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**Report of Geotechnical Exploration for  
FWB Fire Training Facility  
Okaloosa County, Florida  
LMJ File # 17-135**

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## 1.0 INTRODUCTION

This report forwards the results of our Geotechnical Exploration for the proposed **FWB Fire Training Facility** project in Fort Walton Beach, Florida. The purpose of this exploration was to determine the general subsurface conditions at nine boring locations on the site and use this information to provide building foundation, stormwater pond and general pavement recommendations. Our exploration consisted of nine Standard Penetration Test borings, classification of the soil samples, laboratory testing, and analysis by our engineering staff.

## 2.0 SITE AND PROJECT CONDITIONS

The project site is located on the north side of Lewis Turner Boulevard, west of NW Mooney Road in Fort Walton Beach, Florida. We understand that the project consists of a 40x100 one-story metal building, a fire training tower, pavement area, and a dry detention stormwater pond. We understand that the stormwater pond is planned to be on the order of 5 feet deep. Based on the received preliminary site plan information, the proposed metal building will be placed in the footprint of an existing small building which would be demolished. Information of the size and loading of the training tower was not available and one boring was requested for this structure.

## 3.0 SUBSURFACE EXPLORATION

To examine the subsurface conditions on site, we drilled four borings in the proposed pond area to a depth of 16 feet (B-1 to B-4), one boring in the proposed tower area to a depth of 26 feet (B-5), two borings in the proposed building area to a depth of 26 feet (B-6 and B-7), and two borings in the pavement area to a depth of 6 feet (B-8 and B-9). The requested borings were Standard Penetration Test (SPT) borings which consists of driving a 2-inch outside diameter split spoon sampler into the ground using a 140-pound hammer dropped 30 inches. The number of blows required to drive the sampler one foot after seating it 6 inches is referred to as the blow count or "N" value and is a measure of the relative density of subsurface soils. "N" values can be found in **Figure #2** adjacent to the soil description. The SPT borings were drilled in general accordance with ASTM D1586 using a truck mounted drill rig. Five samples were taken to a depth of 11 feet, and the borings were sampled at five foot increments thereafter. The SPT borings were advanced between samples using the mud jetting technique. Each sample was removed from the sampler, classified in the field by the driller, and packaged for visual classification by our engineering staff.

## 4.0 SUBSURFACE CONDITIONS

The requested boring locations are shown in the attached **Figure #1** and should be considered approximate. The borings were located using the received site plan by measuring off existing landmarks and approximating right angles. The number of borings and locations were selected by others. The subsurface conditions encountered in the borings are shown in the attached **Figure #2**. Boundaries between soil layers and soil depths should be considered approximate as the actual transition between soil layers may be gradual. A generalized summary of the conditions encountered in the borings is included below. For a detailed description of the conditions encountered in the borings, the reader is directed to **Figure #2**.



Borings B-6 and B-7 were located in an existing parking area and encountered 3-5 inches of asphalt at the surface. Borings B-1 to B-5 encountered surficial brown, orange, and tan layers of slightly silty sand to a depth of roughly 4-6 feet followed by a layer of tan silty sand to a depth of 6-8 feet. The borings continued with tan, brown, and dark brown slightly silty sand and/or stained sand to the final boring depth of 16 feet in borings B-1 to B-4 and a depth of 26 feet in borings B-5 to B-7.

Borings B-8 and B-9 were drilled to a depth of 6 feet and encountered surficial brown slightly silty sand underlain by tan slightly silty sand. The borings were mostly medium dense or loose at the surface except borings B-7 and B-9 which were medium dense to a depth of roughly 6 feet. The borings became very loose and loose to a depth of 16-17 feet and medium dense conditions thereafter.

Groundwater was encountered between 15-18 feet below existing grade at the time of drilling in borings B-2, B-5, B-6, and B-7. The 16 foot deep borings B-1, B-3 and B-4 and the 6 foot deep borings B-8 and B-9 did not encounter groundwater at the time drilling. Based on our experience in this area, we expect the estimated seasonal high groundwater level to be near 15 feet below existing grades at the time of drilling. Groundwater levels will vary with the amount of local rainfall, changes in site drainage characteristics, and may be different at other times.

## 5.0 LABORATORY TEST RESULTS

Laboratory testing for this project included two falling head permeability tests and two grainsize analysis tests run on portions of the Shelby tube samples. Laboratory testing also included basic properties tests run on the split spoon samples including wash #200 sieve and natural moisture content tests to evaluate and document basic properties and assist in soil classification. The results of the laboratory tests are shown on the boring logs (**Figure #2**) adjacent to the samples tested. The results of the permeability tests are summarized in the following **Table #1**. Grainsize analysis tests were run on portions of the Shelby tube samples, and the grainsize curves for these tests are attached as **Figure #3**.

**Table #1: Falling Head Permeability Test Results**

Boring	Sample Depth (ft)	Sample Description	Dry Unit Weight (pcf)	Saturated Vertical Hydraulic Conductivity ( $K_{vs}$ ) (ft/day)	Percent Fines
B-2	4-5	Tan Slightly Silty Sand	105.7	6.5	11.4
B-2	6-7	Light Brown to Brown Stained Sand	100.1	37.2	3.8-3.5

## 6.0 DISCUSSION AND RECOMMENDATIONS

### 6.1 Basis of Recommendations

Recommendations rendered herein are based on assumed and/or design information available at the time of this letter, the subsurface conditions encountered in the test borings, commonly accepted Geotechnical Engineering principles and practices, and our experience with similar soil and groundwater conditions. Should final project design information differ from the design information used in this letter, or should any soil conditions not discussed in this letter be



encountered during construction, our office should be notified and retained so that this letter can be modified as needed.

Regardless of the care exercised in performing a Geotechnical Exploration, the possibility always exists that soil and/or groundwater conditions will differ from those encountered at the specific boring locations. In addition, construction operations may alter the soil conditions. Therefore, it is recommended that a representative from Larry M. Jacobs & Associates, Inc. (LMJ) be involved during the construction phases discussed in this report.

## **6.2 General Comments**

The soil conditions encountered conditions suitable for construction of the building, dry retention pond, and pavement. The building borings encountered loose and very loose conditions and proper compaction and some undercutting may be needed to increase the allowable bearing capacity and reduce the potential for settlement. The stormwater pond borings encountered moderately permeable silty sand near the proposed pond bottom. The outflow of the ponds could be increased if needed by undercutting the pond bottom to a depth of 7-8 feet below existing grade and backfilling with clean sand. The pavement borings encountered soils which are expected to be suitable for pavement subgrade. The following sections provide site preparation, fill placement, foundation, pavement, and stormwater pond recommendations.

## **6.3 Site Preparation Recommendations**

The building and pavement areas should be cleared and stripped of any vegetation or surficial soils containing significant organic content, roots, tree root mass, asphalt and/or any other deleterious materials. The existing building to be demolished should be completely removed including the foundation and all existing utilities. Utilities should be removed or properly abandoned. Any foundation or utility removal excavations or tree root mass excavations should be properly backfilled in compacted lifts. Additional sitework effort, undercutting of loose soils, or additional compaction may be required in the demolished building area. We recommend including a contingency in the project budget for this work.

After clearing and stripping, the building pad area, pavement subgrade area, and 5 feet beyond the outside perimeter of the building and pavement areas should be compacted to a minimum of 95% of the soil's maximum density as determined by the Modified Proctor Test (ASTM D1557) to a minimum depth of 12 inches using a large traffic sized vibratory roller. Note that large vibratory compaction equipment can cause disturbance to nearby structures. For the building subgrade area, a minimum of 3 tests is recommended and for the pavement subgrade we recommend a minimum of 1 test per 5,000 sf.

## **6.4 Fill Recommendations**

Soils from the pond excavation free of significant organic content, topsoil, or debris can be used as fill on site based on the results of the borings. Any imported fill material can be sand (SP), slightly silty sand (SP/SM or SM/SP) or silty sand (SM). Fill and utility trench backfill should be compacted to a minimum soil density of 95% of the Modified Proctor Test (ASTM D1557) maximum. Fill lifts of up to 6-8 inches are typical using hand operated mechanical equipment and lifts up to 12 inches are typical using a large traffic sized vibratory roller.



We recommend running in-place density tests to verify compaction of all fill with a frequency of one test per 5,000 sf on every 12-inch increment of fill, or fraction thereof. Compaction of backfill for utility excavations should be tested on every 12-inch increment of fill or fraction thereof, ending with the top of finished subgrade at a minimum frequency of 1 test per 75 linear feet.

## **6.5 Metal Building Foundation Recommendations**

The site appears to be suitable for supporting the proposed building on the planned shallow foundation if the site and footing areas are prepared as described in this report. The primary concern for this proposed building location is the very loose soils encountered in one of the building borings. For footings with a maximum footing width of 2 feet, the soils immediately below the footings should be compacted to a minimum depth of 12 inches to a minimum of 95% of the material's Modified Proctor test (ASTM D1557) density. Some areas may require less compaction effort if dense soils are encountered at the footing depth. Footings 2-4 feet wide in loose soils should be undercut 1 foot below the bottom of the footing. The bottom of the undercut should be compacted to a minimum depth of 12 inches to a minimum of 95% of the material's Modified Proctor test (ASTM D1557) density. The width of the undercut should be at least 1 foot wider than the footing and centered below the footing. The undercut should be backfilled with compacted on-site soil to a minimum of 95% of the material's Modified Proctor test (ASTM D1557) density. If footings wider than 4 feet are planned, please contact LMJ for additional undercutting recommendations.

If shallow foundations are prepared as described above and a LMJ representative is able to verify these recommendations using probing or density testing as applicable, footings can be designed based on a net allowable bearing pressure of **2,000 pounds per square foot (psf)**. Settlements from the soils beneath the footings at this pressure are expected to be on the order of one inch. Most of this settlement is expected to occur during construction and with the first loading. Lower design loadings should result in roughly proportionally less settlement.

Note that water should not be allowed to pond next to the building during or after construction and permanent roof drains should be directed away from the building. Saturated conditions below the footings could result in additional settlement.

## **6.6 Tower Foundation Recommendations**

Information for the proposed training tower structure was not available at the time of this report. Based on the single boring near the proposed tower location (Boring B-5), the very loose soils are a significant foundation design concern. Depending on the structural loads, the structure and will likely require undercutting of footing excavations, compaction of the bottom of the undercut, and backfilling of the undercut with compacted soils. The depth of the undercut will be based on the width of the foundation and the anticipated design loads. We would be pleased to provide specific recommendations for the tower structure when the design information is available.

## **6.7 Asphalt Pavement Recommendations**

### **6.7.1 Subgrade Recommendations**

The compacted subgrade material in the pavement areas should be capable of supporting loaded dumptrucks and paving equipment without significant rutting. Typically, this requires a



soil with a minimum LBR value of 30-40 and the top 12 inches of subgrade is expected to consist of native soils which appear to have an adequate LBR value based on the results of the borings. The top 12 inches of pavement subgrade should be compacted to a minimum of 98% of the material's Modified Proctor test (ASTM D1557) density using a large traffic sized vibratory roller.

Stabilization may be required for the pavement subgrade if areas of pavement are not consistent with the borings and laboratory testing and/or proofrolling indicates that the subgrade LBR is lower than expected. We suggest adding subgrade stabilization as an optional bid item for this project.

#### **6.7.2 Asphalt Pavement Base Recommendations**

The use of graded aggregate base is typically recommended because graded aggregate base is a superior base material with a longer lifespan than other base materials and performs well in heavy duty pavement areas. Crushed concrete could also be considered. The base material should have a minimum LBR value of 100 and a minimum thickness of 6 inches for typical light duty pavement and 8 inches for a medium to heavy duty pavement system. The base should be compacted to a minimum of 100% of the material's Modified Proctor test (ASTM D1557) density.

#### **6.7.3 Asphalt Pavement General Recommendations**

Typical asphalt thicknesses of least 1.5-2 inches are common in light duty areas and 2.5-3 inches in medium to heavy duty areas, depending on the expected traffic loads and other design factors. We recommend using a FDOT structural course Superpave Asphaltic Concrete (SP-12.5) meeting the requirements of FDOT Section 334. The asphalt should be compacted to a target of 93% of the laboratory maximum specific gravity ( $G_{mm}$  or Rice Specific Gravity) as determined by FM 1-T 209. Note that specific pavement loading information is not known and a pavement design is not included in our project scope.

#### **6.7.4 Pavement Quality Control Testing**

Proper compaction of the pavement subgrade and base is critical to the performance of the pavement. We recommend running density tests on compacted subgrade at a frequency of one test per 5,000 square feet of pavement area. We recommend running in place density tests on the compacted base material at the same frequency. Base materials should be sent to our laboratory for LBR testing prior to purchase, and the sample should be tested in our lab prior to construction.

After the asphalt has been placed, the asphalt should be cored to determine the thickness that was placed and the compaction or density of the asphalt. The bulk specific gravity ( $G_{mb}$ ) of the cores should be determined in accordance with FM 1-T166.

#### **6.8 Stormwater Pond Recommendations**

The borings encountered conditions suitable for stormwater pond design which consisted of moderate and well draining soils. We recommend replacing 1 foot of existing pond bottom material with clean sand to reduce maintenance concerns as well as reduce the potential pond bottom blinding. Based on the results of the borings, laboratory testing, and our experience with



similar soil conditions, we recommend using the design rates shown in the following **Table #2**. Appropriate factors of safety should be used when designing the stormwater pond.

**Table #2: Stormwater System Design Parameters**

Saturated Vertical Hydraulic Conductivity ( $K_{vs}$ ), (ft/day)	Saturated Horizontal Hydraulic Conductivity ( $K_{hs}$ ), (ft/day)	Average Depth of Confining Layer <sup>1</sup> (ft)	ESHGT <sup>2</sup> Depth (ft)	Fillable Porosity
8	16	26+	15	0.3

<sup>1</sup> Confining layer not encountered in the borings. Depth shown is depth of nearby borings.

<sup>2</sup> ESHGT = Estimated Seasonal High Groundwater Table.

The vertical and horizontal conductivity design parameters can be significantly increased if the pond bottom is undercut to a depth of roughly 7-8 feet to expose the light brown stained sand. The pond bottom could be backfilled with clean sand if needed. The increased rates would be approximately 2-3 times the rates shown in **Table #2**. If the pond bottom is undercut, the pond could be backfilled with clean sand containing less than 3% fines with a minimum permeability value of 30 ft/day when remolded using 100% of the Standard Proctor density energy.

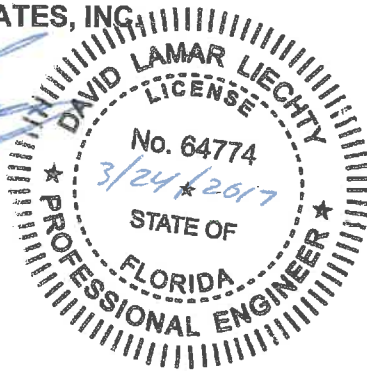
Additionally, the pond should be excavated using a backhoe in order to avoid compaction the pond bottom under the weight of construction equipment. Use of construction equipment should be avoided on the pond bottom. *The design outflow of the pond would be significantly reduced if the pond bottom soils are inadvertently compacted.*

We hope that this letter provides sufficient information for your current requirements. If you have any questions or comments, please do not hesitate to call.

Sincerely,

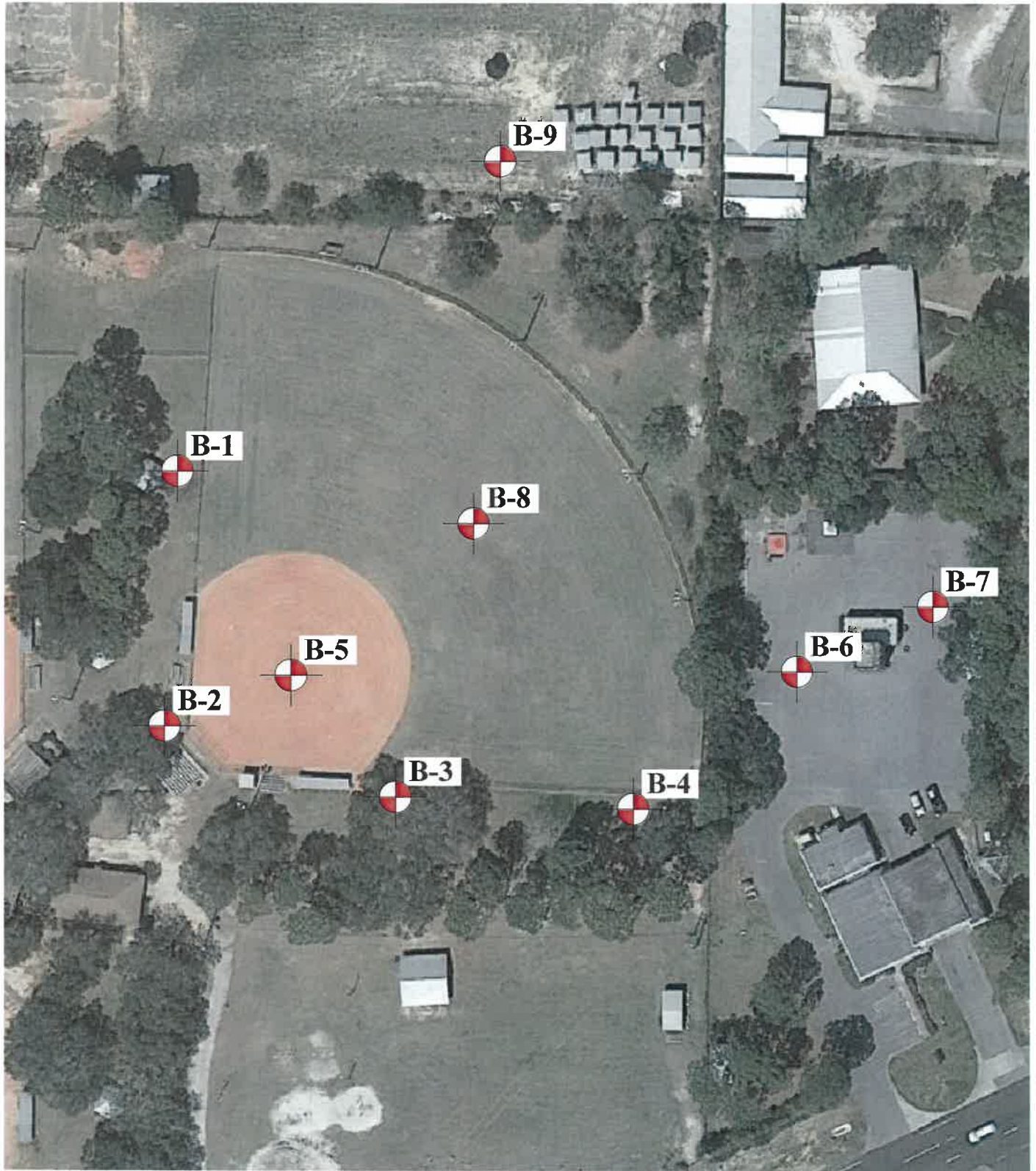
**LARRY M. JACOBS & ASSOCIATES, INC.**

David L. Liechty, PE  
 Project Engineer  
 Florida Reg. #64774



Attachments

# BORING LOCATION PLAN



STANDARD PENETRATION TEST BORING  
ALL BORING LOCATIONS ARE APPROXIMATE

Project #: 17-135 Scale: NTS

Date: 03/23/2017 Checked By: DLL

Project: FWB Fire District Training Facility

Location: Fort Walton Beach, Florida

Geotechnical Engineering



Figure #2

LEGEND

	SAND		SLIGHTLY SILTY SAND
	SILTY SAND		SILT
	CLAY		CLAYEY SAND
	PEAT		GRAVEL

GRANULAR MATERIALS	
SPT BLOWS/FOOT (N)	RELATIVE DENSITY
0-4	VERY LOOSE
5-10	LOOSE
11-30	MEDIUM DENSE
31-50	DENSE
GREATER THAN 50	VERY DENSE

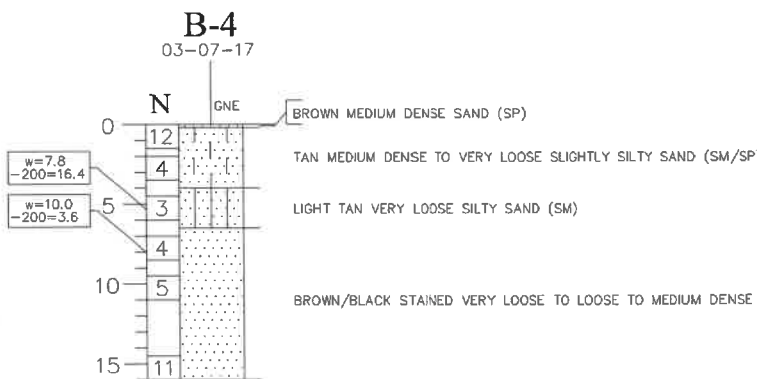
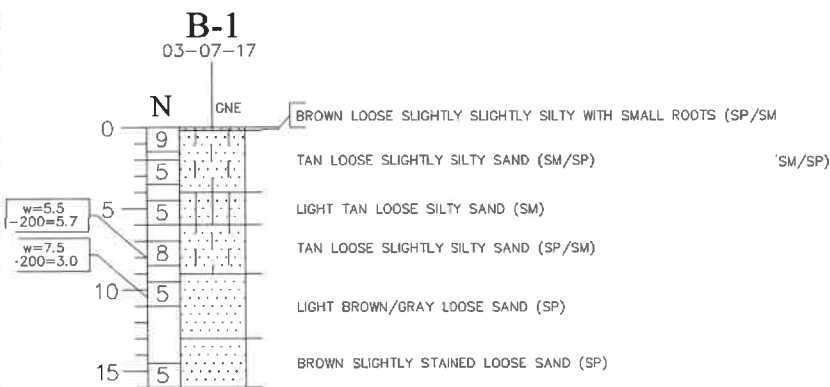
SILTS AND CLAY	
SPT BLOWS/FOOT (N)	RELATIVE DENSITY
0-2	VERY SOFT
3-4	SOFT
5-8	MEDIUM STIFF
9-16	STIFF
17-32	VERY STIFF
GREATER THAN 32	HARD

SYMBOLS:

- GNE= GROUNDWATER NOT ENCOUNTERED AT TIME OF DRILLING
- N = STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
- 
- 
- $w$  = NUMBER OF BLOWS REQUIRED (50) TO ADVANCE SPLIT SPOON SAMPLER A SPECIFIC DISTANCE (2) INCHES
- HW= SPLIT SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
- HA= HAND AUGER
- 
- W= NATURAL MOISTURE CONTENT (%)
- 200= FINES PASSING #200 SIEVE (%)
- O.C.= ORGANIC CONTENT (%)
- LL= ATTERBERG LIMITS (%)
  - LL=LIQUID LIMIT, PL=PLASTIC LIMIT
- LI= LIQUIDITY INDEX
- $c_u$  APPROXIMATE COHESION VALUE (PSF) BASED ON POCKET PENETROMETER READINGS
- $K_v$  = SATURATED VERTICAL HYDRAULIC CONDUCTIVITY (FT/DAY)
- $\gamma_d$  = DRY UNIT WEIGHT (PCF)
- $\gamma_m$  = ESTIMATED MOIST UNIT WEIGHT (PCF)
- $\gamma_b$  = ESTIMATED BOUYANT UNIT WEIGHT (PCF)
- $\phi$  = ESTIMATED ANGLE OF INTERNAL FRICTION (DEGREES)

NOTES:

- 1) SPT BORINGS PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1586
- 2) SUBSURFACE CONDITIONS ARE AT BORING LOCATIONS AND ACTUAL CONDITIONS BETWEEN BORINGS MAY VARY
- 3) ALL CLASSIFICATIONS ARE BASED ON VISUAL EXAMINATION UNLESS ACCOMPANIED BY LABORATORY TEST RESULTS
- 4) BOUNDARIES BETWEEN SOIL LAYERS SHOULD BE CONSIDERED APPROXIMATE AS THE ACTUAL TRANSITION MAY BE GRADUAL
- 5) DEPTH OF BORING IS BELOW EXISTING GRADE AT TIME OF DRILLING
- 6) ELEVATIONS ESTIMATED FROM PROVIDED TOPOGRAPHIC SURVEY



Project #: 17-135 Scale: NTS

Date: 03/24/2017 Checked By: DLL

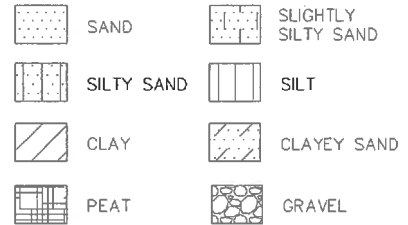
Project: FWB Fire District Training Facility

Location: Fort Walton Beach, Florida



Figure #2

LEGEND



GRANULAR MATERIALS	
SPT BLOWS/FOOT (N)	RELATIVE DENSITY
0-4	VERY LOOSE
5-10	LOOSE
11-30	MEDIUM DENSE
31-50	DENSE
GREATER THAN 50	VERY DENSE

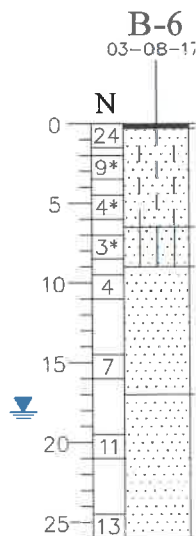
SILTS AND CLAY	
SPT BLOWS/FOOT (N)	RELATIVE DENSITY
0-2	VERY SOFT
3-4	SOFT
5-8	MEDIUM STIFF
9-16	STIFF
17-32	VERY STIFF
GREATER THAN 32	HARD

SYMBOLS:

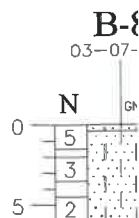
- GNE= GROUNDWATER NOT ENCOUNTERED AT TIME OF DRILLING
- N = STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
- = ENCOUNTERED GROUNDWATER LEVEL
- = ENCOUNTERED PERCHED WATER LEVEL
- $\frac{N}{2}$  = NUMBER OF BLOWS REQUIRED (50) TO ADVANCE SPLIT SPOON SAMPLER A SPECIFIC DISTANCE (2) INCHES
- HW= SPLIT SPOON SAMPLER ADVANCED UNDER WEIGHT OF ROD AND HAMMER
- HA= HAND AUGER
- = SHELBY TUBE SAMPLE
- W= NATURAL MOISTURE CONTENT (%)
- 200= FINES PASSING #200 SIEVE (%)
- O.C.= ORGANIC CONTENT (%)
- LL= ATTERBERG LIMITS (%)
- LL=LIQUID LIMIT, PL=PLASTIC LIMIT
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- $c_{\approx}$  APPROXIMATE COHESION VALUE (PSF) BASED ON POCKET PENETROMETER READINGS
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NOTES:

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- 5) DEPTH OF BORING IS BELOW EXISTING GRADE AT TIME OF DRILLING
- 6) ELEVATIONS ESTIMATED FROM PROVIDED TOPOGRAPHIC SURVEY



\*HAMMER BLOWS  
2 FT SAMPLE:  
5 FT SAMPLE:  
7 FT SAMPLE:



Project #: 17-135 Scale: NTS

Date: 03/24/2017 Checked By: DLL

Project: FWB Fire District Training Facility

Location: Fort Walton Beach, Florida



**Project: FWB Fire Training Facility**  
**Location: Fort Walton, Florida**

**Figure #: 3**  
**Project #: 17-135**  
**Date: 03/24/17**  
**Engineer: DLL**

**Grainsize Analysis - ASTM C136/AASHTO T27**

Sample #	Depth (ft)	Soil Description
◆ B-2/UD	4-5	<b>Tan Slightly Silty Sand</b> <b>Light Brown to Brown Stained Sand (Top)</b> <b>Light Brown to Brown Stained Sand (Bottom)</b>
■ B-2/UD	6-7	
▲ B-2/UD	6-7	

