GILLEN ENGINEERING, LLC
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Construction Materials Testing

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June 10, 2016

985 Builders, LLC
201 Masters Point Court
Slidell, Louisiana 70458

Project No. 9485.01

Attention: Mr. Rick Hopton

Re: Geotechnical Investigation
LA Dental Office
Houma, Louisiana

Gentlemen:

Submitted herein is the report of our investigation of soil and foundation conditions for the proposed LA Dental Office located on West Main Street in Houma, Louisiana. The proposed building will be a relatively light, single-story structure with maximum plan dimensions of 70 ft by 135 ft and a total area of about 8,567 sq ft. This work was performed in accordance with our proposal dated May 13, 2016 and was authorized by Mr. Rick Hopton on May 17, 2016.

This report presents the results of an investigation made to determine a suitable foundation for the proposed structure. The soil borings performed for this investigation indicate the subsurface conditions consist of very soft to firm clays encountered within the bearing zone of a shallow foundation. These clays have weak bearing capacity and high compressibility characteristics. The near-surface clays are also highly plastic and susceptible to volumetric changes due to seasonal fluctuations in the moisture content. Based on this information, we recommend the structure be supported on a pile foundation. Details of our recommendations related to foundation design and construction are included in the body of this report.

We appreciate the opportunity of providing services to you. If we can answer any questions or provide additional information, please call.

Very truly yours,
Gillen Engineering, LLC

Gregory L. Gillen, P. E.

Copies Submitted:
Mr. Rick Hopton (2)
Mr. Tom Pistorius, AIA, NCARB (1)

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1.0 INTRODUCTION

985 Builders, LLC is planning for construction of the new LA Dental Office located on West Main Street in Houma, Louisiana. The site is located on the west side of West Main Street (LA Hwy 24) and about 300 ft south of Martin Luther King Boulevard (LA Hwy 3040). The proposed building will be a relatively light, single-story structure with maximum plan dimensions of 70 ft by 135 ft and a total area of about 8,567 sq ft. The site is assumed to be raised with no more than 2 ft of fill materials. **pistorius**associates, llc is the architect for the project.

Scope/Purpose. The purposes of the investigation reported herein were as follows:

- To determine soil conditions in the proposed construction areas;
- To evaluate pertinent physical properties of the soils encountered; and
- After analyses of available field and laboratory data, to develop guideline recommendations related to foundation design and construction.

2.0 FIELD INVESTIGATION

Subsurface conditions at the project site were investigated by means of three borings made at the locations shown on Figure 1. Boring 1 was advanced to a terminal depth of 50 ft. Borings 2 and 3 were advanced to a terminal depth of 10 ft each. The borings were advanced by a buggy-mounted drill rig utilizing machine auger and rotary wash drilling techniques. The 50-ft boring was grouted upon completion in compliance with the Louisiana Department of Environmental Quality regulations. Graphical logs of the borings showing the types of soils encountered are attached. Symbols and soil classifications used in the graphical boring logs are also attached.

Soil Sampling. Relatively undisturbed samples of the cohesive soils encountered in the borings were taken by pushing a 3-in. OD thin-wall Shelby tube sampler a distance of approximately 2 ft into the soils with hydraulic cylinders on the drill rig (ASTM D 1587). Depths at which these samples were taken are indicated by shaded portions in the "Samples" column of the boring log. After the Shelby tube was recovered from the boring, the sample was carefully extruded in the field and examined visually. One representative portion of each sample was selected and sealed in a cylindrical cardboard container to prevent loss of moisture and to protect the sample during transportation to the laboratory. Another portion of each undisturbed sample was also selected and sealed in a plastic jar for ease in subsequent visual examination.

Disturbed samples of sands and other near-cohesionless soils encountered in the borings were obtained by driving an ASTM standard 2-in. OD split-spoon sampler a distance of 18 in. into the soils with a 140-lb hammer falling a distance of 30 in. (ASTM D 1586). This sampling procedure is referred to as the Standard Penetration Test. The depth at which the split-spoon sample was taken is indicated by crossed-slashes in the "Samples" column of the boring log. The number of blows (N-value) required to drive the sampler the final 12 in. of penetration is recorded at the corresponding depth in the "Field Tests Results" column of the boring log. A representative portion of the split-spoon sample was selected and sealed in a plastic jar to prevent loss of moisture. All jars were placed in protective boxes for transportation to the laboratory for further visual examination.

3.0 LABORATORY INVESTIGATION

The engineering properties considered pertinent for this study are soil classification, shear strengths and plasticity characteristics of the soils encountered. These engineering properties were determined by means of tests completed in our laboratory. Laboratory tests completed for this study include natural moisture content, visual classification, unconfined compression, wash over the No. 200 sieve and liquid and plastic (Atterberg) limits. These tests were performed in accordance with recognize ASTM standards and procedures. The laboratory tests are discussed in the following paragraphs.

Unconfined Compression. The undrained shear strength values for the cohesive soils were evaluated by means of 18unconfined compression tests. In an unconfined compression test, a cylindrical sample of soil is subjected to a uniformly increasing axial load until failure develops. For purely cohesive soils, the undrained shear strength is taken to be equal to one-half of the maximum normal stress that was observed to develop on the sample during the test. Undrained shear strength or simply "cohesion" values determined from the results of the unconfined compression tests are presented in the laboratory data section of the boring log. Also shown are the natural moisture contents and dry unit weights determined as a part of each unconfined compression test. The cohesion values and moisture contents are also presented graphically on the boring log as small open circles and shaded circles, respectively.

Liquid and Plastic (Atterberg) Limits. The compressibility and shrink-swell potential of the subsurface soils were investigated indirectly by means of natural moisture content and liquid and plastic limit tests. For this study, 3 liquid and plastic limit tests were performed on selected samples. The results of the liquid and plastic limit tests can be used to classify fine-grained soils by the Unified Soil Classification System as silts or clays of high or low plasticity. The numerical difference between the liquid and plastic limit is defined as the plasticity index. The magnitude of the liquid limit and plasticity index and the proximity of the natural moisture content to the plastic limit are indicators of the potential for a soil to shrink or swell upon changes in moisture content or to consolidate under loading. The results of the liquid and plastic limit tests are plotted as small vertical lines interconnected by a horizontal-dashed line in the data section of the boring logs.

Moisture Contents. Additionally, 6 natural moisture content tests and visual classifications were performed to verify field classifications for consistency in soil type and to extend the usefulness of shear strength data. The results of these additional moisture content tests are also presented in the "Laboratory Data" section of the boring log. Results of the visual classifications were utilized in the development of the "Description of Material" section in the graphical boring log.

No. 200 Washes. In order to further classify the soil types, 4 soil samples were washed over the No. 200 sieve to determine the percent of fine particles in the sample. Soils passing through the No. 200 sieve are considered to be fine particles (clays and silts). Results of the No. 200 wash are presented as percent fines in the data section of the boring log.

4.0 SUBSURFACE CONDITIONS

The soil conditions encountered within the depths explored at the boring locations consist of clays, clayey silts, silty sands and silty clays. The general soil and groundwater conditions encountered at the project site and the engineering properties of the soils are discussed in the following paragraphs.

Soil Conditions. The near-surface soils at the boring locations are very soft to firm clays (Unified Soils Classification System – CH). The clays were encountered at ground surface and extended to a depth of 29 ft in Boring 1 and to the 10-ft terminal depth of Borings 2 and 3. Stiff to very stiff clays form a 2-ft thick crust at ground surface. Soft to firm clays were also encountered from a depth of 37 ft to 47 ft. The moisture content of the clays ranges from 25% to 78%. Liquid and plastic limit tests performed on selected clay samples yielded liquid limits that range from 55% to 91%, plastic limits that range from 23% to 30% and corresponding plasticity indices of 32 to 62. Washes over the No. 200 sieve reveal the clays have between 95.9% and 99.1% fine particles (clays and silts). Unconfined compression tests performed on selected clay samples yielded undrained shear strengths that range from 200 lbs per sq ft to 2,400 lbs per sq ft with corresponding dry unit weights of 60 lbs per cu ft to 94 lbs per cu ft. A standard penetration test performed within the clays revealed a penetration resistance (N-value) of the weight of hammer (WOH).

Loose clayey silts (ML) were encountered at a depth of 29 ft and extended to a depth of 33 ft. The moisture content of the clayey silts is about 33%. A wash over the No. 200 sieve reveal the clayey silts have between 79.7% fine particles (clays and silts).

Medium dense silty sands (SM) were encountered at a depth of 33 ft and extended to a depth of 37 ft. The moisture content of the silty sands is about 25%. A wash over the No. 200 sieve reveal the silty sands have 14.5% fine particles (clays and silts). A standard penetration test performed within the silty sands revealed a penetration resistance (N-value) of 13 blows per ft.

Firm silty clays were encountered at a depth of 47 ft and extended to the 50-ft terminal depth of the boring. The moisture content of the silty clays is about 39%. An unconfined compression test performed on one selected silty clay sample yielded an undrained shear strength of 770 lbs per sq ft with a corresponding dry unit weight of 82 lbs per cu ft.

Groundwater Conditions. Groundwater conditions at the project site were determined by observing the water levels in the machine auger portion of the boring. Groundwater was observed a depth of 7 ft in Boring 1 and 8 ft in Borings 2 and 3. The groundwater rose to a depth of 3 ft in all three borings after 15 minutes. Notes pertaining to groundwater level observations are presented on the graphical boring log. Proper note should be taken that groundwater conditions will fluctuate seasonally with variations in rainfall, temperature and other environmental factors.

5.0 GUIDELINE FOUNDATION DESIGN RECOMMENDATIONS

The soil borings performed for this investigation indicate the subsurface conditions consist of very soft to firm clays encountered within the bearing zone of a shallow foundation. These clays have weak bearing capacity and high compressibility characteristics. The near-surface clays are also highly plastic and susceptible to volumetric changes due to seasonal fluctuations in the moisture content. Based on this information, we recommend the structure be supported on a pile foundation. Our recommendations related to design and construction of the foundation elements are discussed in the following paragraphs.

5.1 Pile Foundation

Analyses were performed for 30-ft and 35-ft Class 5 timber piles (ASTM D25, min. 6-in. diameter tip). The Class 5 piles should have a minimum spacing of at least 3 ft on centers. All timber piles located above the water table should be treated with a preservative to prevent decay. Capacities for other pile types and sizes could be furnished upon request.

The theoretical ultimate compression capacity of the piles is taken to be equal to the side friction that could develop along the embedded surface of the pile plus the end-bearing capacity. In cohesive soils, the side friction is taken to be equal to the adhesion of the soil to the pile, which is a function of the undrained shear strength (S_u). The end-bearing values for piles terminating in cohesive soils are computed utilizing the undrained shear strength values multiplied by a bearing capacity factor (N_c) with a maximum value of 9. For the granular soils, the skin friction and the end bearing capacity were computed based on the depth to diameter ratio of the shaft, the overburden pressure and the angle of internal friction of the soils. Values for the angle of internal friction are obtained based on a correlation to the standard penetration test blow counts (N-values). The ultimate pile capacities were divided by a safety factor of 2.0 to obtain the allowable (design) compressive capacities below.

Pile Type	Pile Length	Design Capacity (S.F. = 2.0)
Class 5 timber (min. 6" tip)	30'	6 tons
Class 5 timber (min. 6" tip)	35'	8 tons

Settlement and Downdrag Loads. The 30-ft Class 5 piles should have less than 1 in. of total settlement caused by downdrag effects from 1-ft or less of fill materials. If 1-ft to 2-ft of fill materials are placed at the site, we recommend a minimum pile length of 35 ft to allow the piles to tip into the underlying medium dense silty sands. A 35-ft pile with no more than 2 ft of fill materials placed at the site should also have less than 1 in. of total settlement caused by downdrag effects. If more than 2 ft of fill materials are placed at the site, we should be notified immediately to further evaluate downdrag effects.

Pile Driving. The Class 5 timber piles should be driven with a No. 2 Vulcan (7,260 ft-lbs) or equivalent hammer. In order to prevent potential damage to the piles, driving activities should be limited to 25 blows per ft (refusal) or two consecutive feet of at least 20 blows per ft. The adjacent structures should be monitored for vibrations during pile driving activities. Vibrations should not exceed a peak particle velocity (PPV) 0.25 inches per second.

Load Test. Should a pile load test be performed to verify the field capacity of the pile, the load test should be taken to at least 200% of the design load or preferably to failure. Load test procedures and equipment should conform to the description and procedures outlined in ASTM D 1143. The Contractor should be responsible for the design and construction of the load frame including installation of the test pile(s) and reaction piles. The equipment and procedures used to install the test pile and reaction piles should be approved by the Engineer. The test pile should be allowed to set for a minimum period of 14 days prior to testing.

6.0 REPORT LIMITATIONS

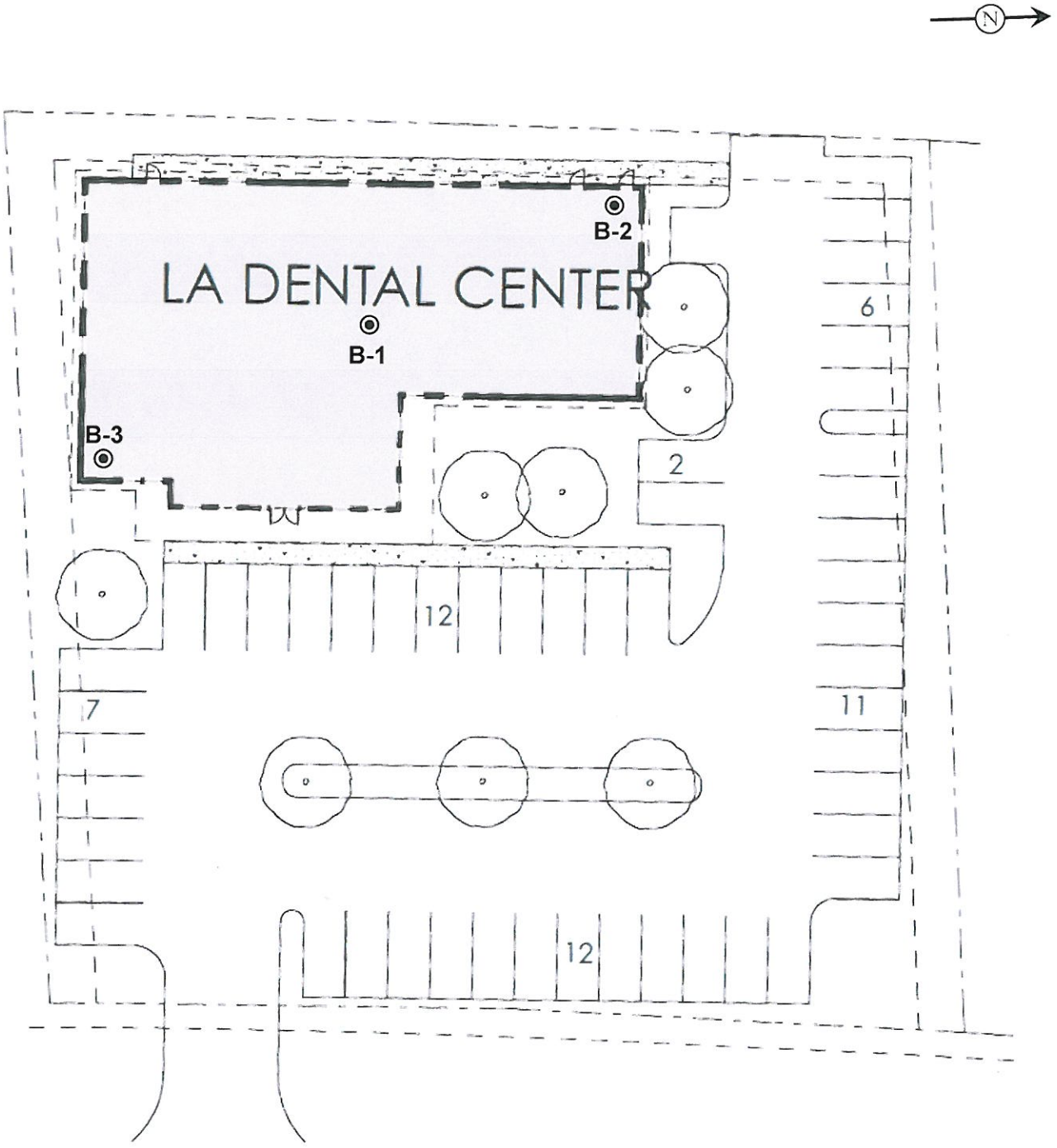
The borings made for this investigation was located in the field based on measurements from features at the site. The boring logs shown in this report contain information related to the types of soils encountered at specific locations and times and show lines delineating the interface between these materials, as well as results of laboratory tests performed on representative samples. The logs also contain our field representative's interpretation of soil conditions that are believed to exist in those depth intervals between the actual samples taken. Therefore, the boring logs contain both factual and interpretative information. It is not warranted that the logs are representative of subsurface conditions at other locations and times.

With regard to groundwater conditions, this report presents data on groundwater level as it was observed during the course of the field work. In particular, water level readings have been made in the borings at the times and under conditions stated in the text of this report and on the boring logs. It should be noted that fluctuations in the groundwater levels can occur with passage of time due to variations in rainfall, temperature and other factors.

The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our field investigation and further on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed. If, during construction, different subsurface conditions from those encountered in our borings are observed, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary. If there is a lapse of time of more than one year between submission of this report and start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if the building location, size, fill height and placement, etc. are changed, we urge that we be promptly informed, and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Further, we request that our firm be retained to review those portions of the plans and specifications for this particular project that pertain to foundations as a means to determine whether the plans and specifications are consistent with the recommendations contained in this report. In addition, we also request our firm be retained to observe construction, particularly the compaction of structural fill, installation of driven piles, concrete placement and such other field observations as might be necessary. We can also perform a pile load test, if desired.

This report has been prepared for the exclusive use of 985 Builders, LLC for design and construction of the foundation elements for the proposed LA Dental Office located in Houma, Louisiana. The only warranty made by us in connection with the services provided is that we have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended.



Legend

◉ Soil Boring

GEOTECHNICAL INVESTIGATION LA DENTAL OFFICE HOUMA, LOUISIANA	GILLEN ENGINEERING, LLC Soil and Foundation Consultants Construction Materials Testing			**BORING LOCATION MAP**	
	Drawn By:	GLG	DATE:	SCALE:	**FIGURE 1**
	Checked By:	GLG	6/10/16	See Drawing	

GILLEN ENGINEERING, LLC
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BORING NUMBER 1

CLIENT 985 Builders, LLC
PROJECT NAME LA Dental Office
PROJECT NUMBER 9485.01
PROJECT LOCATION Houma, Louisiana
DATE STARTED 5/26/16 **COMPLETED** 5/26/16
GROUND ELEVATION _____ **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Triangle Resources, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Machine Auger 0-8': Rotary Wash 8-50'
▽ **AT TIME OF DRILLING** 7.00 ft
LOGGED BY H. Nguyen **CHECKED BY** G. Gillen
▼ **AT END OF DRILLING** 3.00 ft after 15 minutes
NOTES Boring grouted upon completion
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	FIELD TEST RESULTS (N-value)	% FINES	COHESION (ksf)	MOISTURE CONTENT %	DRY UNIT WT. (pcf)	PLASTICITY INDEX
0	Stiff brown clay (CH)			1.86	33	85	
	▼ - firm 2' - 4'			0.83	37	82	59
	- soft 4' - 6'			0.33	48	75	
	▽ - with silt 6' - 8' - very soft 6' - 18' - gray below 6'		95.9	0.21	35	88	
10					48		
		WOH			42		
	- firm below 18'			0.62	45	71	
20							
				0.59	67	61	
30							
				0.55	78	60	
	Loose gray clayey silt (ML) - with sand		79.7		33		
	Medium dense gray silty sand (SM)	10-7-6 (13)	14.5		25		
40	Soft gray clay (CH)	3-1-1 (2)	99.1		43		
	- firm below 42'			0.69	64	63	
50	Firm gray silty clay (CL)			0.77	39	82	
	Bottom of borehole at 50.0 feet.						

△ SPT N VALUE △ (20 40 60 80)
PL MC LL (20 40 60 80)
○ COHESION (ksf) ○ (1 2 3 4)

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BORING NUMBER 2

CLIENT 985 Builders, LLC
PROJECT NAME LA Dental Office
PROJECT NUMBER 9485.01
PROJECT LOCATION Houma, Louisiana
DATE STARTED 5/26/16 **COMPLETED** 5/26/16
GROUND ELEVATION _____ **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Triangle Resources, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Machine Auger
▽ **AT TIME OF DRILLING** 8.00 ft
LOGGED BY H. Nguyen **CHECKED BY** G. Gillen
▼ **AT END OF DRILLING** 3.00 ft after 15 minutes
NOTES Boring backfilled with soil cuttings
AFTER DRILLING ---

DEPTH (ft)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION	FIELD TEST RESULTS (N-value)	% FINES	COHESION (ksf)	MOISTURE CONTENT %	DRY UNIT WT. (pcf)	PLASTICITY INDEX	△ SPT N VALUE △ 20 40 60 80 / PL MC LL 20 40 60 80 / ○ COHESION (ksf) ○ 1 2 3 4
0			Very stiff brown clay (CH)			2.40	25	94	62	
			▼ - firm 2' - 8'			0.74	41	78		
			- with silt 4' - 6'			0.58	35	84		
			▽			0.52	42	78		
10			- very soft and gray below 8'			0.20	62	66		
			Bottom of borehole at 10.0 feet.							
20										
30										
40										
50										

GILLEN ENGINEERING, LLC
Soil and Foundation Consultants
Construction Materials Testing

BORING NUMBER 3

CLIENT 985 Builders, LLC
PROJECT NAME LA Dental Office
PROJECT NUMBER 9485.01
PROJECT LOCATION Houma, Louisiana
DATE STARTED 5/26/16 **COMPLETED** 5/26/16
GROUND ELEVATION _____ **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Triangle Resources, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Machine Auger
▽ **AT TIME OF DRILLING** 8.00 ft
LOGGED BY H. Nguyen **CHECKED BY** G. Gillen
▼ **AT END OF DRILLING** 3.00 ft after 15 minutes
NOTES Boring backfilled with soil cuttings
AFTER DRILLING ---

DEPTH (ft)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION	FIELD TEST RESULTS (N-value)	% FINES	COHESION (ksf)	MOISTURE CONTENT %	DRY UNIT WT. (pcf)	PLASTICITY INDEX	△ SPT N VALUE △ 20 40 60 80 / PL MC LL 20 40 60 80 / ○ COHESION (ksf) ○ 1 2 3 4
0			Stiff brown clay (CH)				31			
			▼ - firm with silt 2' - 8'			0.51	30	89	32	
						0.57	36	84		
						0.65	33	87		
10			▽ - soft and gray below 8'			0.36	59	66		

Bottom of borehole at 10.0 feet.

20
30
40
50

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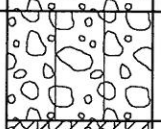
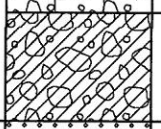
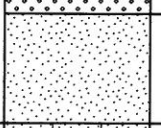
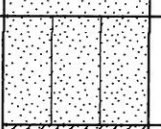
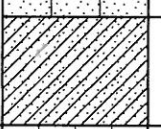
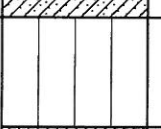
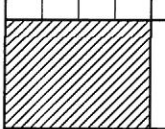
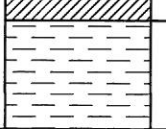
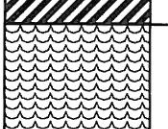
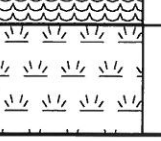
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS