VETERANS BEACH REHABILITATION
Addendum 2 –
Geotechnical Exploration Report

Attachment is the geotechnical exploration report for Veterans Beach.

ACKNOWLEDGEMENT

It is the vendor's responsibility to ensure their receipt of all addenda, and to clearly acknowledge all addenda within their initial bid or proposal response in the space provided on the Submittal Checklist included in the original solicitation document. Failure to do so may subject the bidder to disqualification.

UNIVERSAL
ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION
Veterans Beach Purple Heart Memorial Seawall Repair
SW Lakeview Drive
Sebring, Highlands County, Florida

Project No: 0530.1900147.0000

Prepared For:

Polston Engineering
2925 Kenilworth Boulevard
Sebring, Florida 33870

Prepared By:

Universal Engineering Sciences, Inc.
5971 County Lakes Drive
Fort Myers, Florida 33905

August 12, 2019

UNIVERSAL ENGINEERING SCIENCES
Consultants In: Geotechnical Engineering • Environmental Sciences
Geophysical Services • Construction Materials Testing • Threshold Inspect
Building Inspection • Plan Review • Building Code Administration

LOCATIONS:
- Atlanta
- Daytona Beach
- Fort Myers
- Fort Pierce
- Gainesville
- Jacksonville
- Miami
- Ocala
- Orlando (Headquarters)
- Palm Coast
- Panama City
- Pensacola
- Rockledge
- Sarasota
- St. Petersburg
- Tampa
- Tifton
- West Palm Beach

August 12, 2019.

Polston Engineering
2925 Kenilworth Boulevard
Sebring, Florida 33870

Attention: Mr. Marvin Wolfe, P.E.
marvin@polstonengineering.org

Reference: **GEOTECHNICAL EXPLORATION**
Veterans Beach Purple Heart Memorial Seawall Repair
SW Lakeview Drive
Sebring, Highlands County, Florida
UES Project No. 0530.1900147.0000

Dear Mr. Wolfe:

Universal Engineering Sciences, Inc. (UES) has completed the subsurface exploration for the seawall repair located along the Lake Jackson at the Veterans Beach Purple Heart Memorial in Sebring, Highlands County, Florida. The scope of our exploration was planned in conjunction with and authorized by your firm according to UES proposal dated April 22, 2019.

This report contains the results of our exploration, and engineering interpretation of these with respect to the project characteristics described to us and recommendations to aid seawall repair.

We appreciated the opportunity to have worked with you on this project and look forward to a continued association. Please do not hesitate to contact us if you should have any questions, or if we may further assist you as your plans proceed.

Respectfully submitted,
UNIVERSAL ENGINEERING SCIENCES, INC.

Ashok Neela
Staff Engineer

Lindsey N. Weaver, P.E. 41790
Regional Manager
Florida Registration #41790

LINDSEY N. WEAVER LICENSE STATE OF FLORIDA PROFESSIONAL ENGINEER

(Email: cc Client)

Table of Contents

LIST OF APPENDICES

EXECUTIVE SUMMARY

We prepared this summary to provide a quick overview of our findings. Please review, and rely on, the full report for recommendations and other considerations.

PROJECT DESCRIPTION

We understand the project under consideration involves the construction of approximately 250 linear feet of seawall along Lake Jackson at the Veterans Beach Purple Heart Memorial in Sebring, Highlands County, Florida.

SOIL AND GROUNDWATER CONDITIONS

The soils found at the boring locations consist of brown, gray, light brown, light gray and reddish brown fine sands and fine sand with silt fines in loose, medium dense and dense states to around 7.5 feet below ground surface. A very hard stratum was encountered from 7.5 feet to around 10.5 feet. No samples were recovered from this zone. Based on the uniformity of the layer across all borings and the lack of hard rock in the typical soil profile in the area, we believe the hard layer may consist of concrete. Medium dense, dense and very dense fine sand with trace of silt was encountered below the hard stratum to the maximum depth explored of 30 feet below ground surface.

The groundwater was measured at a depth of 2.5 below existing grade. The groundwater level will fluctuate with seasonal rainfall and possibly water level fluctuations within the adjacent lake.

1.0 INTRODUCTION

1.1 GENERAL

In this report we present the results of our geotechnical exploration on the site of the proposed seawall located along Lake Jackson at the Veterans Beach Purple Heart Memorial in Sebring, Highlands County, Florida. This report contains the results of our exploration, an engineering interpretation of the subsurface data obtained with respect to the project characteristics described to us, and our recommendations for geotechnical design and general site preparation. Our scope of services was in general accordance with the proposal and terms and conditions dated April 22, 2019.

2.0 SCOPE OF SERVICES

2.1 PROJECT DESCRIPTION

We understand the project under consideration involves the construction of approximately 250 linear feet of seawall along Lake Jackson at the Veterans Beach Purple Heart Memorial in Sebring, Highlands County, Florida. We anticipate the seawall will consist of corrugated steel sheet piles or possibly precast concrete panels.

We were provided with a site map of the proposed improvements. We used this information in preparing our exploration.

No site or project improvements, other than those described herein, should be designed using the soil information presented in this report. Moreover, UES will not be responsible for the performance of any site improvement so designed and constructed.

Our geotechnical recommendations are based upon the above provided information, assumptions, and considerations. ***If UES is not informed of changes to final design information, the recommendations contained herein are not considered valid, as we cannot be responsible for the consequences of changes of which we were not informed.***

A general location plan of the project area appears in Appendix A: Site Location Plan.

2.2 PURPOSE

The purposes of this exploration were:

- to explore the general subsurface conditions near the existing Seawall;
- to interpret or review the subsurface conditions with respect to the existing seawall; and
- to provide site preparation and recommendations for the Seawall repair.

Recommendations concerning other earthwork related aspects of the proposed construction were beyond the scope of this study. Our work did not address the potential for surface expression of deep geological conditions, such as sinkhole development related to karst activity.

This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. Universal Engineering Sciences

would be pleased to perform these services, if you so desire.

2.3 FIELD EXPLORATION

The subsurface conditions along the proposed Seawall area were explored with four (4) borings advanced to depths 30 feet below existing grade. These borings were advanced using the rotary wash method, and samples were collected while performing the Standard Penetration Test (SPT) at regular intervals.

We performed the Standard Penetration Test according to the procedures of ASTM D-1586; however, we used continuous sampling to detect slight variations in the soil profile at shallow depths. The basic procedure for the Standard Penetration Test is as follows: A standard split-barrel sampler is driven into the soil by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler 1 foot, after seating 6 inches, is designated the penetration resistance, or N-value, this value is an index to soil strength and density.

Consider the indicated boring locations and depths to be approximate. The drilling crew located the boring based upon estimated distances and spatial relations from existing site features. If more precise location and elevation data are desired, a registered professional land surveyor should be retained to locate the boring and determine their ground surface elevations. The Boring Location Plan is presented in Appendix B.

Soil, rock, water, and/or other samples obtained from the project site are the property of the client. Unless other arrangements are agreed upon in writing, UES will store such samples for no more than 60 calendar days from the date UES issued the first document that includes the data obtained from these samples. After that date, UES will dispose of all samples.

2.4 LABORATORY TESTING

The soil samples recovered from the test borings were returned to our laboratory and visually classified by our technical staff. For classification purposes, we performed the following laboratory tests:

Three (3)	Moisture content tests
Three (3)	#200 sieve wash tests

The results of the tests are presented at the respective boring and depth where the sample was obtained on the Boring Logs, Appendix B.

3.0 FINDINGS

3.1 SURFACE CONDITIONS

The site comprised of existing sea wall with parking spaces. The site is relatively level. We also examined U.S.G.S. topographic quadrangle maps and the Soil Conservation Service Soil Survey of Highlands County for relevant information about the site. According to USGS topographic information, the elevation across the property is about approximately +103 to +105 feet NGVD

The site of the proposed Seawall is located along the Lake Jackson in close proximity of the park entrance.

We examined U.S.G.S. topographic quadrangle maps and the USDA Natural Resources Conservation Service (NRCS) Soil Survey of Highlands County Area for relevant information about the site. The Highlands County soil survey identifies generally one (1) soil type on the site, as further described in Table 1.

TABLE 1: USDA SOIL CLASSIFICATIONS

Soil Unit No.	Drainage Characteristics	Hydrologic Group	Presence of Shallow Rock	Depth to Water Table	Location on Site
44-Satellite-Basinger-Urban land complex	Rises and flats on marine terraces, somewhat poorly drained, low runoff	A/D	> 80 inches	About 12 to 42 inches	Entire Site

3.2 SUBSURFACE CONDITIONS

The boring locations and detailed subsurface conditions are illustrated in Appendix B: Boring Location Plan and Boring Logs. The classifications and descriptions shown on the logs are generally based upon visual characterizations of the recovered soil samples and a limited number of laboratory tests. Also, see Appendix B: Soils Classification Chart, for further explanation of the symbols and placement of data on the Boring Logs.

Table 2: General Soil Profile summarizes the conditions encountered.

TABLE 2: GENERAL SOIL PROFILE

Typical Depth (ft.)	Soil Descriptions
0.1 to 7.5	Loose, Medium Dense and Dense Brown, Gray, Light Brown, Light Gray and Reddish Brown Fine Sand and Fine Sand with Silt (SP, SP-SM)
7.5 to 10.5	Hard Concrete or Rock like Layer
10.5 to 30*	Medium Dense, Dense and Very Dense Brown, Light Brown and Reddish Brown Fine Sand with trace of Silt (SP)

*** Termination of Deepest Boring**
[ ] Bracketed Text Indicates: Unified Soil Classification

A very hard stratum was encountered from 7.5 feet to around 10.5 feet. No samples were recovered from this zone. Based on the uniformity of the layer across all borings and lack of hard rock in the typical soil profile in the area, we believe the hard layer may consist of concrete.

Our exploration encountered the groundwater at a depth of 2.5 feet below existing grade at the time of the exploration. The apparent water table can be expected to fluctuate with seasonal rainfall. Fluctuations in groundwater levels should be anticipated throughout the year, primarily due to seasonal variations in rainfall, surface runoff and other factors that may vary from the time

the borings were conducted.

4.0 RECOMMENDATIONS

4.1 GENERAL

The following recommendations are made based upon a review of the attached soil test data, our understanding of the proposed sea wall repair and experience with similar projects and subsurface conditions. If the flood wall locations or grading plans change from those discussed previously, we request the opportunity to review and possibly amend our recommendations with respect to those changes.

Additionally, if subsurface conditions are encountered during constructions which were not encountered in the borings, report those conditions immediately to us for observation.

In this section of the report, we present our recommendations for groundwater conditions, flood wall foundations design parameters and construction related services.

4.2 GROUNDWATER CONDITIONS

The groundwater level will fluctuate with seasonal rainfall and possibly water level fluctuations within the adjacent lake. Based upon our review of U.S.G.S. data and regional hydrology, our best estimate is the seasonal high groundwater table would be 1 to 2 feet below existing grade, on average.

4.3 SEAWALL DESIGN PARAMETERS

In this section of the report, we present our detailed recommendations for soil design parameters with respect to the proposed seawall repair. We recommend the soil parameters outlined in Tables 2 (page 5) be used for seawall evaluation.

The hard layer encountered at a depth of 7.5 feet will impact the type and construction of the seawall. It will not be possible to drive steel sheet piles through this layer if the wall will be cantilevered embedment depths of greater than 7 to 8 feet is anticipated. An embedment depth of less than 7 feet may be possible using concrete panels with tie backs. Alternatively, another mean of stabilizing the shore line to prevent erosion may need to be considered.

4.4 CONSTRUCTION RELATED SERVICES

We recommend that the owner retained Universal Engineering Sciences to perform the construction materials testing and observations on this project. Field tests and observations include verification of pile installation procedures.

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 extent of the engineering design, we are most qualified to address problems that might arise during construction in a timely cost-effective manner.

TABLE 3: RECOMMENDED SOIL RELATED DESIGN PARAMETERS

Soil Description	Typical Depth (1)	Typical "N" Value	Unit Weight (Saturated) Pcf	Unit Weight (Moist) Pcf	Effective Soil Unit Weight (submerged) pcf (2)	Phi Angle ∅ Degrees	Earth Pressure Coefficient (Rankine assuming β=0)		
							K_A (3)	K_P (4)	K_O (5)
Loose, Medium Dense and Dense Brown, Gray, Light Brown, Light Gray and Reddish Brown Fine Sand and Fine Sand with Silt (SP, SP-SM)	0 to 7.5	8 to 34	115	110	53	32	0.31	3.25	0.47
Hard Stratum	7.5 to 10.5	50+	135	130	73	38	0.24	4.20	0.38
Medium Dense, Dense and Very Dense Brown, Light Brown and Reddish Brown Fine Sand with trace of Silt (SP)	10.5 to 30	17 to 81	120	115	58	33	0.29	3.39	0.46

1. Refer to boring logs for strata depth and thickness at individual boring
2. Effective unit weight when below the water table
3. Active Earth Pressure Coefficient
4. Passive Earth Pressure Coefficient
5. At rest Earth Pressure Coefficient
Wall Friction Angle (smooth concrete) - 17°
Friction Angle Mass Concrete on Soil use ∅

5.0 LIMITATIONS

This report has been prepared in order to aid the architect/engineer in the seawall repair. The scopes of services provided were limited to the specific project and locations described herein. The description of the project's design parameters represents our understanding of significant aspects relevant to soil and foundation characteristics.

No site or project facilities/improvements, other than those described herein, should be designed using the soil information presented in this report. Moreover, UES will not be responsible for the performance of any site improvement so designed and constructed.

We note that since the applicability of geotechnical recommendations is very dependent upon project characteristics, most specifically: improvement locations, grade alterations, and actual structural loads applied, UES must review the preliminary and final site and grading plans, and structural design loads to validate all recommendations rendered herein. Without such review our recommendations should not be relied upon for final design or construction of any site improvements.

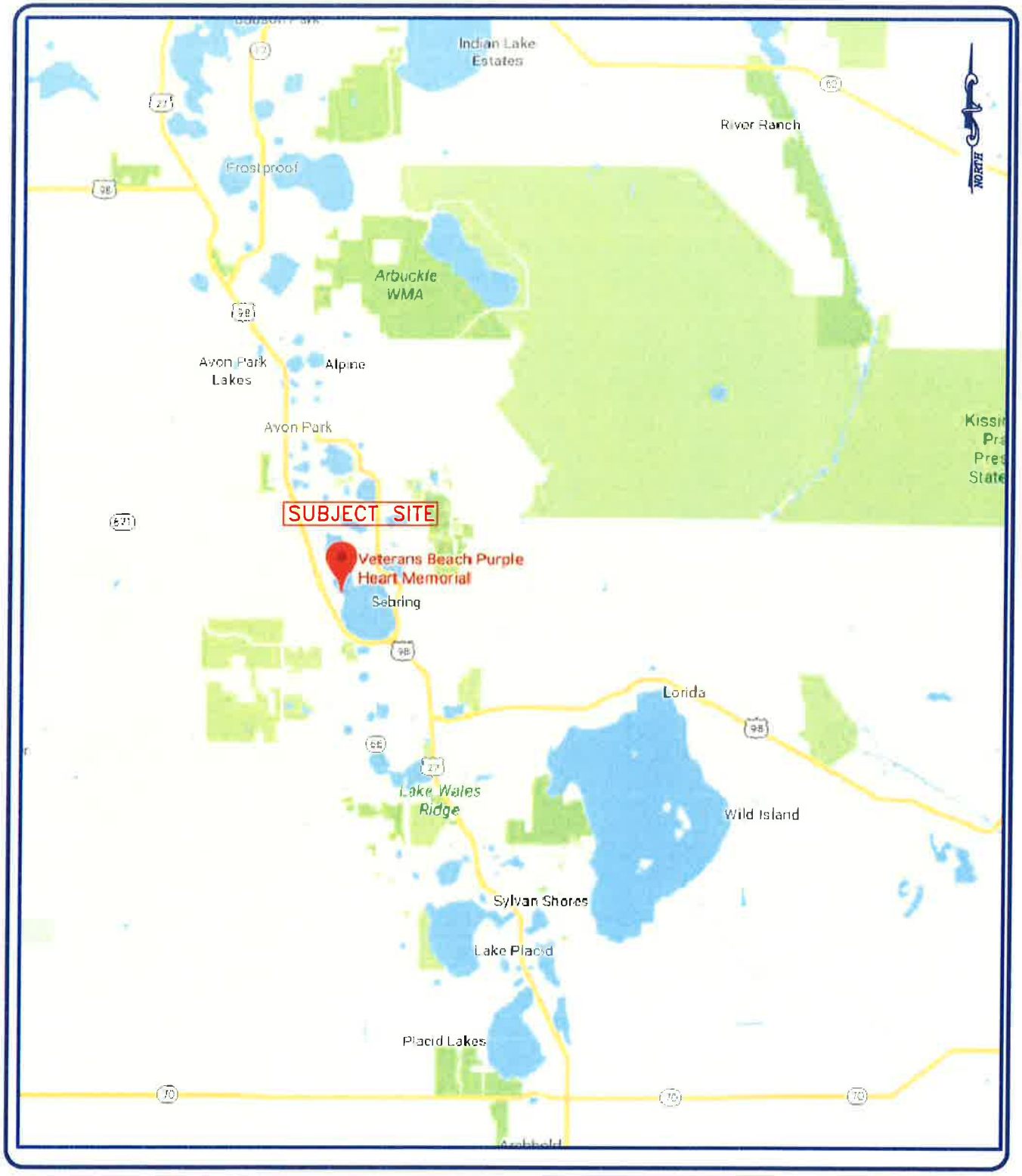
The recommendations submitted in this report are based upon the data obtained from the limited number of soil borings performed at the locations indicated on the Boring Location Plan and from other information as referenced. This report does not reflect any variations which may occur between the boring locations or unexplored areas of the site. This report should not be used for estimating such items as cut and fill quantities.

Our field exploration did find unsuitable, organic soils, at the time of occurrence. However, 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 to negate presence of anomalous materials or 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 such 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 Universal 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 Universal to locate or identify such concerns. Universal 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.

For a further description of the scope and limitations of this report please review the document attached within Appendix C "Important Information About Your Geotechnical Engineering Report" prepared by ASFE, an association of firms practicing in the geosciences.

APPENDIX A



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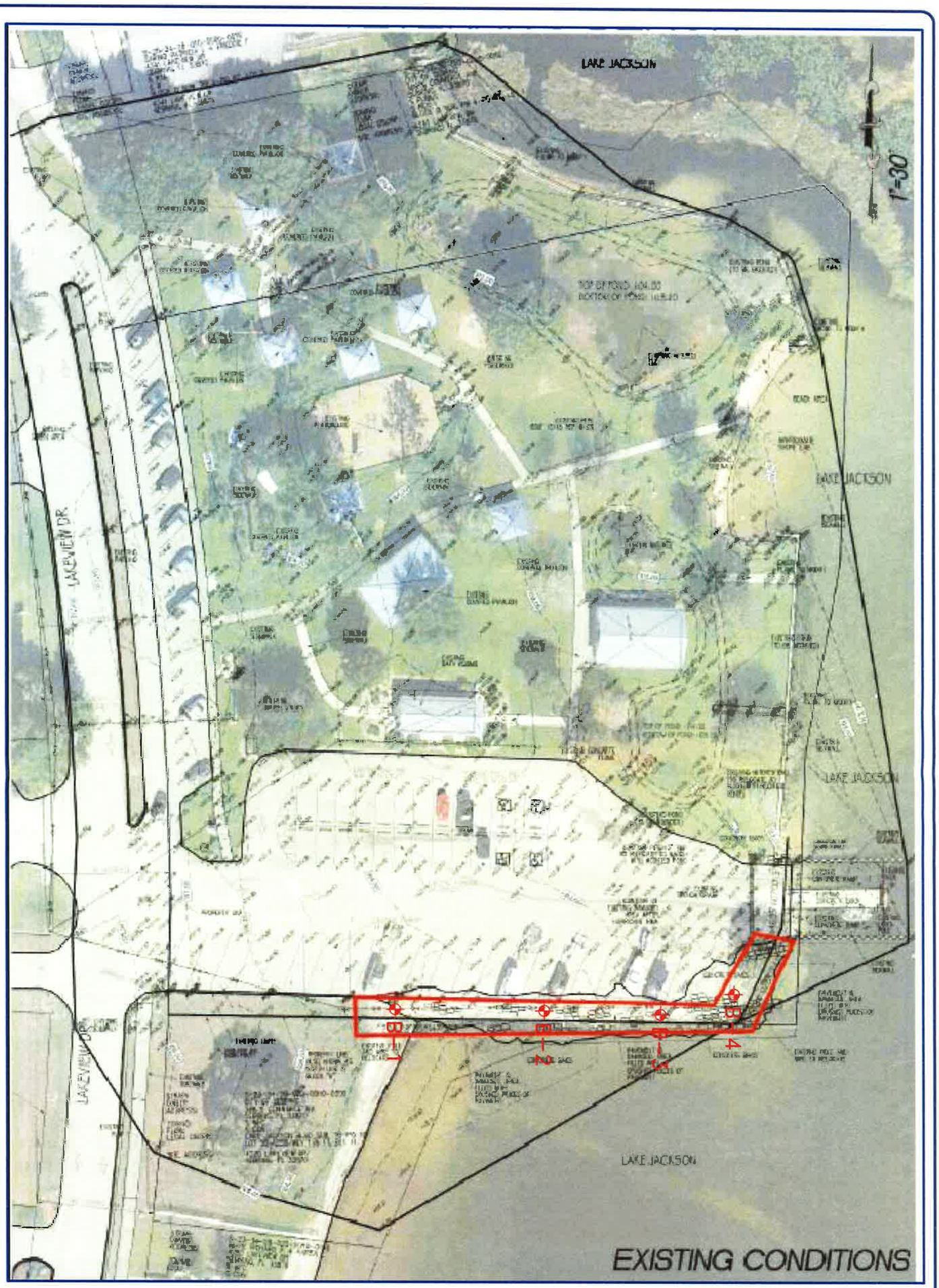
PROPOSED VETERANS BEACH PURPLE HEART MEMORIAL SEAWALL REPAIR
SW LAKEVIEW DRIVE
SEBRING, HIGHLANDS COUNTY, FLORIDA

SITE LOCATION MAP

CLIENT: POLSTON ENGINEERING		DRAWN BY: AN	DATE: 08/02/2019
SCALE: NOT TO SCALE	PROJECT NO: 0530-1900147	REVIEWED BY: LW	APPENDIX: A

APPENDIX B



B-1 Approximate SPT boring location

APPENDIX: B

UNIVERSAL ENGINEERING SCIENCES

PROPOSED VETERANS BEACH PURPLE HEART MEMORIAL SEAWALL REPAIR
SW LAKEVIEW DRIVE
SEBRING, HIGHLANDS COUNTY, FLORIDA

BORING LOCATION PLAN

CLIENT: POLSTON ENGINEERING

DRAWN BY:	AN	DATE:	AUGUST 02, 2019
REVIEWED BY:	LW	DATE:	AUGUST 02, 2019
REPORT NO:		SCALE:	NOT TO SCALE
PROJECT NO:	0530.1900147.0000		

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0530.1900147.0000
REPORT NO.:	
PAGE:	1

PROJECT: Proposed Seawall Reapir
4261 Lakeview Dr
Sebring, Highlands County, FL

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

CLIENT: Polston Engineering

LOCATION: See Boring Locaton Plan

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 2.5
DATE OF READING: 07/30/2019
EST. W.S.W.T. (ft):

DATE STARTED: 7/30/19
DATE FINISHED: 7/30/19
DRILLED BY: CH/JE
TYPE OF SAMPLING: ASTM 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	UCS (tsf)	ORG. CONT. (%)
0						Asphalt						
		9-7-12	19			Medium Dense Reddish Brown and Brown Fine Sand with Silt (SP-SM)						
		8-8-9	17	▼		Medium Dense and Dense Brown, Gray, Light Brown and Light Gray Fine Sand (SP)						
		6-7-9	16									
5		8-10-14	24				1	23				
		13-19-15	34									
		50/0"	50+			Hard Concrete or Rock like Layer						
10						Medium Dense, Dense and Very Dense Brown, Light Brown and Reddish Brown Fine Sand with trace of Silt (SP)						
15		19-31-50	81									
20		6-16-14	30									
25		10-9-11	20									
30		14-27-23	50			BORING TERMINATED						

BORING_LOG 4261 VETERANS BEACH PURPLE HEART MEMORIAL PROJECT-SEA WALL REPAIR.GPJ UNIENGSC.GDT 8/12/19

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0530.1900147.0000
REPORT NO.:	
PAGE:	2

PROJECT: Proposed Seawall Reapir
4261 Lakeview Dr
Sebring, Highlands County, FL

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

CLIENT: Polston Engineering

LOCATION: See Boring Locaton Plan

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft):
DATE OF READING: 07/30/2019
EST. W.S.W.T. (ft):

DATE STARTED: 7/30/19
DATE FINISHED: 7/30/19
DRILLED BY: CH/JE
TYPE OF SAMPLING: ASTM 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	UCS (tsf)	ORG. CONT. (%)
0						Asphalt						
		5-7-10	17			Medium Dense Reddish brown and Brown Fine Sand with Silt (SP-SM)						
		9-6-6	12			Loose, Medium Dense and Dense Brown and Gray Fine Sand (SP)						
		4-4-4	8									
5		7-7-9	16									
		10-13-20	33			Hard Concrete or Rock like Layer						
10						Medium Dense, Dense and Very Dense Brown and Reddish Brown Fine Sand with trace of Silt (SP)						
15		18-25-49	74				3	23				
20		7-13-11	24									
25		9-10-10	20									
30		20-21-25	46			BORING TERMINATED						

BORING_LOG 4261 VETERANS BEACH PURPLE HEART MEMORIAL PROJECT-SEA WALL REPAIR.GPJ UNIENGSC.GDT 8/12/19

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0530.1900147.0000
REPORT NO.:	
PAGE:	3

PROJECT: Proposed Seawall Reapir
4261 Lakeview Dr
Sebring, Highlands County, FL

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

CLIENT: Polston Engineering

LOCATION: See Boring Locaton Plan

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft):
DATE OF READING: 07/30/2019
EST. W.S.W.T. (ft):

DATE STARTED: 7/30/19
DATE FINISHED: 7/30/19
DRILLED BY: CH/JE
TYPE OF SAMPLING: ASTM 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	UCS (tsf)	ORG. CONT. (%)
0						Asphalt						
		6-6-6	12			Loose and Medium Dense Brown, Gray and Light Brown Fine Sand (SP)						
		5-7-8	15									
		5-4-5	9									
5		8-8-8	16									
		12-11-14	25									
						Hard Concrete or Rock like Layer						
10						Medium Dense and Dense Brown, Light Brown and Reddish Brown Fine Sand with trace of Silt (SP)						
15		22-21-18	39									
20		8-8-9	17									
25		8-10-18	28									
30		15-19-20	39			BORING TERMINATED						

BORING_LOG 4261 VETERANS BEACH PURPLE HEART MEMORIAL PROJECT-SEA WALL REPAIR.GPJ UNIENGSC.GDT 8/12/19

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0530.1900147.0000
REPORT NO.:	
PAGE:	4

PROJECT: Proposed Seawall Reapir
4261 Lakeview Dr
Sebring, Highlands County, FL

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

CLIENT: Polston Engineering

LOCATION: See Boring Locaton Plan

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft):
DATE OF READING: 07/30/2019
EST. W.S.W.T. (ft):

DATE STARTED: 7/30/19
DATE FINISHED: 7/30/19
DRILLED BY: CH/JE
TYPE OF SAMPLING: ASTM 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	UCS (tsf)	ORG. CONT. (%)
0						Asphalt						
		5-6-7	13			Medium Dense Reddish Brown Fine Sand with Silt (SP-SM)	11	7				
		8-6-7	13			Medium Dense Brown, Gray and Light Brown Fine Sand (SP)						
		6-7-7	14									
5		6-7-7	14									
		10-12-16	28			Hard Concrete or Rock like Layer						
10						Medium Dense and Very Dense Brown and Reddish Brown Fine Sand with trace of Silt (SP)						
15		26-28-25	53									
20		9-10-9	19									
25		11-12-12	24									
30		15-14-16	30			BORING TERMINATED						

BORING_LOG 4261 VETERANS BEACH PURPLE HEART MEMORIAL PROJECT-SEA WALL REPAIR.GPJ UNIENGSC.GDT 8/12/19

UNIVERSAL ENGINEERING SCIENCES

KEY TO BORING LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

FINE-GRAINED SOILS (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

Descriptive Terms	Unconfined Compressive Strength kPa	SPT Blow Count
Very soft	< 25	< 2
Soft	25 to 50	2 to 4
Medium stiff	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very stiff	200 to 400	15 to 30
Hard	> 400	> 30

GENERAL NOTES

1. Classifications are based on the Unified Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

2. Surface elevations are based on topographic maps and estimated locations.

3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times.

SYMBOLS

▼ Measured Water Table Level

▽ Estimated Seasonal High Water Table

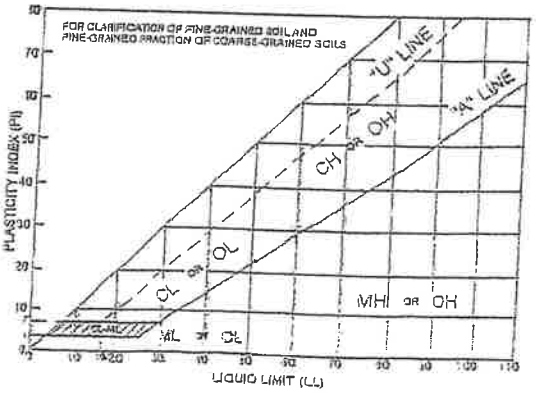
Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty 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 diatomaceous fine sandy or silty soils, organic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
Highly Organic Soils			Pt	Peat and other highly organic soils	

Determining percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows:

Less than 5 percent..... GW, GP, SW, SP
More than 12 percent..... GM, GC, SM, SC
5 to 12 percent..... Borderline cases requiring dual symbols*

Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols



Plasticity Chart

Particle Size	Material
Sieve sizes < #200	Silt or clay
mm < 0.074	Sand
#200 to #40	Fine
0.074 to 0.42	Medium
#40 to #10	Coarse
0.42 to 2.00	
#10 to #4	
2.00 to 4.76	

Particle Size	Material
Sieve	Gravel
#4 to 3/4 in.	Fine
3/4 in. to 3 in.	Coarse
3 in. to 12 in.	Cobble
12 in. to 36 in.	Boulders
mm	
4.76 to 19.1	
19.1 to 76.2	
76.2 to 304.8	
304.8 to 914.4	

*When the percent passing a No. 200 sieve is between 5% and 12%, a dual symbol is used to denote the soil. For example: SP-SC, poorly-graded sand with clay content between 5% and 12%.

APPENDIX C

Important Information about Your

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 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 your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the 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.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of 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,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- 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 study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the 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 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 construction recommendations included in your report. *Those 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 recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower 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. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing 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 Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors 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 contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors 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 contractors do not 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.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental 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 geoenvironmental 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, a number of 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 ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

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CONSTRAINTS AND RESTRICTIONS

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

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 opinion 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 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 east 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 indicated 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 fluctuation 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 and 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 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 investigation. 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.