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August 17, 2018

GLE Associates
5405 Cypress Center Drive - Suite 110
Tampa, Florida 33609

Attention: Ms. Crystal Davis

Reference: **REPORT OF A LIMITED GEOTECHNICAL EXPLORATION**
Victory Pointe Apartments Unit 404 Building Distress
Jacksonville, Florida
UES Project No. 0930.1800180.0000 Report No. 1594409

Dear Ms. Davis:

Universal Engineering Sciences, Inc. has completed a subsurface exploration at the referenced site in Jacksonville, Florida. These services were provided in general accordance with our Proposal No. 1576360 dated June 7, 2018. This report contains the results of our exploration, an engineering evaluation with respect to the project characteristics described to us, and recommendations for remedial measures at the site.

PROJECT INFORMATION

Project information was provided to us through recent phone conversations and a recent site visit. Based on our site observations, the site is developed with several existing two-story multi-unit apartment buildings. We have not been provided with any maps or plans of the subject site. The apartment complex is located just west of Lane Avenue on the south side of Ramona Boulevard in Jacksonville, Florida.

A site visit was performed by a UES representative to observe the existing distress to Unit 404. The main distress noted was some sloping of first level floor slabs, cracks in the interior ceilings and walls, and some separation of exterior brick facing. The structure shows signs of apparent cosmetic repairs which may have previously been performed.

We assume the structure is supported on a conventional shallow foundation system. The site visit was performed to develop a scope of services to explore possible subsurface soil conditions that may be adversely affecting the foundations of the structure within the area of the observed distress.

Post construction determination of settlement and distress are often very difficult to obtain. It can involve both structural issues and geotechnical issues. Our field exploration is limited to areas accessible to our drilling equipment adjacent to the areas of the observed distress; therefore the findings will based on the information obtained from our limited field exploration. It should

be noted that due to these restrictions the geotechnical causes of the observed distress may not be able to definitively be determined.

PURPOSES

The purposes of this exploration were to explore the general subsurface conditions in the vicinity of unit 404 at the site with respect to the distress noted to the structure. It was requested to provide an evaluation of the probable causes of the distress and recommendations for repair.

This report presents the soil conditions encountered 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 desire.

Our investigation was confined to the zone of soil within the upper approximate 40 feet below the ground surface. 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. We will be pleased to conduct an investigation to evaluate the probable effect of the regional geology upon the existing construction if you desire.

FIELD EXPLORATION

To explore the subsurface conditions within the distressed structure areas, we located and performed one (1) Standard Penetration Test (SPT) boring, drilled to a depth of 40 feet below the existing ground surface, in general accordance with the methodology outlined in ASTM D 1586. We also performed four (4) static cone penetrometer soundings and auger borings, drilled to depths of approximately 6.5 feet below the existing ground surface. We recorded static cone penetrometer readings at six inch intervals, in general accordance with the methodology outlined in ASTM D 1452. A summary of these field procedures is included in Appendix A. Soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory for further evaluation.

LABORATORY INVESTIGATION

Representative soil samples obtained during our field exploration were returned to our office and reviewed by a geotechnical engineer. The samples were visually classified in general accordance with ASTM D 2488 (Unified Soil Classification System).

Six (6) fines content tests, six (6) moisture content tests, and three (3) Atterburg limits tests were conducted in the laboratory on representative soil samples obtained from the borings. These tests were performed to aid in classifying the soils and to help quantify and correlate engineering properties. The results of these tests are presented on the Boring Logs in Appendix A. A brief description of the laboratory procedures used is also provided in Appendix A.

GENERAL SUBSURFACE CONDITIONS

SOIL SURVEY

Based on 2014 Soil Survey data for Duval County, Florida, as prepared by the US Department of Agriculture Soil Conservation Service, the predominant predevelopment soil type at the site is identified as Urban Land-Mascotte-Sapelo complex (73) A summary of characteristics of this soil series was obtained from the Soil Survey and is included in Table 1.

TABLE 1
Summary of Soil Survey Information

Soil Type	Constituents	Hydrologic Group	Natural Drainage	Soil Permeability (Inches/Hr)	Seasonal High Water Table
Urban Land (73)	- -	-	-	- -	-
Mascotte (73)	0-15" Fine sand 15-25" Fine sand, loamy fine sand 25-28" Loamy fine sand, fine sand 28-58" Sandy clay loam, fine sandy loam 58-80" Fine sand, loamy fine sand	C/D	Poorly Drained	0-15" 6.0 – 20 15-25" 0.6 – 2.0 25-28" 6.0 – 20 28-58" 0.2 – 0.6 58-80" 0.6 – 2.0	0.5 – 1.5
Sapelo (73)	0-23" Fine sand 23-32" Fine sand, loamy fine sand 32-56" Fine sand 56-80" Sandy clay loam, fine sandy loam	B/D	Poorly Drained	0-23" 6.0 – 20 23-32" 0.6 – 2.0 32-56" 6.0 – 20 56-80" 0.2 – 2.0	0.5 – 1.5

General Soil Profile

The boring locations and detailed subsurface conditions are included in the Attachments on the 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. When reviewing these records, it should be understood that the soil conditions will vary between the boring locations. The following table summarizes the soil conditions encountered.

TABLE 2 General Soil Profile		
Typical depth (ft)		Soil Descriptions
From	To	
0	1 to 2	Very loose to medium dense fine sand (SP), slightly silty fine sand (SP-SM), and slightly clayey fine and (SP-SC)
1 to 2	22.5	Very loose to medium dense clayey to very clayey fine sand (SC) and firm to very stiff clay (CH)
22.5	28	Loose silty fine sand (SM)
28	40*	Medium dense to very dense slightly clayey to clayey fine sand (SP-SC/SC) with cemented sand and shell fragments
* Termination Depth of Deepest Boring ( ) Indicates Unified Soil Classification		

Groundwater Level

The groundwater level was measured and recorded at the boring locations at depths ranging from 3.7 to greater than 6 feet below the existing ground surface. The groundwater levels may not be stabilized levels due to the clayey soils encountered near the surface. The depth to the groundwater level at each boring location, where recorded, is noted on the attached Boring Logs. It should be anticipated the groundwater level will fluctuate due to seasonal climatic variations, surface water runoff patterns, construction operations, and other interrelated factors. Based upon our review of U.S.G.S. data, Duval County Soils Survey, and regional hydrogeology, it is our opinion the seasonal high water level will perch above the clayey soils at the ground surface.

EVALUATION

Based on the results of our subsurface exploration, there was not an obvious geotechnical related cause for the distress noted. It is our opinion the distress may be related to the clayey material encountered at the foundation bearing levels at the boring locations. The clayey material can create somewhat of a shrink/swell soil condition as the groundwater table and moisture conditions fluctuate throughout the year. It has been our experience that structures constructed over similar subsurface conditions typically experience settlement as clayey soils lose moisture during dry weather conditions and may undergo some slight shrinkage.

CONCEPTUAL FOUNDATION SYSTEM REPAIRS

Conceptual options discussed herein are intended to help you decide on the next course of action. They are not intended as design level recommendations nor to allow others to prepare remedial plans for bidding.

Although it may be possible to raise the distressed foundations somewhat, foundation repairs to an existing distressed structure may not return the structure to a "like new" condition. However,

proper performance of remedial measures can often result in reduction of future foundation settlement and limiting distress to tolerable levels. Tolerable levels will vary with the expectation of the owner. Because the near surface clayey soils cannot be economically removed from beneath the existing structure, some aesthetic and nuisance distress (i.e. stucco and masonry cracks, rubbing or racked windows and doors, etc.) would likely occur unless the foundation and slab areas were deeply underpinned to a competent bearing layer or similar suitable end bearing stratum and then lifted sufficiently to close the existing gaps. A specialty foundation contractor who specializes in foundation and floor slab repair can be consulted regarding the possibility of lifting the foundations and floor slab to help reduce the presence of existing cracks.

Recommendations for Remedial Measures

Based on the soil conditions encountered, it is our opinion that remedial measures at the site should include systems which will transfer the loads from the distressed foundations and floor slabs to more competent bearing soils below the clayey soils near the surface. The following are options which may be feasible at this site.

1. Underpinning methods are an option to provide support for the distressed building foundations. Underpinning consists of installing either end bearing pin piles or helical piers and fastening them to the existing shallow foundations. Before underpinning design, the structure should be analyzed by a licensed structural engineer to determine the loads to be supported and the locations where the underpin elements should be placed. Typically, underpins are spaced about 6 feet apart and are not placed below large wall openings such as patio door openings, window openings, and entry openings. The depth of the underpinning elements would need to be determined from the applied structural load as determined by a structural engineer and soil strength characteristics of the deeper soils. Based on the SPT boring performed at the site it appears a competent bearing stratum may be encountered at a depth range of approximately 30 to 35 feet below the existing ground surface.

   Helical piers are structural steel elements which are advanced in the ground by torque. The torque can be monitored to ensure design bearing loads are attained. The foundation elements typically consist of either a single or double helix attached to a steel shaft. Structural loads are transferred through the near surface clayey soils to a more competent bearing stratum.

   Pin piles are used as a method of soil stabilization and support for foundations and slabs. Often referred to as micro piles or mini piles, pin piles vary from 2- 6 inches in diameter. Due to their small size, pin piles are ideal for building foundations on sites with physical and geotechnical restraints. The piles are driven into the ground with pneumatic or vibratory hammers to competent bearing soils encountered below the surface clayey soils. A structural engineer should be consulted to help determine pier spacing and to structurally evaluate the existing members to be supported.

Underpinning systems are typically designed by a specialty contractor who has experience with installation of these systems working in conjunction with a structural engineer. We recommend Universal be provided the opportunity to review any design methods with respect to these recommendations to confirm that the intent of our recommendations has been implemented in the design.

2. It may be desired to simply perform cosmetic repairs to the building exterior and monitor for additional settlements. Cosmetic repairs should be reviewed by a licensed engineer or architect familiar with the building material and implemented by a qualified contractor. Generally, repairs should be made to allow for future movement. Special construction considerations include the use of elastomeric sealers and paints, flexible repair materials, slip connections between load bearing and non-load bearing elements, etc. However, cosmetic repairs should be performed with the understanding that there is the potential for additional distress to occur in the future. Additionally, it is assumed that some type of floor leveling topping would be necessary to cosmetically repair the floor slabs.

Regardless of the repair methods chosen, the building should be periodically monitored for future settlement related distress. If any changes to the building condition are noticed we should be contacted for further evaluation.

Quality Control

An engineering technician familiar with the installation of helical piles into subsurface soil conditions similar to those at this site and acting under the direction and supervision of the geotechnical engineer should witness the installation of underpinning elements. His/her duties should include, but not be limited to, the following:

1. Keep an accurate record of underpinning elements installation and procedures.

2. Verify that all underpinning elements are installed to the proper capacity and to a depth indicative of the elements bearing in the desired bearing formation.

3. Confirm the installation equipment is operating properly.

4. Inspect the underpinning prior to installation for defects and confirm that the elements are not damaged during installation.

LIMITATIONS

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. An Association of Engineering Firms Practicing in the Geosciences (ASFE) publication, "Important

Information About Your Geotechnical Engineering Report" appears in Appendix B, and will help explain the nature of geotechnical issues.

We trust this report meets your needs and addresses the geotechnical issues associated with the proposed construction. We appreciate 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
Certificate of Authorization No. 549

8/17/18

Stephen R. Weaver, P.E.
Geotechnical Services Manager
FL P.E. No. 37389

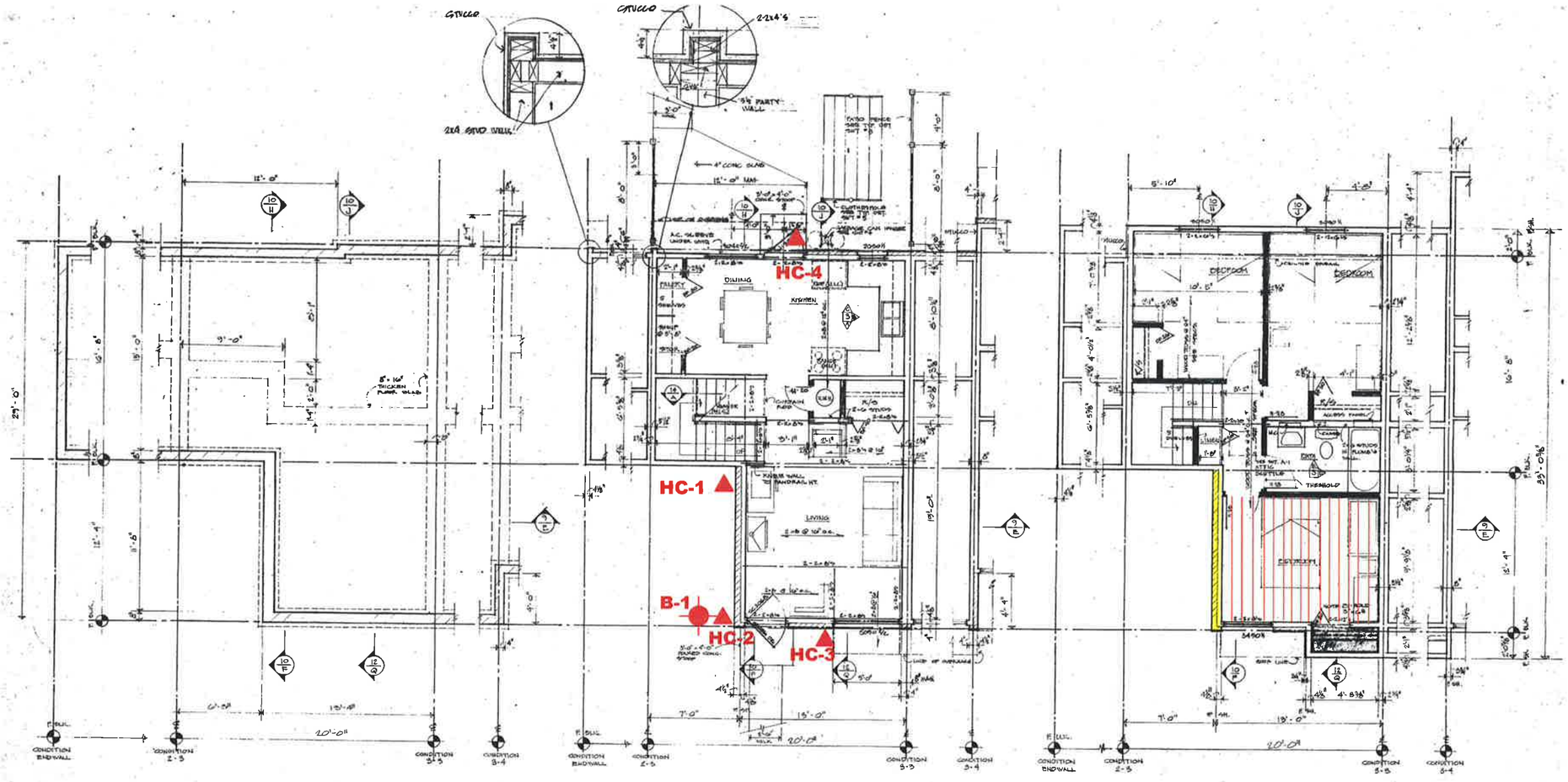
SRW/srw

STEPHEN R. WEAVER
LICENSE NO. 37389
STATE OF FLORIDA
PROFESSIONAL ENGINEER

Jacob Fuller
Staff Geotechnical Engineer

APPENDIX A

BORING LOCATION PLAN
BORING LOGS
KEY TO BORING LOGS
FIELD EXPLORATION PROCEDURES
LABORATORY TESTING PROCEDURES



GRAPHIC SCALE

10' 0 5' 10' 20'

(IN FEET)

LEGEND

▲ AUGER BORING LOCATION

SPT BORING LOCATIONS

CLIENT: GLE ASSOCIATES, INC.

GEOTECHNICAL EXPLORATION
VICTORY POINTE APARTMENTS UNIT 404
JACKSONVILLE, FLORIDA

BORING LOCATION PLAN

DRAWN BY: TW	DATE: 8/12/18
CHECKED BY: JF	DATE: 8/12/18
SCALE: 1"=10'	
PROJECT NO: 0930.1800180.0000	REPORT NO:

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PAGE NO:

FIGURE 1

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-1

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

CLIENT: GLE ASSOCIATES, INC.

LOCATION: SEE BORING LOCATION PLAN

REMARKS: PP - UNCONFINED COMPRESSIVE STRENGTH MEASURED WITH POCKET PENETROMETER

G.S. ELEVATION (ft):
WATER TABLE (ft): 3.7
DATE OF READING: 8/2/18
EST. W.S.W.T. (ft):

DATE STARTED: 8/2/18
DATE FINISHED: 8/2/18
DRILLED BY: S. TORRES
TYPE OF SAMPLING: ASTM D 1586

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)	ORG. CONT. (%)
0						Very loose dark gray slightly Silty fine SAND (SP-SM)						
		WOH-1-1	2			Firm orangish-gray to red CLAY (CH) PP=2.0 tsf						
		1-2-3	5	▼		PP=3.5 tsf						
		2-3-4	7			PP=4.25 tsf						
5						Stiff to very stiff dark gray to gray to orangish-brown Sandy CLAY (CH)						
		5-6-6	12			PP=4.5 tsf						
		6-9-8	17			Soft to firm dark gray to grayish-brown CLAY (CH) PP=1.75 tsf						
		WOH-2-3	5			PP=2.5 tsf						
10		1-1-3	4									
						Very loose dark gray Silty Clayey fine SAND (SC)						
15		WOH	WOH				25.2	30.5				
						Very loose gray Clayey fine SAND with cemented Sand and Shell fragments (SC)						
20		1-2-1	3									

BORING_LOG 0930.1800180.0000-VICTORY POINTE APARTMENTS UNIT 404.GPJ UNIENGSC.GDT 8/17/18

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-2

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

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)	ORG. CONT. (%)
20												
						Loose dark greenish-gray Silty fine SAND with trace Shell (SM)						
25		2-2-3	5									
						Medium dense to very dense gray Clayey fine SAND with many cemented Sand and Shell fragments (SC)						
30		18-12-14	26				15.5	17.6				
35		3-18-50/4"	68/10"				16.4	30.0				
						Dense gray slightly Clayey fine SAND with cemented Sand and Shell fragments (SP-SC)						
40		5-11-36	47									

BORING LOG 0930.1800180.0000-VICTORY POINTE APARTMENTS UNIT 404.GPJ UNIENGSC.GDT 8/17/18

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-3

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

CLIENT: GLE ASSOCIATES, INC.

LOCATION: SEE BORING LOCATION PLAN

REMARKS: *STATIC CONE PENETROMETER READING IN KG/CM2

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 8/2/18
EST. W.S.W.T. (ft):

DATE STARTED: 8/2/18
DATE FINISHED: 8/2/18
DRILLED BY: S. TORRES
TYPE OF SAMPLING: ASTM D 1452

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)	ORG. CONT. (%)
0			*5			Very loose brown to light brown slightly Clayey fine SAND (SP-SC)						
			*5									
			*5			Very loose to loose grayish-brown to reddish-orange very Clayey fine SAND (SC)						
			*10									
			*15									
			*20			Medium dense grayish-brown to light gray very Clayey fine SAND (SC)						
			*50				46.7	25.4	46	30		
			*40									
			*35									
5			*50									
			*50									
			*50									

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BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-4

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

CLIENT: GLE ASSOCIATES, INC.

LOCATION: SEE BORING LOCATION PLAN

REMARKS: *STATIC CONE PENETROMETER READING IN KG/CM2

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 8/2/18
EST. W.S.W.T. (ft):

DATE STARTED: 8/2/18
DATE FINISHED: 8/2/18
DRILLED BY: S. TORRES
TYPE OF SAMPLING: ASTM D 1452

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)	ORG. CONT. (%)
0			*10			Loose brown to light brown slightly Clayey fine SAND (SP-SC)						
			*25									
			*40			Medium dense brown to orangish-brown very Clayey fine SAND (SC)						
			*35									
			*30			Stiff gray to reddish-orange to dark gray to gray to grayish-brown CLAY (CH)						
			*50				59.2	28.3	53	36		
			*50									
			*50									
			*50									
5			*50									
			*50									
			*50			Stiff gray to orangish-brown Sandy CLAY (CH)						

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BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-5

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

CLIENT: GLE ASSOCIATES, INC.

LOCATION: SEE BORING LOCATION PLAN

REMARKS: *STATIC CONE PENETROMETER READING IN KG/CM2

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 8/2/18
EST. W.S.W.T. (ft):

DATE STARTED: 8/2/18
DATE FINISHED: 8/2/18
DRILLED BY: S. TORRES
TYPE OF SAMPLING: ASTM D 1452

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)	ORG. CONT. (%)
0			*5			Very loose brown slightly Silty fine SAND (SP-SM)						
			*10									
			*10			Loose brown to orangish-brown fine SAND (SP)						
			*25									
			*50			Stiff brown to orangish-brown CLAY (CH)						
			*50									
			*60									
			*55			Stiff gray to orangish-brown to gray to grayish-brown CLAY (CH)						
			*50									
5			*50									
			*55									
			*50									

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BORING LOG

PROJECT NO.:	0930.1800180.0000
REPORT NO.:	
PAGE:	A-6

PROJECT: VICTORY POINTE APARTMENTS UNIT 404
GLE ASSOCIATES, INC.
JACKSONVILLE, FLORIDA

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

CLIENT: GLE ASSOCIATES, INC.

LOCATION: SEE BORING LOCATION PLAN

REMARKS: *STATIC CONE PENETROMETER READING IN KG/CM2

G.S. ELEVATION (ft):
WATER TABLE (ft): NE
DATE OF READING: 8/2/18
EST. W.S.W.T. (ft):

DATE STARTED: 8/2/18
DATE FINISHED: 8/2/18
DRILLED BY: S. TORRES
TYPE OF SAMPLING: ASTM D 1452

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)	ORG. CONT. (%)
0						Medium dense brown to grayish-brown slightly Silty fine SAND (SP-SM)						
			*45									
			*35			Stiff brown to orangish-gray Sandy CLAY (CH)						
			*40			Stiff brown to grayish-brown to reddish-orange CLAY (CH)						
			*50									
			*50				54.3	28.8	53	35		
			*15									
			*20			Firm to stiff grayish-brown slightly Sandy CLAY with Orange seams (CH)						
			*35									
5			*50									
			*50			Stiff gray slightly Sandy CLAY with traces of Wood (CH)						
			*60			Medium dense gray very Clayey fine SAND with traces of Wood (SC)						

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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 EXPLORATION PROCEDURES

Standard Penetration Test Borings

The penetration borings were made in general accordance with the latest revision of ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced by rotary drilling techniques using a circulating bentonite fluid for borehole flushing and stability. At 2 ½ to 5 foot intervals, the drilling tools were removed from the borehole and a split-barrel sampler inserted to the borehole bottom and driven 18 inches into the soil using a 140 pound hammer falling on the average 30 inches per hammer blow. The number of blows for the final 12 inches of penetration is termed the "penetration resistance, blow count, or N-value". This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young's Modulus.

Auger Borings - Manual

The auger borings were performed manually by the use of a post-hole auger and in general accordance with the latest revision of ASTM D 1452, "Soil Investigation and Sampling by Auger Borings". Representative samples of the soils brought to the ground surface by the augering process were placed in glass jars, sealed and transported to our laboratory where they were examined by our engineer to verify the driller's field classification.

Static Cone Penetrometer

A static cone penetrometer was used to check the in-place strength of the soils encountered by the boring. At 6 inch intervals, the static cone penetrometer was forced 6 inches into the soil ahead of the boring. The maximum resistance required to force the penetrometer into the soil was recorded for each 6 inch increment. The penetration resistance (in TSF) was determined using a calibrated dial gauge. An approximation to correlate the dial gauge reading to N-values in sandy soils can be calculated by dividing the penetrometer readings by 4.

LABORATORY TESTING PROCEDURES

Natural Moisture Content

The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of "pore" or "free" water in a given mass of material to the mass of solid material particles.

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Atterberg Limits

The Atterberg Limits consist of the Liquid Limit (LL) and the Plastic Limit (PL). The LL and PL were determined in general accordance with the latest revision of ASTM D 4318. The LL is the water content of the material denoting the boundary between the liquid and plastic states. The PL is the water content denoting the boundary between the plastic and semi-solid states. The Plasticity Index (PI) is the range of water content over which a soil behaves plastically and is denoted numerically by as the difference between the LL and the PL. The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of "pore" or "free" water in a given mass of material to the mass of solid material particles.

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

CONSTRAINTS AND RESTRICTIONS

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.

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 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 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 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.

LIST OF APPENDICES