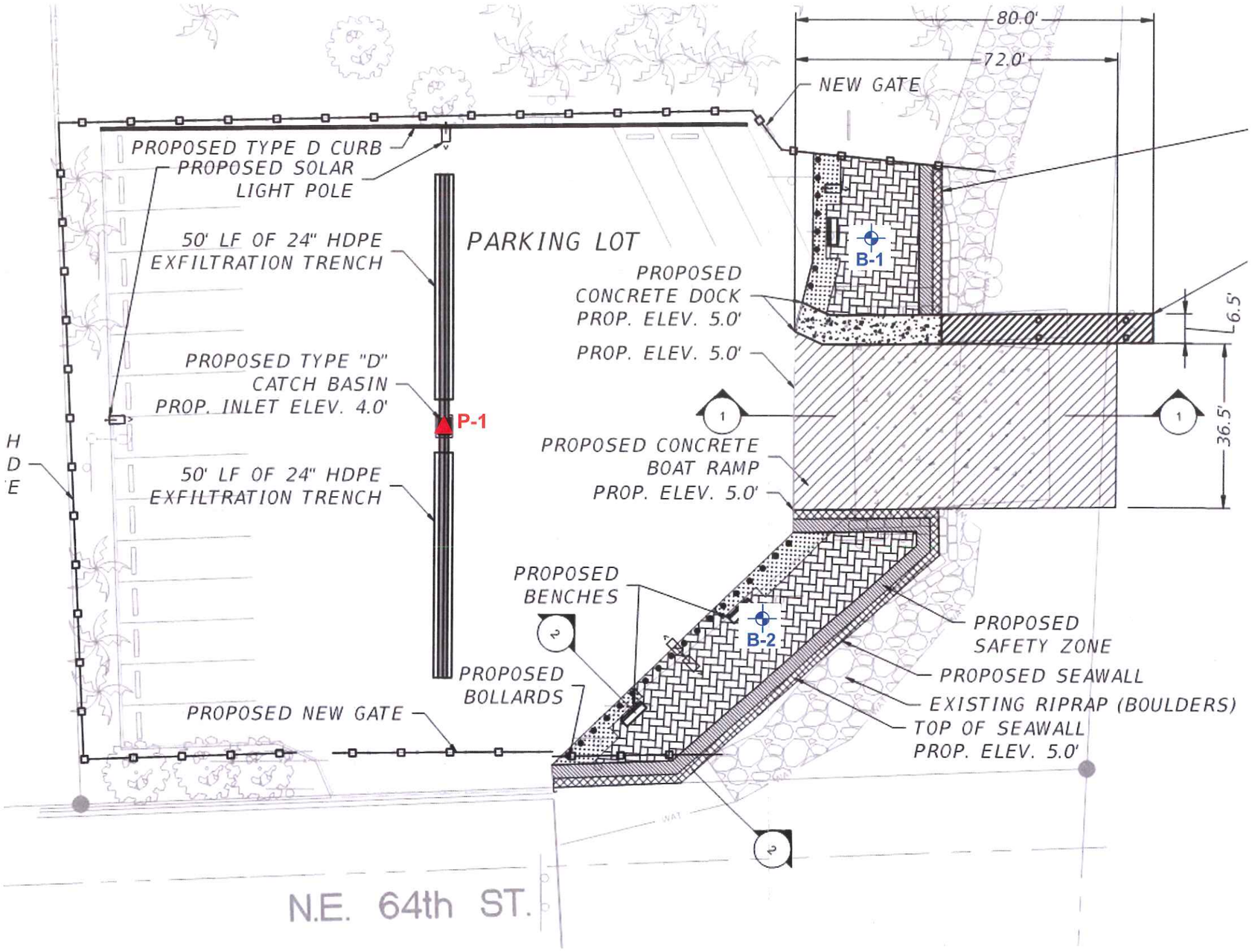
8.0 CLOSURE

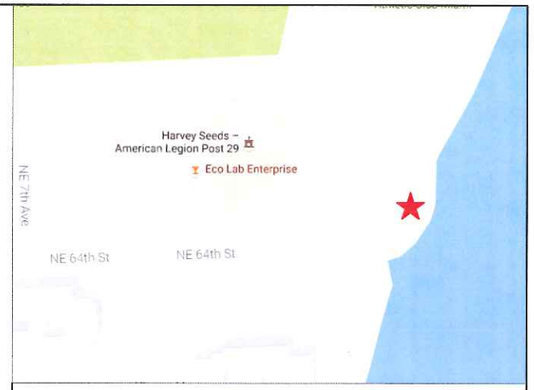
We appreciate the opportunity to provide specialized engineering and testing services on this project and look forward to an opportunity to participate in construction related aspects of the development. If you have questions about information contained in this report contact the writer at 305.901-2151.

****

DRAWINGS

NV5





Site Vicinity Map

N

0 25

Approximate Scale in Feet

LEGEND:

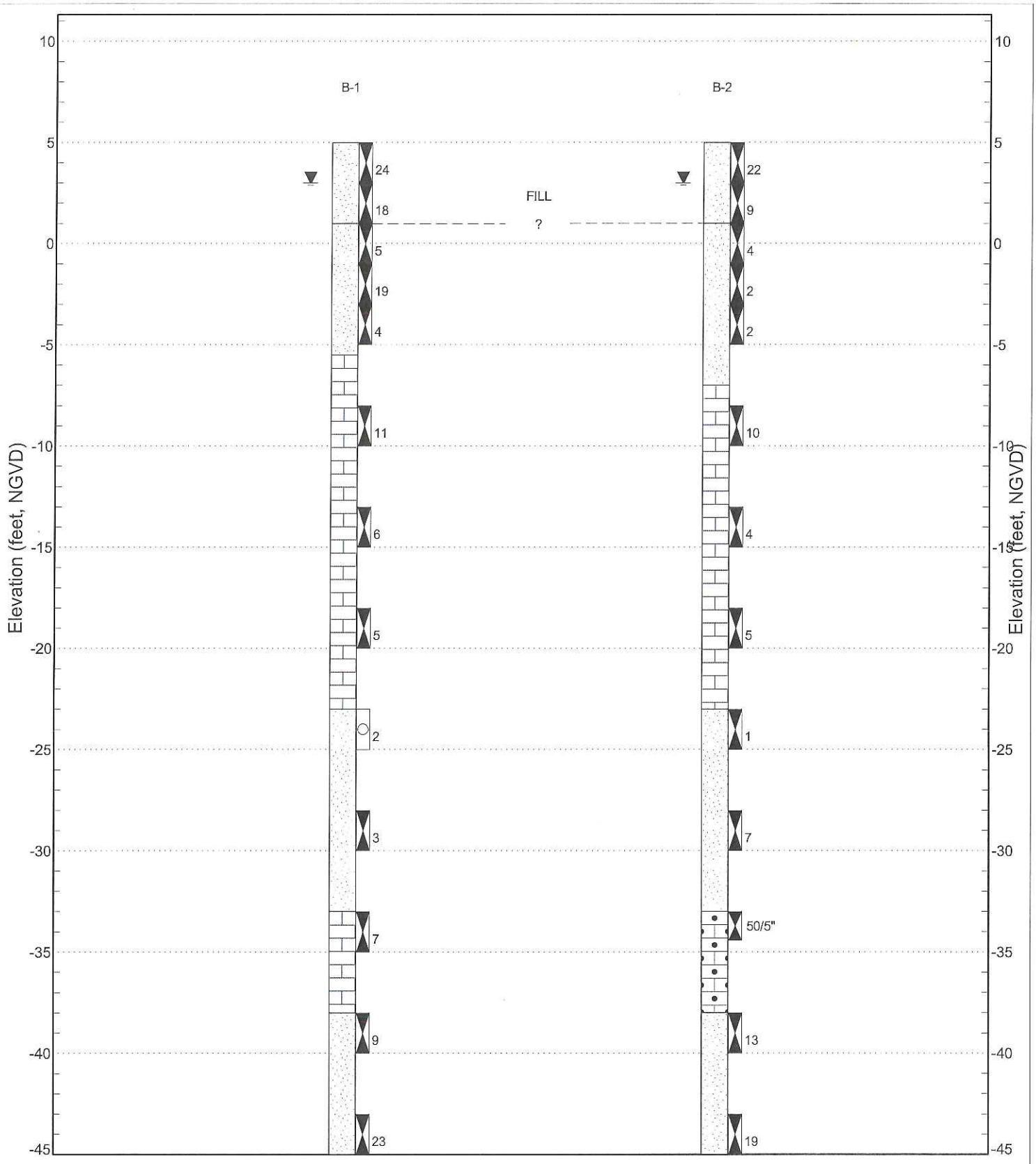
B-1 - Number and approximate location of Test Boring.

P-1 - Number and approximate location of Drainage Test.

NOTES:

1. Test locations shown are approximate.
2. Test location symbols are not to scale.
3. Base for this drawing was taken from Sheet No. 6, Conceptual Site Plan prepared by City of Miami Capital Improvements Program,undated.

NV5	DRAWING TITLE: Site Vicinity Map & Test Location Plan				DWN BY: PO
	PROJECT NAME: Legions Park				CKD BY: AB
	PROJECT LOCATION: 6447 NE 7th Avenue, Miami, FL 33138	PROJECT NO: 15499	DATE: 11/29/16	DWG NO: 1	APD BY: —



GENERALIZED SUBSURFACE PROFILE

N|V|5

PROJECT NAME: Legions Park		
PROJECT LOCATION: 6447 NE 7th Ave, Miami, FL 33138		
PROJECT NUMBER: 15499		**DATE:** 11/29/16
DRAWN BY: PO	**CHECKED BY:** AB	**DRAWING NO:** 2

LEGEND

- Sandstone
- Limestone
- Sand
- Standard Penetration Test
- No Recovery
- Water Level

APPENDIX A

BORING LOG DATA

BORING NUMBER B-1

NV5

PROJECT NAME Legions Park

PROJECT NUMBER 15499 **PROJECT LOCATION** 6447 NE 7th Ave, Miami, FL 33138

DATE STARTED 11/28/16 **COMPLETED** 11/28/16 **GROUND ELEVATION** 5 ft **HOLE SIZE** 3 inches

DRILLING CONTRACTOR NV5 **GROUND WATER LEVELS:** 2.0 ft / Elev 3.0 ft

DRILLING METHOD Rotary drill with mud, wash & casing

LOGGED BY Y. Garcia/ J. Riveria **CHECKED BY** P. Ocando

NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
0						5
	SPT	14-12-12-29 (24)	SP		SAND, medium dense, fine to medium, light brown with trace limestone fragments (FILL)	
	SPT	17-12-6-6 (18)			SAND, medium dense, fine to medium, brown to gray with trace limestone fragments (FILL)	1.0
5	SPT	3-3-2-4 (5)	SP		SAND, loose, fine to medium, dark brown with trace limestone fragments	0
	SPT	10-7-12-3 (19)			SAND, medium dense, fine, dark brown with trace limestone fragments	
10	SPT	2-2-2-3 (4)			SAND, very loose, fine to medium, dark brown to gray with trace limestone fragments	-5
					10.5	-5.5
15	SPT	10-6-5-6 (11)	LS		LIMESTONE, very soft, tan with sand	-10
20	SPT	3-3-3-2 (6)			LIMESTONE, very soft, tan	-15
25	SPT	3-3-2-1 (5)			LIMESTONE, very soft, light brown	-20
					28.0	-23.0
30	NR	1-1-1-3 (2)	SP		NO RECOVERY (POSSIBLE SAND)	-25
35	SPT	1-2-1-2 (3)			SAND, very loose, fine, greenish gray	-30

(Continued Next Page)

BORING NUMBER B-1

NV5

PROJECT NAME Legions Park

PROJECT NUMBER 15499 **PROJECT LOCATION** 6447 NE 7th Ave, Miami, FL 33138

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
35						-30
			SP		38.0	-33.0
40	SPT	2-3-4-7 (7)	LS		LIMESTONE, very soft, greenish gray with sand	-35
					43.0	-38.0
45	SPT	3-4-5-5 (9)	SP		SAND, loose, fine to coarse, light gray with trace limestone fragments	-40
50	SPT	6-10-13-16 (23)			50.0 SAND, medium dense, fine, light gray	-45 45.0

Boring terminated at 50.0 feet.

BORING NUMBER B-2

NV5

PROJECT NAME Legions Park

PROJECT NUMBER 15499 **PROJECT LOCATION** 6447 NE 7th Ave, Miami, FL 33138

DATE STARTED 11/28/16 **COMPLETED** 11/28/16 **GROUND ELEVATION** 5 ft **HOLE SIZE** 3 inches

DRILLING CONTRACTOR NV5 **GROUND WATER LEVELS:** 2.0 ft / Elev 3.0 ft

DRILLING METHOD Rotary drill with mud, wash & casing

LOGGED BY Y. Garcia/ J. Riveria **CHECKED BY** P. Ocando

NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
0						5
	SPT	7-14-8-9 (22)	SP		SAND, medium dense, fine to coarse, light brown with trace limestone fragments (FILL)	
	SPT	6-5-4-3 (9)			SAND, loose, fine to medium, brown with wood and brick fragments (FILL)	1.0
					4.0	
5	SPT	2-2-2-2 (4)	SP		SAND, very loose, fine to medium, dark brown with trace limestone fragments and silt	0
	SPT	2-1-1-1 (2)			SAND, very loose, fine to medium, dark brown with trace limestone fragments	
10	SPT	1-1-1-1 (2)			SAND, very loose, fine to coarse, dark gray with trace limestone fragments and silt	-5
					12.0	-7.0
15	SPT	4-5-5-5 (10)	LS		LIMESTONE, very soft, tan	-10
20	SPT	7-2-2-3 (4)			LIMESTONE, very soft, tan	-15
25	SPT	5-3-2-2 (5)			LIMESTONE, very soft, light brown	-20
					28.0	-23.0
30	SPT	1-WOH-1-1 (1)	SP		SAND, very loose, fine, light gray with trace limestone fragments	-25
35	SPT	5-5-2-2 (7)			SAND, loose, fine, light gray with trace limestone fragments	-30

(Continued Next Page)

BORING NUMBER B-2

PROJECT NAME Legions Park

PROJECT NUMBER 15499 **PROJECT LOCATION** 6447 NE 7th Ave, Miami, FL 33138

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
35						-30
			SP			
					38.0	-33.0
	SPT	12-12-50/5" (100)			SANDSTONE, hard, tan	
40			SS			-35
					43.0	-38.0
	SPT	4-7-6-10 (13)			SAND, medium dense, fine to medium, tan to gray with trace limestone fragments	
45						-40
			SP			
	SPT	7-8-11-12 (19)				
50					50.0 SAND, medium dense, fine, light gray	-45 45.0

Boring terminated at 50.0 feet.

KEY TO SYMBOLS

Symbol Description

Strata symbols

 Fill

 Concrete

 Silty sand

 Asphalt

 Limestone

 Sandstone

 Sand

 Gravel

 Peat

Misc. Symbols

 Groundwater level measured at boring completion. The date checked is indicated.

 Boring continues

 End of Boring

Soil Samplers

 Standard penetration test. 140 lb. hammer dropped 30"

 Hand Auger

 Rock Core

Notes:

1. Exploratory borings were drilled on 11/28/16 using a 3-inch diameter rotary drill with mud, wash and casing.

2. Groundwater was encountered at 2.0 feet below grade upon boring completion.

3. Boring locations were taped from existing features.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs.

NV5

NOTES RELATED TO RECORDS OF TEST BORING AND GENERALIZED SUBSURFACE PROFILE

1. Groundwater level was encountered and recorded (if shown) following the completion of the soil test boring on the date indicated. Fluctuations in groundwater levels are common; consult report text for a discussion.

2. The boring location was identified in the field by offsetting from existing reference marks and using a cloth tape and survey wheel.

3. The borehole was backfilled to site grade following boring completion, and patched with asphalt cold patch mix when pavement was encountered.

4. The Record of Test Boring represents our interpretation of field conditions based on engineering examination of the soil samples.

5. The Record of Test Boring is subject to the limitations, conclusions and recommendations presented in the report text.

6. "Field Test Data" shown on the Record of Test Boring indicated as 11/6 refers to the Standard Penetration Test (SPT) and means 11 hammer blows drove the sampler 6 inches. SPT uses a 140-pound hammer falling 30 inches.

7. The N-value from the SPT is the sum of the hammer blows required to drive the sampler the second and third 6-inch increments.

8. The soil/rock strata interfaces shown on the Record of Test Boring are approximate and may vary from those shown. The soil/rock conditions shown on the Record of Test Boring refer to conditions at the specific location tested; soil/rock conditions may vary between test locations.

9. Relative density for sands/gravels and consistency for silts/clays and limestone are described as follows:

SPT Blows/ Foot	Sands/Gravels Relative Density	SPT Blows/Foot	Silt/Clay Relative Consistency	SPT Blows/ Foot	Limestone Relative Consistency
0-4	Very loose	0-2	Very Soft	0-20	Very Soft
5-10	Loose	3-4	Soft	21-30	Soft
11-30	Medium Dense	5-8	Firm	31-45	Medium Hard
31-50	Dense	9-15	Stiff	46-60	Moderately Hard
Over 50	Very Dense	16-30	Very Stiff	61-50/2"	Hard
		Over 30	Hard	Over 50/2"	Very Hard

10. Grain size descriptions are as follows:

NAME	SIZE LIMITS
Boulder	12 inches or more
Cobbles	3 to 12 inches
Coarse Gravel	3/4 to 3 inches
Fine Gravel	No. 4 sieve to 3/4 inch
Coarse Sand	No. 10 to No. 4 sieve
Medium Sand	No. 40 to No. 10 sieve
Fine Sand	No. 200 to No. 40 sieve
Fines	Smaller than No. 200 sieve

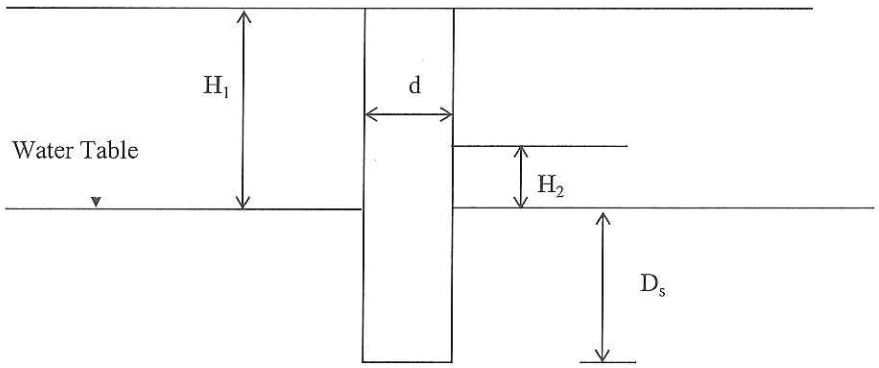
11. Definitions related to adjectives used in soil/rock descriptions:

PROPORTION	ADJECTIVE	APPROXIMATE ROOT DIAMETER	ADJECTIVE
About 10%	with a trace	Less than 1/32"	Fine roots
About 25%	with some	1/32" to 1/4"	Small roots
About 50%	and	1/4" to 1"	Medium roots
		Greater than 1"	Large roots

APPENDIX B

LABORATORY TEST RESULTS

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
" USUAL OPEN - HOLE TEST "



HYDRAULIC CONDUCTIVITY

K = Hydraulic Conductivity = $4Q/[\pi d(2H_2^2 + 4H_2Ds + H_2d)]$

5.02E-04 CFS/FT^2-FT HEAD

Time (Min.)	Flow (GPM)
1	11.00
2	11.00
3	10.00
4	9.00
5	9.00
6	10.00
7	10.00
8	10.00
9	10.00
10	10.00

Q =	Average Flow Rate =	0.022280 CFS
d =	Diameter of Test Hole =	6.0 inches
H_2 =	Head on Water Table =	2.0 feet
D_s =	Depth below Ground Water Table =	13.0 feet

TEST LOCATION :		See Drawing No. 1
TEST ELEVATION :	5.0	NGVD (estimated)
DEPTH TO WATER TABLE H_1:	2.0'	Below Existing Grade
DEPTH OF TEST HOLE :	15.0'	Below Existing Grade
AVERAGE FLOW RATE:	10.00	GPM

SOIL PROFILE :

0.0' -10.5'	Sand, medium dense, fine to medium, light brown to dark brown with trace limestone fragments
10.5'-15.0'	Limestone, very soft, tan

NOTES: The soil profile is determined by cuttings & should not be relied upon as an accurate record of soil type or for transition zones.

PERCOLATION TEST

N|V|5

PROJECT NAME: Legions Park

PROJECT LOCATION: 6447 NE 7th Avenue, Miami, FL 33138

PROJECT NO: 15499	**TEST DATE:** 11/28/16	**TEST NO:** P-1
TESTED BY: Y. Garcia /J. Rivera		**CHECKED BY:** RF