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GEOTECHNICAL EXPLORATION REPORT

HOLT FIRE DISTRICT
HOLT, OKALOOSA COUNTY, FLORIDA

UES PROJECT NUMBER 1730.2100089.0000
UES REPORT NUMBER 1916906

DECEMBER 2, 2021

Prepared For:

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December 2, 2021

Municipal Engineering Services, Inc.
8574 Turkey Bluff Road
Navarre, Florida 32566

Attn: Mr. Dale Long
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Reference: **Geotechnical Exploration Report**
Holt Fire District
Holt, Okaloosa County, Florida
UES Project Number 1730.2100089.0000
UES Report Number 1916906

Mr. Long:

Universal Engineering Sciences (UES) has completed the geotechnical exploration for the above referenced site in Holt, Okaloosa County, Florida. These services were performed in general accordance with our Proposal Number 1859652 dated April 20, 2021, and authorized by you.

The following report presents the results of our geotechnical exploration, and a geotechnical engineering interpretation of those results with respect to the project characteristics provided to us. This report provides geotechnical engineering recommendations for pavement design, site preparation, stormwater drainage design, and construction related services.

We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please contact us if you have any questions or if we may further assist you as your plans proceed.

Respectfully Submitted,

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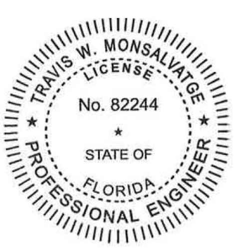

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 GENERAL

In this report, we present the results of the geotechnical engineering exploration of the site for the proposed Holt Fire District development to be located at 620 Hwy 90 in Holt, Okaloosa County, Florida. We have divided this report into the following sections:

- SCOPE OF SERVICES – Defines what we did;
- FINDINGS – Discusses what we encountered;
- RECOMMENDATIONS – Discusses what we encourage you to do;
- LIMITATIONS – Discusses the restrictions inherent in this report; and
- APPENDICES – Presents support materials referenced in this report.

2.0 SCOPE OF SERVICES

2.1 PROJECT DESCRIPTION

Project information was provided to us by the Client, via email correspondence, in conjunction with the preparation of the Universal Engineering Sciences (UES) proposal provided to the Client. Prior to the performance of our field exploration program we were provided with an updated conceptual site plan (undated) entitled, "Central Fire Station #1," as prepared by the Client.

The subject site is a 3-acre moderately wooded parcel in Holt, Okaloosa County, Florida. The site is identified by the Okaloosa County Property Appraiser as Parcel Reference Number 34-3N-25-0000-0012-0010.

We understand that the proposed site development will consist of a Fire Station building, an Okaloosa County Community Center building, paved drive areas, a septic drain field, and one stormwater pond area. Per the Client's direction, the scope of the geotechnical exploration was limited to the roadway, septic drain field, and stormwater pond areas only. The geotechnical exploration and this report do not address or provide recommendations for the development of the proposed structures. The portion of our scope regarding the septic drain field was limited to the performance of soil test borings and one remolded laboratory falling head permeability test. The boring logs and corresponding permeability test results for the septic drain field portion of the scope have been presented in Appendices B and C, respectively. Evaluations and/or recommendations concerning development of the proposed septic drain field were not included in our scope.

We were not provided with finished elevations for the proposed site development. For purposes of the geotechnical exploration and this report, it was assumed that minimal amounts (i.e. 2 feet or less) of fill and/or excavation will be necessary to achieve finished grades in the roadway areas of the site. With regard to the stormwater pond area, it was assumed that the pond will be relatively shallow, with depths of 5 feet or less below existing grades (BEG).

Our recommendations have been based upon the previously supplied and assumed information. If any of this information is incorrect, or changes, please inform UES so that we may review our recommendations. Without such a review, the recommendations herein may not be valid. No other site or project facilities should be designed using the soil information contained herein. As such, UES will not be responsible for the performance of any other site improvement designed using the data in this report.

2.2 PURPOSES

The purposes of this exploration program were:

- To explore the general subsurface conditions within the proposed roadway, septic drain field, and stormwater pond areas of the site;
- To interpret and review the subsurface conditions with respect to the proposed construction;
- To perform a series of laboratory tests on selected subsurface soil samples to assist with engineering soil classification, and to establish relevant soil engineering characteristics; and
- To provide geotechnical engineering recommendations for pavement design, stormwater design, and site preparation.

This report presents an evaluation of site conditions based on traditional geotechnical engineering procedures for site characterization. The recovered samples were not examined, visually or analytically, either for chemical composition or for environmental hazards. UES would be pleased to perform these services, if you desire.

Our exploration was confined to the zone of soil likely to be stressed by the proposed construction. Our work did not address the potential for surface expression of deep geological conditions. This evaluation requires a more extensive range of field services than performed in this study. UES would be pleased to provide a proposal for an exploration to evaluate the probable effect of the regional geology upon the proposed construction, if you desire.

2.3 GEOTECHNICAL EXPLORATION

The field exploration program was initiated and completed on November 10, 2021. The test boring locations have been shown on the attached Boring Location Plan in Appendix B. The boring locations were determined in the field, by UES personnel, using a hand-held GPS, Google Earth aerial imagery, the provided plat plans, and existing field reference points on and adjacent to the site. As such, the boring locations should be considered accurate only to the degree implied by the methods of location used.

We were not provided with topographic information for the project site. As such, elevations at the boring locations have not been presented and/or discussed in this report or on the attachments.

Upon completion of the field tests and/or sampling, recovered soil samples were place in labeled plastic containers, sealed, and transported to our laboratory where they were classified by a geotechnical engineer. Select samples of the soils were then chosen for specific laboratory tests. Samples of the soils not used for testing will be held in our laboratory for your inspection for 90 days following the issue date of this report, and then discarded unless we are notified and other arrangements are made.

2.4 FIELD EXPLORATION PROGRAM

The field exploration program consisted of the following:

- Performing four Standard Penetration Test (SPT) borings in the proposed pavement areas, each boring drilled to a depth of 6 feet BEG; and

- Performing five SPT borings in the proposed stormwater pond and septic drain field areas drilled to depths of 20 to 30 feet BEG.

Descriptions of the procedures used to perform the borings are presented on an attachment in Appendix B.

2.5 LABORATORY TESTING PROGRAM

2.5.1 Visual Classification

In the laboratory, the soil samples recovered from the field exploration were visually and physically examined by a geotechnical engineer. Approximate soil classifications were estimated in general accordance with the USCS Soil Classification System (ASTM D2487). The resulting soil descriptions and estimated soil classifications have been presented on the Boring Logs in Appendix B. Where applicable, the descriptions and classifications presented on the Boring Logs have been revised to reflect the results of any laboratory testing performed on the samples.

2.5.2 Laboratory Testing

Laboratory soil tests were performed on selected soil samples obtained from the borings to aid in the classification of the soils, and to help in the evaluation of pertinent engineering characteristics of the soils. The classifications and laboratory testing completed for this project consisted of performing the following procedures/tests in general accordance with the methods listed.

- Soil Classification per the Unified Soil Classification System – ASTM D2487

- Natural Moisture Content Testing – ASTM D2216

- Percent -200 Soil Fines Content Testing – ASTM D1140

- Laboratory Remolded Falling-Head Permeability Testing – FM 5-513

Detailed explanations of these test procedures have been presented in Appendix C. The results of the tests have been summarized on the boring logs and/or reports attached in Appendices B and C.

3.0 FINDINGS

3.1 SITE DESCRIPTION

At the time of the field exploration, the property of the proposed development area consisted of moderately wooded, undeveloped land. An overhead power line easement was located along the northern perimeter of the subject site.

As discussed previously, we were not provided with specific topographic information for the project site. Based on observation, the site appeared to be relatively level. Based on elevation information available on Google Earth, approximate elevations on the site range from 201 to 202 feet.

3.2 USDA NRCS SOIL SURVEY

Based on the Web Soil Survey for Okaloosa County, Florida, as prepared by the USDA NRCS, the predominant, pre-development soil types at the site are identified as: 23 – Troup sand, 0 to 5 percent slopes; and 36 – Bonifay sand, 0 to 5 percent slopes. A summary of the characteristics of these soil series was obtained from the Soil Survey, and has been included in Table 1. **Please note that the information presented in the following table is for the pre-development soils, and that the soils present on the site may have been altered during any past development of the site.**

Table 1 – Summary of USDA NRCS Soil Survey Information

Soil Type	Constituents and Depths (in.)	Internal Drainage	Hydrologic Soil Group	Soil Permeability		Seasonal High Water Table	Corrosion Potential	
				Depth (in)	Perm (in/hr)	(ft)	Uncoated Steel	Concrete
23 – Troup sand, 0 to 5% slopes	SM, SP-SM (0-48) SC, SC-SM, CL, CL-ML (48-80)	Somewhat excessively drained	A	0-48 48-80	6.0-20 0.6-2.0	>6	Low	Moderate
36 – Bonifay sand, 0 to 5% slopes	SP-SM (0 to 44) SC-SM, SC, SM (44 to 59) SC-SM, SC (59 to 80)	Well drained	A	0-44 44-59 59-80	6.0-20 0.6-2.0 0.2-0.6	4 – 5 Jan – Feb PERCHED	Low	High

3.3 SUBSURFACE CONDITIONS

The general subsurface conditions encountered during the subsurface exploration have been described in Table 2. For more detailed soil descriptions and stratifications at the boring locations, the Boring Logs presented in Appendix B should be reviewed. Also, the Soils Classification Chart in Appendix B should be referenced for further explanation of the symbols and placement of data on the Boring Logs.

The Boring Logs represent our interpretation of the subsurface conditions based on a review of the field logs, an engineering examination of the samples, and a limited number of laboratory tests. The horizontal stratification lines designating the interface between various strata represent approximate boundaries. Transition between different strata in the field may be gradual in both the horizontal and vertical directions. Groundwater, or lack thereof, encountered in the borings, and noted on the Boring Logs, represents conditions only at the time of the field exploration.

Table 2 – General Soil Profile				
Stratum No.	Typical depths (ft. BEG)		Soil Descriptions	Range of SPT "N" Blow Counts (blows/ft.)
	From	To		
1	0	0.1 to 0.3	Sandy TOPSOIL with roots and organics [1]	---
2	0.1 to 0.3	4 to 6	Loose SAND with silt and silty SAND [SP-SM, SM]	4 to 10
3	4 to 6	20 to 22	Loose to very dense silty and/or clayey SAND and SAND with silt [SM, SC, SC-SM, SP-SM]; occasionally hard sandy CLAY [CL/CH]	7 to 52
4	22	30[2]	Dense poorly-graded SAND and SAND with silt [SP, SP-SM]	28 to 38

[1] Topsoil is a term used to describe organic soils, which are usually dark in color, and typically suitable for the support of plant life.

[2] Termination depth of the stormwater borings SW-1 through SW-3.

[ ] Brackets indicate Unified Soil Classification System (ASTM D2487)

At the time of the field exploration, groundwater was not encountered in the borings during drilling or immediately following completion of the borings.

3.3.1 Notable Findings – Dense/Hard and Moisture Sensitive Soils

A notable finding during the exploration program was the presence of dense/hard sands and sandy clays in the proposed stormwater pond area, starting at depths of 6 to 8 feet BEG and extending down to a depth of 30 feet BEG. These dense sands had SPT "N" values greater than 30 blows per foot (bpf) ranging up to 52 bpf.

It has been our experience that soils with SPT "N" blow counts in excess of about 30 bpf may prove to be difficult to excavate through with smaller sized equipment. Based on the boring data, it would appear that these soils could pose general construction problems (including underground utility installation operations, pond excavation, and/or general excavation operations) starting at depths as shallow as 6 feet BEG. We recommend the contract documents stipulate that the site contractor is solely responsible for selecting their equipment appropriately for these anticipated site conditions without recourse for a change order after the project has been awarded.

The silty and clayey soils in areas of the project site generally exhibit extreme sensitivity to even slight changes in moisture content, and will lose most of their strength when wet. When such moisture sensitive soils are exposed to construction traffic, a loss of soil strength may result. After disturbance and when wet, these fine-grained soils may rut and deflect significantly, do not provide adequate subgrade support, and require remediation or moisture conditioning. It is not uncommon for construction equipment to severely disturb the upper several feet of the subgrade during initial phases of site earthwork operations, especially if site preparation work is performed while the soils are wet. This may result in the need for both undercutting and replacement of the disturbed soils or drying and recompaction of the affected soils. Alternatively, it may be desirable to place a protective layer of aggregate base material in the pavement areas to serve as a working surface.

4.0 RECOMMENDATIONS

4.1 GEOTECHNICAL ASSESSMENT

In this section of the report, we present recommendations for pavement design, site preparation, stormwater design, and construction related services. The following geotechnical design recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. If there are any changes in these project criteria, a review should be made by UES to determine if modifications to the recommendations are warranted.

Once final design plans and specifications are available, a general review by UES is recommended as a means to check that the evaluations made in the preparation of this report are correct, and that the presented earthwork and design recommendations are properly interpreted and implemented.

4.2 GROUNDWATER CONSIDERATIONS

The groundwater table will fluctuate seasonally depending upon local rainfall. The typical wet season groundwater level is defined as the highest groundwater level sustained for a period of 2 to 4 weeks during the "wet" season of the year, for existing site conditions, in a year with average normal rainfall amounts. Based on historical data, the rainy season in Northwest Florida is typically between June and September and, in the case of Bonifay sands, January to February of any given year.

Groundwater was not encountered in the borings during drilling operations or immediately following completion. As such, our best estimate for the stabilized, seasonal high phreatic groundwater table is deeper than the boring termination depths (6 feet and 30 feet BEG). The best estimates for seasonal high phreatic groundwater table, discussed in this paragraph, have been based upon our review of USGS data, the Okaloosa County Soils Survey, data obtained from our exploration, regional hydrogeology, local climate/rainfall data, and experience.

Please note that the groundwater levels could temporarily exceed the estimated seasonal high phreatic levels during any given year in the future. Should impediments to surface water drainage exist on the site, or should rainfall intensity, duration, or total quantities exceed the normally anticipated conditions, the groundwater level may be higher than our estimated seasonal high estimates. We recommend positive drainage be established and maintained on the site during construction. We further recommend permanent measures be constructed to maintain positive drainage throughout the life of the project. All site improvement designs should incorporate the seasonal high groundwater levels as appropriate.

4.2.1 Transient Perched Groundwater

The soil borings generally encountered deposits of hydraulically restrictive, medium dense to dense silty and/or clayey soils [SM, SC, SC-SM and CL/CH] at approximate depths ranging from 4 to 6 feet BEG. During periods of above normal rainfall or for short periods following unusually intense rainfall events (most especially tropical storm and hurricane events), there may be temporary water seepage zones (a.k.a., perched groundwater) present immediately above relatively shallow, high relative density, hydraulically restrictive soils that could adversely affect the performance of site improvements including pavements, utility construction/installation, and stormwater systems.

It should be noted that the USDA NRCS Okaloosa County Soil Survey have identified a "High Water Table", for areas within the Bonifay sand unit, to be a "perched" condition at depths of 4 to 5 feet during the months of January to February. The transient/perched groundwater above and within these soils needs to be considered when setting finished site elevations, and when considering and/or determining the potential need for underdrains to control perched groundwater, and keep structure subgrades dry.

Perched groundwater levels can generally be expected to occur about ±6 to 12 inches above the hydraulically restrictive soils, where present, if the groundwater table is unable to drain into a more pervious layer. It should be noted that undercutting of these materials would affect the depth of the hydraulically restrictive layer and the depth of the perched water table. The potential for groundwater to perch will be directly related to rainfall and irrigation amounts, as well as site grading and impervious areas.

4.3 ASPHALT (FLEXIBLE) PAVEMENTS

In areas **not** intended for Fire Station vehicular traffic (i.e., fire engine, fire truck), we have recommended a flexible pavement section consisting of asphaltic concrete over a compacted base course, underlain by a compacted stabilized subgrade. Because traffic loadings are commonly unavailable, we have generalized our pavement design into two groups; standard duty and heavy duty. **Once anticipated traffic loadings are available, UES should be provided an opportunity to review and determine if additional recommendations are required.** The group descriptions and the recommended component thicknesses have been presented in Table 3.

Table 3 – Summary of Asphalt (Flexible) Pavement Sections

Traffic Group	Component Thickness (inches)		
	Stabilized Subgrade (LBR≥40)	*GAB or Limerock Base Course (LBR≥100)	Surface Course
Standard Duty	12	6	1.5
Heavy Duty	12	8	2

Notes:
*GAB = Graded Aggregate Base

The Design Traffic Groups are defined as follows:

Standard Duty: Automobiles, light (pickup) trucks and limited heavy truck traffic, ESAL's up to 100,000 over a 20-year design life.

Heavy Duty: Heavy truck traffic areas, ESAL's up to 250,000 over a 20-year design life.

4.3.1 Stabilized Subgrade

The stabilized subgrade is the top surface of a roadbed upon which the pavement structure and shoulders are constructed. The primary function of the stabilized subgrade is to provide a stable and firm platform for construction of the pavement without undue deflection that would impact the pavement's performance. In addition, the stabilized subgrade enhances the overall strength of the pavement section.

Beneath all base course materials, we recommend a stabilized subgrade having a minimum Limerock Bearing Ratio (LBR) (FM 5-515) of 40 percent and minimum compacted thickness of 12 inches as specified by the latest version of the Florida Department of Transportation (FDOT) “Standard Specifications for Road and Bridge Construction” (SSRBC) for Type B Stabilized Subgrade, Section 160 and Section 914. The stabilized subgrade material should be compacted to at least 98 percent of the modified Proctor maximum dry density (ASTM D1557) at a moisture content within +2 percent of the modified Proctor optimum moisture content.

Based on experience, it is anticipated that the on-site shallow depth soils will be capable of meeting the minimum LBR requirement for a stabilized subgrade. For soils not meeting the LBR requirement, stabilized subgrade can be constructed by blending the soils with a stabilizing agent such as limerock or soil fines. If a blend is proposed, we recommend that the Contractor perform a mix design to determine the optimum mix proportions. The need for a stabilizing agent to be mixed with either on-site native soils or proposed imported fill soils to meet the required LBR of 40 percent for the stabilized subgrade should be verified by the Contractor before bidding and construction.

4.3.2 Base Course

The base course is a layer or layers of select or specified material of designed thickness placed on a subbase or stabilized subgrade to provide uniform and stable support for binder and surface courses. The base course typically provides a significant portion of the structural capacity in a flexible pavement system.

For this project, we recommend the limerock base course consist of locally available limerock complying with the requirements of the FDOT SSRBC, Section 200 and Section 911. Alternatively, we recommend the use of GAB in accordance with Section 204 of the latest edition of the FDOT SSRBC. A minimum LBR of 100 should be used for limerock and GAB courses. Regardless of the material selected, the base course should be compacted to 98 percent of the modified Proctor maximum dry density at a moisture content within +2 percent of the modified Proctor optimum moisture content.

4.3.3 Hot Mix Asphalt (HMA) Surface Course

The surface course should consist of FDOT SuperPave (SP fine) asphaltic concrete having a minimum field density of 93.5 percent of the laboratory maximum density (G_{mm}). Specific requirements for the SuperPave asphaltic concrete structural course are outlined in the current edition of the FDOT SSRBC, Section 334.

The allowable layer thicknesses for Type SP Asphalt Concrete mixtures are 1 to 1½ inches for Type SP-9.5, and 1½ to 2½ inches for Type SP-12.5. Type SP-9.5 is limited to the top two structural layers and is limited to a maximum of two layers.

Hot mix asphalt (HMA) mixes should be FDOT approved, assigned an FDOT Mix Design Number, and current. HMA mixes should have a “fine” gradation classification. We recommend the percent of Reclaimed Asphalt Pavement (RAP) be limited to less than 30 percent. The Asphalt Binder Grade for HMA with less than 20 percent RAP is PG 67-22. The Asphalt Binder Grade for HMA with 20 to 29 percent RAP is PG 64-22.

After placement and field compaction, the asphaltic concrete should be cored to evaluate material thickness and to perform laboratory density tests. Cores should be obtained at frequencies of at least one core per 5,000 square feet of placed pavement, or a minimum of two cores per day's production, whichever is greater.

4.3.4 Effects of Groundwater

One of the most critical factors influencing pavement performance in Northwest Florida is the relationship between the pavement subgrade and the groundwater level. Roadways and parking areas have been damaged because of deterioration of the base conditions and/or the base/surface course bond. We recommend that the seasonal high groundwater table and the bottom of the flexible pavement base course be separated by at least 18 inches.

In areas where the separation is not available, we recommend raising finished site elevations sufficiently to provide the minimum separation. As an alternative to raising site grades, sloping site subgrades to drainage points (i.e. perimeter swales and collection areas) to prevent stormwater from collecting under the pavement areas, and/or the incorporation of underdrains into the pavement design to capture groundwater and route it away from pavement base and subgrade materials may also be considerations. Please note that underdrain systems will require regular maintenance over the useful life of the project to function properly.
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4.3.5 Curbing

Typical curbing is extruded and placed atop the pavement surface. This type of curbing does not act as a horizontal cutoff for lateral migration of storm and irrigation water into the base material and because of this it is common for base and subgrade materials adjacent to these areas to become saturated, promoting subsequent localized pavement deterioration. Consequently, we recommend that all pavements abutting irrigated landscape areas be equipped with an underdrain system that penetrates a minimum depth equal to the bottom of stabilized subgrade to intercept trapped shallow water and discharge it into a closed system or other acceptable discharge point.

Alternatively, curbing around any landscaped sections adjacent to the parking lots and driveways could be constructed with full-depth curb sections to reduce horizontal water migration. However, underdrains may still be required dependent upon the soil type and spatial relationships. UES should review final grading plans to evaluate the need and placement of pavement and landscape underdrains.

4.3.6 Construction Traffic

Incomplete pavement sections will not perform satisfactorily under construction traffic loadings. We recommend that construction traffic (e.g. construction equipment, concrete trucks, sod trucks, dump trucks, etc.) be re-routed away from these pavements during construction of the development, or alternatively that the pavement section be only partially completed until the need for most of the construction traffic has gone away (i.e. allow construction traffic to drive over the compacted base course, and then repair the base course locally as needed and install the pavement section after the need for the majority of the construction traffic has gone away).

4.4 CONCRETE (RIGID) PAVEMENTS

Due to the nature of this project, we anticipate that portions of the project may use Portland Cement Concrete pavement. Concrete pavement is a rigid pavement resulting in much lighter load transfer to subgrade soils than flexible (asphalt) pavement. Rigid pavement may be constructed of unreinforced Portland cement concrete providing a minimum 28-day compressive strength of 4,000 psi, and a minimum 28-day flexural strength of 550 psi. Portland cement should be Type I. In addition to the following recommendations discussed in this section, refer to the "Guide to Jointing of Non-Reinforced Concrete Pavements," published by the Florida Concrete and Products Association, Inc., and "Building Quality Concrete Parking Areas," published by the Portland Cement Association.

4.4.1 Pavement Thickness

Concrete pavement thickness should be uniform throughout, with the exception of thickened slab areas (curbs, and adjacent to construction and expansion joints). Our recommendations for concrete pavement thicknesses are based on: the recommended subgrade compaction; modulus of subgrade reaction (k) equal to at least 75 pounds per cubic inch; a 20-year design life; and equivalent single axle loads (E_{18}SAL). The Table 4 summarizes our recommendations for pavement thicknesses.

Table 4 – Summary of Unreinforced Concrete (Rigid) Pavement Sections

Service Level	Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Saw Cut Depth
Standard Duty	6 Inches	10 Feet x 10 Feet	2 Inches
Heavy Duty	7 Inches	12 Feet x 12 Feet	2 $^{1}/_{3}$ Inches

The Design Traffic Groups are defined as follows:

Standard Duty: Automobiles, light (pickup) trucks and limited heavy truck traffic, ESAL's up to 100,000 over a 20-year design life.

Heavy Duty: Heavy truck traffic areas, ESAL's up to 250,000 over a 20-year design life. The heavy duty section is also recommended for any dumpster pads and associated access drives.

4.4.2 Control Joints

Control joints, for crack control for the pavement, should be spaced closely, at about 8 to 12 feet apart, and should provide a uniform square or a compact rectangular pattern. The joint pattern, including placement of utility access facilities (manholes, junction boxes, fill ports, etc.) should be submitted for review and approval prior to construction. Depth of the joints should be at least one-third of the concrete slab thickness. Joints should be sawed as soon as the concrete can withstand traffic, while not so soon as to cause raveling of the concrete surface and aggregate during sawing.

Construction joints and expansion joints are the pavement features most susceptible to damage, and for that reason, their use should be minimized. Placement of construction joints should be approved prior to commencement of concrete placement. Construction joint placement should be planned to occur at narrow sections of pavements, such as driveways. In the event expansion joints are provided, they should be thoroughly cleaned of debris, on completion, and then properly sealed with an appropriate preformed or self-leveling petroleum resistant joint sealer.

4.4.3 Subgrade Preparation

Subgrade soils should consist of freely draining material and be compacted to a minimum density of 95 percent of the modified Proctor maximum dry density to a depth of at least 1 foot below the bottom of the pavement section, or the full depth of the fill, whichever is greater. Based on the boring data obtained, it is anticipated that the shallow soils (the upper approximately 3 to 6 feet) prevalent on the site will be relatively free draining. However, in some areas of the site, the use of imported suitable free draining soils (i.e. SP and SP-SM) may be required to facilitate a free draining layer for the rigid pavement. In addition, the undercutting of existing subgrade soils, and replacement with free draining soils, may be required in rigid pavement areas where the pavement subgrades are approximately 3 or more feet below existing site grades.

Pavement should be constructed only over stable, smooth, and free draining subgrade. Rutting of subgrades from concrete trucks and other traffic should be repaired prior to placement of concrete. The subgrade should be thoroughly wetted immediately prior to concrete placement, to minimize absorption of moisture from the concrete during curing

4.4.4 Concrete Placement

Placement and curing of concrete pavement should conform with all applicable American Concrete Institute (ACI) standards, and in particular with recommended procedures for hot weather concrete work. Cure the concrete pavement either with moist curing (burlap or plastic sheeting) or with a liquid curing compound. A fugitive dye should be considered for the curing compound as a means of verification that the curing compound is applied properly and remains in place for a sufficient period of time.

4.4.5 Effects of Groundwater

One of the most critical influences on the pavement performance in Northwest Florida is the relationship between the pavement subgrade and the seasonal high groundwater level. We recommend that the seasonal high groundwater and the bottom of the rigid pavement be separated by at least 18 inches.

Groundwater can result in early failure of concrete pavements by resulting in “pumping” of subgrade fines through joints and cracks. Where the proposed concrete pavement will be constructed within 18 inches of the seasonal high groundwater table, we recommend, as a minimum, a geotextile fabric be placed beneath all joints to prevent pumping of subgrade fines through the joints. The fabric should extend a minimum 2 feet beyond the joint on each side of the joint. The fabric may consist either of a woven or non-woven geotextile, such as Typar 3401 or equivalent. The fabric should be placed over the prepared subgrades immediately prior to placing reinforcement (if any) and concrete.

4.5 STORMWATER DESIGN

The soils encountered in the borings for the pond (SW-1 to SW-3) generally consisted of marginally permeable sands with silt [SP-SM] extending from existing grades to approximate depths of 4 to 6 feet BEG. Below this depth and extending to approximate depths of 22 feet BEG, the soils encountered were generally relatively low permeability and/or hydraulically restrictive soils (i.e. estimated permeability rates of less than 0.1 foot per day) consisting of silty and/or clayey sands [SM, SC, SC-SM] and sandy clays [CL/CH]. Underlying these soils at the boring locations, a stratum of sand and sand with silt [SP and SP-SM] was encountered to approximate depths of 30 feet BEG. Groundwater was not encountered in the borings during drilling operations or following completion of each boring.

UES performed two laboratory falling-head permeability tests on remolded test specimens prepared using a bulk sample of representative soils recovered from approximate depths of 2 to 4 feet BEG at the stormwater boring location SW-1 and a bulk sample recovered from approximate depths of 23 to 30 feet BEG at the boring locations SW-1 through SW-3. The saturated vertical permeability rates from these tests were about 1 to 14 feet per day. It should be noted that the soils encountered at approximate depths of 23 to 30 feet BEG were relatively dense with SPT N values ranging from 34 to 38 blows per foot. As a result, the actual in-place permeability rates may be lower than those represented by a remolded specimen due to the dense soil conditions.

Based on the results of our field exploration and laboratory testing program, the sand with silt [SP-SM] found at the stormwater boring locations may be suitable for the treatment and disposal of stormwater runoff via a shallow dry stormwater pond. If the permeability rates for the sand with silt are not acceptable for a shallow dry stormwater pond, then we believe the use of deep, vertical sand chimneys, in conjunction with a shallow dry pond, may also be an option for stormwater treatment on this site. We have worked on projects in the vicinity of the subject site, where ponds have been constructed using vertical sand chimneys. These ponds, when properly maintained, have appeared to have performed satisfactorily.

We recommend considering the remolded permeability values to be representative of the saturated vertical coefficient of permeability (K_{vs}). Unsaturated vertical permeability (K_{vu}) is generally less than saturated values due to the lack of laminar flow through the soil. The Northwest Florida Water Management District (NWFWMD) suggests that the unsaturated vertical permeability may be estimated as about 2/3 of the saturated values.

The saturated horizontal coefficient of permeability (K_{hs}) can range from 1 to 10 times the saturated vertical permeability rate (K_{vs}). This is because the flow direction is parallel to the direction of depositional planes. In addition, the NWFWMD recommends using a vertically weighted equivalent horizontal saturated hydraulic conductivity for modeling ponds with vertical sand chimneys to account for the variability of soil parameters in multi-layered stratigraphy. The data subsequently discussed regarding saturated hydraulic conductivity for a pond with sand chimney(s) includes the recommended vertically weighted equivalency.

The results of the individual laboratory permeability tests performed on samples recovered from the boring locations have been presented on the boring logs included in Appendix B, and the reports in Appendix C. The permeability values presented on the boring logs/reports represent the vertical saturated coefficient of permeability (K_{vs}). It should be noted that the coefficients of permeability indicated on the boring logs/reports are not an infiltration rate. The actual infiltration rate is influenced by the coefficient of permeability as well as several other factors, including the elevation of the bottom of the drainage system, the water level in the system, the elevation of the wet season water table, and the confining layer. These factors must be accounted for in an appropriate groundwater model to determine the infiltration rate of a given soil stratum.

Based upon our visual/physical examination of the site soils, the results of our laboratory testing, and observation of the existing site conditions, we recommend that you consider the surficial soils to have a fillable porosity of 25 percent. Presented in Table 5 is a summary of our stormwater drainage design parameters. Please note we have not applied a Factory of Safety to the values presented in Table 5 and Table 6.

Table 5 – Soil Design Parameters for Dry Shallow Pond Design	
Corresponding Soil Boring Locations	SW-1
Estimated Drainage Stratum Depths (ft. BEG)	0 to 4
Saturated Horizontal Hydraulic Conductivity K_{hs} (ft./day)	1.1
Saturated Vertical Hydraulic Conductivity, K_{vs} (ft./day)	1.1
Unsaturated Vertical Hydraulic Conductivity, K_{vu} (ft./day)	0.7
Estimated Fillable Porosity of Soil (percentage)	25
Depth of Measured Groundwater Table (ft.)	Not Encountered at 30 BEG
Estimated Seasonal High Groundwater Table (ft.)	>30
Base of aquifer (ft.)	6

General Notes:

1) A factor of safety (F.O.S) has not been applied to the values presented in this Table.

2) Estimated bottom depth of drainage stratum corresponds with the shallower bottom depth encountered in the two borings (4 feet BEG in Boring SW-2).

3) The average of the permeability test results for sand with silt [SP-SM].

4) Base of Aquifer is set as top of dense clayey sand stratum (SW-1)

Table 6 – Stormwater Pond Sand Chimney Design Parameters	
Corresponding Soil Boring Test Locations	SW-1 through SW-3
Estimated Drainage Stratum Depths (ft. BEG)	22 to 30
Vertically Weighted Saturated Horizontal Hydraulic Conductivity (remolded laboratory permeability), K_{hs} (ft./day)	3.9
Saturated Vertical Hydraulic Conductivity, K_{vs} (ft./day)	14
Unsaturated Vertical Hydraulic Conductivity, K_{vu} (ft./day)	9.1
Estimated Fillable Porosity of Soil, percentage	20
Estimated Depth of Phreatic Groundwater Table (ft. BEG)	Not Encountered at 30 BEG
Estimated Seasonal High Groundwater Table (ft. BEG)	>30
Base of Aquifer (ft. BEG)	30

General Notes:

1) Equivalent Length and Width of Pond, for a mounding analysis using PONDS - Should equal the dimensions of the chimney, not the pond bottom.

2) Maximum Area for Unsaturated Infiltration (ft^2) – to be determined by the Designer, based on the outflow required, but the value must equal the chimney footprint.

3) For a sand chimney, the area of the chimney should be input as the starting point of the Stage vs. Area table in PONDS, with an elevation slightly lower than the pond bottom (generally 0.1 feet). The chimney input must NOT be shown as beginning at the actual chimney bottom elevation, to prevent the PONDS program from including the volume of sand within the chimney when the program is run.

4) A factor of safety (F.O.S) has not been applied to the values presented in this Table.

5) Estimated top depth of drainage stratum corresponds with the deepest top depth encountered in the borings.

6) Base of Aquifer is based on boring termination depth of 30 feet.

We note that UES performs remolded laboratory permeability testing using generally accepted practices of the local engineering community. These types of tests are the quickest and most economical for stormwater management system design. However, the User of this information is cautioned that the potential variability of results of these types of tests can be significant and the reproducibility of results can vary by factors of up to 100 percent. Also, the permeability measured by such tests may not be representative of the total effective aquifer thickness. Factors of safety can compensate for part of the inherent test limitations but the Designer must exercise judgment regarding final selection and applicability of provided soil design input parameters.

Should the modeling analysis indicate marginally acceptable compliance with Water Management District design criteria, it may be advisable to perform more extensive and representative in-situ permeability testing by collecting "undisturbed" horizontal and vertical soil samples and/or installing grouted piezometers or wells for slug testing. UES can perform these field tests if desired.

Additionally, the actual exfiltration rates for the stormwater drainage system may be influenced by spatial geometry of the system, natural soil variability, in-situ depositional characteristics and soil density, retention volumes, and groundwater mounding effects. Appropriate factors of safety should be incorporated into the design process.

4.5.1 Sand Chimney Installation Guidelines

In order for vertical sand chimneys to be effective for the stormwater pond, they will need to be keyed into the deeper deposit of sands [SP-SM, SP] found below the stratum of hydraulically restrictive soils [SM, SC, SC-SM, CL/CH]. Based upon the findings of the borings, we have anticipated that the sands [SP-SM, SP] will be found starting at approximate depths of 22 to 30 feet BEG. Our recommended design parameters for the deep vertical sand chimney(s) are contingent upon keying into the sands [SP-SM, SP] for the full areal footprint(s) of the sand chimney(s) during construction.

UES recommends the following guidelines for the design and installation of vertical sand chimneys.

- We recommend sizing the chimneys based on the treatment volume required for the project, and the desired recovery time for the ponds. Each chimney should be installed as a single trench, as long and narrow as possible. We recommend each vertical sand chimney be keyed-in a minimum depth of 2 feet into the sands [SP-SM, SP] underlying the hydraulically restrictive soils [SM, SC, SC-SM, CL/CH].

- UES should be retained to observe the chimney excavations prior to backfilling operations to verify that the design embedment depth indicated on the construction plans has been achieved, and that the desired stratum of granular soil has been "keyed-into" appropriately. Due to the dense soils encountered, we recommend that the soils at the bottom of the excavation into the desired stratum be scarified to promote drainage. Furthermore, prior to backfilling, we recommend samples of the keyed-in and proposed backfill material be obtained to run laboratory testing including laboratory permeability testing and percent fines content (i.e. No. 200 sieve analysis) to determine that the materials meet the proposed design criteria. We recommend planning at least 48 hours to complete these tests.

- The sand backfill used to construct the chimneys should be a free-draining granular material containing less than 5 percent fines. We recommend the backfill material have a minimum laboratory remolded permeability rate of 20 feet per day ($\approx 1 \times 10^{-2}$ cm/sec). The fillable porosity of the sand backfill should be assumed to be 25 percent.

- We recommend mounding some of the chimney sand at the bottoms of the ponds to promote the settlement of soil fines away from the chimneys. Alternatively, to help prevent the vertical sand chimneys from becoming clogged over time, we recommend placing a layer of geotextile filter fabric (Type D-3, FDOT Standard Index 199, geotextile fabric with AOS greater than or equal to 70) on top of the vertical sand chimneys and covering the filter fabric with a 6-inch layer of open graded No. 57 stone. Over time, as the chimneys becomes silted over, the layer of filter fabric and overlying open graded No. 57 stone can be relatively easily removed and replaced. It is imperative that the chimneys be protected against silt build-up during construction (i.e., using a silt fence). If the tops of the chimneys become silted over during construction, they must be scraped off and replaced with clean chimney sand material. Failure to prevent the tops of the chimneys from becoming silted over will negatively affect the performance of the ponds and vertical sand chimneys.

The presence of hydraulically restrictive soils (including soils with the USCS Classifications of SM, SC, SC-SM, and CL/CH) can lead to localized wetness and ponding within the bottoms of stormwater ponds following storm events. Transient, perched groundwater levels can be expected to occur above these hydraulically restrictive soils, where present, if stormwater is unable to drain and/or dissipate into a more pervious layer. It is recommended that the bottom of the stormwater pond be graded towards the sand chimney(s) to facilitate stormwater drainage down through the chimney(s) and reduce the potential for localized wetness and ponding within the pond.

4.6 SITE PREPARATION

We recommend normal, good practice site preparation procedures. These procedures include stripping the proposed construction areas of surficial vegetation, and other non-soil and/or deleterious materials present; proofrolling and compacting the exposed subgrade, verifying subgrade compaction, and placing engineered fill to the desired grades. An expanded and more detailed synopsis of this work is provided in the following sections.

4.6.1 Temporary Groundwater Control

Based on the boring data obtained, we do not anticipate any shallow groundwater conditions. If encountered, we recommend that the groundwater level be lowered and maintained at a depth of at least 2 feet below bearing levels and excavation bottoms during construction. Dewatering may consist of ditching, well points, or other means. Furthermore, we recommend that the Contractor determine the actual groundwater levels at the time of construction to determine the groundwater impact on the construction procedures. If groundwater is encountered during construction, the Geotechnical Engineer of Record should be notified so that they can determine whether there is a need for substructure drainage, perimeter drains, or other recommendations for dewatering.

4.6.2 Nearby Structures and Vibrations

Care should be exercised to avoid damaging any nearby structures while the site preparation and earthwork operations are underway. Prior to commencing site work operations in areas of this site that will be constructed near adjacent structures and/or developments, we recommend that occupants of adjacent structures should be notified and the existing conditions of the structures be documented with photographs and survey. Compaction should cease if deemed detrimental to adjacent structures.

Pre-construction building surveys of all off-site adjacent structures are also recommended. Absent these surveys, we recommend that the vibratory function of the compaction equipment be turned off when operating within 50 feet of any adjacent structures. UES can provide vibration monitoring services to help document and evaluate the effects of the surface compaction operations on existing structures.

4.6.3 Existing Underground Utilities

It has been our experience that poorly compacted backfill is commonly found above and around underground utilities. Therefore, it is recommended that the location of any existing underground utility lines within the proposed construction areas be established prior to initiating construction. Where feasible, provisions should be made to relocate or abandon interfering utilities. It should be noted that if abandoned underground pipes are not properly removed or plugged, they might serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying pavements and structures.

Any trenches/excavations required to remove the abandoned utilities should be backfilled in accordance with recommendations presented in subsequent sections of this report. Whether existing utility lines are abandoned or not, it is recommended that existing trench and excavation fill materials be excavated to undisturbed native soils; the exposed utilities be evaluated for any deterioration or damage (pressure testing being recommended for any water bearing utilities); any damage or deterioration discerned be properly repaired; and the utility trenches be backfilled to finished elevations in accordance with recommendations presented in subsequent sections of this report.

4.6.4 Site Preparation and Grading

Site preparation/development must be scheduled carefully to realize the benefits of seasonal weather conditions, and reduce downtime for soil drying, removal of unsuitable or saturated materials, etc. Grading operations and pavement construction activities should be performed during seasonally dry weather. These operations and activities should not be performed during or immediately following periods of heavy precipitation.

Strip the proposed construction limits of all deleterious materials including trees, as well as root systems greater than ½-inch in diameter, surficial vegetation, topsoil, and any other deleterious materials present within and 5 feet beyond the limits of construction. All excavations required to remove stumps and any root systems associated with the removal of trees should be extended down to undisturbed soils, and the excavations backfilled to finished elevations in accordance with the recommendations presented in subsequent sections of this report. Based on the boring data obtained, approximate depths of surficial topsoil will range up to approximately 2 to 4 inches in thickness. However, significant areas of possibly greater stripping depths may be required to remove deeper root systems associated with the trees on the site, as well as localized areas of greater thicknesses of organic surficial soils. All materials removed in conjunction with the initial stripping operations should be hauled offsite.

After stripping, removal of unsuitable surface soils, and rough excavation grading, we recommend that areas to provide support for structural fill be evaluated carefully for the presence of soft, surficial soils, and/or plastic soils. In addition, finished subgrade elevations in cut areas should also be carefully evaluated after excavation operations. Such evaluation should include observing, probing, and proofrolling performed by others and witnessed by the Geotechnical Engineer of Record or his designated representative.

The proofrolling should be performed using a loaded tandem axle dump truck, or similar rubber-tired construction vehicle/equipment, weighing between 15 and 20 tons**.** Exposed subgrade conditions permitting, a typical proofrolling sequence required to evaluate subgrade conditions would entail a minimum of two vehicle/equipment passes in each of two perpendicular directions. However, due to the limited width of a residential road (typically approximately 20 to 25 feet), proofrolling in only one direction (along the length of the road alignment) will be the likely sequence. Areas that wave, rut, or deflect significantly, and continue to do so after several passes of the proofrolling vehicle/equipment, should be undercut to firmer soils. Undercut areas should be backfilled in thin lifts with approved, compacted fill materials. For any required undercutting operations, undercut volumes should be determined by field measurement. Methods such as counting trucks should not be used for determination of undercut volume, as they are less accurate.

It is recommended that all proofrolled subgrades be moisture conditioned and compacted to at least 95 percent of the materials' modified Proctor (ASTM D1557) maximum dry density to a depth of at least 8 inches below the proofrolled subgrade elevations. Based on the loose soils encountered within the upper 4 to 6 feet at the boring locations, we recommend that a vibratory roller be used to densify the near surface materials. This should be done prior to placement of fill on the proofrolled subgrades.

Based on our understanding of the proposed construction, it is anticipated that there will not be extensive areas where excavation operations, beyond the initial site stripping operations, will be required to achieve final site grades. However, in areas where excavation operations are required to achieve final site grades, it is recommended that the final exposed subgrade elevations be checked and proofrolled in a manner similar to the operations discussed in the previous paragraphs.

All proofrolling operations should be witnessed and monitored carefully by the Geotechnical Engineer of Record or his designated representative. It is imperative to the success of the site and subgrade preparation operations that the UES Geotechnical Engineer/representative be on the site immediately prior to, and during the performance of any proofrolling operations on the project site. The Engineer/Representative will be able to observe site conditions at the time of the proofrolling operations, and be immediately available to make recommendations regarding subgrade preparation or assist in developing appropriate stabilization procedures based on the observed conditions encountered during construction.

During general construction operations, loose sandy soils will likely be encountered at the stripped subgrade level. As a result, unstable subgrade conditions may be anticipated during general construction operations. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Where unstable subgrade conditions develop, stabilization measures will need to be employed.

Subgrade improvement should include scarification, moisture conditioning (e.g., aerate or wet), and compaction of the exposed subgrade soils. The success of this procedure will depend primarily upon favorable weather conditions. Even with adequate time and favorable weather conditions, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1.5 feet. A UES representative should observe subgrade preparation, and could assist in developing appropriate stabilization procedures based on conditions encountered during construction.

Upon completion of grading, care should be taken to maintain the subgrade moisture contents prior to subsequent construction. Construction traffic over the completed subgrade(s) should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade(s) should become frozen, desiccated, saturated, or disturbed, the affected materials should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to any subsequent construction.

4.6.5 Fill Placement

Once the site has been stripped and prepared, place fill material as required to meet finished grades. The recommended criteria for soil fill characteristics (both on-site and imported materials) and compaction procedures are listed as follows. The project design documents should include the following recommendations to address proper placement and compaction of project fill materials. Earthwork operations should not begin until representative samples of native and proposed fill soils to be compacted and/or used are collected and tested (allow 3 to 4 days for sampling and testing). The maximum dry density and optimum moisture content should be determined. In addition, gradation and Atterberg limits testing may be necessary, and should be performed at the Geotechnical Engineer's discretion.

4.6.6 Earth Fill Materials

Engineered fill should meet the following material properties.

- Imported fill should include granular soils containing less than 12 percent passing the number 200 sieve. Suitable soils will have USCS classifications of SP orSP-SM. The fill material should have a modified Proctor (ASTM D1557) maximum dry density of at least 100 pcf.

- On-site soil materials satisfactory for structural fill will have USCS classifications of SP, SP-SM, and some SM. On-site soils used for fill should have less than 20 percent passing the No. 200 sieve and be non-plastic. **Silty materials that exceed the recommended fines content and plastic materials should not be used as structural fill material, and should be hauled off-site, and replaced with suitable fill materials with suitable moisture contents.** The fill material should have a modified Proctor (ASTM D1557) maximum dry density of at least 100 pcf.

- Organic content or other foreign matter (debris) should be no greater than 3 percent by weight, and no large roots (greater than ¼ inch in diameter) should be allowed.

- Material utilized as fill should not contain rocks greater than 3 inches in diameter or greater than 30 percent retained on the ¾-inch sieve.

Although at least some of the silty sands that are prevalent on the site may be re-used for engineered fill, the re-use of these materials may be difficult and, depending on prevalent weather conditions at the time of handling, could prove to be impractical. These materials will be moisture sensitive, and may pose handling and compaction problems both during grading operations, as well during the extended time period of the construction operations on the site. Additionally, the use of these materials should be limited to areas with similar in-situ soils.

If clean sandy soils [SP and SP-SM] are to be used for fill material to raise site grades, we recommend that no less than 3 feet of clean sandy soils be placed on top of silty and/or clayey soils [SM, SC-SM, and SC] due to the potential for a perched groundwater condition to occur within the clean sands. The potential for a perched groundwater level to occur above the silty and clayey soils should be avoided as this could result in unstable and pumping subgrade conditions.

4.6.7 Compaction Recommendations

The following recommendations have been presented for fill placement and compaction. The recommendations are also applicable for the compaction of existing soil materials on the project site.

- Maximum loose lift thicknesses – 12 inches with 10-inch thick compacted lifts, mass fill. Loose lifts of 6 to 8 inches in trenches and other confined spaces where hand operated equipment is used.

- Minimum Compaction requirements – Unless noted otherwise in other sections of this report, 95 percent of the maximum dry density as determined by the modified Proctor (ASTM D1557) compaction test in pavement areas. Under lawn or unpaved areas, compact each layer of backfill or fill material to at least 92 percent of the modified Proctor maximum dry density.

- Soil moisture content at time of compaction should be within ±2 percent of the optimum moisture content. Fill materials with greater than about 10 percent passing the No. 200 sieve will generally be sensitive to even slight changes in moisture. The moisture content of these soils should be maintained slightly below the optimum moisture content in order to help mitigate the potential for moisture related instability during placement and compaction.

- Where required, aerate the fill soils until they are within the previously recommended moisture range prior to placement and compaction.

- Work in small areas that are graded to shed water and avoid ponding. Positive drainage must be maintained both during and after construction in order to direct rainwater off the compacted fill area as quickly as possible.

- Disc and aerate areas that are subjected to rainfall or otherwise become wet. Do not leave these soils exposed to the elements for long periods of time as soils that have already been compacted may become wet and unstable. Protect the fill soil each night and before rain events by methods such as mounding the soil or grading the surface to positive outfall and smooth-rolling to minimize water infiltration.

4.6.8 Test Criteria to Evaluate Fill and Compaction

The following minimum criteria for the evaluation and compaction of fill materials have been recommended. The recommendations are also applicable for the evaluation and compaction of existing soil materials on the project site.

- One modified Proctor compaction test for each soil type compacted and/or used as project fill. Gradation and Atterberg limits testing may be necessary and should be performed at the Geotechnical Engineer’s discretion.

- Pavement areas – Perform compliance tests for fill, stabilized subgrade, and base course placement/compaction operations at a frequency of not less than one test per lift per 5,000 square feet or one test per lift for every 250 linear feet of roadway, whichever is greater.

- Trench fill areas – One density test every 75 linear feet per lift or three tests per lift, whichever is greater.

4.7 FILL SUITABILITY EVALUATION

It is often the case that the soils excavated from stormwater pond areas are re-used as structural fill throughout the development. Refer to Table 7 for suitability based on percent fines content.

Table 7 – Suitability of Excavated Soils for Re-use as Fill

Designation*	% fines passing No. 200 sieve	USCS Soil Classification	Suitability for re-use as fill material
Group A	0 - 5	SP	Favorable, freely draining, clean sands
Group B	5 - 12	SP-SM, SP-SC	Suitable, will require some aeration and moisture control
Group C	12 - 50	SM, SC, SC-SM	Poor, impedes infiltration, limit overall use, use with caution in pavement or pond areas
Group D	> 50	CL, CH, ML, MH, CL-ML	Very Poor, not recommended for fill material, may be used as stabilizing material in pavement subgrade
Group E	organic	PT, OL, OH, SP-OL, SM-OL, SC-OL	Unsuitable, must be completely removed/demucked and replaced with Group A or B soils

Based on the results of our soil boring and laboratory testing program, the soils to be excavated at the stormwater boring locations will consist primarily of Groups B and C soils. More detailed discussions concerning Groups B and C soils, as well as the other Group designations presented in Table 7, have been presented in the following paragraphs.

Clean sandy soils (Group A) with less than 5 percent soil fines are typically free-draining and require minimal moisture control during placement and compaction. The sands with silt and clay (Group B), with contents of 5 to 12 percent soil fines, will require some extra care during placement and compaction. These soils are less freely-draining and might require aeration and drying prior to usage, during use in the rainy season and when placed near the groundwater table. We recommend that imported fill material meet the Group A and Group B qualifications. Refer to Section 4.5.6 for more information regarding these materials.

Soils classified as silty or clayey, Group C and D (greater than 12 percent fines), will impede infiltration and cause a perched water condition. In general, we do not recommend using these soils as structural fill material as they will require stringent moisture control during stockpiling, placement and compaction. Refer to Section 4.5.6 for more information regarding these materials.

Although not found at the boring locations, Group E soils include excessively organic soils. Group E soils are <u>not</u> suitable for use as structural fill. Depending upon the organic content and composition of the material, it may be possible for Group E soils to be blended with Group A and B soils and reused in landscape and green areas (i.e. not suitable for use in pond berms, pavements, building pads, and utility support). Please note these soils will tend to retain moisture and will not be freely draining and may lead to soggy ground conditions following rainfall and irrigation. Drainage improvements (i.e. underdrains) may be required in areas adjacent to these soils.

4.8 CONSTRUCTION RELATED SERVICES

We recommend the Owner retain UES to provide construction monitoring and testing services during the site preparation procedures for confirmation of the adequacy of the earthwork operations. Field tests and observations include proofrolling monitoring, verification of pavement subgrades by monitoring earthwork operations and performing quality assurance tests during the placement of compacted structural fill and pavement courses. We can also provide, asphalt placement monitoring and testing, concrete placement monitoring and testing, and general construction observation services.

The geotechnical engineering design does not end with the advertisement of the construction documents. The design is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, we are most qualified to address problems that might arise during construction in a timely and cost-effective manner.

4.9 EXCAVATION AND SAFETY

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 allow for the safety of workers entering trenches or excavations. It is mandated by this federal regulation 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 followed, 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 stability of both the excavation sides and bottom. The Contractor's “responsible person”, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in all local, state, and federal safety regulations.

We are providing this information solely as a service to our Client. UES 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.

5.0 LIMITATIONS

This report has been prepared for the exclusive use of ***Municipal Engineering Services, Inc.***, and other designated members of their Design/Construction Team associated with the proposed construction for the specific project discussed in this report. No other site or project facilities should be designed using the soil information contained in this report. As such, UES will not be responsible for the performance of any other site improvement designed using the data in this report.

This report should not be relied upon for final design recommendations or professional opinions by unauthorized third parties without the expressed written consent of UES. Unauthorized third parties that rely upon the information contained herein without the expressed written consent of UES assume all risk and liability for such reliance.

The recommendations submitted in this report have been based upon the data obtained from the soil borings performed at the locations indicated on the Boring Location Plan and from other information as referenced. This report does not reflect any variations which may occur between the boring locations. The nature and extent of such variations may not become evident until the course of construction. If variations become evident, it will then be necessary for a re-evaluation of the recommendations of this report after performing on-site observations during the construction period, and noting the characteristics of the variations.

Borings for a typical geotechnical report are widely spaced and generally not sufficient for reliably detecting the presence of isolated, anomalous surface or subsurface conditions, or reliably estimating unsuitable or suitable material quantities. Accordingly, UES does not recommend relying on our boring information for estimation of material quantities unless our contracted services specifically include sufficient exploration for such purpose(s), and within the report we so state that the level of exploration provided should be sufficient to detect anomalous conditions or estimate such quantities. Therefore, UES will not be responsible for any extrapolation or use of our data by others beyond the purpose(s) for which it is applicable or intended.

All users of this report are cautioned that there was no requirement for UES to attempt to locate any man-made buried objects or identify any other potentially hazardous conditions that may exist at the site during the course of this exploration. Therefore no attempt was made by UES to locate or identify such concerns. UES cannot be responsible for any buried man-made objects or environmental hazards which may be subsequently encountered during construction that are not discussed within the text of this report. We can provide this service if requested.

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems. A Geotechnical Business Council (GBC) document entitled "Important Information About Your Geotechnical Engineering Report" appears in Appendix D, and will help explain the nature of geotechnical issues. Further, we include a document in Appendix D, entitled “Constraints & Restrictions”, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

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APPENDIX A

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HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

SITE LOCATION MAP

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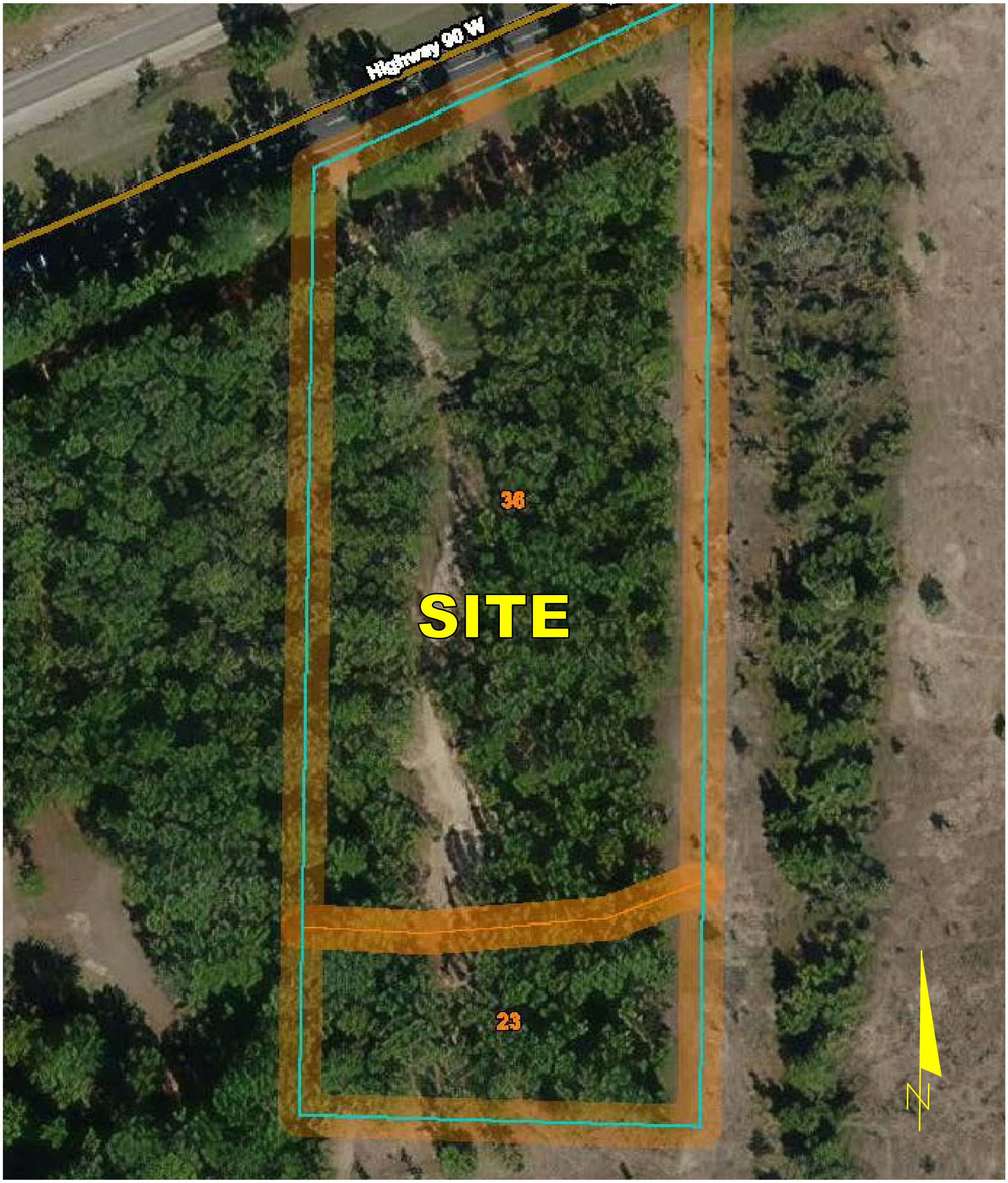
SCALE:	NTS	PROJECT NO:	1730.2100089.0000	REPORT NO:		PAGE NO:	A - 1



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HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

USDA NRCS SOIL SURVEY MAP

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APPENDIX B

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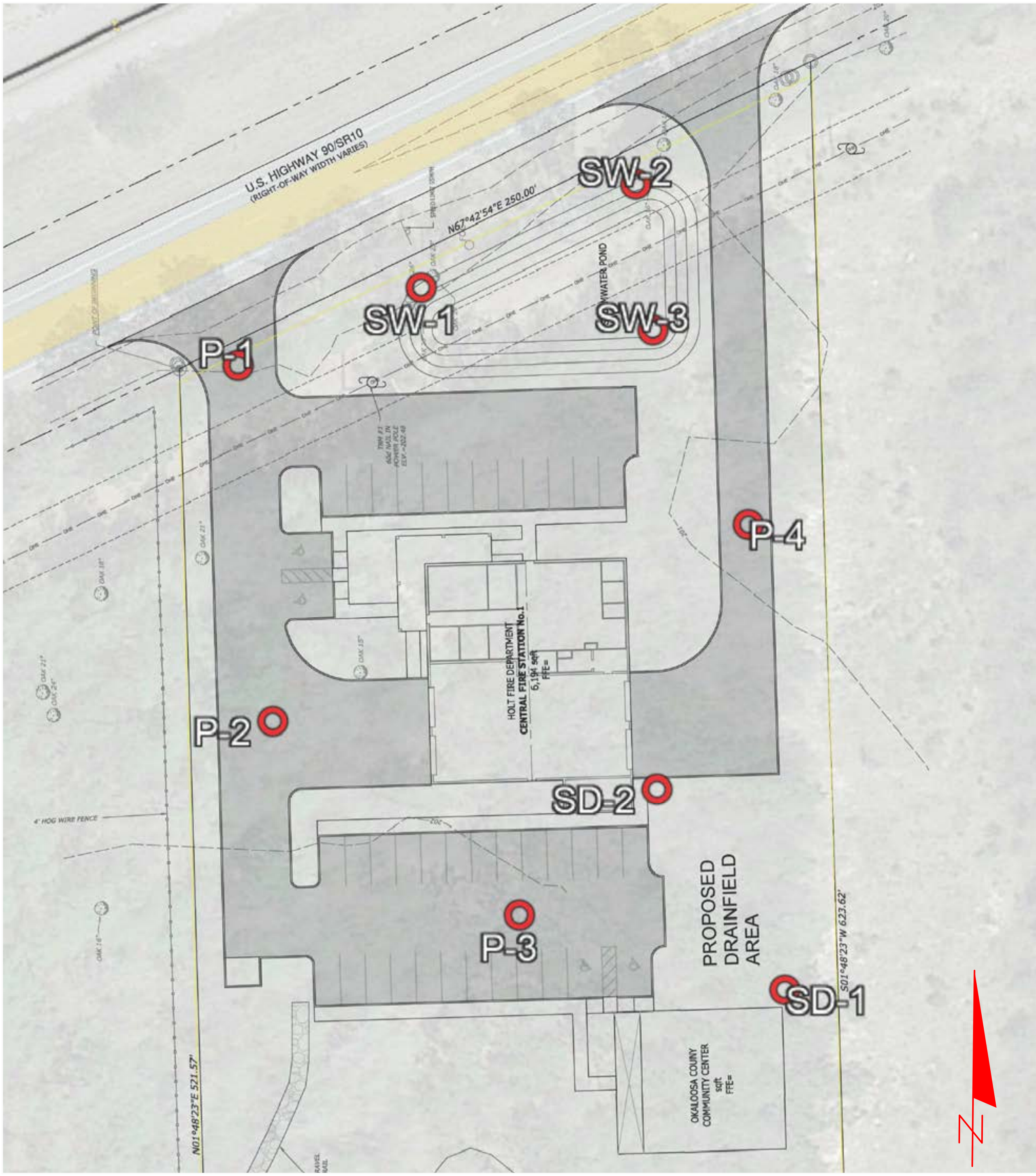

LEGEND

BORING LOCATION

NOTE: ALL BORING LOCATIONS SHOWN ARE APPROXIMATE.

1730.2100089-A

UNIVERSAL
ENGINEERING SCIENCES

HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING LOCATION PLAN

DRAWN BY: KD	DATE: 11/17/21	CHECKED BY: TWM	DATE: 11/17/21
SCALE: NTS	PROJECT NO:1730.2100089.0000	REPORT NO:	PAGE NO: B - 1

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-2

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **P-1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORGANIC CONTENT (%)
									LL	PI		
0						Approximately 2" of Topsoil						
1						Loose light brown SAND, with silt [SP-SM]						
2		2-4-4-4	8				9.9	5.3				
3												
4		3-4-3-3	7			Loose light tan SAND, with trace of silt [SP-SM]						
5												
6		3-5-5-5	10			Boring Terminated at 6'						

BORING HOLT FIRE DISTRICT.GPJ GAINESVILLE TEMPLATE.GDT 11/22/21

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-3

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **P-2**   SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0						Approximately 2" of Topsoil						
1	X					Loose brown silty SAND [SM]						
2		2-2-3-3	5									
3	X					Loose light brown SAND, with silt [SP-SM] and trace of roots						
4		3-3-3-3	6			Loose orangish brown SAND, with silt [SP-SM]						
5	X											
6		3-3-4-4	7				11	5.0				
						Boring Terminated at 6'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-4

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **P-3**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0						Approximately 4" of Topsoil						
1						Loose light brown silty SAND [SM], with trace of roots						
2	X	2-2-2-2	4									
3												
4	X	2-3-2-2	5			Loose reddish orange silty SAND [SM], with trace of clay						
5												
6	X	2-3-3-4	6			Boring Terminated at 6'	18	6.5				

BORING HOLT FIRE DISTRICT.GPJ GAINESVILLE TEMPLATE.GDT 11/22/21

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	1730.2100089.0000
REPORT NO.:	
PAGE:	B-5

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **P-4** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0						Approximately 4" of Topsoil						
1						Loose brown SAND, with silt [SP-SM] and trace of roots						
2		2-3-3-3	6									
3												
4		3-3-3-4	6			Loose orangish brown silty SAND [SM]	12	5.1				
5												
6		4-4-3-4	7			Boring Terminated at 6'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-6

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **SD-1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0						Approximately 4" of Topsoil						
1						Loose brown silty SAND [SM], with trace of roots						
2	X	2-2-2-2	4			Loose orangish brown silty SAND [SM], with trace of roots						
4	X	2-2-2-3	4			Loose to medium dense reddish orange silty SAND [SM], with trace of clay	12	5.3				
6	X	3-4-4-4	8				23	11				
8	X	4-4-4-4	8									
10	X	4-4-5-5	9									
15	X	5-6-7	13									
17						Medium dense reddish orange silty clayey SAND [SC-SM]						
20	X	5-10-10	20									
22						Medium dense orange silty SAND [SM]						
25	X	10-13-15	28									
27						Dense light orange SAND, with silt [SP-SM]						
30	X	10-15-20	35			Boring Terminated at 30'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-7

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **SD-2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0						Approximately 3" of Topsoil						
0–2	X	2-2-2-3	4			Loose brown silty SAND [SM]	13	5.7				
2–4	X	2-3-3-3	6			Loose orangish brown silty SAND [SM]	13	5.6			0.4*	
4–6	X	3-3-4-4	7			Loose reddish brown silty clayey SAND [SC-SM]						
6–8	X	3-4-4-4	8			Loose to medium dense reddish orange silty SAND [SM], with trace of clay						
8–10	X	4-4-4-4	8									
13.5–15	X	5-5-6	11									
17						Medium dense orange silty SAND [SM]						
18.5–20	X	6-9-11	20									
20						Boring Terminated at 20'						

*K VALUE FROM BULK SAMPLE

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-8

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **SW-1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORGANIC CONTENT (%)
0						Approximately 4" of Topsoil						
0–2	X	3-4-3-4	7			Loose light brown SAND, with silt [SP-SM], trace of roots and black organic nodules	11	5.4				
2–4	X	3-3-3-3	6			Loose tan SAND, with silt [SP-SM]	9.0	5.2			1.1*	
4–6	X	4-4-5-5	9			Loose light tan SAND, with silt [SP-SM]	6.2	4.0				
6–8	X	12-16-23-31	39			Dense to medium dense orange clayey SAND [SC]	22	14				
8–10	X	15-20-24-28	44									
13.5–15	X	10-15-15	30									
17						Medium dense reddish orange silty clayey SAND [SC-SM]						
18.5–20	X	10-13-15	28									
22						Dense light orange SAND, with silt [SP-SM]						
23.5–25	X	11-18-20	38									
27						Dense light orange SAND [SP]						
28.5–30	X	13-16-19	35									
30						Boring Terminated at 30'						

*K VALUE FROM BULK SAMPLE

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-9

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **SW-2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0–2	X	3-4-4-4	8			Loose brown SAND, with silt [SP-SM] and trace of roots						
2–4	X	2-3-3-3	6			Loose tan SAND, with silt [SP-SM]						
4–6	X	3-4-4-5	8			Loose orangish brown silty SAND [SM], with trace of clay	13	9.8				
6–8	X	7-13-15-20	28			Medium dense to dense orange clayey SAND [SC]						
8–10	X	15-20-25-30	45									
12						Dense reddish orange silty SAND [SM], with trace of clay						
13.5–15	X	9-15-17	32									
17						Medium dense orange silty SAND [SM]						
18.5–20	X	10-11-14	25				15	13				
22						Dense light orange SAND, with silt [SP-SM]						
23.5–25	X	12-17-20	37									
27						Dense orangish white SAND [SP]						
28.5–30	X	12-17-20	37									
30						Boring Terminated at 30'						

BORING HOLT FIRE DISTRICT.GPJ GAINESVILLE TEMPLATE.GDT 11/22/21

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 1730.2100089.0000
REPORT NO.:
PAGE: B-10

PROJECT: HOLT FIRE DISTRICT
HIGHWAY 90
HOLT, FLORIDA

BORING DESIGNATION: **SW-3** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: MUNICIPAL ENGINEERING SERVICES, INC.
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 11/10/21
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/21
DATE FINISHED: 11/10/21
DRILLED BY: E. MARCEV
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORGANIC CONTENT (%)
0	X					Loose light brown SAND, with silt [SP-SM] and trace of roots						
2	X	3-3-3-4	6			Loose tan SAND, with silt [SP-SM] and trace of roots						
4	X	3-3-3-3	6				9.4	4.0				
6	X	3-5-5-6	10			Medium dense orange clayey SAND [SC]						
8	X	8-13-14-15	27			Hard orange sandy CLAY [CL/CH]						
10	X	13-22-30-32	52									
12						Dense orange silty clayey SAND [SC-SM]						
15	X	12-20-21	41									
17						Dense orange silty SAND [SM]						
20	X	11-16-15	31									
22						Dense light orange SAND [SP]						
25	X	10-15-19	34									
27						Dense light orange to brown SAND, with silt [SP-SM]						
30	X	10-16-19	35			Boring Terminated at 30'						

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KEY TO BORING LOGS

SYMBOLS AND ABBREVIATIONS

SYMBOL	DESCRIPTION
N-Value	No. of Blows of a 140-lb. Weight Falling 30 Inches Required to Drive a Standard Spoon 1 Foot
WOR	Weight of Drill Rods
WOH	Weight of Drill Rods and Hammer
	Sample from Auger Cuttings
	Standard Penetration Test Sample
	Thin-wall Shelby Tube Sample (Undisturbed Sampler Used)
RQD	Rock Quality Designation
▼	Stabilized Groundwater Level
▽	Seasonal High Groundwater Level (also referred to as the W.S.W.T.)
NE	Not Encountered
GNE	Groundwater Not Encountered
BT	Boring Terminated
-200 (%)	Fines Content or % Passing No. 200 Sieve
MC (%)	Moisture Content
LL	Liquid Limit (Atterberg Limits Test)
PI	Plasticity Index (Atterberg Limits Test)
NP	Non-Plastic (Atterberg Limits Test)
K	Coefficient of Permeability
Org. Cont.	Organic Content
G.S. Elevation	Ground Surface Elevation

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS 5% or less passing No. 200 sieve	SW**	Well-graded sands and gravelly sands, little or no fines
			SP**	Poorly graded sands and gravelly sands, little or no fines
		SANDS with 12% or more passing No. 200 sieve	SM**	Silty sands, sand-silt mixtures
			SC**	Clayey sands, sand-clay mixtures
FINE-GRAINED SIOLS 50% or more passes the No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diamicaceous fine sands or silts, elastic silts
			CH	Inorganic clays or clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
			PT	Peat, muck and other highly organic soils

*Based on the material passing the 3-inch (75 mm) sieve
** Use dual symbol (such as SP-SM and SP-SC) for soils with more than 5% but less than 12% passing the No. 200 sieve

RELATIVE DENSITY
(Sands and Gravels)
Very loose – Less than 4 Blow/Foot
Loose – 4 to 10 Blows/Foot
Medium Dense – 11 to 30 Blows/Foot
Dense – 31 to 50 Blows/Foot
Very Dense – More than 50 Blows/Foot

CONSISTENCY
(Silts and Clays)
Very Soft – Less than 2 Blows/Foot
Soft – 2 to 4 Blows/Foot
Firm – 5 to 8 Blows/Foot
Stiff – 9 to 15 Blows/Foot
Very Stiff – 16 to 30 Blows/Foot
Hard – More than 30 Blows/Foot

RELATIVE HARDNESS
(Limestone)
Soft – 100 Blows for more than 2 Inches
Hard – 100 Blows for less than 2 Inches

MODIFIERS

These modifiers Provide Our Estimate of the Amount of Minor Constituents (Silt or Clay Size Particles) in the Soil Sample
Trace – 5% or less
With Silt or With Clay – 6% to 11%
Silty or Clayey – 12% to 30%
Very Silty or Very Clayey – 31% to 50%

These Modifiers Provide Our Estimate of the Amount of Organic Components in the Soil Sample
Trace – Less than 3%
Few – 3% to 4%
Some – 5% to 8%
Many – Greater than 8%

These Modifiers Provide Our Estimate of the Amount of Other Components (Shell, Gravel, Etc.) in the Soil Sample
Trace – 5% or less
Few – 6% to 12%
Some – 13% to 30%
Many – 31% to 50%

FIELD PROCEDURES

Standard Penetration Test Borings (Flight Auger Advanced)

The borings were advanced by mechanically twisting continuous flight augers in to the soils. At intervals of 2 to 5 feet in the borings, Standard Penetration Testing and split-barrel sampling were performed. At the selected test/sampling depth, a split-barrel sampler was inserted to the bottom of each boring and driven 24-inches into the soil using a manual safety hammer with a 140-pound hammer falling an average of 30 inches per hammer blow. The sum of the hammer blow counts for the second and third 6-inch intervals of penetration is termed the standard penetration resistance blow count, or N-value. This value is an index of several in-place geotechnical properties of the materials tested, such as consistency and relative density.

After driving the sampler 24 inches, the sampler was retrieved from each boring, and a representative sample of the material within the split-barrel sampler was placed in a labeled plastic container and sealed. After completing the drilling operations, the samples obtained from the borings were transported to our laboratory where they were examined by a geotechnical engineer. This procedure was performed in general accordance with the latest revision of ASTM Designation D1586 entitled “Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils”.

APPENDIX C

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PERMEABILITY, -200 SIEVE WASH, AND MOISTURE CONTENT

FALLING HEAD PERMEABILITY (FM 5-513)

CLIENT: Municipal Engineering Services, Inc.
UES PROJECT #: 1730.2100089.0000
PROJECT: Holt Fire District - Holt, Florida
SAMPLE NUMBER: 1
DESCRIPTION: Light orange SAND
DATE SAMPLED: 11/10/2021
DATE TESTED: 11/15/2021
CLASSIFICATION: SP
SAMPLED BY: GEO
TESTED BY: GS
SAMPLED FROM: SW-1 , SW-2, SW-3

Sample SOURCE/ BORING NO.	SW-1 to SW-3
Sample NUMBER / DEPTH	23'-30'

PERMEABILITY TESTING SUMMARY			
PERMEABILITY (K)	→	13.7	ft/day
DRY DENSITY	→	*NOT RECORDED*	lbs/ft^3
MOISTURE CONTENT	→	*NOT RECORDED*	%
-200 FINES CONTENT	→	4.3	%

FALLING HEAD PERMEABILITY (FM 5-513)			
No. of LAYERS:	3	Wt. of MOLD (lbs):	9.43
BLOWS/LAYER:	25	Wt. of MOLD/SOIL (lbs):	12.69
HEIGHT (FT)	TRIAL #1 (SEC)	TRIAL #2 (SEC)	PERMEABILITY
7			4.87E-03
6	5.3		4.77E-03
5	11.6		4.75E-03
4	19.7		4.94E-03
3	30.3		4.85E-03
2	45.2		
1	69.4		
Average Permeability	4.8E-03		cm/sec

MOISTURE CONTENT (ASTM D 2216)	
Pan NUMBER	
Wt. of WET SOIL & PAN (g)	
Wt. of DRY SOIL & PAN (g)	
Wt. of PAN (g)	
Wt. of Water (g)	
Wt. of Dry Soil (g)	
MOISTURE CONTENT (%)	NO DATA

-200 SIEVE WASH (ASTM D 1140)	
Pan NUMBER	97
Wt. of DRY SOIL & PAN (g)	280.8
Wt. of WASH SOIL & PAN (g)	276.5
Wt. of PAN (g)	181.6
Wt. of Original Dry Sample (g)	99.2
Wt. of -200 Material (g)	4.3
Wt. of Washed Dry Sample (g)	94.9
-200 FINES CONTENT (%)	4.3

NUMBER OF INCHES MOLD WAS SHORT? 0.205 **INCHES (ZERO INCHES IS DEFAULT)**

PERMEABILITY CONSTANT USED WAS → 0.40 **(PERM CONSTANTS ARE CALLED OUT FROM THE "CONSTANTS" SHEET)**

Respectfully Submitted,

Certificate of Authorization No. 549

PERMEABILITY, -200 SIEVE WASH, AND MOISTURE CONTENT

FALLING HEAD PERMEABILITY (FM 5-513)

CLIENT:	Municipal Engineering Services, Inc.	**UES PROJECT #:**	1730.2100089.0000		
PROJECT:	Holt Fire District - Holt, Florida	**SAMPLE NUMBER:**	2		
DESCRIPTION:	Tan SAND with silt	**DATE SAMPLED:**	11/10/2021	**DATE TESTED:**	11/15/2021
CLASSIFICATION:	SP-SM	**SAMPLED BY:**	GEO	**TESTED BY:**	GS
SAMPLED FROM:	SW-1				

Sample SOURCE/ BORING NO.	**SW-1**
Sample NUMBER / DEPTH	**2'-4'**

PERMEABILITY TESTING SUMMARY			
PERMEABILITY (K)	→	**1.1**	**ft/day**
DRY DENSITY	→	**109.2**	**lbs/ft^3**
MOISTURE CONTENT	→	**8.9**	**%**
-200 FINES CONTENT	→	**9.0**	**%**

FALLING HEAD PERMEABILITY (FM 5-513)			
No. of LAYERS:	**3**	**Wt. of MOLD (lbs):**	**9.43**
BLOWS/LAYER:	**25**	**Wt. of MOLD/SOIL (lbs):**	**13.39**
HEIGHT (FT)	**TRIAL #1 (SEC)**	**TRIAL #2 (SEC)**	**PERMEABILITY**
7			3.71E-04
6	**66.8**		3.66E-04
5	**148.6**		3.68E-04
4	**254.5**		3.91E-04
3	**395.6**		3.63E-04
2	**601.1**		
1	**935.1**		
Average Permeability	**3.7E-04**		**cm/sec**

MOISTURE CONTENT (ASTM D 2216)	
Pan NUMBER	**108**
Wt. of WET SOIL & PAN (g)	**328.1**
Wt. of DRY SOIL & PAN (g)	**316.2**
Wt. of PAN (g)	**181.8**
Wt. of Water (g)	11.9
Wt. of Dry Soil (g)	134.4
MOISTURE CONTENT (%)	**8.9**

-200 SIEVE WASH (ASTM D 1140)	
Pan NUMBER	**A1**
Wt. of DRY SOIL & PAN (g)	**303.1**
Wt. of WASH SOIL & PAN (g)	**289.6**
Wt. of PAN (g)	**153.6**
Wt. of Original Dry Sample (g)	149.5
Wt. of -200 Material (g)	13.5
Wt. of Washed Dry Sample (g)	136.0
-200 FINES CONTENT (%)	**9.0**

NUMBER OF INCHES MOLD WAS SHORT? **0.000** **INCHES (ZERO INCHES IS DEFAULT)**

PERMEABILITY CONSTANT USED WAS → **0.41** **(PERM CONSTANTS ARE CALLED OUT FROM THE "CONSTANTS" SHEET)**

Respectfully Submitted,

PERMEABILITY, -200 SIEVE WASH, AND MOISTURE CONTENT

FALLING HEAD PERMEABILITY (FM 5-513)

CLIENT: Municipal Engineering Services, Inc.
PROJECT: Holt Fire District - Holt, Florida
DESCRIPTION: Orangish Brown silty SAND
CLASSIFICATION: SM
SAMPLED FROM: SD-2

UES PROJECT #: 1730.2100089.0000
SAMPLE NUMBER: 3
DATE SAMPLED: 11/10/2021 **DATE TESTED:** 11/15/2021
SAMPLED BY: GEO **TESTED BY:** GS

Sample SOURCE/ BORING NO.	SD-2
Sample NUMBER / DEPTH	2'-4'

PERMEABILITY TESTING SUMMARY			
PERMEABILITY (K)	→	0.4	ft/day
DRY DENSITY	→	114.5	lbs/ft^3
MOISTURE CONTENT	→	8.9	%
-200 FINES CONTENT	→	17.6	%

FALLING HEAD PERMEABILITY (FM 5-513)

No. of LAYERS:	3	Wt. of MOLD (lbs):	9.43
BLOWS/LAYER:	25	Wt. of MOLD/SOIL (lbs):	13.59

HEIGHT (FT)	TRIAL #1 (SEC)	TRIAL #2 (SEC)	PERMEABILITY
7			1.44E-04
6	162.1		1.43E-04
5	305.9		1.32E-04
4	632.2		1.58E-04
3	993.4		1.39E-04
2	1527.5		
1	2405.7		
Average Permeability		1.4E-04	cm/sec

MOISTURE CONTENT (ASTM D 2216)	
Pan NUMBER	2B
Wt. of WET SOIL & PAN (g)	295.1
Wt. of DRY SOIL & PAN (g)	283.5
Wt. of PAN (g)	152.8
Wt. of Water (g)	11.6
Wt. of Dry Soil (g)	130.7
MOISTURE CONTENT (%)	8.9

-200 SIEVE WASH (ASTM D 1140)	
Pan NUMBER	3B
Wt. of DRY SOIL & PAN (g)	276.4
Wt. of WASH SOIL & PAN (g)	255.3
Wt. of PAN (g)	156.3
Wt. of Original Dry Sample (g)	120.1
Wt. of -200 Material (g)	21.1
Wt. of Washed Dry Sample (g)	99.0
-200 FINES CONTENT (%)	17.6

NUMBER OF INCHES MOLD WAS SHORT? 0.000 **INCHES (ZERO INCHES IS DEFAULT)**

PERMEABILITY CONSTANT USED WAS → 0.41 **(PERM CONSTANTS ARE CALLED OUT FROM THE "CONSTANTS" SHEET)**

Respectfully Submitted,

Certificate of Authorization No. 549

LABORATORY PROCEDURES

Natural Moisture Content Test

A number of the soil samples recovered during the field exploration were chosen for natural moisture content testing. In this test, the soil sample is placed into a metal pan of known weight, weighed, dried for a minimum of 12 hours in a 110 ± 5°C oven, and then weighed again to record the weight of water released during drying. The natural moisture content of the soil is termed the ratio of "pore" or "free" water in a given mass of material to the mass of solid material particles. This test was conducted in general accordance with ASTM Designation D2216 entitled "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass".

Percent -200 Soil Fines Content Test

A number of the soil samples recovered during the subsurface exploration were chosen to determine the percentage of silt and clay fines present in the individual samples. In this test, the Natural Moisture Content test (ASTM D2216) was performed and the sample was then washed over a No. 200 mesh sieve. The materials present in the sample that did not pass through the No. 200 sieve was then placed back in its original pan and dried until the water retained from the wet-sieve process was totally evaporated. Once dried, the sample was weighed again to determine the weight of fines removed during the wet-sieve process. The percent of soil by weight passing the No. 200 sieve is termed the percentage of fines or portion of the sample in the silt and clay size range. This test was conducted in general accordance with ASTM D1140, Standard Test Methods for Determining the Amount of Material Finer than the No. 200 (75-μm) Sieve in Soils by Washing.

Falling-Head Permeability Testing

Using bulk samples of auger cuttings recovered from specific depth intervals in the stormwater pond borings during the field exploration, laboratory falling head permeability testing was performed to determine the permeability rate (a.k.a., hydraulic conductivity values) of the soils. In this test, the sampled material was compacted in three lifts in a 4-in permeability mold of known weight and volume. Once the material was compacted into the mold, the mold and material were then weighed. In addition to weighing the mold and soil, the natural moisture content test (ASTM D2216) was performed on the trimmings left over from the sample compaction. The dry density of the material was then calculated using the volume, weight, and moisture content of the compacted sample.

Once the density procedure was performed, the permeability mold with the compacted material was then covered with a porous stone and spring system to control loosening of the materials during the permeability test. A support collar and top plate was then placed atop the permeability mold (the top plate is equipped with a vent port to allow air to escape the mold/sample as well as an influent port to allow water to saturate the compacted sample). Once the apparatus was assembled and properly tightened, a one-half inch diameter vertical tube, marked with one-foot increments, was attached to the influent port. The tubing was then filled with water and permitted to drain into the influent port, through the sample, and out of the effluent tube at the bottom of the apparatus. Once the sample was saturated and nearly devoid of air, the tubing was filled with water to seven feet above the apparatus and allowed to drain thrrough the sample while the time (in seconds) it took for the water to drop each one foot increment was recorded. The vertical permeability rate of the compacted soils was then calculated using data obtained from the procedure. This test was conducted in general accordance with the State of Florida Department of Transportation test procedure Designation FM 5-513 entitled "Florida Method of Test for Coefficient of Permeability – Falling Head Method".

APPENDIX D

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

CONSTRAINTS & RESTRICTIONS

The intent of this document is to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.

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