GE GILLEN ENGINEERING, LLC
Soil and Foundation Consultants
Construction Materials Testing

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November 30, 2016

Mr. and Mrs. John Reis
417 Venus Drive
Mandeville, Louisiana 70471

Report No. 9517.01

Re: Geotechnical Investigation
Proposed Reis Residence
258 Jackson Avenue
Mandeville, Louisiana

Dear Mr. and Mrs. Reis:

Submitted herein is the report of our investigation of soil and foundation conditions for your proposed residence located at 258 Jackson Avenue in Mandeville, Louisiana. The proposed residence will be a two-story, elevated structure with maximum plan dimensions of approximately 38 ft by 69 ft. The structure will be elevated on concrete masonry columns at a height of 10 ft above finish grade. This work was performed in general agreement with our proposal dated October 5, 2016 and was authorized by Mr. John Reis on November 9, 2016.

This report presents the results of an investigation made to determine a suitable foundation system for the proposed structure. Results of this investigation indicate dense silty sands, clayey sands and sandy silts, hard silty clays, and very stiff to hard sandy clays were encountered within the bearing zone of a shallow foundation. Based on this information, it is our opinion that the structure could be founded on a shallow foundation designed for an allowable net soil bearing pressure of 4,000 lbs per sq ft. Details of our recommendations related to design and construction of the foundation elements 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

Gregg L. Gillen
Gregory L. Gillen, P. E.

Copies Submitted:
Mr. and Mrs. John Reis (2)
Mr. Bill Thomassie, P. E. (1)

1.0 INTRODUCTION

Mr. and Mrs. John Reis are developing plans for construction of their proposed residence located at 258 Jackson Avenue in Mandeville, Louisiana. The proposed residence will be a two-story, elevated structure with maximum plan dimensions of approximately 38 ft by 69 ft. The structure will be elevated on concrete masonry columns at a height of 10 ft above finish grade. The row of columns located on each side of the rear driveway will be spaced approximately 22 ft apart to allow vehicle access under the structure. The construction plans are being prepared by Diamond Design Residential Planners.

The project site is located in the southwest corner at the intersection of Jackson Avenue and Jefferson Street. A 3-ft wooden fence is located on the street sides of the property. The site has several large trees, of which some will be removed for construction.

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

- To determine soil conditions in the proposed construction area;
- 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 soil conditions at the project site were investigated by means of 2 borings made at the locations shown on Figure 1. The borings were located in opposite corners of the proposed foundation footprint and were advanced to a terminal depth of 20 ft each. The borings were advanced by a truck-mounted drill rig utilizing machine auger drilling techniques. 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 logs. 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.

In addition, disturbed samples of the near-surface soils were also 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 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 possible testing.

3.0 LABORATORY INVESTIGATION

The engineering properties which were considered to be pertinent for this study are soil classification, shear strength and plasticity characteristics. These engineering properties were determined by means of tests completed in our laboratory. Laboratory tests completed for this study include moisture content, visual classification, unconfined compression and washes over the No. 200 sieve. These tests were performed in accordance with recognized ASTM standards and procedures. The laboratory tests are discussed in the following paragraphs.

Unconfined Compression. Undrained shear strength values for the cohesive soils were evaluated by means of 12 unconfined 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 which 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 logs. Also shown are the natural moisture contents and unit weights determined as a part of each unconfined compression test. The cohesion values and moisture contents are also presented graphically on the boring logs as small open circles and shaded circles, respectively.

Moisture Contents. Additionally, 2 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 and plasticity data. The results of these additional moisture content tests are also presented in the "Laboratory Data" section of the boring logs. Results of the visual classifications were utilized in the development of the "Description of Material" section in the graphical boring logs.

No. 200 Washes. In order to further classify the soil types, 10 selected 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 washes are presented as percent fines in the data section of the boring log.

4.0 SUBSURFACE CONDITIONS

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

4.1 Soil Conditions

The near-surface soils at the location of Boring 1 are dense silty sands (Unified Soils Classification System – SM). The silty sands were encountered at ground surface and extended to a depth of 4 ft. The moisture content of the silty sands is about 10%. Washes over the No. 200 sieve revealed the silty sands have between 40.4% and 52.6% fine particles (silts and clays). A standard penetration test performed within the silty sands yielded a blow count (N-value) of 46 blows per ft.

The near-surface soils at the location of Boring 2 are dense sandy silts (ML). The sandy silts were encountered at ground surface and extended to a depth of 2 ft. The moisture content of the sandy silts is about 7%. A wash over the No. 200 sieve revealed the sandy silts have 61.3% fine particles (silts and clays). A standard penetration test performed within the sandy silts yielded a blow count (N-value) of 30 blows per ft.

Generally underlying the near-surface silty sands and sandy silts are dense clayey sands (SC). The clayey sands were encountered at a depth of 4 ft in Boring 1 and 2 ft in Boring 2 and extended to a depth of 8 ft in Boring 1 and 4 ft in Boring 2. The moisture content of the clayey sands ranges from 4% to 11%. Washes over the No. 200 sieve revealed the clayey sands have between 45.6% and 49.0% fine particles (silts and clays). Unconfined compression tests performed on selected clayey sand samples yielded undrained shear strengths that range from 3,780 lbs per sq ft to 6,630 lbs per sq ft with corresponding dry unit weights of 112 lbs per cu ft to 118 lbs per cu ft.

Hard silty clays (CL) were encountered in Boring 2 from a depth of 4 ft to 8 ft. The moisture content of the silty clays is about 16%. Unconfined compression tests performed on two selected silty clay samples yielded undrained shear strengths of 6,310 lbs per sq ft and 8,460 lbs per sq ft with corresponding dry unit weights of 109 lbs per cu ft and 111 lbs per cu ft.

Very stiff to hard sandy clays (CL) were encountered at a depth of 8 ft in both borings and extended to a depth of 12 ft. The moisture content of the sandy clays ranges from 16% to 18%. Washes over the No. 200 sieve revealed the sandy clays have between 66.4% and 69.4% fine particles (silts and clays). Unconfined compression tests performed on two selected sandy clay samples yielded undrained shear strengths of 2,530 lbs per sq ft and 4,060 lbs per sq ft with corresponding dry unit weights of 110 lbs per cu ft and 109 lbs per cu ft.

Stiff to very stiff clays (CH) were encountered at a depth of 12 ft and extended to the 20-ft terminal depth of both borings. The moisture content of the clays ranges from 37% to 42%. Unconfined compression tests performed on selected clay samples yielded undrained shear strengths that range from 1,190 lbs per sq ft to 2,630 lbs per sq ft with corresponding dry unit weights of 80 lbs per cu ft to 85 lbs per cu ft.

4.2 Groundwater Conditions

Groundwater conditions at the project site were determined by observing water levels upon completion of the borings. No free water was observed in either boring after 15 minutes. Notes pertaining to groundwater level observations are presented on each 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 borings performed for this investigation indicate dense silty sands, clayey sands and sandy silts, hard silty clays, and very stiff to hard sandy clays were encountered within the bearing zone of a shallow foundation. Based on this information, it is our opinion that the structure could be founded on a shallow foundation designed for an allowable net soil bearing pressure of 4,000 lbs per sq ft. Our recommendations related to design and construction of the foundation elements are discussed in the following paragraphs.

5.1 Site Preparation

Objectionable Materials. Site preparation for this project should include, as a minimum, the removal of any objectionable materials at or near the existing ground surface. Objectionable materials that should be removed include organic matter, topsoil, debris, rubble, trees, stumps and roots. After removal of objectionable materials, any areas that will receive structural concrete or fill materials should be proof-rolled. Proof-rolling should be conducted with two passes by a fully-loaded dump truck or other suitable vehicle approved by the Engineer. After proof-rolling, any areas that are soft or "pump" should be overexcavated and replaced with compacted select fill.

Pumping Soils. The near-surface soils at this project site are silty. Silty soils are sensitive to increases in moisture content and have a tendency to lose strength as the moisture content increases or as construction vehicles pass over the area. Such materials, if wet, are subject to pumping when being compacted. Soils that are stable during proof-rolling and compaction could become unstable from exposure to inclement weather, groundwater level fluctuations and/or construction vehicles. Therefore, the Contractor should be cautioned to provide adequate drainage both during and after earthwork activities and to minimize construction traffic.

Should the earthwork occur during extended rainy periods, it may be difficult to establish a stable working platform so that fill materials or structural concrete could be placed. Should this situation occur, we suggest that the wet materials be overexcavated to a minimum depth of 2 ft below the bottom of the foundation and a layer of geotextile fabric be placed over the soft and pumping area. The geotextile fabric should conform to Mirafi 600X or equal material. An 18-in. layer of sand having 15% or less passing the No. 200 sieve should be placed over the fabric by backdumping. The sand should be spread and compacted to at least 70% relative density (ASTM D 4254). Select fill materials could then be placed to bring the project site to the desired finish subgrade elevation.

Select Fill Materials. The select fill materials used for this project should consist of a soil having a liquid limit of not more than 45% and a plasticity index of 25 or less. Select fill used for this project should be compacted from horizontally-placed loose lifts not exceeding 9 in. in thickness to a density which is equal to at least 95% standard Proctor density (ASTM D 698). Field density tests should be completed in each lift of the select fill materials to provide some assurance that adequate and uniform densities are being obtained before proceeding with subsequent lifts. Any subgrade soils that are disturbed from clearing activities should also be recompacted and tested prior to placement of select fill. The field density tests should be completed by a competent geotechnical engineering firm retained by the Owner. The surface of each lift should be scarified prior to placement of subsequent lifts.

Excavations. All foundation excavations should be inspected prior to concrete placement. Any foundation soils that have become soft or saturated should be overexcavated and replaced with compacted select fill materials. These select fill materials should be compacted to at least 95% of the maximum unit dry weight as determined by standard Proctor procedures (ASTM D 698). Finish grades around the proposed buildings should be established to promote quick run-off of rainwater away from the foundations in all directions.

5.2 Shallow Foundation

The near-surface dense silty sands, clayey sands and sandy silts, hard silty clays, and very stiff to hard sandy clays appear to be desiccated (dehydrated) primarily from the root systems of the existing trees. After several trees along with other organic matter, topsoil, etc. are removed during construction, the near-surface soils will be exposed to weather conditions and would potentially rehydrate. Although the near-surface soils are considered to be slightly to non-expansive, rehydration could cause some volumetric changes in the soils. Therefore, the concrete masonry columns elevating the structure should be supported on a shallow foundation stiffened with grade beams to provide rigidity to mitigate potential differential movements between columns. The columns should not be supported on isolated spread footings.

For a rigid foundation, we recommend a monolithic slab and grade beam system. The exterior grade beams should extend at least 2 ft below finish grade. Interior ribs should be used to stiffen the floor slab and should be located beneath load-bearing columns or spaced on not more than 20-ft centers in both directions. These ribs should extend at least 18 in. below the bottom of the floor slab and, together with the exterior grade beams, should be reinforced for both positive and negative bending. The exterior grade beams and interior ribs bearing in natural soils could be dimensioned based on an allowable net soil bearing pressure of 4,000 lbs per sq ft with a minimum bearing width of 16 in. Should the foundation be supported on more than 1 ft of compacted select fill materials, the allowable net soil bearing pressure should be reduced to 2,500 lbs per sq ft. The allowable net soil bearing pressure should not be exceeded for any maximum combination of dead, live or wind loads.

The floor slab should be reinforced and could be designed based on a soil modulus, k, of 150 lbs per cu in. Column, wall or concentrated loads could be supported satisfactorily by means of thickened monolithic portions of the slab in accordance with design procedures of the American Concrete Institute (ACI). Design of the thickened sections should be based on the design criteria of the above-mentioned exterior grade beams.

Further, we forewarn the risk of constructing a shallow foundation in close proximity to trees. The root systems of trees could potentially cause isolated volumetric changes under the foundation from moisture absorption in the soils and potential root growth. The root system generally extends beyond the drip line of the tree.

6.0 REPORT LIMITATIONS

The borings made for this report were located in the field by measurements from existing features shown on your plot plan. The locations of the borings should therefore be considered accurate only to the degree implied by the methods used in its determination. 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 levels as they were 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 seasonal fluctuations in the groundwater level can occur due to variations in rainfall, temperature and other factors.

Unanticipated soil conditions at a construction site are commonly encountered and cannot be fully predicted by mere soil samples and test borings. Such unexpected conditions frequently require that additional expenditures be made by the owner to attain a properly designed and constructed project. Therefore, provisions for some construction contingency funds are recommended to accommodate such potential extra cost.

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, or appear to be present during earthwork activities, 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 structure location is 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 the foundation 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 placement and compaction of soils, placement of concrete and such other field observations.

This report has been prepared for the exclusive use of Mr. and Mrs. John Reis for design and construction of their proposed residence located at 258 Jackson Avenue Drive in Mandeville, 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.

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BORING NUMBER 1

PAGE 1 OF 1

CLIENT Mr. and Mrs. John Reis
PROJECT NAME Reis Residence
PROJECT NUMBER 9517.01
PROJECT LOCATION Mandeville, Louisiana
DATE STARTED 11/17/16 **COMPLETED** 11/17/16
GROUND ELEVATION ____ **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Triangle Resources, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Machine Auger
AT TIME OF DRILLING ---
LOGGED BY H. Nguyen **CHECKED BY** G. Gillen
AT END OF DRILLING --- no free water after 15 minutes
NOTES Boring backfilled with soil cuttings
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	FIELD TEST RESULTS (N-value)	% FINES	COHESION (ksf)	MOISTURE CONTENT %	DRY UNIT WT. (pcf)	PLASTICITY INDEX
0	Dense tan silty sand (SM)	14-21-25 (46)	40.4		10		
	- brown with clay below 2'		52.6		10		
5	Dense brown clayey sand (SC)		45.6	3.78	4	112	
	- tan below 6'		49.0	5.36	11	118	
10	Hard gray sandy clay (CL)		69.4	4.06	16	109	
15	Very stiff gray clay (CH)			2.63	37	85	
20	- stiff below 17'			1.30	39	80	

Bottom of borehole at 20.0 feet.

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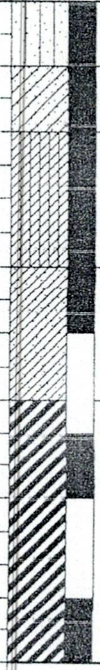
BORING NUMBER 2

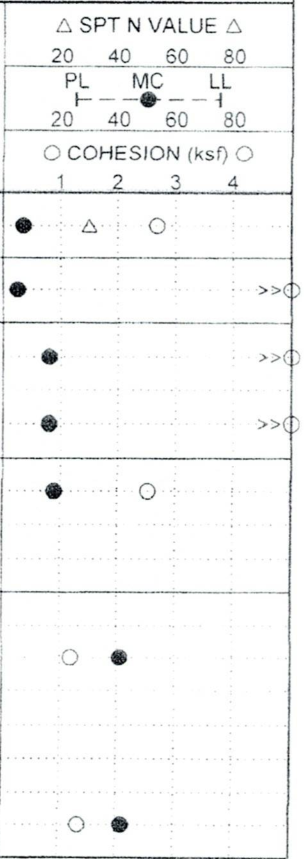
PAGE 1 OF 1

CLIENT Mr. and Mrs. John Reis
PROJECT NUMBER 9517.01
DATE STARTED 11/17/16 **COMPLETED** 11/17/16
DRILLING CONTRACTOR Triangle Resources, Inc.
DRILLING METHOD Machine Auger
LOGGED BY H. Nguyen **CHECKED BY** G. Gillen
NOTES Boring backfilled with soil cuttings

PROJECT NAME Reis Residence
PROJECT LOCATION Mandeville, Louisiana
GROUND ELEVATION ____ **HOLE SIZE** 4 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AT END OF DRILLING --- no free water after 15 minutes
AFTER DRILLING ---



DEPTH (ft)	MATERIAL DESCRIPTION	FIELD TEST RESULTS (N-value)	% FINES	COHESION (ksf)	MOISTURE CONTENT %	DRY UNIT WT. (pcf)	PLASTICITY INDEX
0	Dense tan sandy silt (ML) - with clay	7-15-15 (30)	61.3	2.68	7	101	
	Dense tan clayey sand (SC)		46.1	6.63	5	115	
5	Hard gray silty clay (CL)		71.0	8.46	16	111	
			70.6	6.31	16	109	
10	Very stiff gray sandy clay (CL)		66.4	2.53	18	110	
	Stiff gray clay (CH)						
15				1.19	41	82	
20				1.35	42	80	



Bottom of borehole at 20.0 feet.

25
30
35
40

SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS