June 29, 2023

Town of Southwest Ranches
13400 Griffin Road
Southwest Ranches, FL 33330
Attn: Ms. Emily McCord Aceti, Community Services Manager
Email: eaceti@swranches.org

RE: Geotechnical Services Report
SW Meadows Sanctuary Park
Southwest Ranches, Florida
TSFGeo Project No. 7111-23-156

Dear Emily:

TSFGeo is pleased to transmit our Geotechnical Engineering Services Report for the referenced project. This report includes the results of field exploration and geotechnical recommendations for the foundations, as well as general site development.

We appreciate the opportunity to perform this Geotechnical Study and look forward to continued participation during the design and construction phases of this project. If you have any questions about this report, or if we may be of further service, please contact our office.

Respectfully submitted,

TSFGeo

Esvard Janvier
Staff Engineer

Harmon C. Bennett, P.E.
Principal Engineer
FL Reg. No. 53130

HARMON COY BENNETT LICENSE No 53130 STATE OF FLORIDA PROFESSIONAL ENGINEER

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY
Harmon C Bennett
2023.06.29 10:49:12 -04'00'
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.

TIERRA SOUTH FLORIDA, INC
2765 VISTA PARKWAY S-10
WEST PALM BEACH, FL 33411
HARMON COY BENNETT, P.E. No. 53130

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1.0 EXECUTIVE SUMMARY

A geotechnical exploration and evaluation of the subsurface conditions have been completed for the design and construction of the proposed improvements to the property at SW 163rd Ave, located in Southwest Ranches, Florida. The project anticipates the construction of a restroom structure, parking areas, and a drainage canal area. Loading information has not been provided at this time.

Any compaction (or proofrolling) performed within 50 feet of existing structures should be done with the equipment in static mode only. Ground vibrations induced by the compaction operations should be closely monitored to assess if there is a potential impact on any existing adjacent structures.

Topsoil exists at the surface for all borings. A layer of limestone generally exists below the topsoil, or layers of limerock fill or silty sand, underlain by alternating layers of sandy soils and limestone or silty sand to the boring termination depths. The near-surface sandy soils were generally classified as SP or SM. Based on the SPT N-Values recorded the soils above the limestone are generally in the loose-density-condition, to medium-density condition. Occasional surface layers are in the very-loose-density-condition. The majority of the limestone layers are in the dense to very-dense-density-condition. The groundwater table was encountered from the ground surface to a depth of approximately 3 feet below the ground surface. All noted depths should be considered approximate.

The limestone strata encountered within the project site correspond to rock formations that offer high resistance to driving and excavation. Special equipment and breaking tools are typically required to excavate these layers. These layers may also be difficult to dewater due to their relatively high porosity and permeability in some layers.

The geotechnical study completed for the proposed new improvements confirms that the site will be suitable for the planned construction when viewed from a soil mechanics and foundation engineering perspective. It is anticipated that the site grade will be raised 1 to 2 feet from the existing ground surface. After following proper site preparation procedures, the structure may be supported on shallow spread foundations on the engineered fill material and may employ conventional slab-on-grade for the ground floors, with an allowable bearing pressure of 2,500 psf. Details related to site development, foundation design, and construction considerations are included in subsequent sections of this report.

The owner/designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report before utilizing our engineering recommendations in preparation for design/construction documents.

2.0 PROJECT INFORMATION

2.1 Project Authorization

TSFGeo has completed a geotechnical exploration of the proposed improvements to the property at SW 163rd Ave, in Southwest Ranches, Florida. The geotechnical services were performed in accordance with TSFGeo's Proposal No. 2304-215, dated April 12, 2023, Revision 3 on April 25, 2023.

2.2 Project Description

Our understanding of the project is based on general information obtained from The Town of Southwest Ranches. We understand the project includes the improvement to the property at SW 163rd Ave, located in Southwest Ranches, Florida. The project anticipates the construction of a restroom structure, parking areas, and a drainage canal area. Loading information has not been provided at this time.

The geotechnical recommendations presented in this report are based on the available project information, building location, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform TSFGeo in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. TSFGeo will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

2.3 Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to enable an evaluation of acceptable foundation systems for the proposed construction.

This report includes a brief outline of the testing procedures, a presentation of available project information, a description of the site and subsurface conditions, and a presentation of the geotechnical recommendations regarding the following:

- Foundation soil preparation requirements.
- Foundation types, depths, allowable bearing capacities, and an estimate of a potential settlement.
- Pavement Recommendations.
- Soil Parameters related to drainage testing.
- Comments regarding factors that may impact the construction and performance of the proposed project.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous and toxic materials in the soil, bedrock, surface water, groundwater, or air on, below or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for information purposes only.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location and Description

The project site is located on a property bounded by Holmberg Road to the south, NW 66th Ave to the west, NW 5th Place to the north, and NW 63rd Way to the east, in Parkland, Florida. At the time of field exploration, the area was observed to be fairly level grass-covered natural surfaces with pine trees generally throughout the site.

3.2 Subsurface Conditions

Based on a eview of the "Soil Survey of Broward County, Florida," prepared by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), the site is anticipated to have the mapped as noted below. A portion of the mapping for the site is included as **Soil Map - Broward County, Florida, East Part**

> **Map Unit 8 - Dania muck, frequently ponded, 0 to 1 percent slopes** -The Dania component makes up 85 percent of the Map Unit. Slopes are 0 to 1 percent. This component is on marshes on marine terraces on coastal plains. The parent material consists of herbaceous organic material over limestone. Depth to a root restrictive layer, bedrock, lithic, is 10 to 29 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 3 inches during January, June, July, August, September, October, November, December. Organic matter content in the surface horizon is about 75 percent.

> **Map Unit 12 - Hallandale fine sand, 0 to 2 percent slopes -** The Hallandale component makes up 90 percent of the Map Unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits over limestone. Depth to a root restrictive layer, bedrock, lithic, is 2 to 20 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, October, November. Organic matter content in the surface horizon is about 3 percent.

Subsurface conditions at the site were explored with engineering borings located as shown on the **Boring Location Plan** in **the Appendix**. The study included the drilling of eighteen (18) Standard Penetration Test (SPT) borings to a depth of approximately between 18 and 20 feet for the structures, and a total of five (5) Standard Penetration Test (SPT) to a depth of approximately 6 feet for the roadway and parking areas. One (1) Borehole Permeability test was completed, which included auger borings extended to a depth of approximately 15 feet below grade. The soil test borings profiles are presented on Sheet 2 as an attachment. Samples of the in-place materials were recovered at frequent intervals using a standard split spoon driven with a 140-pound hammer freely falling 30 inches (the SPT after ASTM D 1586). Samples of the in-place soils were returned to our laboratory for classification by a geotechnical engineer, in general accordance with the Unified Soil Classification System (ASTM D 2487).

Topsoil exists at the surface for all borings. A layer of limestone generally exists below the topsoil, or layers of limerock fill or silty sand, underlain by alternating layers of sandy soils and limestone or silty sand to the boring termination depths. The near-surface sandy soils were generally classified as SP or SM. Based on the SPT N-Values recorded the soils above the limestone are generally in the loose-density-condition, to medium-density condition. Occasional surface layers are in the very-loose-density-condition. The majority of the limestone layers are in the dense to very-dense-density-condition. The groundwater table is at a depth between approximately the ground surface to 3 feet below the ground surface. All noted depths should be considered approximate. Additional information regarding the borings may be found in the **Appendix** on the attachments titled **Soil Profiles – Sheets 1 – 7.**

The above subsurface description is of a generalized nature and intended to highlight the major subsurface stratification features and material characteristics. The boring logs should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, and penetration resistance. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. 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. Water level information obtained during field operations is also shown on the boring logs. The samples that were not altered by laboratory testing will be retained for 30 days from the date of this report and then will be discarded.

3.3 Groundwater Information

Groundwater levels were measured in the borings when first encountered. The groundwater was, typically, encountered between the ground surface and a depth of approximately 3 feet below the ground surface. Groundwater levels are expected to fluctuate with seasonal fluctuations. We expect the groundwater to, typically, fluctuate within about 2 feet from where it was encountered during the drilling operation.

In general, the seasonal high groundwater level is not intended to define a limit or ensure that future seasonal fluctuations in groundwater levels will not exceed the estimated levels. Post-development groundwater levels could exceed the normal seasonal high groundwater level estimate as a result of a series of rainfall events, changing conditions at the site that alter surface water drainage characteristics, or variations in the duration, intensity, or total volume of rainfall. We recommend that the Contractor determine the actual groundwater levels at the time of the construction to determine the groundwater impact on his or her construction procedures.

3.4 Borehole Permeability (BHP) Test Results

One (1) BHP test was performed using the usual open-hole, constant-head methodology. The hole was advanced to approximately 15 feet below the existing grade and was drilled with a hollow stem auger so that soil samples could be retrieved for visual classification by an engineer. The boring was completed as an open well with gravel pack (6-20 silica sand). The well-screen slot widths were 0.020 inches. Water from the drill rig tank was then pumped into the open well, and the amount of water required to maintain a constant head was recorded. The test results are presented in the **Appendix** as **Summary of Exfiltration Test Results**.

4.0 LABORATORY TESTING

4.1 Laboratory Classification Testing

Representative soil samples collected from the borings were visually classified and stratified in the laboratory in general accordance with the Unified Soil Classification System (UCSC). Our classification was based on visual inspection of the samples, using the results from the laboratory testing as confirmation. The laboratory tests performed included natural moisture content, grain size analysis, organic content, and Atterberg limits. Laboratory test results are presented in the **Appendix** as **Summary of Laboratory Tests** and **Grain Size Data Sheets**. Tests were performed in general accordance with the test methods noted in Table 4.1 below.

Table 4.1 – Soil Sample Testing Methods	
Test Type	**Test Method**
Sieve Analysis	ASTM C 136 (AASHTO T 27)
Moisture Content	ASTM D 2216 (AASHTO T 265)
Organic Content	ASTM D 2974 (AASHTO T 267)
Atterberg Limits	Liquid Limit : ASTM D 4318 (AASHTO T 89) Plastic Limit : ASTM D 4318 (AASHTO T 90)

4.2 Environmental Corrosion Testing

Environmental corrosion tests were performed on selected soil samples recovered from borings completed along the project alignment. Environmental corrosion tests include parameters such as pH, resistivity, chloride and sulfate content. These laboratory test results were used to perform the environmental classification in accordance with Section 1.3 of FDOT Structures Design Guidelines. Tests were performed in general accordance with test methods noted in Table 4.2 below. The test results are provided in the **Appendix** as the **Summary of Corrosion Test Results**.

Table 4.2 - Test Methods for Corrosion Series	
Test Type	**Test Method**
pH of Soils	FM 5-550
Chloride Ion in Soil	FM 5-552
Sulfates in Soil	FM 5-553
Electrical Resistance of Soil	FM 5-551

5.0 EVALUATION AND RECOMMENDATIONS

5.1 Geotechnical Discussion

The geotechnical study completed for the proposed construction confirms that the site will be suitable for the planned construction when viewed from a soil mechanics and foundation engineering perspective. It is anticipated that 1 to 2 feet of fill material will be placed for the structure and roadway. After following proper site preparation procedures, as recommended in Section 5.2 of this report, the structure may be supported on shallow spread foundations on the engineered fill with an allowable bearing pressure of 2,500 pounds per square foot (psf) and employ conventional slab-on-grade for the ground floors.

Any compaction (or proofrolling) performed within 50 feet of existing structures should be done with the equipment in static mode only. Ground vibrations induced by the compaction operations should be closely monitored to assess if there is a potential impact on any existing adjacent structures.

The limestone strata encountered within the project site correspond to rock formations that offer high resistance to driving and excavation. Special equipment and breaking tools are typically required to excavate these layers. These layers may also be difficult to dewater due to their relatively high porosity and permeability in some layers.

Recommendations for the geotechnical aspects of site preparation, foundation design, and related construction are presented in the following sections of this report.

5.2 Site Preparation

To prepare for construction, we recommend that any topsoil, foundation remnants, debris, silt, and existing vegetation, including trees, roots, and any organic soils be removed in its entirety from the footprint of the proposed construction and waste. Existing utilities, if any, should be removed from the building footprint area. The building footprint should be compacted with a self-propelled roller (Ingersoll-Rand SD-100D or equivalent) **with at least 20 passes (with an operating vibration frequency of 31.5 Hz/1890 VPM and average speed of 1.4 mph)** until the subsoils achieve 95 percent of maximum dry density per ASTM D 1557 (Modified Proctor) to a depth of at least 12 inches below the existing grade. If encountered, unsuitable soil and material such as organics or muck encountered under the proposed construction site should also be removed and replaced with properly compacted structural fill as recommended in this report. The soil densification should encompass the entire footprint of the structure plus a 10-foot wide perimeter that extends beyond the maximum lines of the superstructure.

The rolled subgrade should be visually observed for signs of pumping, weaving, or other types of instability. Signs of such instability could be due to the existence of weak and/or compressible subsoils. Corrective action for this condition should include excavation of weak subsoils followed by replacement with clean granular fill compacted to 95 percent of the ASTM D 1557 maximum dry density. Structural fill used to raise the site to structure bottom levels should consist of clean sand and/or sand and gravel (ASTM D 2487), with a maximum of 12 percent passing the U.S. Standard No. 200 sieve. The structural fill should be placed in thin lifts (12-inch thick loose measure), near the optimum moisture content for compaction, and be compacted to at least 95 percent of maximum dry density (ASTM D 1557).

Following site preparation as discussed herein, the foundation areas should be excavated, and the footing subgrade should be compacted with a heavy roller or at least a heavy plate compactor to the above-mentioned 95 percent criteria. Unsuitable material or organic soils (if any) found at foundation bottoms should be removed and replaced with structural fill, as discussed above. In areas where footings bear at lower elevations (possibly close to or slightly below the water table), the footing excavation should be dewatered, and the footing subgrade should be compacted in the dry with a heavy roller or at least a heavy plate compactor to the above mentioned 95 percent criteria to a depth of at least 12 inches below the existing grade. The footings should be formed and poured in-the-dry. Before placing the steel for the foundations, the footing subgrade should be inspected by a TSFGeo representative.

If additional structural fill is required to achieve design grade, each lift of compacted engineered fill should be tested by a representative of the geotechnical engineer before placement of subsequent lifts. The edges of compacted fill should extend 5 feet beyond the edges of buildings before sloping.

5.3 Foundation Recommendations

Conventional spread footings are generally the most economical when the existing soil conditions allow them to be founded at shallow depths. Following the completion of site preparation, as discussed herein, we recommend supporting the planned structures on conventional spread foundations based on engineered fill and/or the surficial granular soils of the site. The footings may be designed and proportioned for a maximum bearing pressure of 2,500 pounds per square foot (psf). Footings widths and depths should follow, as a minimum, Florida Building Code guidelines when the geometry produces a bearing pressure less than the allowable.

The settlement of foundations based on the in-situ granular soils and/or engineered fill will occur as an elastic response of the soils to the building loads applied. For foundations that are based on soils prepared as discussed herein, we estimate that total and differential average foundation settlements should be on the order of 1 inch and ½ inch, respectively. In our opinion, these settlements are within the range considered tolerable for the type of structure planned. The settlement forecast is based on imposed soil-bearing pressure of 2,500 pounds per square foot (psf). Because the subsoils at the site are granular, the settlement should occur as the loads are applied to foundations and should essentially be complete by the time the building construction is finished.

Excavating equipment may disturb the granular bearing soil in foundation areas. The upper 12 inches of the footing subgrade should be compacted to achieve not less than 95 percent of the maximum dry density as determined by ASTM D 1557 immediately before reinforcing and concrete placement.

Foundations of existing adjacent structures should be adequately protected/shored during construction/adjacent excavation.

The site preparation and foundation excavations should be observed by a representative of TSFGeo before steel or concrete placements to assess whether those foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Loose soil zones encountered at the bottom of the footing excavations should be removed to the level of medium dense soils or adequately compacted structural fill as directed by the geotechnical engineer.

5.4 Floor Slab Recommendations

Following stripping and surface soil preparation as described herein, the building pad area should be leveled and filled to subfloor elevation before placing concrete. Slab subgrade should consist of clean sand and/or sand and gravel (ASTM D 2487), with a maximum of 12 percent passing the U.S. Standard No. 200 sieve and compacted to at least 95 percent of maximum dry density per ASTM D 1557 (Modified Proctor) to a depth of at least 12 inches below the slab grade. Structural fill used to raise the site to floor slab bottom levels should consist of clean granular fill as described above. The structural fill should be placed in thin lifts (12-inch thick loose measure), near the optimum moisture content for compaction, and be compacted to at least 95 percent of maximum dry density (ASTM D 1557).

Our experience indicates that floor slabs constructed without a vapor barrier will often experience future problems associated with moisture and mildew. Therefore, we recommend interior floor slab subgrade soils be covered with a vapor barrier (such as visqueen, normally 6 mil thick) before constructing the slab-on-grade Floor.

Slab-on-grade construction may be used for the ground floor slabs of the structure. The slabs should be adequately reinforced to carry the loads that are to be applied. The floor slab design, if based on elastic methods, should employ a modulus of subgrade reaction of 150 pounds per cubic inch (PCI).

The floor slabs should be liberally jointed and separated from columns and walls to help avoid potential problems with cracking because of differential loadings.

The friction factor between the soil and floor slabs should be taken as 0.35 without the vapor barrier. A friction factor of 0.21 should be used for the vapor barrier-soil interface.

5.5 Flexible Pavement

The flexible pavement component thickness noted below in **Table 5.5** could be utilized as a guide in the pavement design for light-duty trucks. **The Final pavement recommendation should be provided by the Civil Engineer based on actual vehicular loading information.**

The following flexible pavement component thicknesses are based on a design life of 20 years. The Heavy-Duty pavement design is based on 100,000 ESAL, 18-kips equivalent axle loads.

Table 5.5 – Typical Pavement Section, Flexible

TYPE OF PAVEMENT	MATERIAL DESCRIPTION	LAYER THICKNESS (INCHES)	
		PARKING AREAS	HEAVY-DUTY AREAS
Flexible	Asphaltic Concrete	1.5	2.0
	Base Course (LBR = 100)	6	8
	Stabilized Subgrade (LBR = 40)	8	10

The base course materials in the pavements should consist of limerock, having a minimum Limerock Bearing Ratio (LBR) of 100. Base materials should meet the requirements presented in the latest revisions of the Florida Department of Transportation (FDOT) "Specifications for Road and Bridge Construction," Section 911 (limerock). The base course should be compacted to at least 98 percent of maximum dry density (AASHTO 180).

The subgrade should have a minimum LBR of 40. The stabilized subgrade should be compacted to at least 95 percent of maximum dry density (AASHTO 180).

5.6 Rigid Concrete Pavement

If dumpsters are to be parked on the pavement, it is recommended that rigid concrete pavement be constructed according to the information provided in **Table 5.6**. In addition, the apron utilized for unloading the dumpsters by heavy-duty trucks should also be provided with a rigid pavement. A minimum Portland concrete pavement thickness of 8 inches is recommended for the project if a rigid pavement is employed. The concrete should be reinforced to withstand the traffic loadings anticipated and should be jointed to reduce the chances for crack development. The minimum rigid pavement thickness recommended above is based upon concrete with an unconfined compressive strength of 3,500 psi and a modulus of rupture of 450 psi.

Table 5.6 – Typical Pavement Section, Rigid		
TYPE OF PAVEMENT	MATERIAL DESCRIPTION	LAYER THICKNESS (INCHES)
		HEAVY-DUTY AREAS
Rigid	Portland Concrete	8
	Base Course	Alternate 1 4” Asphalt Base (Type B-12.5)
		Alternate 2 7” Limerock Base (LBR=100)
	Stabilized Subgrade (LBR = 40)	10

Actual pavement section thickness should be provided by the Design Civil Engineer based on traffic loads, volume, and the owner's design life requirements. The noted sections represent minimum thickness representative of typical local construction practices and, as such, periodic maintenance should be anticipated. All pavement materials and construction procedures should conform to FDOT, American Concrete Institute (ACI), or appropriate city/county requirements.

5.7 Utilities

All utilities should be installed per the requirements of the Civil Engineering drawings and specifications. When backfilling over utility lines, the clean granular fill should be placed in no more than 6- to 12-inch-thick loose lifts and compacted to at least 95 percent of the material’s maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D 1557).

The limestone strata encountered within the project site correspond to rock formations that offer high resistance to driving and excavation. Special equipment and breaking tools are typically required to excavate these layers. These layers may also be difficult to dewater due to their relatively high porosity and permeability in some layers.

6.0 CONSTRUCTION CONSIDERATIONS

It is recommended that TSFGeo be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. TSFGeo cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundation if not engaged in the construction observation and testing for this project.

6.1 Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P." This document was issued to better ensure the safety of workmen entering trenches or excavations. This federal regulation mandates that excavations, whether they be utility trenches, basement excavations, or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced, and if they are not closely adhered to, the owner and the Contractor could be liable for substantial penalties.

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 the stability of both the excavation sides and bottoms. 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 local, state, and federal safety regulations.**

We are providing this information solely as a service to our client. TSFGeo does not assume responsibility for construction site safety or the Contractor's or other parties' compliance with local, state, and federal safety or other regulations.

6.2 Utility Trench Backfill

The limestone strata encountered within the project site correspond to rock formations that offer high resistance to driving and excavation. Special equipment and breaking tools are typically required to excavate these layers. These layers may also be difficult to dewater due to their relatively high porosity and permeability in some layers.

Before backfilling, where possible, the bottom of the excavation should be inspected by a geotechnical engineer to ensure that no loosely placed materials are at the bottom. Where possible, the bottom of the excavation should be compacted/densified.

The utility line should be installed over at least 4 inches of granular bedding material. If peat/soft material is encountered at the bottom of the excavation, we recommend that the unsuitable be over-excavated by 2 feet and backfilled with limerock. Once the line is in place, an additional 12 inch of granular material should be placed and compacted to at least 98% of the Modified proctor. The remainder should be backfilled with suitable fill and compacted to at least 98% of the Modified proctor.

Structural fill used to raise the site to structure bottom levels should consist of clean sand and/or sand and gravel (ASTM D 2487), with a maximum of 12 percent passing the U.S. Standard No. 200 sieve. The structural fill should be placed in thin lifts (12-inch-thick loose measure), near the optimum moisture content for compaction, and be compacted to at least 95 percent of maximum dry density (ASTM D 1557). The structural fill to be placed below the water level should consist of well-graded gravel (ASTM D 2487) or clean sand with a maximum of 5 percent passing the U.S. Standard No. 200 sieve.

Ground movements and vibrations induced by the excavation and compaction operations should be closely monitored to assess if there is a potential impact on the existing structures.

6.3 Lateral Earth Pressures

Below-grade structures should be designed to resist earth pressure from granular backfill, surcharge loads, and unbalanced hydrostatic forces. For walls that are not restrained during backfilling but are free to rotate at the top, active earth pressure should be used in the design. Walls that are restrained should be designed assuming at-rest earth pressure. In cases where the wall moves into the backfill, passive earth pressure criteria should be used. Recommended equivalent fluid densities for each pressure condition with no allowance for surcharge loads are presented below in **Table 6.3**.

Table 6.3 - Lateral Earth Pressure Coefficients Based on 120 pcf Saturated Unit Weight and an assumed SPT N-Value of 10-20 for the backfill soil compaction.

Mode	Symbol	Coefficient	Above Water Pressure (pcf)	Below Water Pressure (pcf)*
Active	Ka	0.33	40	82
At Rest	K_0	0.5	60	92
Passive	Kp	3.00	360	237

* Includes the water pressure weight. Drains are not required if the design is completed with Below Water Pressure values.

6.4 Perimeter Canal

Based on project discussions, a canal is proposed to be constructed around the perimeter of the east and south property lines. It is anticipated that the canal construction would be to lower the groundwater level in the vicinity of the canal. The slopes of the canal may easily stand near 1H:1V within the limestone layer. However, for maintenance and safety reasons the likely be sloped 3H:1V.

The limestone strata encountered within the project site correspond to rock formations that offer high resistance to driving and excavation. Special equipment and breaking tools are typically required to excavate these layers. These layers may also be difficult to dewater due to their relatively high porosity and permeability in some layers.

7.0 INSPECTIONS/QUALITY CONTROL TESTING

During construction, it is important that work is performed under qualified inspection to ensure proper procedures are followed. We will perform all foundation and earthwork-related inspections, and reports will be prepared for your records and submission to the appropriate governmental agencies. We can also perform testing services, soils, concrete, and asphalt for compliance with project requirements.

8.0 REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by TSFGeo and design details furnished by Town of Southwest Ranches for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, TSFGeo should be notified immediately to determine if changes in the foundation recommendations are required. If TSFGeo is not retained to perform these functions, TSFGeo will not be responsible for the impact of those conditions of the project.

It is imperative that TSFGeo be present for observation and testing during construction in order to provide written confirmation (certifications) that the geotechnical engineering study report has been complied with.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

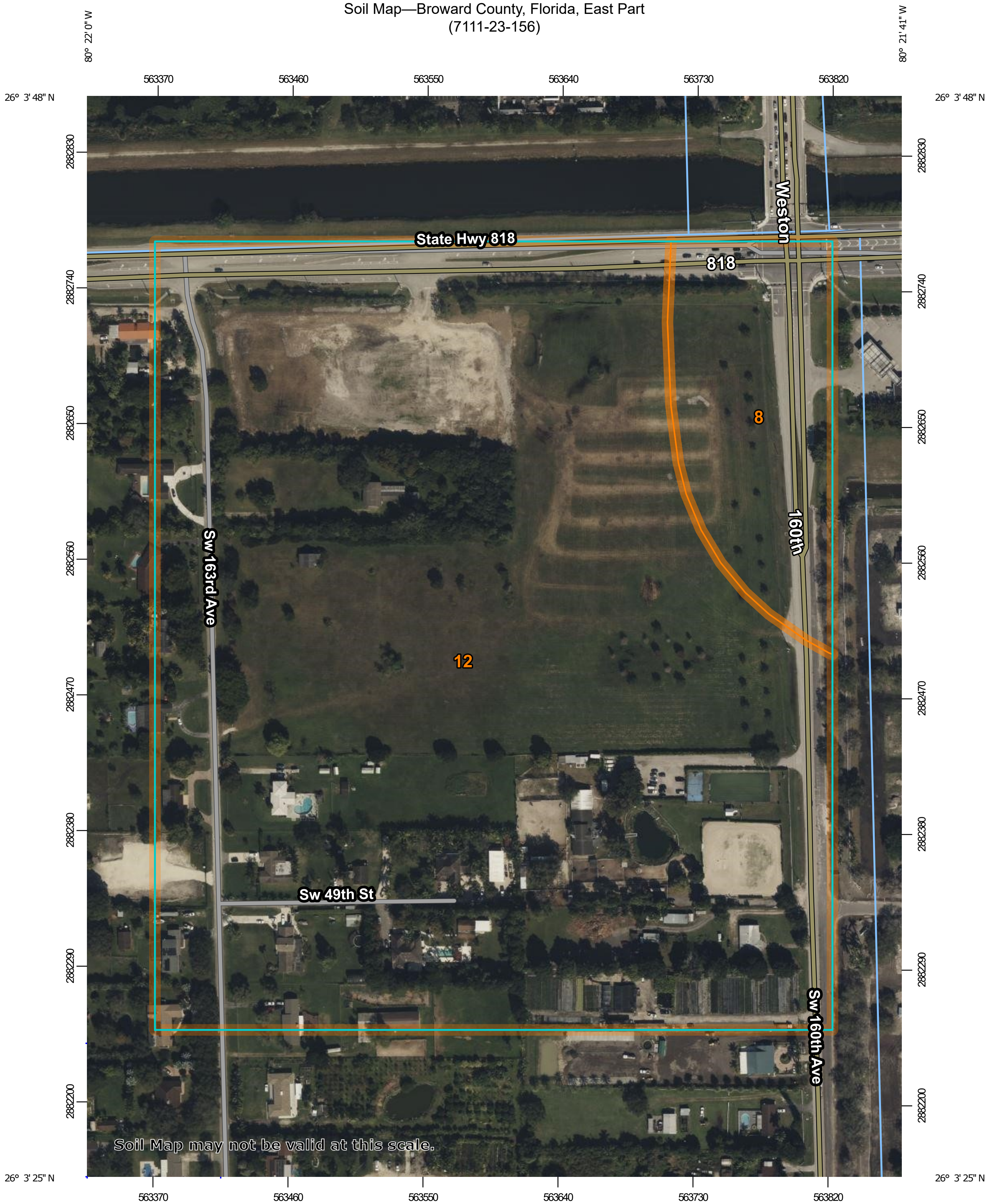
After the plans and specifications are complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations.

This report has been prepared for the exclusive use of the Town of Southwest Ranches for the proposed improvements to the property at SW 163rd Ave, located in Southwest Ranches, Florida.

APPENDIX

Soil Map - Broward County, Florida, East Part
Boring Location Plan - Sheet 1
Soil Profiles - Sheets 2-7
Summary of Exfiltration Test Results
Summary of Corrosion Test Results
Summary of Laboratory Test Results
Grain Size Data Sheets

Soil Map—Broward County, Florida, East Part
(7111-23-156)



Map Scale: 1:3,500 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Broward County, Florida, East Part
Survey Area Data: Version 18, Sep 1, 2022

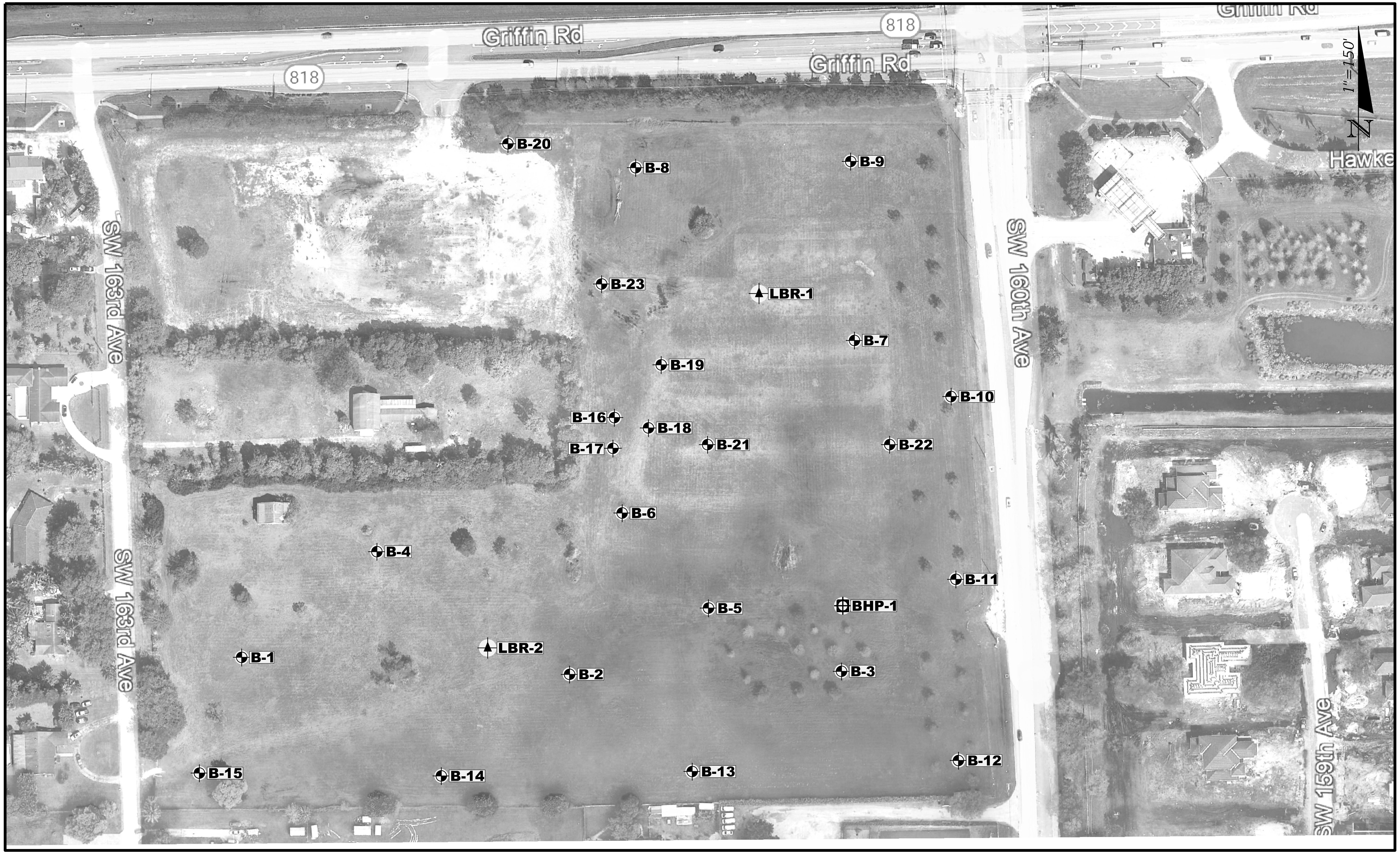
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 14, 2022—Jan 24, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Dania muck, frequently ponded, 0 to 1 percent slopes	6.1	10.4%
12	Hallandale fine sand, 0 to 2 percent slopes	52.5	89.6%
Totals for Area of Interest		**58.6**	**100.0%**



Approximate Location of SPT Boring
Approximate Location of BHP Test
Approximate Location of LBR Sample

DRAWN BY:	APPROVED BY:	ENGINEER OF RECORDS		SCALE:	PROJECT NUMBER:	BORING LOCATION PLAN	SHEET NO.
JO	HB	HARMON BENNETT, P.E. FLORIDA LICENSE NO.: 53130	TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	NTS	7111-23-156	**SW MEADOWS SANCTUARY PARK** SOUTHWEST RANCHES, FLORIDA	1
CHECKED BY: EJ	DATE: 6/29/2023						

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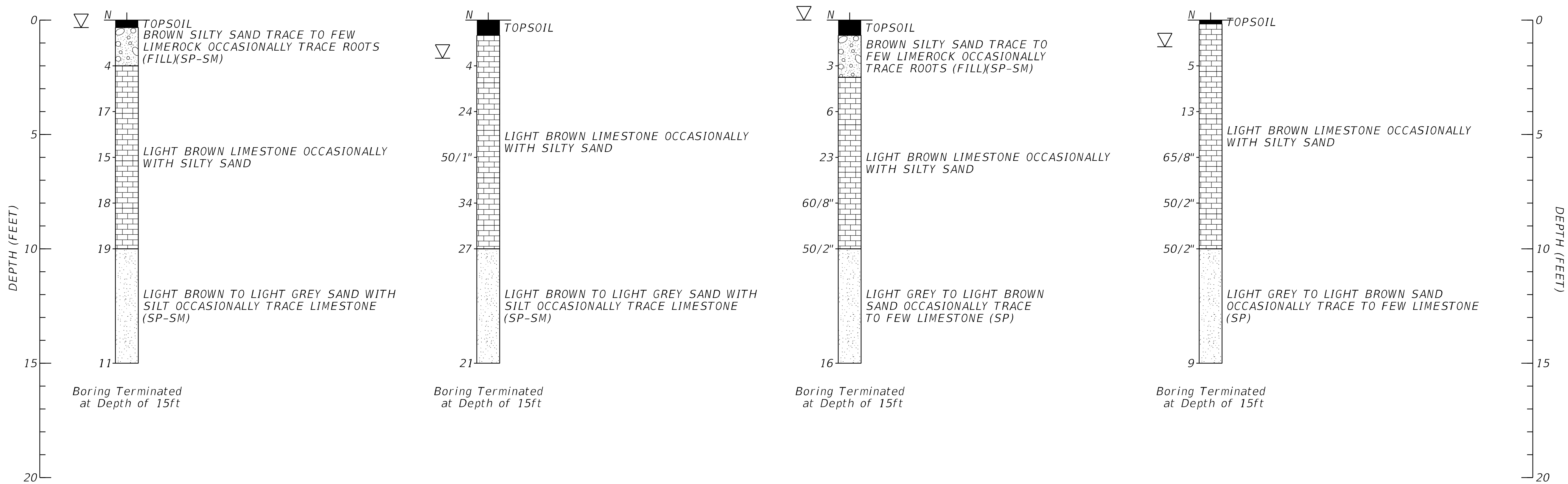
	B-1	B-2	B-3	B-4
Bore #	B-1	B-2	B-3	B-4
Date	6/13/2023	6/9/2023	6/16/2023	6/13/2023
Driller	Y. OVIEDO	Y. OVIEDO	Y. OVIEDO	Y. OVIEDO
Hammer	AUTO	AUTO	AUTO	AUTO
Rig	CME-75	CME-75	CME-550	CME-75
Latitude	26.0601197	26.0600463	26.0600533	26.0605356
Longitude	-80.3655712	-80.3641278	-80.3629374	-80.3649722



LEGEND

- ▽ ENCOUNTERED GROUNDWATER TABLE
- GNE GROUNDWATER NOT ENCOUNTERED IN UPPER 10 FEET
- | | CASING
- Asphalt / Topsoil
- Silty Sand
- Sand
- Limestone Hard
- Gravelly Sand

NOTES

1. BORING LOCATIONS WERE MARKED IN THE FIELD USING A HANDHELD GPSMap GARMIN 78s. ACTUAL LOCATIONS AND THEIR COORDINATES ARE APPROXIMATE.
2. DEPTH SHOWN ARE IN FEET FROM EXISTING GROUND SURFACE
3. SPT N-VALUES SHOWN ABOVE WERE OBTAINED USING AUTOMATIC HAMMERS. GENERALLY DESIGN CORRELATIONS AND PROGRAMS USE SAFETY HAMMERS N-VALUES. HENCE, THE ABOVE N-VALUES NEED TO BE MULTIPLIED BY 1.24 TO OBTAIN EQUIVALENT SAFETY HAMMER N-VALUES FOR DESIGN PURPOSE.
4. THE LIMESTONE STRATA ENCOUNTERED WITHIN THE PROJECT SITE CORRESPOND TO ROCK FORMATION THAT TYPICALLY OFFER HIGH RESISTANCE TO EXCAVATION AND DRILLING. SPECIAL EQUIPMENT AND BREAKING TOOLS ARE TYPICALLY REQUIRED TO EXCAVATE AND DRILL WITHIN THESE LIMESTONE LAYERS. THESE LIMESTONE LAYERS A RE ALSO DIFFICULT TO DEWATER DUE TO ITS HIGH POROSITY AND PERMEABILITY.
5. THE SAND STRATA ENCOUNTERED IN THIS AREA IS SOMETIMES MIXED WITH CEMENTED SAND AND LIMESTONE THAT COULD OFFER HIGH RESISTANCE AND LEAD TO CAVING SOILS. SPECIAL EQUIPMENT AND/OR PROCEDURES MAY BE REQUIRED TO EXCAVATE AND STABILIZE EXCAVATIONS.

DRAWN BY: JO	APPROVED BY: HB	ENGINEER OF RECORDS	TIERRA SOUTH FLORIDA	SCALE: NTS	PROJECT NUMBER: 7111-23-156	SOIL PROFILES	SHEET NO. 2
CHECKED BY: EJ	DATE: 6/29/2023	HARMON BENNETT, P.E. FLORIDA LICENSE NO.: 53130	2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411			SW MEADOWS SANCTUARY PARK SOUTHWEST RANCHES, FLORIDA	

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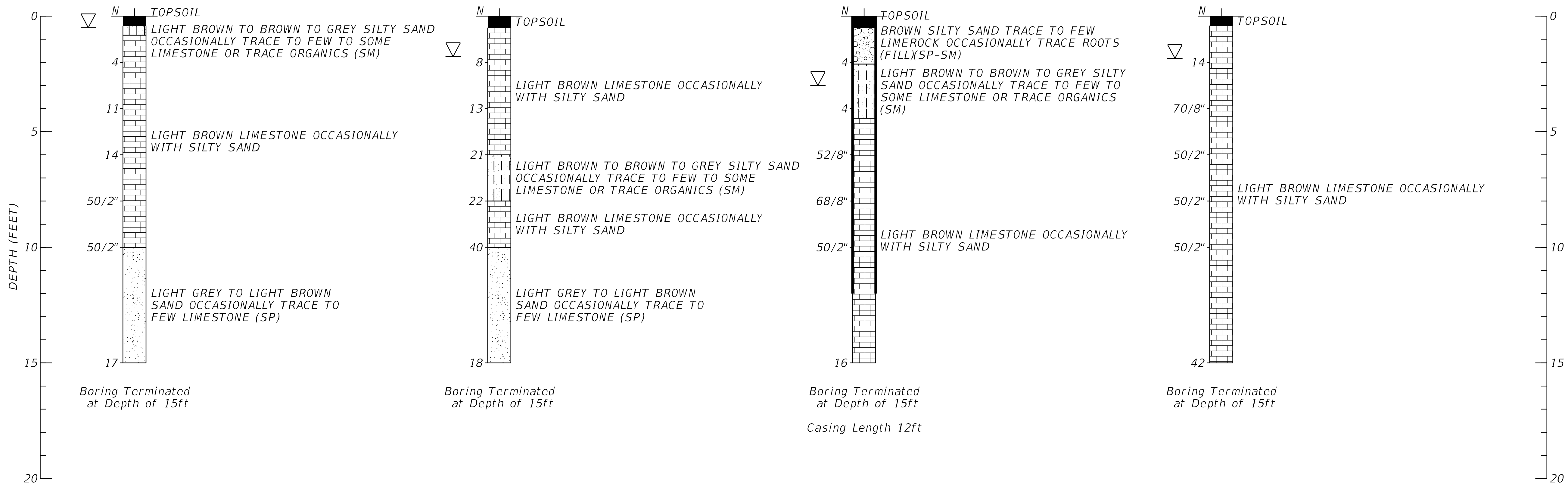
Bore #	B-5	B-6	B-7	B-8
Date	6/13/2023	6/12/2023	6/16/2023	6/9/2023
Driller	Y. OVIEDO	Y. OVIEDO	Y. OVIEDO	Y. OVIEDO
Hammer	AUTO	AUTO	AUTO	AUTO
Rig	CME-75	CME-75	CME-550	CME-75
Latitude	26.0603039	26.060682	26.0613604	26.0620568
Longitude	-80.3635228	-80.3638961	-80.3628755	-80.3638281



Boring Terminated at Depth of 15ft (B-5)

Boring Terminated at Depth of 15ft (B-6)

Boring Terminated at Depth of 15ft (B-7)

Casing Length 12ft

Boring Terminated at Depth of 15ft (B-8)

LEGEND

- ▽ ENCOUNTERED GROUNDWATER TABLE
- GNE GROUNDWATER NOT ENCOUNTERED IN UPPER 10 FEET
- | | CASING
- Asphalt / Topsoil
- Silty Sand
- Sand
- Limestone Hard
- Gravelly Sand

NOTES

1. BORING LOCATIONS WERE MARKED IN THE FIELD USING A HANDHELD GPSMap GARMIN 78s. ACTUAL LOCATIONS AND THEIR COORDINATES ARE APPROXIMATE.
2. DEPTH SHOWN ARE IN FEET FROM EXISTING GROUND SURFACE
3. SPT N-VALUES SHOWN ABOVE WERE OBTAINED USING AUTOMATIC HAMMERS. GENERALLY DESIGN CORRELATIONS AND PROGRAMS USE SAFETY HAMMERS N-VALUES. HENCE, THE ABOVE N-VALUES NEED TO BE MULTIPLIED BY 1.24 TO OBTAIN EQUIVALENT SAFETY HAMMER N-VALUES FOR DESIGN PURPOSE.
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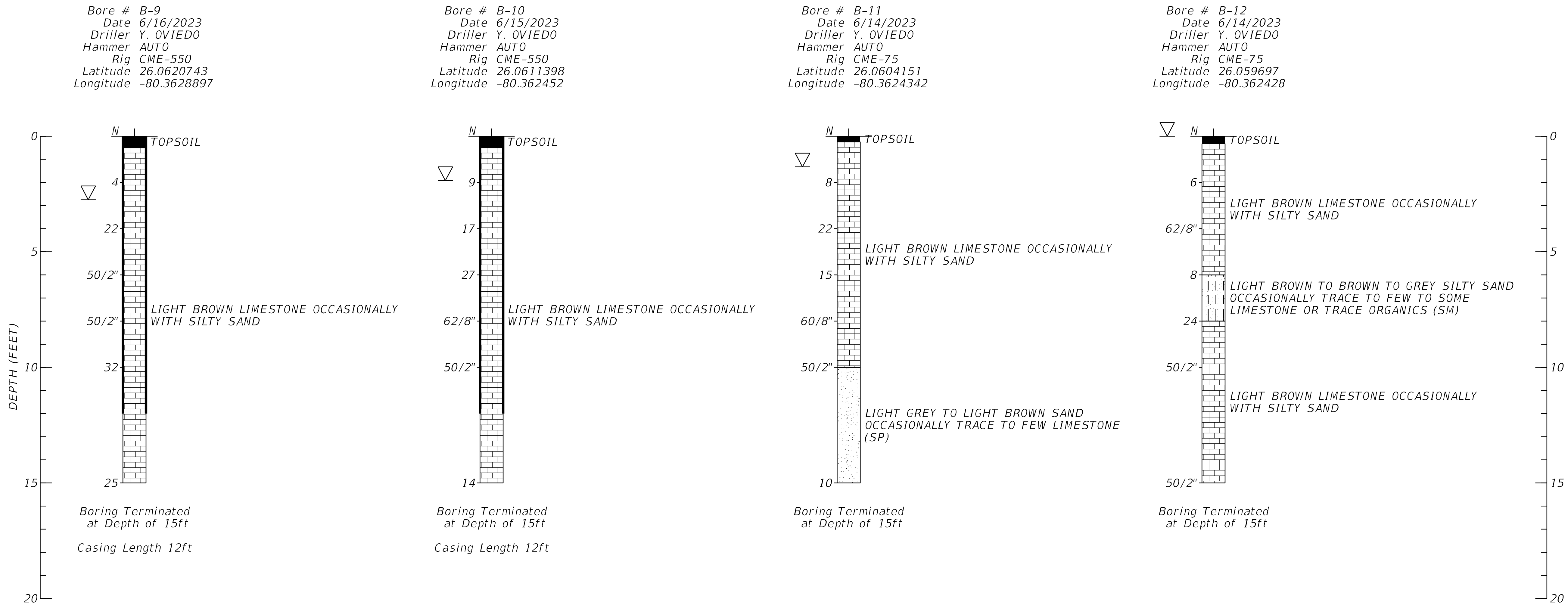
DRAWN BY: JO	APPROVED BY: HB	ENGINEER OF RECORDS		SCALE:	PROJECT NUMBER:	SOIL PROFILES	SHEET NO.
CHECKED BY: EJ	DATE: 6/29/2023	HARMON BENNETT, P.E. FLORIDA LICENSE NO.: 53130	TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	NTS	7111-23-156	**SW MEADOWS SANCTUARY PARK** SOUTHWEST RANCHES, FLORIDA	3



LEGEND

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DRAWN BY:	APPROVED BY:	ENGINEER OF RECORDS		SCALE:	PROJECT NUMBER:	SOIL PROFILES	SHEET NO.
JO	HB	HARMON BENNETT, P.E.	TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	NTS	7111-23-156	SW MEADOWS SANCTUARY PARK	4
CHECKED BY: EJ	DATE: 6/29/2023	FLORIDA LICENSE NO.: 53130				SOUTHWEST RANCHES, FLORIDA	

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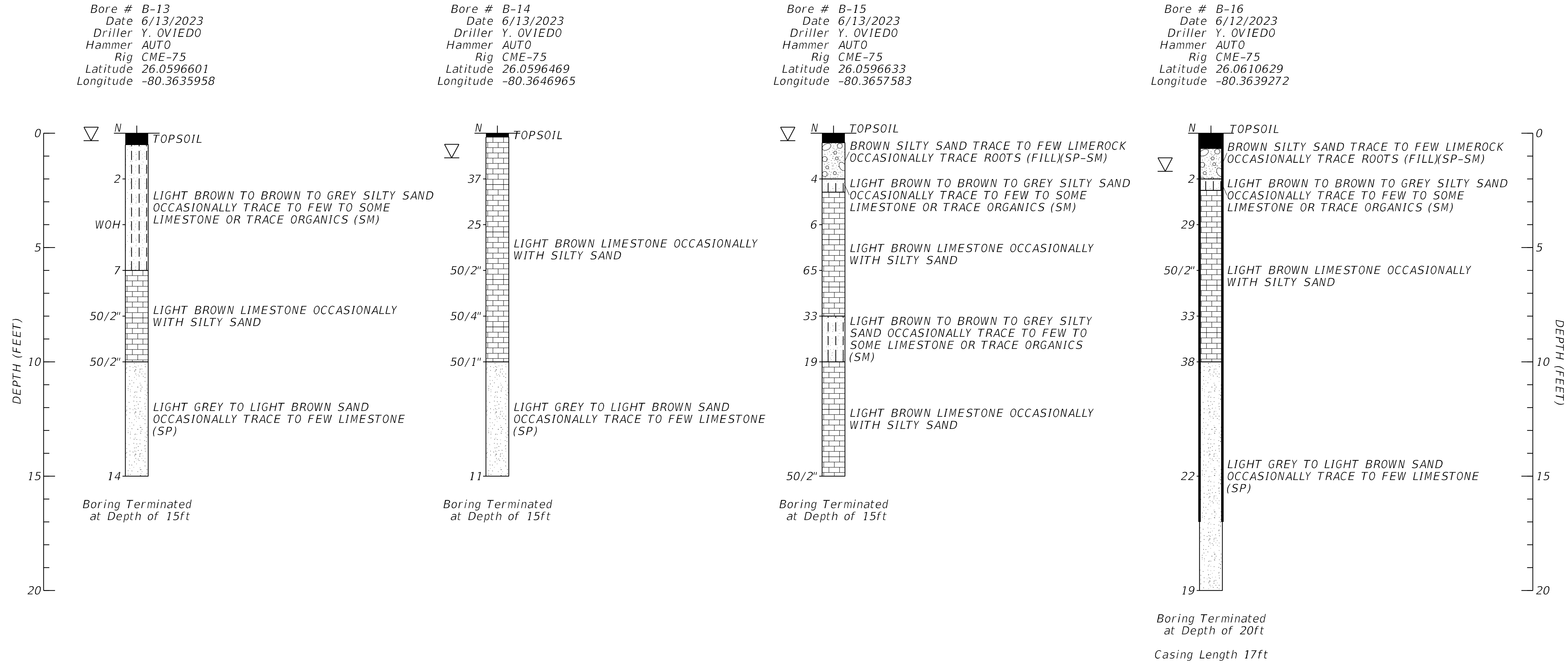

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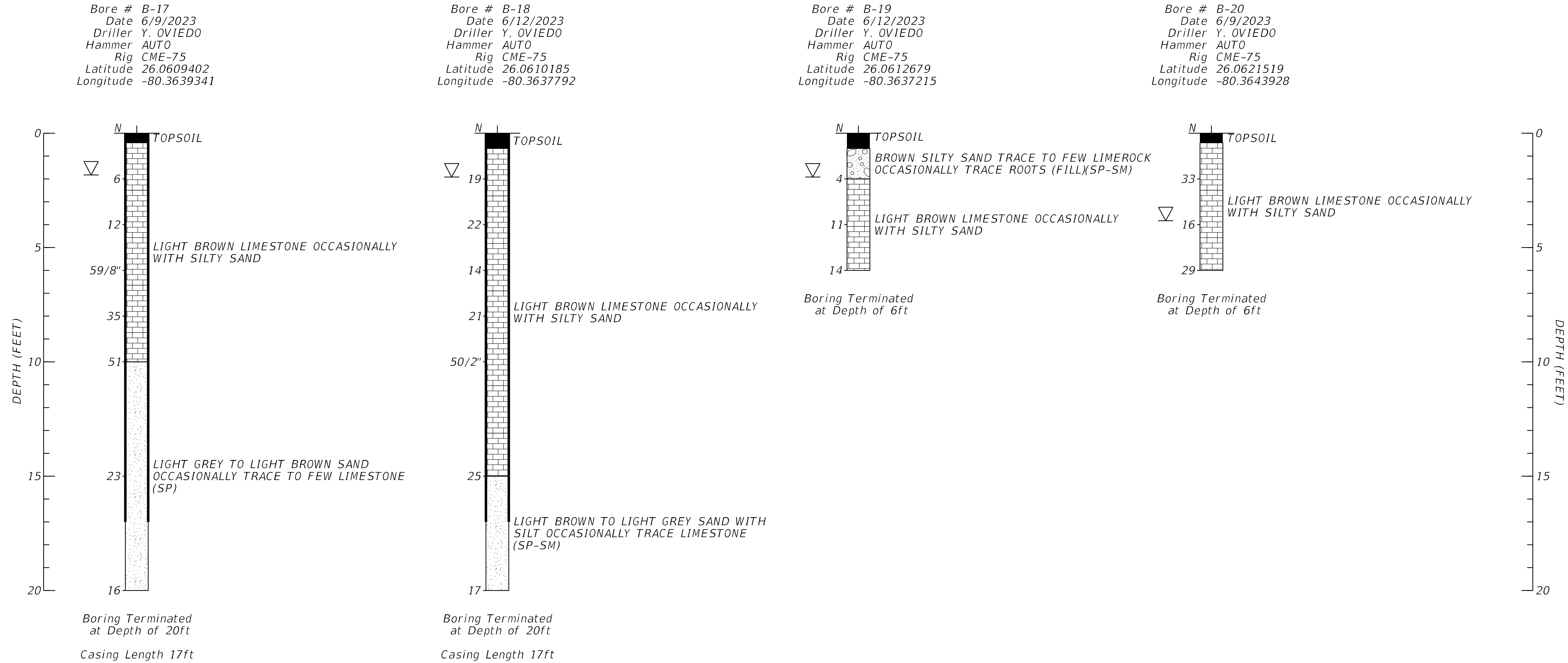
DRAWN BY:	APPROVED BY:	ENGINEER OF RECORDS		SCALE:	PROJECT NUMBER:		SHEET NO.
JO	HB	HARMON BENNETT, P.E.	TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	NTS	7111-23-156	SOIL PROFILES SW MEADOWS SANCTUARY PARK SOUTHWEST RANCHES, FLORIDA	5
CHECKED BY: EJ	DATE: 6/29/2023	FLORIDA LICENSE NO.: 53130					



LEGEND

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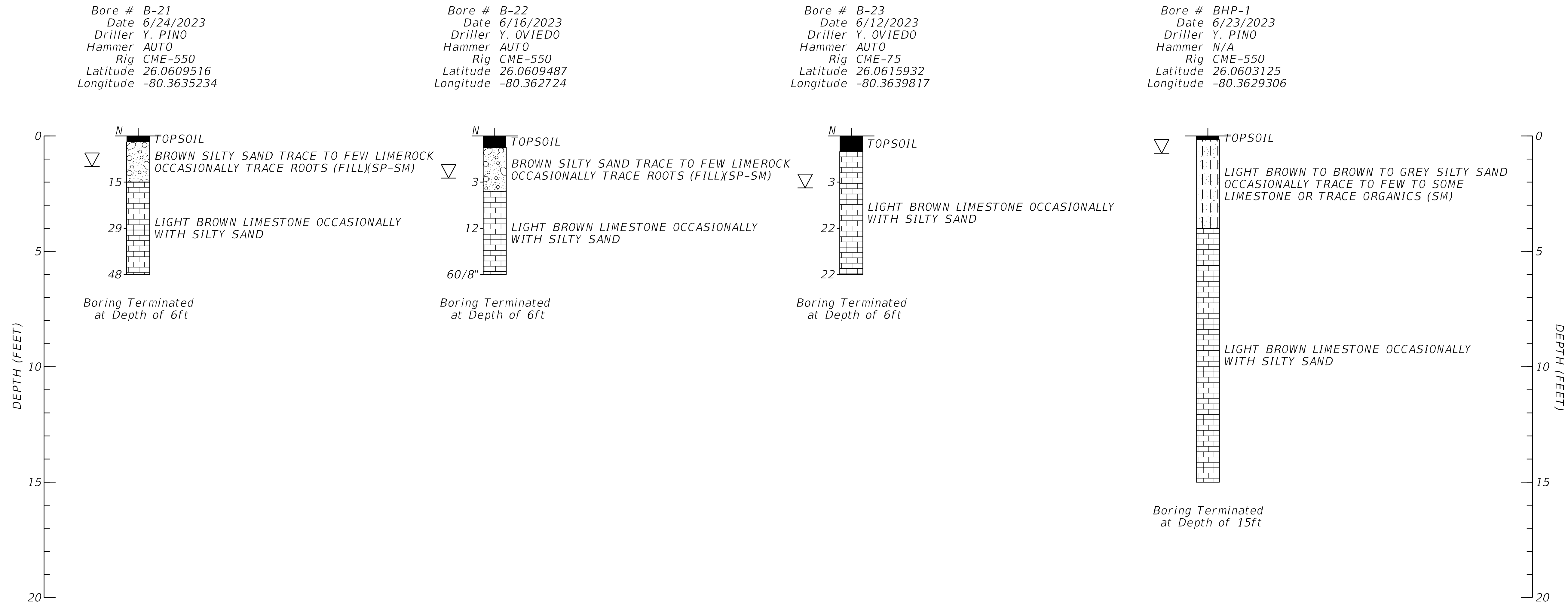
DRAWN BY: JO	APPROVED BY: HB	ENGINEER OF RECORDS HARMON BENNETT, P.E. FLORIDA LICENSE NO.: 53130	TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	SCALE: NTS	PROJECT NUMBER: 7111-23-156	SOIL PROFILES SW MEADOWS SANCTUARY PARK SOUTHWEST RANCHES, FLORIDA	SHEET NO. 6
CHECKED BY: EJ	DATE: 6/29/2023						



LEGEND

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DRAWN BY: JO	APPROVED BY: HB	ENGINEER OF RECORDS	TIERRA SOUTH FLORIDA	SCALE:	PROJECT NUMBER:	SOIL PROFILES	SHEET NO.
CHECKED BY: EJ	DATE: 6/29/2023	HARMON BENNETT, P.E. FLORIDA LICENSE NO.: 53130	2765 VISTA PARKWAY, STE-10 WEST PALM BEACH, FL 33411	NTS	7111-23-156	SW MEADOWS SANCTUARY PARK SOUTHWEST RANCHES, FLORIDA	7

Summary of Exfiltration Test Results

Geotechnical Services Report
SW Meadows Sancutary Park
Town of Southwest Ranches
TSFGeo Project No. 7111-23-156

Test Location	Date Performed	Diameter		Depth of Hole	Depth to Groundwater Level Below Ground Surface (Feet)		Hydraulic Head, H_2	Saturated Hole Depth, Ds	Average Flow Rate, Q	Horizontal Hydraulic Conductivity (K)
		Hole (Inches)	Casing (Inches)	(Feet)	Prior to Test	During Test	(Feet)	(Feet)	(gpm)	($ft^3/sec/ft^2$-ft Head)
BHP-1	6/23/2023	6	4	15.0	0.8	0.0	0.8	14.3	0.30	5.79E-05

Note:

(1) The above hydraulic conductivity values represent an ultimate value. The designer should decide on the required factor of safety

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure.

(3) Casing diameter was used for the calculation of hydraulic conductivity values.

TIERRA SOUTH FLORIDA

SUMMARY OF CORROSION TEST RESULTS

Geotechnical Services Report
SW Meadows Sancutary Park
Town of Southwest Ranches
TSFGeo Project No. 7111-23-156

Boring Number	Depth (ft)	pH (FM 5-550)	Resistivity (ohm-cm) (FM 5-551)	Chlorides (ppm) (FM 5-552)	Sulfates (ppm) (FM 5-553)	Environmental Classification* (Soil)	
						Steel	Concrete
B-20	2 - 4	8.8	1,300	240	15	Moderately Aggressive	Moderately Aggressive

* As per FDOT Structures Design Guidelines, Table 1.1, Updated January, 2019
**** Any reading represented as "0.0" is below the detection limit of 4.8 ppm**

Structures Design Guidelines — Topic No. 625-020-018
1 - General Requirements — January 2023

Table 1.3.2-1 Criteria for Substructure Environmental Classifications

Classification	Environmental Condition	Units	Steel		Concrete	
			Water	Soil	Water	Soil
Extremely Aggressive (If any of these conditions exist)	pH		< 6.0		< 5.0	
	Cl	ppm	> 2,000		> 2,000	
	SO_4	ppm	N.A.		> 1,500	> 2,000
	Resistivity	Ohm-cm	< 1,000		< 500	
Slightly Aggressive (If all of these conditions exist)	pH		> 7.0		> 6.0	
	Cl	ppm	< 500		< 500	
	SO_4	ppm	N.A.		< 150	< 1,000
	Resistivity	Ohm-cm	> 5,000		> 3,000	
Moderately Aggressive	This classification must be used at all sites not meeting requirements for either slightly aggressive or extremely aggressive environments.					

pH = acidity ($-\log_{10}H^+$; potential of Hydrogen), Cl = chloride content, SO_4 = Sulfate content.

2. Superstructure: Any superstructure located within 2,500-feet of any coal burning industrial facility, pulpwood plant, fertilizer plant, or any other similar industry classify as Moderately Aggressive. All others classify as Slightly Aggressive.

SUMMARY OF LABORATORY TESTS
Geotechnical Services Report
SW Meadows Sancutary Park
Town of Southwest Ranches
TSFGeo Project No. 7111-23-156

Boring Number	Sample Number	Sample Depth (ft)	Unified Symbol	Sieve Analysis, Percentage Passing								Written Description	Atterberg Limits			Organic Content (%)	Natural Moisture Content (%)
				3/4"	3/8"	#4	#10	#40	#60	#100	#200		Liquid Limit	Plastic Limit	Plasticity Index		
B-01	6	15.0	SP-SM	100	100	100	99	97	96	88	7	LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)					25.8
B-02	6	15.0	SP-SM	100	98	96	93	88	86	76	10	LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)					23.7
B-06	4	6 TO 8	SM	95	87	81	73	59	50	44	29	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)	N/P	N/P	N/P		12.7
B-07	2	2 TO 4	SM	95	83	70	66	61	49	28	13	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)	N/P	N/P	N/P	1.5	30.7
B-12	4	6 TO 8	SM	88	84	79	75	63	56	46	32	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)	N/P	N/P	N/P		20.0
B-13	2	2 TO 4	SM	100	100	100	100	96	77	41	22	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)				2.2	34.5
B-13	3	4 TO 6A	SM	92	92	89	87	82	66	49	18	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)				1.6	32.6
B-15	2	2 TO 4A	SM	100	95	89	85	74	61	37	19	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)				4.0	40.5
B-15	6	8 TO 10	SM	100	99	97	96	89	81	62	22	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)					19.2
B-16	1	0 TO 2	SM	99	97	97	97	93	77	47	31	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)	N/P	N/P	N/P		29.8
B-16	7	20.00	SP	93	88	86	85	85	84	72	5	LIGHT GREY TO LIGHT BROWN SAND OCCASIONALLY TRACE TO FEW LIMESTONE (SP)					21.4
B-18	7	20.00	SP-SM	100	99	96	95	94	94	83	9	LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)					23.2

SUMMARY OF LABORATORY TESTS
Geotechnical Services Report
SW Meadows Sancutary Park
Town of Southwest Ranches
TSFGeo Project No. 7111-23-156

Boring Number	Sample Number	Sample Depth (ft)	Unified Symbol	Sieve Analysis, Percentage Passing								Written Description	Atterberg Limits			Organic Content (%)	Natural Moisture Content (%)
				3/4"	3/8"	#4	#10	#40	#60	#100	#200		Liquid Limit	Plastic Limit	Plasticity Index		
B-22	1	0 TO 2	SM	100	94	93	93	88	71	40	23	LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)	N/P	N/P	N/P		19.6

GRAIN SIZE DATA SHEET

PROJECT INFORMATION
Geotechnical Services Report
SW Meadows Sancutary Park
Town of Southwest Ranches
TSFGeo Project No. 7111-23-156

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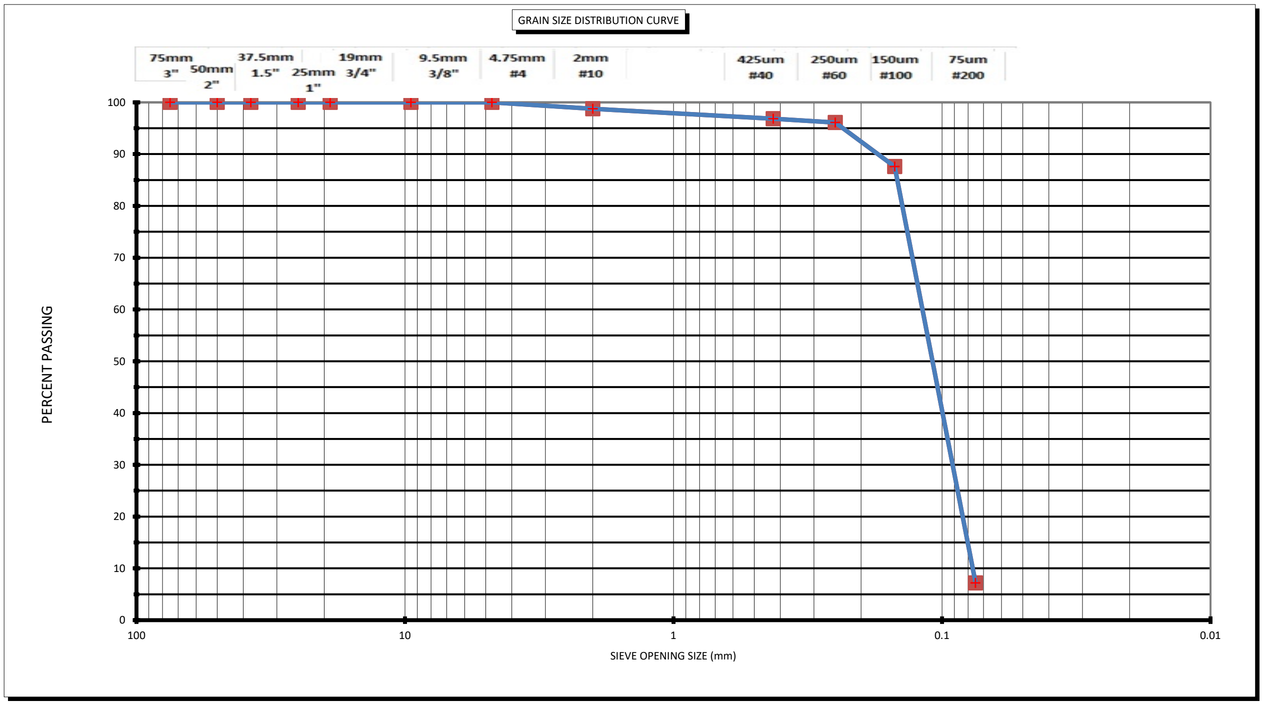

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 1.4
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =1
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-01 **SAMPLE #** 6 **DEPTH (ft):** 15.00
STRATUM: 6

SOIL CLASSIFICATION: SP-SM
MC% 25.8 LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)
OC%
-200% 7

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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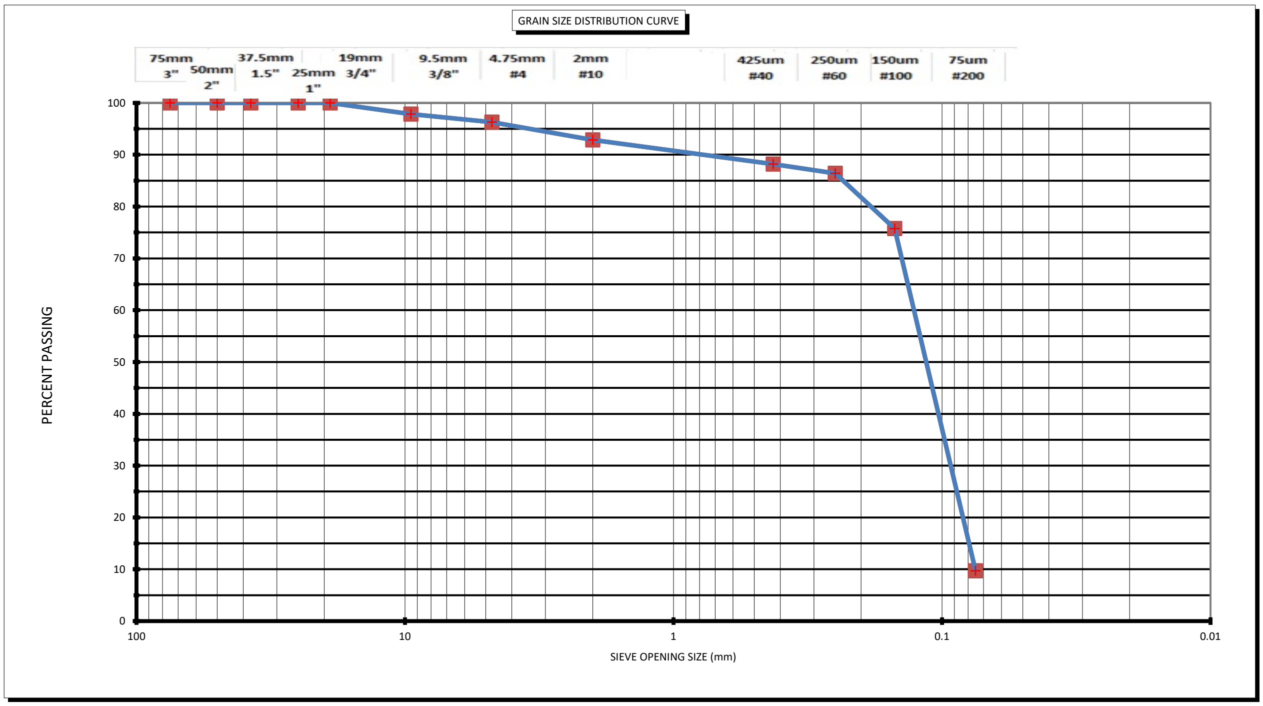

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 1.4
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =1
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-02 **SAMPLE #** 6 **DEPTH (ft):** 15.00
STRATUM: 6

SOIL CLASSIFICATION: SP-SM
MC% 23.7
OC%
-200% 10

LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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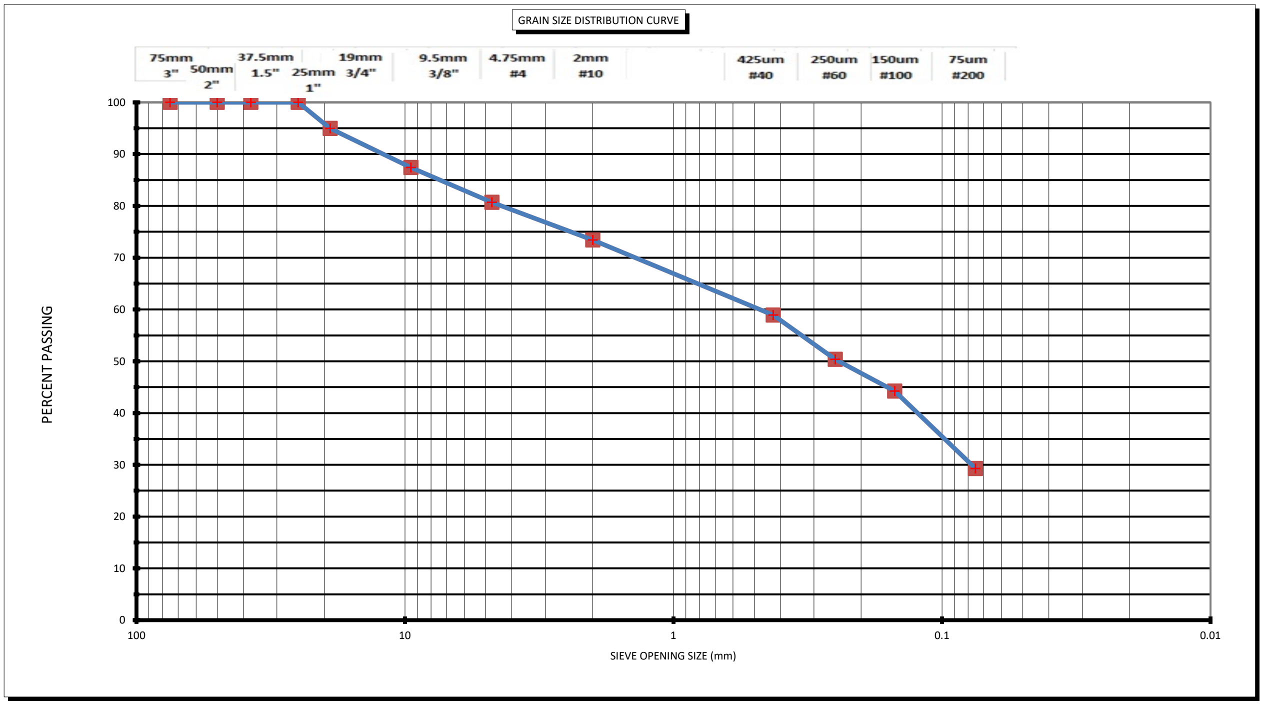

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 5.7
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.2
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-06 **SAMPLE #** 4 **DEPTH (ft):** 6 TO 8

STRATUM: 5

SOIL CLASSIFICATION: SM

MC% 12.7

OC%

-200% 29

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	N/P
PLASTIC LIMIT	N/P
PLASTIC INDEX	N/P

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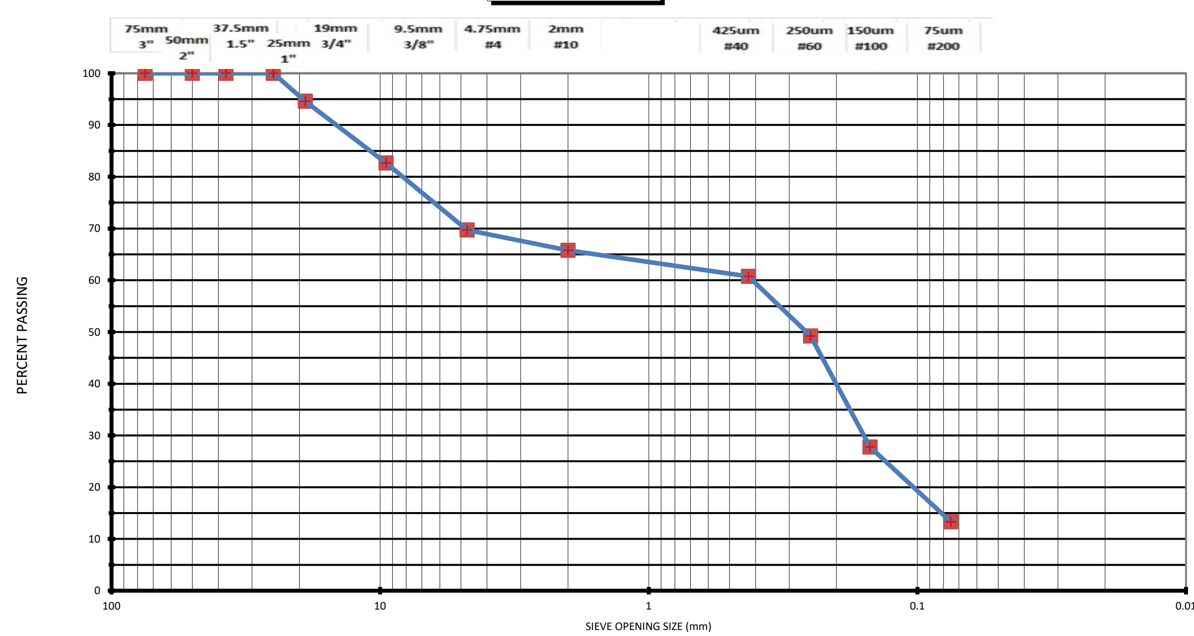

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 5.3
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.7
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-07 **SAMPLE #** 2 **DEPTH (ft):** 2 TO 4
STRATUM: 5

SOIL CLASSIFICATION: SM
MC% 30.7
OC% 1.52
-200% 13

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	N/P
PLASTIC LIMIT	N/P
PLASTIC INDEX	N/P

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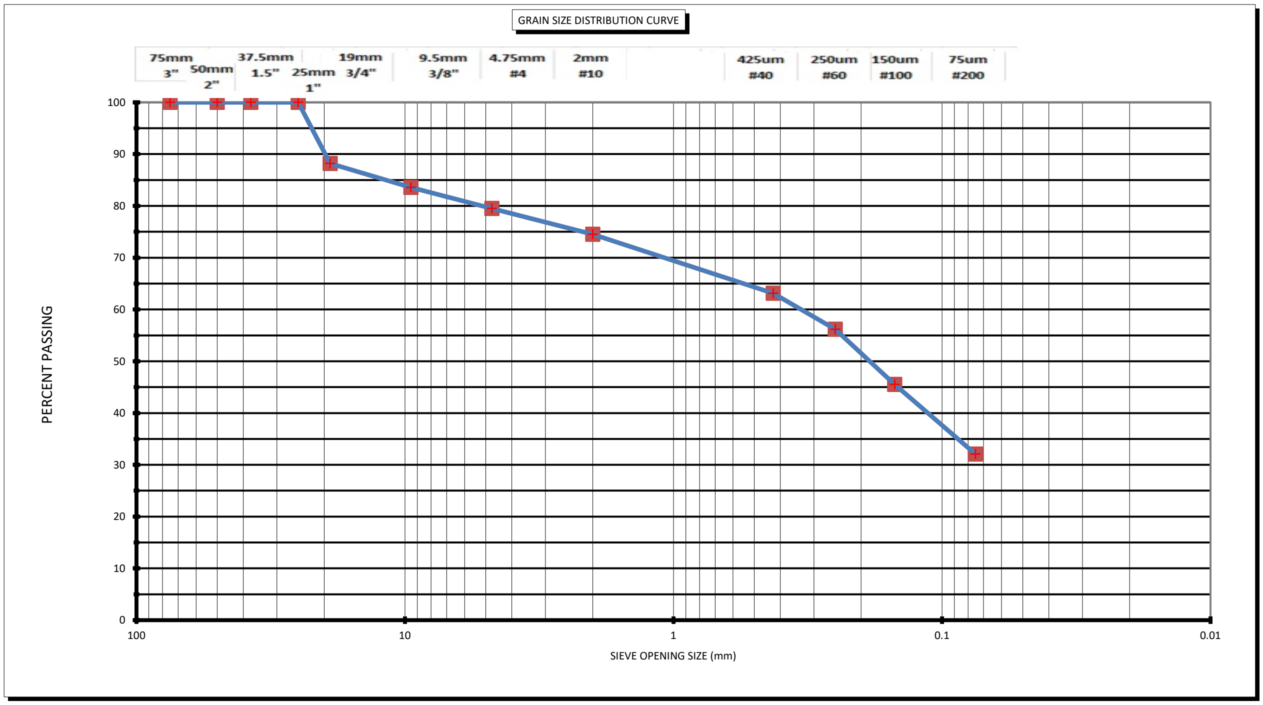

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 4.1
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.2
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-12 **SAMPLE #** 4 **DEPTH (ft):** 6 TO 8

STRATUM: 5

SOIL CLASSIFICATION: SM

MC% 20.0 LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

OC%

-200% 32

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	N/P
PLASTIC LIMIT	N/P
PLASTIC INDEX	N/P

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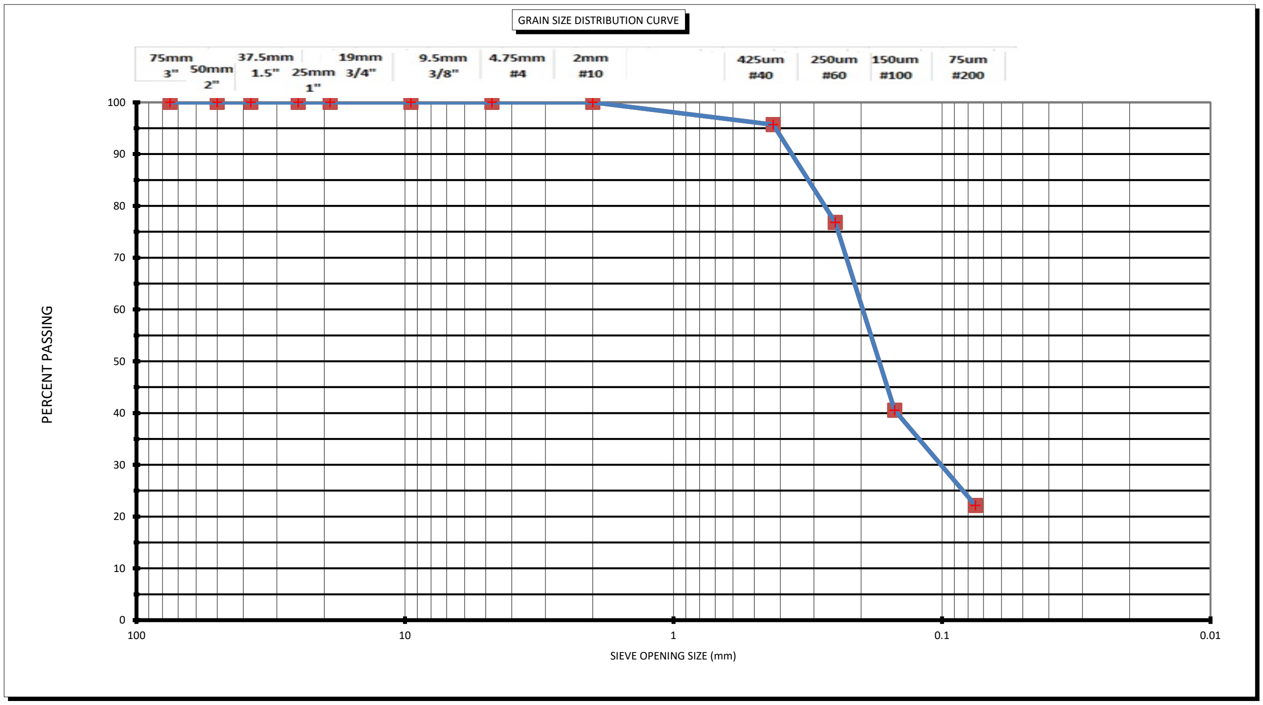

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 3.7
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.3
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-13 **SAMPLE #** 2 **DEPTH (ft):** 2 TO 4
STRATUM: 5

SOIL CLASSIFICATION: SM
MC% 34.5
OC% 2.20
-200% 22

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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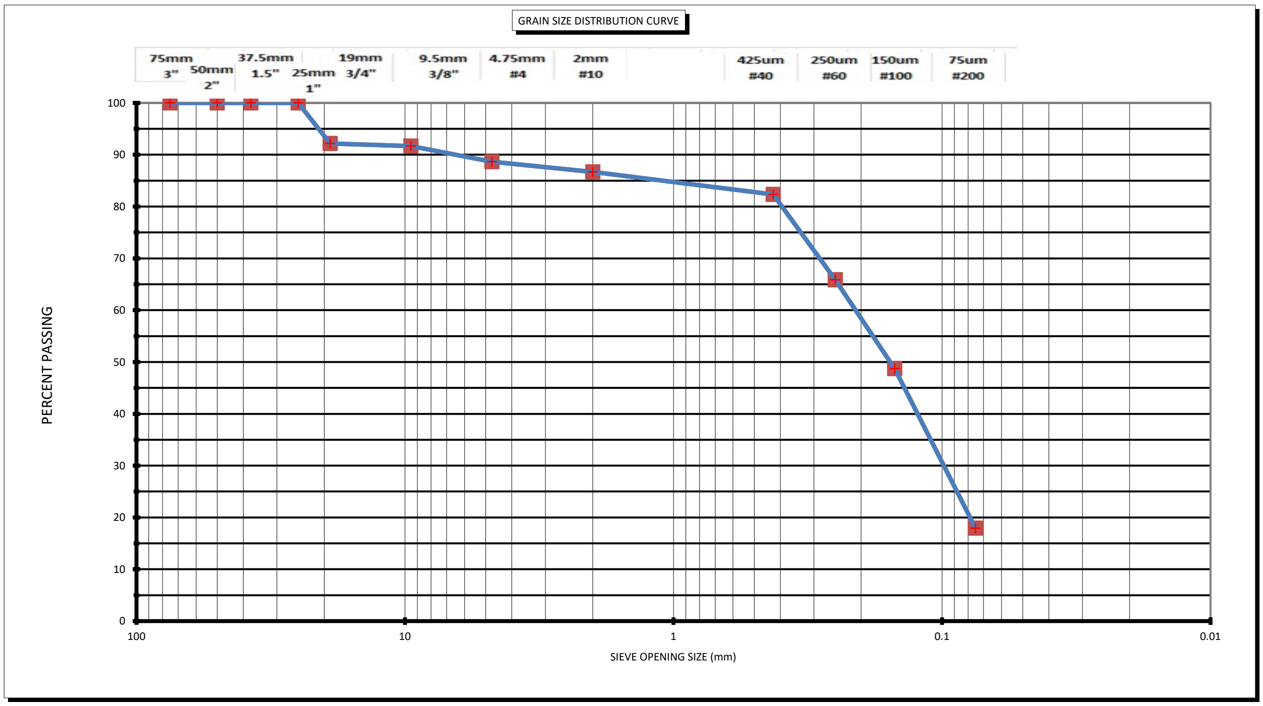

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 2.7
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.7
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-13 **SAMPLE #** 3 **DEPTH (ft):** 4 TO 6A
STRATUM: 5

SOIL CLASSIFICATION: SM

MC% 32.6
OC% 1.61
-200% 18

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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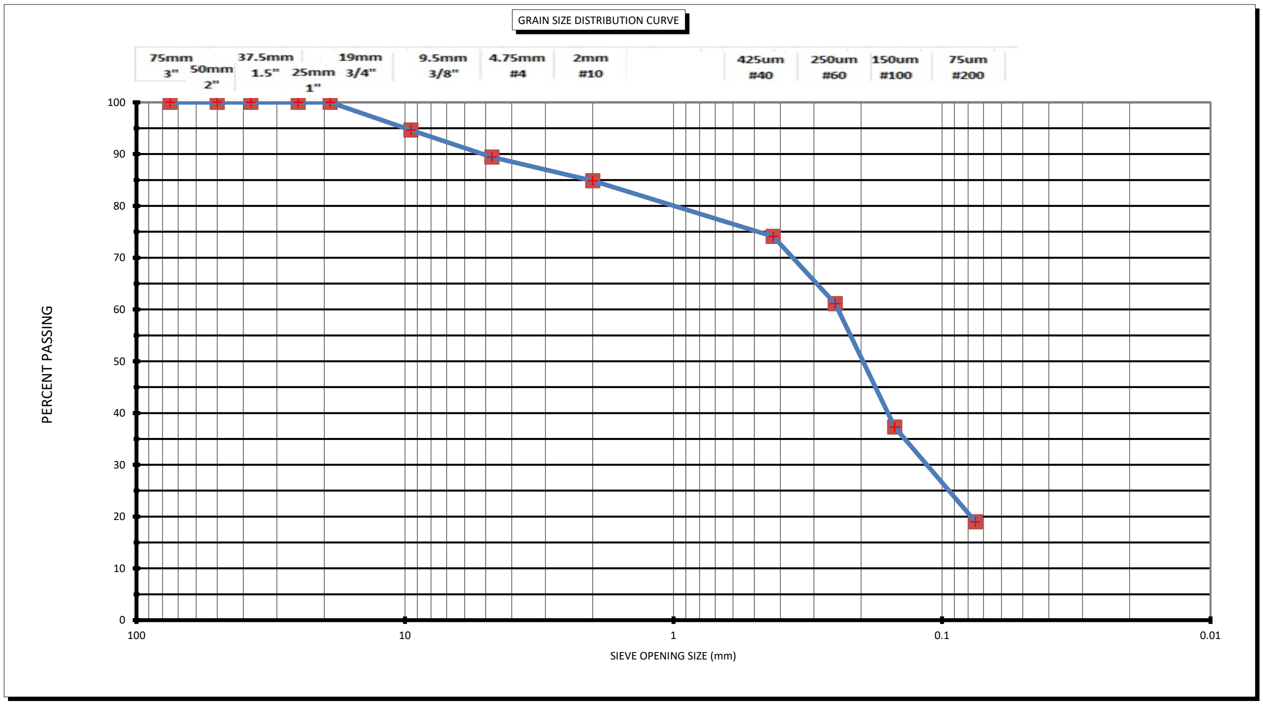

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 3.1
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.6
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING #	**B-15**	**SAMPLE #**	**2**	**DEPTH (ft):**	**2 TO 4A**
				STRATUM:	**5**

SOIL CLASSIFICATION: **SM**

MC% 40.5
OC% 4.02
-200% 19

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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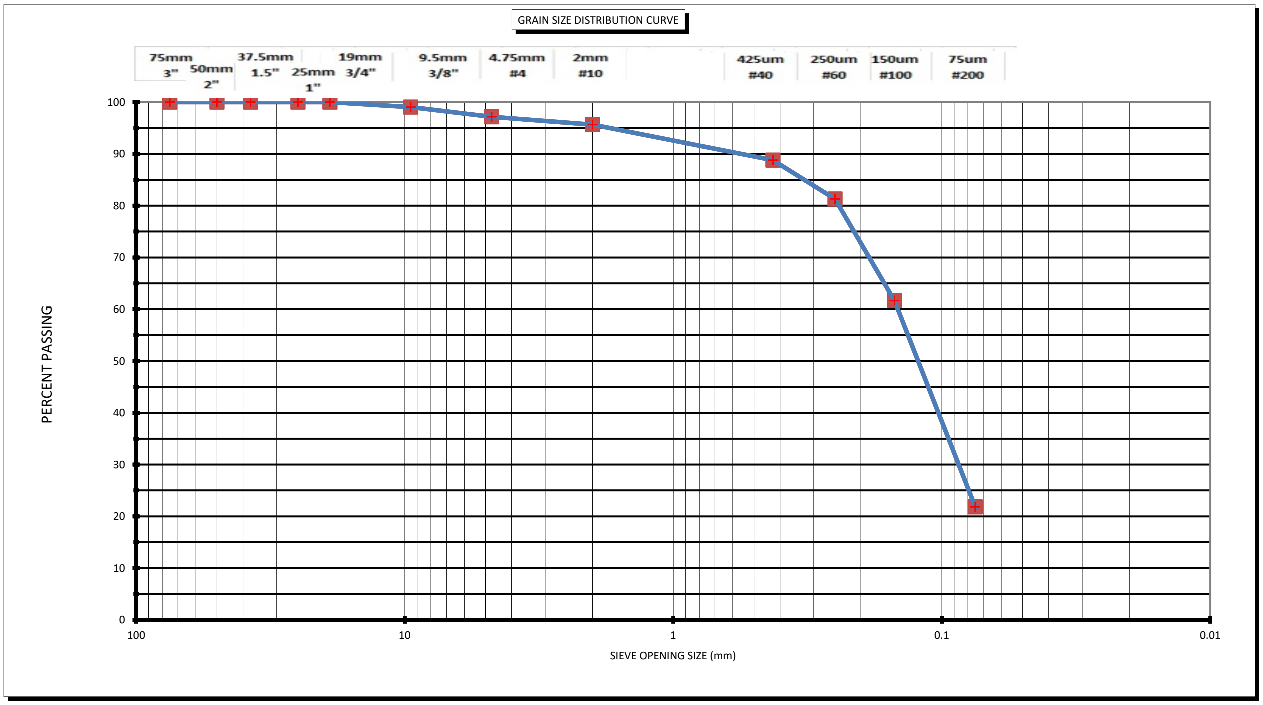

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 1.9
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.7
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-15 **SAMPLE #** 6 **DEPTH (ft):** 8 TO 10

STRATUM: 5

SOIL CLASSIFICATION: SM

MC% 19.2

OC%

-200% 22

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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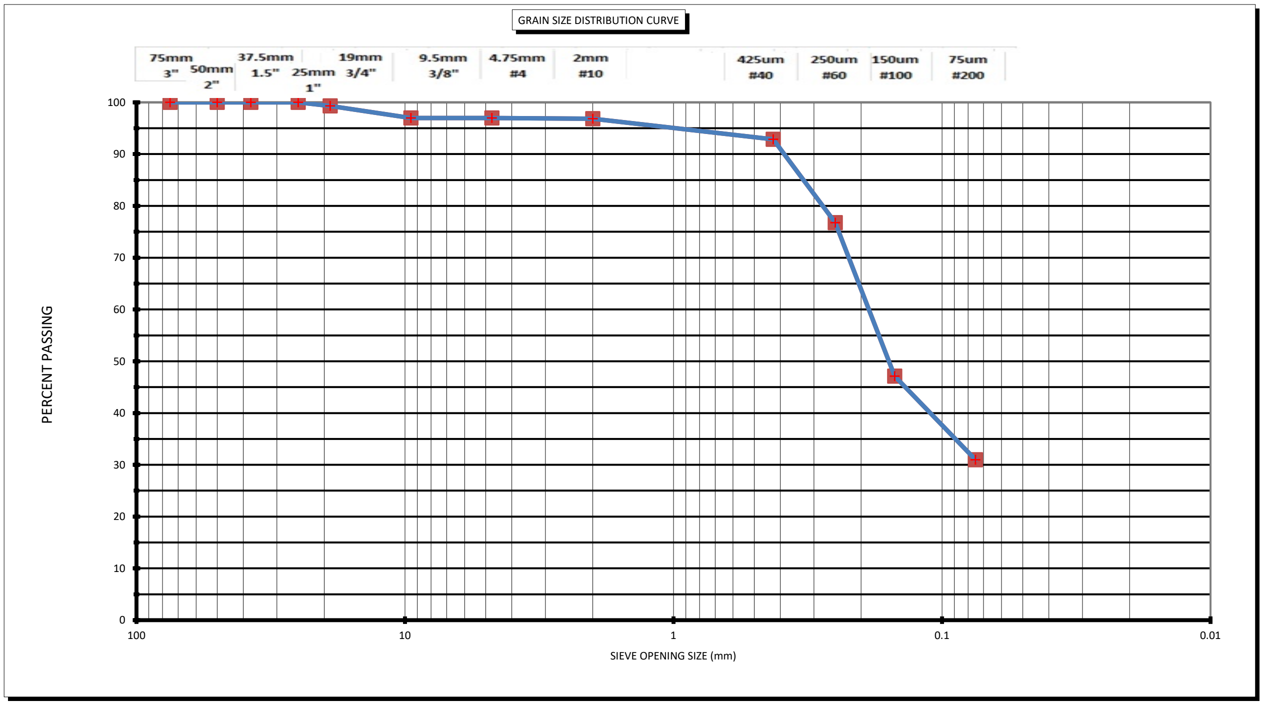

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 2.4
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.4
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-16 **SAMPLE #** 1 **DEPTH (ft):** 0 TO 2

STRATUM: 5

SOIL CLASSIFICATION: SM

MC% 29.8 **LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)**

OC%

-200% 31

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	N/P
PLASTIC LIMIT	N/P
PLASTIC INDEX	N/P

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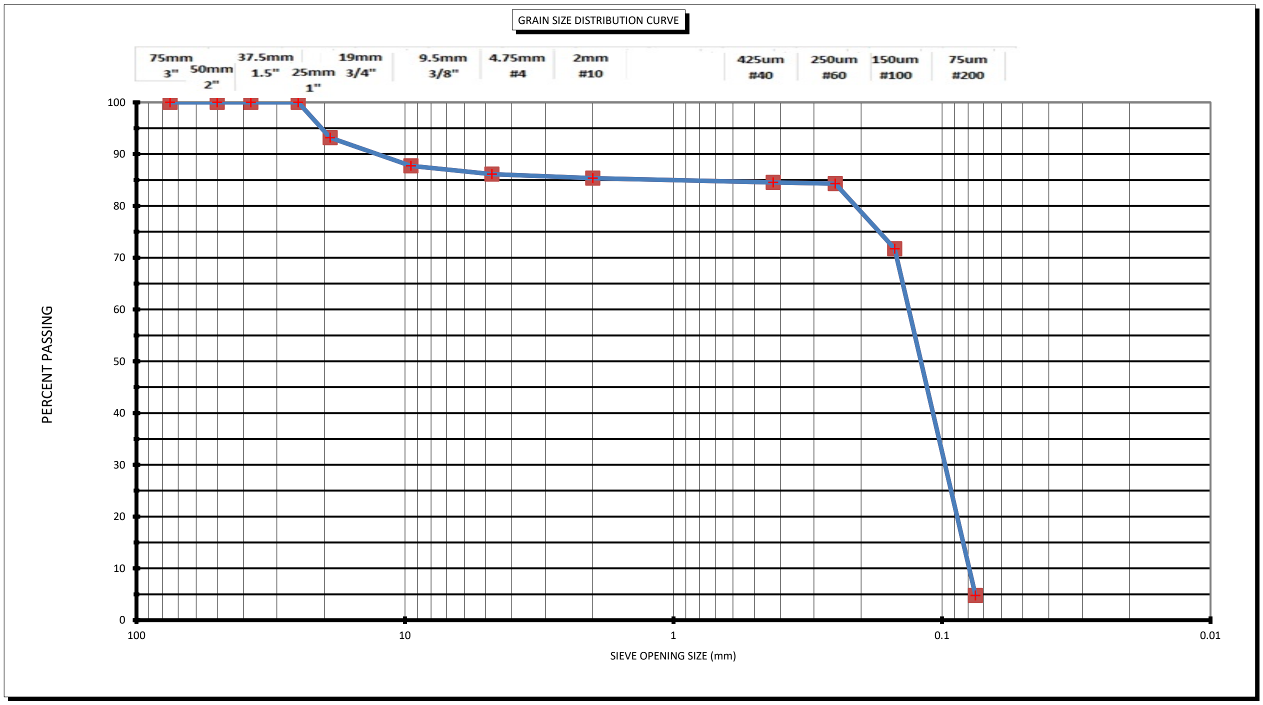

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 1.4
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.9
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-16 **SAMPLE #** 7 **DEPTH (ft):** 20.00
STRATUM: 4

SOIL CLASSIFICATION: SP

MC% 21.4
OC%
-200% 5

LIGHT GREY TO LIGHT BROWN SAND OCCASIONALLY TRACE TO FEW LIMESTONE (SP)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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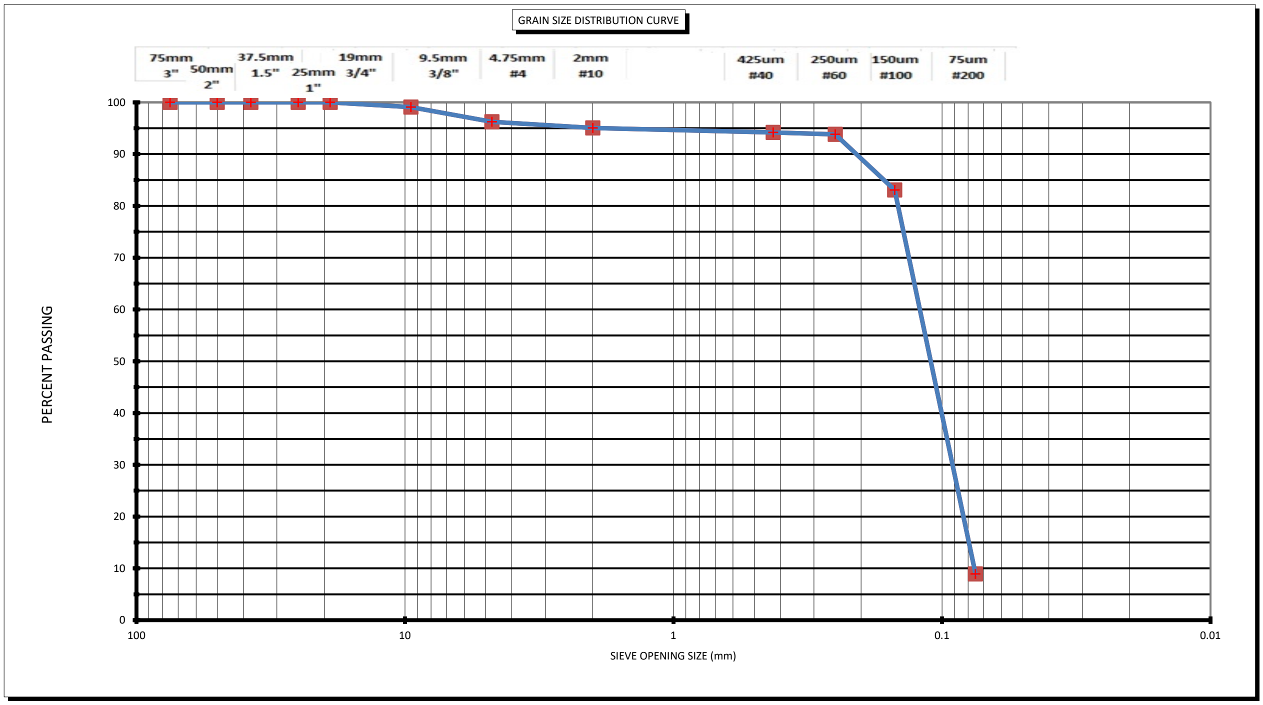

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 1.4
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =1
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-18 **SAMPLE #** 7 **DEPTH (ft):** 20.00
STRATUM: 6

SOIL CLASSIFICATION: SP-SM
MC% 23.2 LIGHT BROWN TO LIGHT GREY SAND WITH SILT OCCASIONALLY TRACE LIMESTONE (SP-SM)
OC%
-200% 9

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTIC INDEX	

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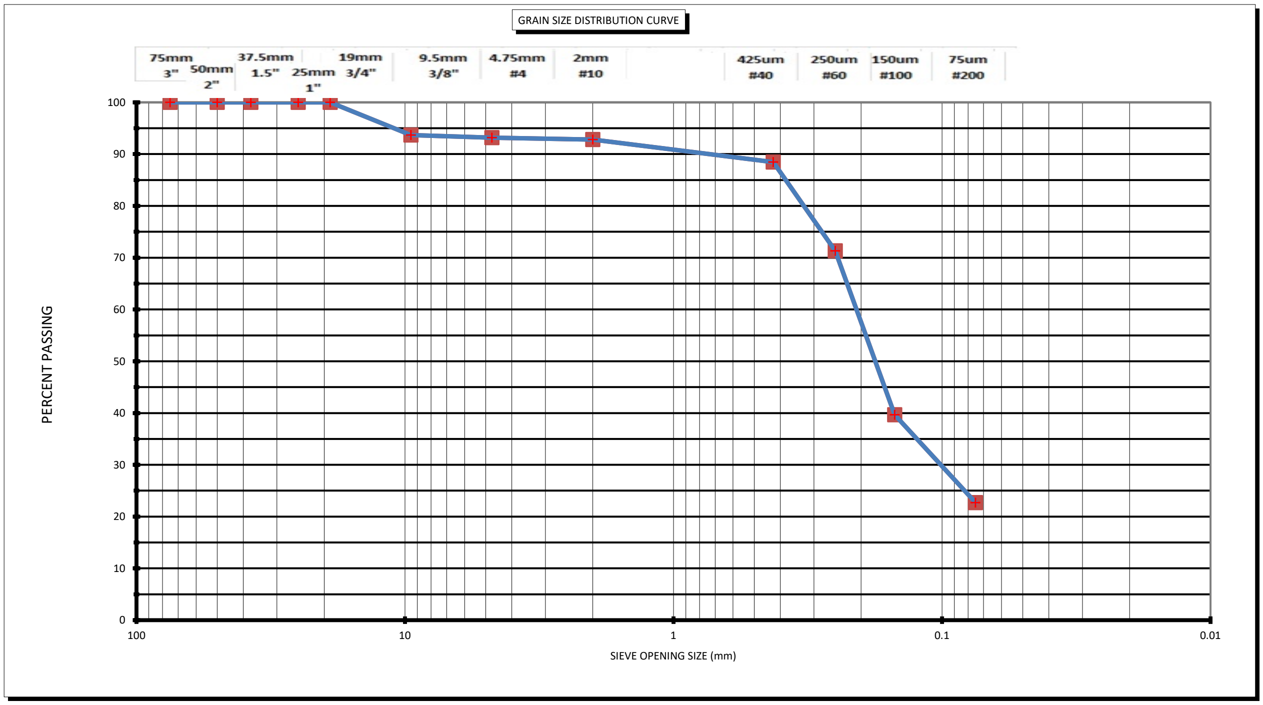

ASTM D 2487 Classification of Soil for Engineering Purposes			Coarse Sand	< #4 and > #10	Cu = D60 / D10 = 2.7
Coarse Gravel	< 3" and > 3/4"		Medium Sand	< #10 and > #40	Cc = (D30)^2 / (D10 x D60) =0.7
Fine Gravel	< 3/4" and > #4		Fine Sand	< #40 and > #200	

BORING # B-22 **SAMPLE #** 1 **DEPTH (ft):** 0 TO 2
STRATUM: 5

SOIL CLASSIFICATION: SM
MC% 19.6
OC%
-200% 23

LIGHT BROWN TO BROWN TO GREY SILTY SAND OCCASIONALLY TRACE TO FEW TO SOME LIMESTONE OR TRACE ORGANICS (SM)

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	N/P
PLASTIC LIMIT	N/P
PLASTIC INDEX	N/P