STRATUM ENGINEERING, LLC
Geotechnical Engineering ♦ Testing and Inspection Services

September 16, 2015

New Millennium Construction, LLC
3173 Terrace Avenue East
Slidell, Louisiana 70458
Phone: (985) 649-7381

Attn: Mr. David Kaufmann

Re: Geotechnical Engineering Report
Proposed Clement Residence
3 Jennifer Lane
Slidell, Louisiana
SE Project No. G15-072

Dear David:

Stratum Engineering, LLC (SE) is pleased to submit our Geotechnical Engineering Report for the above referenced project. This report includes the results of our field exploration and laboratory testing, and recommendations for foundation design as well as general site development.

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
STRATUM ENGINEERING, LLC

William "Dean" McInnis, P.E.
Project Manager

Tony Y. Maroun, P.E.
Principal

STATE OF LOUISIANA
TONY Y. MAROUN
License No. 26198
PROFESSIONAL ENGINEER
CIVIL ENGINEERING

9/16/15

WDM/TYM:nsv

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EXECUTIVE SUMMARY

An exploration and evaluation of the subsurface conditions have been completed for the proposed Clement Residence to be constructed at 3 Jennifer Lane in Slidell, Louisiana.

The site encompasses about 1.3 acres of land designated as lots 23A and 23B adjacent to Bayou Bonfouca in Slidell. The property is mainly vacant with the exception of a boat slip and a small covered area near the Palms Inlet. The site is currently covered with short surface vegetation and a few sparse trees, but was formerly occupied by a residential structure which was destroyed during Hurricane Katrina and subsequently removed from the property. The site proximity to Bayou Bonfouca makes it susceptible to flooding due to storm surge thus requiring the structure to be elevated about 10 feet above the surface. Detailed grading information was unavailable at the time of this report; however, we understand that about six (6) feet of fill will be needed to achieve the ground floor design grade.

The project includes the construction of a two-story elevated residence having a footprint of approximately 3,500 square feet with a ground floor slab to be used for parking. The building will be elevated above the existing grade using concrete masonry unit (CMU) columns. Detailed structural loading information was not available at the time of the report; however, it was assumed that maximum column loads will be on the order of 25 kips.

A total of two (2) borings were drilled to a depth of 20 and 50 feet below the existing ground surface in the building area. Based on the borings, the site is generally covered with about six (6) to 8 inches of silty sandy topsoil with organics. The topsoil was followed by loose silty sand to a depth of 2 feet. The sand was followed by alternating layers of firm to stiff lean clay and lean clay with sand extending to around 27 feet. Loose to medium dense sand was encountered below the clays extending to a depth of at least 50 feet, the maximum depth explored. Groundwater was encountered at an approximate depth of about 11 ½ feet during the drilling operations.

The results of the exploration indicate that the near surface soils present at the site are fair in bearing quality. However, these soils could experience some settlement with the addition of the required fill as well as the building structural loads. Provided some settlement, on the order of 1 ½ inch can be tolerated, the structure may be supported on a shallow foundation system. Spread footings and continuous footings, bearing at least three (3) feet below the finished grades on compacted structural fill, could be designed for maximum allowable bearing pressures of 2,500 and 2,000 psf, respectively, based on dead loads and design live loads. However, considering the area is susceptible to frequent flooding, a shallow foundation system could become inundated with flood water that would soften the bearing soil and could cause some settlements that may not be tolerated by the structure. Consequently, a pile foundation system consisting of small treated timber piles was also evaluated for support of the proposed residential structure.

The owner/designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations in preparation of design/construction documents.

PROJECT INFORMATION

Project Authorization

Stratum Engineering, LLC (SE) has completed a geotechnical exploration for the proposed Clement Residence to be constructed in Slidell, Louisiana. The exploration was accomplished in general accordance with SE Proposal No. G15-133, dated August 18, 2015.

Project Description

The project includes the construction of a two-story residence which will be elevated above the existing grades using concrete masonry unit (CMU) columns. The residence will have a footprint of approximately 3,500 square feet. Detailed structural loading information was unavailable at the time of the report; however, a maximum column load on the order of 25 kips is anticipated for the structure.

The geotechnical recommendations presented in this report are based on the available project information, building location, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform SE in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. SE will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to enable an evaluation of a foundation system for the proposed residential structure. Two (2) borings were drilled to a depth of 20 and 50 feet below the existing ground surface in the building area. Our scope of services included a reconnaissance of the project site, drilling the soil borings, select laboratory testing, and preparation of this geotechnical report. The report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and provides recommendations regarding the following:

- Foundation types, allowable bearing pressure, allowable pile capacity, and an estimate of settlement;
- Seismic site classification;
- Site preparation, including subgrade preparation and fill compaction requirements;
- Factors influencing construction and performance of the proposed development.

The scope of geotechnical services did not include an environmental assessment for determining the presence or absence of wetlands; or hazardous or toxic materials in the soil, surface water, groundwater, or air on or below, or around this site. Any statements in this report, or on the boring logs, regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The site of the proposed residential structure is located on two (2) lots designated as 23A and 23B immediately adjacent to Bayou Bonfouca at 3 Jennifer Lane in Slidell, Louisiana. The property is currently vacant and covered with short surface vegetation and a few sparse trees, but was formerly occupied by a residential structure which was destroyed during Hurricane Katrina and subsequently removed from the property. Due to the site proximity to Bayou Bonfouca, it is susceptible to flooding due to storm surge, thus requiring the structure to be elevated about 10 feet above the surface. Although grading information was not available at the time the report was prepared, based on conversations with Dammon Engineering, we understand that about six (6) feet of fill will be needed to achieve the ground floor design grade.

Drilling, Sampling, and Laboratory Testing Procedures

The borings were drilled with an All Terrain Vehicle (ATV) mounted drill rig. Auger and wet rotary drilling techniques were used to advance the borings. Samples were generally obtained continuously from the ground surface to a depth of ten feet and at a maximum of five foot intervals thereafter. Drilling and sampling techniques were accomplished in general accordance with ASTM Standards.

Undisturbed samples of cohesive soils were generally obtained using thin-wall tube sampling procedures in general accordance with the procedures for “Thin-Walled Tube Geotechnical Sampling of Soils” (ASTM D1587). These samples were extruded in the field with a hydraulic ram and were wrapped in aluminum foil prior to placement in a plastic wrapping to preserve moisture. The samples were transported to the laboratory in containers to prevent disturbance.

For cohesionless soils and semi-cohesive soils, Standard Penetration Tests (SPT) were performed to obtain standard penetration values of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling 30 inches, required to advance the split-barrel sampler one (1) foot into the soil. Samples of granular soils were obtained utilizing a two (2) inch O.D. split-barrel sampler in general accordance with procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D1586). To perform the test and obtain a sample, the sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration test indicate the relative density of cohesionless soils and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components. The split spoon samples were identified according to the project number, boring number and depth, and were also placed in polyethylene plastic wrapping to protect against moisture loss.

The laboratory testing program included supplementary visual classification and water content tests on all of the soil samples. In addition, selected samples were subjected to percent passing the #200 sieve and Atterberg Limits determination. Additional estimates of unconfined compressive strength were made using a hand penetrometer. The laboratory testing was performed in general accordance with ASTM Standard Procedures.

Subsurface Conditions

Based on the borings, the site is generally covered with about six (6) to 8 inches of silty sandy topsoil with organics. The topsoil was followed by loose gray silty sand to a depth of 2 feet. The sand was followed by alternating layers of firm to stiff tannish gray lean clay and lean clay with sand extending to around 27 feet. The clay was underlain by loose gray clayey sand to 32 feet and was followed by loose to medium dense gray silty sand to a depth of 47 feet. The deep boring was terminated in medium dense gray poorly graded sand at a depth of 50 feet, the maximum depth explored.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at the boring locations. The record includes soil descriptions, stratification, penetration resistances, laboratory test data and locations of the samples. The stratification shown on the boring logs represents the conditions only at the actual boring locations. Variations may occur and should be expected across the site. The stratification represents the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on the boring logs. The samples, which were not altered by laboratory testing, will be retained for 60 days from the date of this report and then will be discarded.

Groundwater Conditions

Groundwater was encountered at approximately 11 ½ feet in the borings during drilling. However, it should be noted that groundwater level will fluctuate with tidal changes in the nearby Bayou Bonfouca, seasonal variations in rainfall, as well as extended periods of drought or surface runoff. Perched water may be encountered between the interface of the granular soils and the underlying natural low permeability cohesive soils. Therefore, it is recommended that the actual groundwater level at the site be determined by the contractor at the time of the construction activities.

IBC Site Classification

The International Building Code (IBC), 2012 edition, was reviewed to determine the site classification for seismic design. Based on the soils encountered in the borings and our experience in the general vicinity, the site can be classified as Site Class “D”, as outlined in Section 1613.3.2 of the Building Code.

EVALUATION AND RECOMMENDATIONS

General

The type and depth of foundation suitable for a given structure primarily depends on several factors including the subsurface conditions, the function of the structure, the loads it may carry, the cost of the foundation and the criteria set by the Design Engineer with respect to vertical and differential movement which the structure can withstand without damage.

Although the results of the exploration indicate that the near surface soils present at the site are fair in bearing quality, these soils could experience some settlement with the addition of six (6) feet of fill as well as the building structural loads. Provided some settlement can be tolerated, the structure may be supported on a shallow foundation system. Furthermore, since the Palm Lake area is susceptible to flooding during tropical weather events, a shallow foundation system could become inundated with flood water causing an intolerable amount of settlement. Consequently, an alternate pile foundation system consisting of small treated timber piles was also evaluated for support of the proposed residential structure. Details related to site development, foundation designs, as well as construction considerations are included in subsequent sections of this report.

Site Preparation

Site preparation is expected to include, but not be limited to, demolishing and removing any existing foundation elements and trees, as well as stripping any topsoil and unsuitable material from the development area. Existing utilities should be located and re-routed as necessary. Based on the borings, 6 to 8 inches of topsoil was encountered at the boring locations. However, the actual stripping depth should be determined by a representative of the Geotechnical Engineer at the time of construction.

Consideration should be given to the presence of any existing foundations and their effect on the proposed construction. Based on conversations with Mr. David Kaufmann, we understand that the previous structure was destroyed by Hurricane Katrina and was subsequently removed from the property. Based on the type of residences constructed in the area, the previous residence was likely supported on shallow foundations. Therefore, a review of the foundation elements from the previous structures should be made to confirm that they have been removed in order to avoid a conflict with the new foundation. If such a conflict exists, the remaining shallow foundations should be removed and the excavations backfilled with compacted structural fill.

The exposed subgrade in the building area should be proofrolled with a tandem axle dump truck or a similar heavily loaded rubber tired vehicle. Soils, which are observed to rut or deflect excessively under the moving load, should be undercut and replaced with properly compacted structural fill. The proofrolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

After the subgrade preparation and observation have been completed, the structural fill should be placed in a relatively uniform horizontal lift and should be adequately keyed into the stripped and scarified soils. The structural fill may consist of sandy clay, silty sand or clayey sand. The fill should have a maximum liquid limit of 40 and a maximum plasticity index of 18 percent.

The structural fill should be placed in maximum lifts of eight (8) inches of loose material and should be compacted within the range of one (1) percentage point below to three (3) percentage points above the optimum moisture content value. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. The fill should be compacted to at least 95 percent of the Standard Proctor maximum dry density as determined by ASTM D698 Standard Procedure. Adequate drainage should be provided prior and during site work. The site should be graded to promote rapid runoff. Each lift of compacted structural fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. In-place density measurements should be taken to assure that the above degree of compaction is achieved.

Shallow Foundations

Provided the site is prepared as recommended in the report, the proposed residence may be supported on a shallow foundation system. Spread and continuous footings bearing at least three (3) feet below the finished grade on compacted structural fill may be designed for maximum allowable bearing pressures of 2,500 and 2,000 psf, respectively. Minimum dimensions of twenty-four (24) inches for column footings and eighteen (18) inches for continuous footings should be used in foundation design to minimize the possibility of a localized bearing failure. The above bearing capacities include a design factor of safety of three (3).

The uplift resistance of shallow spread footings formed in open excavations should be limited to the weight of the foundation concrete and the soil above it. For preliminary design purposes, the uplift resistance can be computed by using a total unit weight of 115 pcf for the structural fill placed and compacted above the footing and the unit weight of 150 pcf for the concrete. Concrete reinforcing steel should be properly sized to resist uplift forces. We recommend that a factor of safety of at least 1.5 be used when determining the allowable uplift resistance of spread footings.

Soil resistance to horizontal forces is developed by lateral earth pressures acting on the face of the footing and by friction or adhesion on the footing base. We recommend that the allowable passive pressure be computed for spread footings below grade using the following equation:

$$P_p = 2000 + 120H \text{ (Clay)}$$

$$P_p = 350H \text{ (Sand)}$$

where P_p is the lateral soil resistance in psf (pounds per square foot) and H is the depth in feet. For exterior footings, H is measured from one (1) foot below adjacent finished grade, provided that the adjacent finished grade extends level and at least beyond a point that makes a 45-degree angle from the bottom of the exterior footing to the finished ground surface.

The top foot of passive resistance at foundations should be neglected unless the ground surface around the footing is covered by concrete or pavement. The resistance to sliding of spread footings bearing in structural fill can be computed by multiplying the footing base contact area by a sliding friction factor of 0.38. Spread footings should also be sized to resist overturning due to moment forces.

The foundation excavations should be observed by a representative of SE prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of firm soils or adequately compacted fill as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted structural fill or graded crushed stone, as determined by the Geotechnical Engineer.

Footing excavations should be observed and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond prior to or after concrete placement. The foundation concrete should be placed during the same day the excavation is made. If it is required that footing excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

Foundation Settlement

Post construction settlement of a spread footing bearing in the fill and designed for the recommended bearing pressure is estimated to be on the order of 1 inch. Differential settlements could be 50 percent of the total settlement.

Fill Settlement

Analyses were made to estimate the settlement under a loaded area roughly about 68 feet by 58 feet. Based on a uniform loading caused by an average of six (6) feet of fill, equivalent to about 720 psf, long term consolidation settlement at the center of the filled area was estimated to be about one (1) to 1 ½ inches. These estimates do not take into account settlement of the fill due to poor compaction.

Floor Slab

We understand the soil supported ground floor slab used for parking under the proposed elevated structure will bear on six (6) feet of compacted structural fill. Placement of the new fill and preparation of the subgrade should be performed in accordance with the Site Preparation section of the report to identify any soft or unstable soils which should be removed from the floor slab area prior to additional fill placement and/or floor slab construction. The floor slab should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

Alternate Pile Foundation

Analyses were made based on the field data and laboratory test results with regard to a pile foundation for support of the proposed residential structure. Consideration was given to small treated timber piles to support the proposed residence.

The driven piles at this site will generally derive their support through "skin friction" along their embedded lengths and some end bearing when embedded in the medium sand encountered at a depth of about 38 feet. The small timber piles should have minimum tip and butt diameters of 6 and 8 inches, respectively. They should conform to ASTM D25 and the American Wood Preservers Association (AWPA) Standards for quality and treatment, respectively.

The recommended pile length and corresponding capacities are from the existing ground surface at the time of drilling. Therefore, the pile length should be adjusted to account for the fill that will be placed to raise the site grades. The recommended pile length and the estimated corresponding allowable capacities are presented in the following table:

Estimated Allowable Single Pile Load Capacity in Tons* F.S. = 2.0 in Compression F.S. = 3.0 in Tension		
Pile Penetration in feet	**Small Treated Timber Pile (6” Tip – 8” Butt)**	
	Compression	**Tension**
±30	8+	5

*** Capacities are soil pile related capacities and consideration should be given to the structural integrity of the pile member.**

The recommended capacities are soil/pile related capacities and the final design capacity should be governed by the building code for the type of pile used. The estimated pile capacities include a factor safety of two (2) in compression and three (3) in tension. Provided the piles are tipped in the sand, drag loads at this site should be insignificant.

Pile Settlement

It is estimated that long term settlement of piles loaded to their allowable capacities will be on the order of one (1) inch. Stratum Engineering should be contacted to evaluate the effect of drag loads imparted on the pile if more than the anticipated amount of fill is added in the building area. Differential settlement is expected to be on the order of 50 percent of the total settlement.

Spacing and Group Effect

A group of piles subjected to vertical loads may not necessarily have the same capacity as the sum of the capacities of the individual piles. For axially loaded piles, published results indicate that the ratio of capacity per pile in a group to that of a single isolated pile typically ranges from 0.5 to 1.0. This efficiency factor depends on the spacing or distance between each pile. In planning groups of driven piles, a minimum center-to-center spacing of 3D (where D is the pile diameter) is recommended to avoid the reduction in capacity and maximize the pile group efficiency.

Pile Installation

Pile driving hammers used to drive foundation piles should be selected according to pile type, length, size and weight of pile, as well as potential vibrations resulting from pile driving operations. Care should be taken to assure that the hammer selected is capable of achieving the desired penetration without causing damage to the piles or causing excessive vibrations which could damage existing, nearby structures.

Hammers having a rated energy in the range of 7,000 to 10,000 foot-pounds per blow are recommended for the small timber piles. Each pile should be driven to the desired tip elevation and the driving resistance should be monitored without interruption in the driving operations.

Driving of the center piles in the cluster first will better facilitate the driving operations. Accurate records of the final tip elevation and driving resistances should be obtained during the pile driving operations. Some pile heaving may be experienced during installation of adjacent displacement type piles. It is therefore recommended that the tip elevation of the piles be recorded and if significant heave is noted after driving of subsequent piles, provisions must be made for reseating them.

Pile Driving Monitoring

We recommend that the pile driving be monitored by the Geotechnical Engineer or his representative. Sometimes, premature refusal occurs due to poor performance of the hammer rather than from soil resistance. Any changes in hammer blow counts should be carefully examined before making any decisions about the pile penetration.

Pile Load Test

It is recommended that the pile capacity be verified by a field load test. At least one (1) pile of the type of pile used should be driven to the design tip elevation within the building footprint using the same equipment and technique proposed for the job piles. The pile should be load tested to failure in accordance with ASTM D1143 Standard Procedure. The pile load test should be performed under the guidance of the Geotechnical Engineer so that the data may be interpreted and the recommended pile capacity adjusted, if necessary, according to the load test results.

Vibration Monitoring

Thresholds of vibration induced cracking are generally site specific and depend on the type and age of the structure, the frequency of ground vibration, and the type of soil supporting the structure. Research by the U.S. Bureau of Mines (USBM) and other investigative groups have established criteria relating the occurrence of structural damage to certain frequencies and level of ground motion. According to the USBM, within the range of four (4) to 12 hertz, the maximum particle velocity recommended to preclude the threshold damage to plaster-on-wood old structures is 0.5 inch per second (ips).

Peak particle velocities of 0.25 ips are perceived to be uncomfortable to humans. Furthermore, peak particle velocities in excess of 0.25 ips could densify near surface cohesionless soils resulting in cosmetic cracks in structures supported on these soils. Therefore, if sustained peak particle velocities exceed 0.25 ips, the construction activities causing these vibration levels should be halted and the construction procedures altered to maintain a safe level of vibration and minimize potential damage to any nearby structures.

CONSTRUCTION CONSIDERATIONS

It is recommended that SE be retained to provide observation and testing of construction activities involved in the foundations and related activities of this project. SE cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the foundations, if not engaged to also provide construction observation and testing for this project.

Moisture Sensitive Soils/Weather Related Concerns

The upper soils encountered at this site are extremely sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, an increase in the moisture content of the soil can cause significant reductions in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Drainage and Groundwater Concerns

Water should not be allowed to collect in the foundation excavations, floor slab area, or on the prepared subgrade in the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water around the structure.

Groundwater was encountered at 11 ½ feet in the building borings during drilling. However, it is possible that groundwater may be encountered at different depths at other times of the year. Additionally, perched water may be encountered in discontinuous zones within the overburden soils. Any water accumulation, which should be expected in the pool area, should be removed from the excavations by pumping. If excessive and uncontrolled amounts of seepage occur, the Geotechnical Engineer should be consulted.

Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, Part 1928, Subpart P”. This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. SE does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

REPORT LIMITATIONS

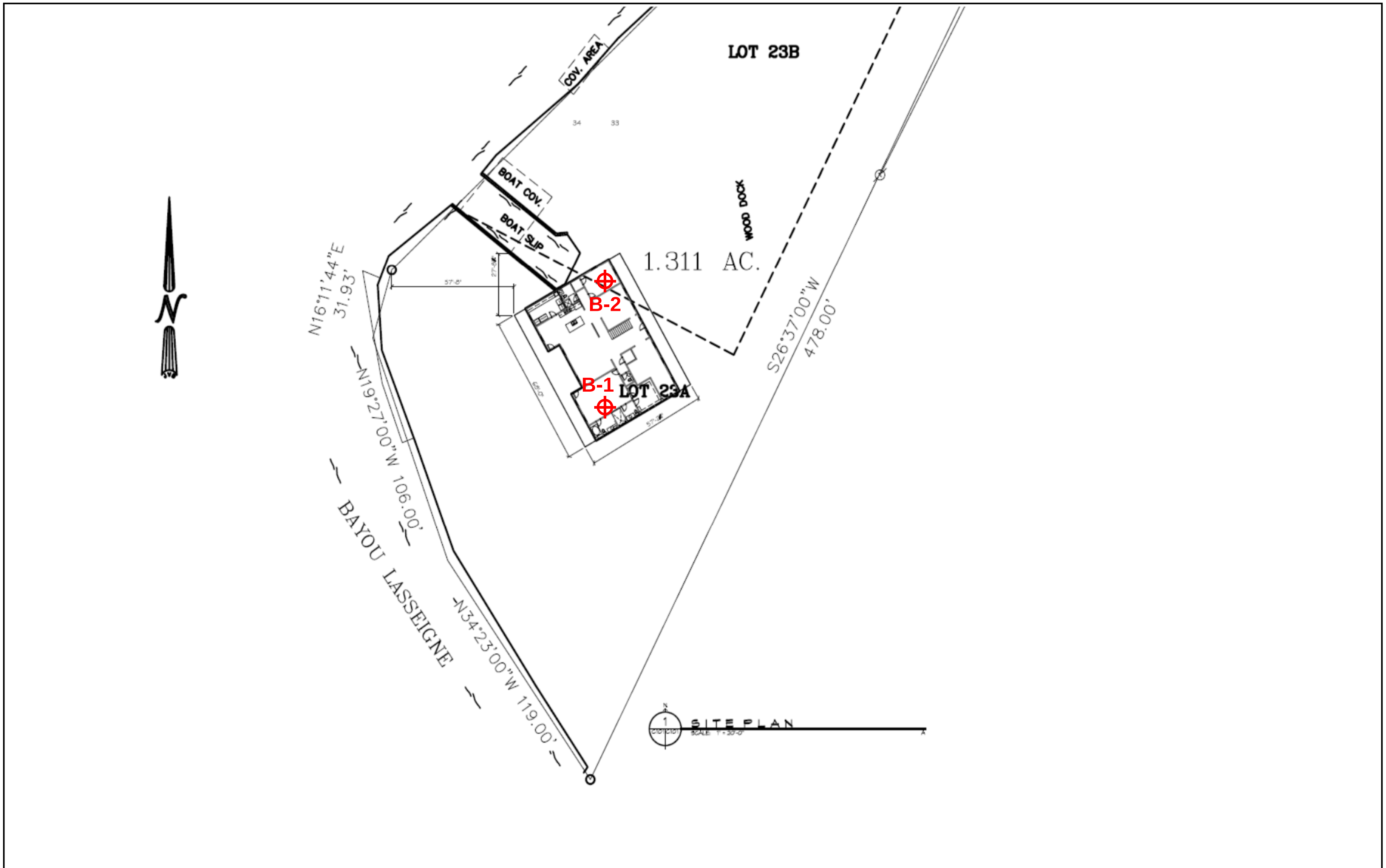
The recommendations submitted in this report are based on the available subsurface information obtained by SE and design details furnished by Dammon Engineering and New Millennium Construction, LLC. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, SE should be notified immediately to determine if changes in the foundation recommendations are required. If SE is not notified of such changes, SE will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated in to the design documents. At that time, it may be necessary to submit supplementary recommendations. If SE is not retained to perform these functions, SE will not be responsible for the impact of those conditions on the project. This report has been prepared for the exclusive use of New Millennium Construction, LLC for the specific application to the proposed Clement Residence to be constructed in Slidell, Louisiana.

APPENDIX

STRATUM ENGINEERING, LLC



⌖ = BORING LOCATION

STRATUM ENGINEERING, LLC

BORING LOCATION PLAN

GEOTECHNICAL ENGINEERING SERVICES
PROPOSED CLEMENT RESIDENCE
3 JENNIFER LANE
SLIDELL, LOUISIANA

LOG OF BORING B-1

STRATUM ENGINEERING, LLC

PROPOSED CLEMENT RESIDENCE
3 JENNIFER LANE
SLIDELL, LOUISIANA

TYPE OF BORING: WET ROTARY **LOCATION:** BUILDING AREA **PROJECT NO.:** G15-072

DEPTH, FT.	DESCRIPTION	N-BLOWS/FT.	UNCONFINED COMPRESSIVE STRENGTH tsf	HAND PENTROMETER tsf	TORVANE tsf	UNIT DRY WEIGHT pcf	MOISTURE CONTENT %	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE
	6" Silty Sandy Topsoil with Organics	5					12			
	Loose gray Silty Sand									
	Firm to stiff tannish gray Lean Clay with sand		0.52	0.75		113	20	27	10	79
5				1.50			21			
	-stiff to very stiff at 6'		1.99	2.00		110	22			
	Stiff tannish gray Lean Clay			1.25			28			
10										
			1.17	1.25		102	25			
15										
	Stiff to very stiff tannish gray Lean Clay with sand									
				2.25			22			
20										
			1.86	2.00		110	19			
25										
	Loose gray Clayey Sand									
		5					37			
30										
	Loose gray Silty Sand									
		5					27		NP	12
35										
	-becomes medium to dense at 38'	33					25			12
40										
		26					28			
45										
	Dense gray Poorly Graded Sand									
		41					24			4
50										

DEPTH OF BORING: 50 Feet **GROUNDWATER:** Encountered at 11 ½ Feet During Drilling
DATE: 8/26/2015

STRATUM ENGINEERING, LLC

LOG OF BORING B-2

PROPOSED CLEMENT RESIDENCE
3 JENNIFER LANE
SLIDELL, LOUISIANA

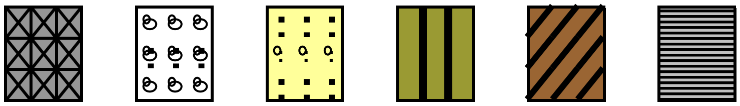
TYPE OF BORING: AUGER ROTARY **LOCATION:** BUILDING AREA **PROJECT NO.:** G15-072

DEPTH, FT.	DESCRIPTION	N-BLOWS/FT.	UNCONFINED COMPRESSIVE STRENGTH tsf	HAND PENTROMETER tsf	TORVANE tsf	UNIT DRY WEIGHT pcf	MOISTURE CONTENT %	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE
	8" Silty Sandy Topsoil with Organics Loose gray Silty Sand with trace of pea gravel	5					11		NP	13
	Very stiff tannish gray Sandy Lean Clay		2.81	3.00		118	16			
5	Stiff tannish gray Lean Clay with sand			1.25			21			
			1.23	1.50		113	20	37	21	
				1.75			25			
10	∇									
	Very stiff tannish gray Lean Clay		2.27	2.75		102	27			
15										
	-with sand layers at 18'			2.25			21			
20	Boring Terminated at 20 Feet									
25										
30										
35										
40										
45										
50										

DEPTH OF BORING: 20 Feet **GROUNDWATER:** Encountered at 11 ½ Feet During Drilling
DATE: 8/26/2015

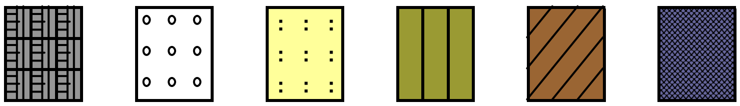
KEY TO TERMS AND SYMBOLS USED ON LOGS

SOIL TYPE



ROCK | GRAVEL | SAND | SILT | CLAY | PEAT

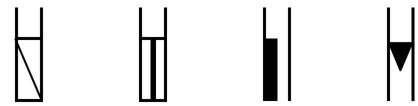
MODIFIERS



STONE | GRAVELY | SANDY | SILTY | CLAYEY | FILL

SAMPLER TYPE

NO SAMPLE | AUGER SAMPLE | SHELBY TUBE | SPLIT SPOON



NO RECOVERY | ROCK CORE | 2" SHELBY TUBE | TXDOT CONE

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487 (1980)

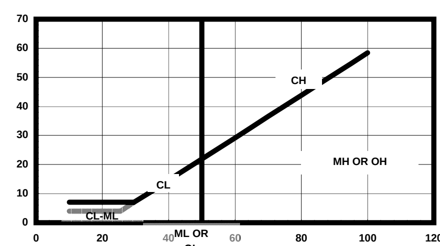
MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE	GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING NO. 4 SIEVE	CLEAN GRAVEL (LITTLE OR NO FINES	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		W/ APPRECIA BLE FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% PASSING NO. 4 SIEVE	CLEAN SANDS LITTLE FINES	SW	WELL GRADED SAND, GRAVELY SAND (LITTLE FINES)
			SP	POORLY GRADED SANDS, GRAVELY SAND (L.FINES)
		SANDS WITH APPREA. FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS,SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/ LOW PI
			CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
HIGHLY ORGANIC SOIL			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNCLASSIFIED FILL MATERIALS				ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS AND MAN-MADE SOIL MIXTURES

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	SHEAR STRENGTH IN TONS/FT^2
VERY SOFT	0. TO 0.125
SOFT	0.125 TO 0.25
FIRM	0.25 TO 0.5
STIFF	0.5 TO 1.0
VERY STIFF	1.0 TO 2.0
HARD	> 2.0 OR 2.0+

RELATIVE DENSITY - GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS/FOOT)
VERY LOOSE	0-4
LOOSE	4-9
MEDIUM DENSE	10-29
DENSE	30-49
VERY DENSE	> 50 OR 50+



ABBREVIATIONS

HP - HAND PENETROMETER
TV - TORVANE
MV - MINIATURE VANE

UC - UNCONFINED COMPRESSION TEST
UU - UNCONSOLIDATED UNDRAINED TRAIXIAL
CU - CONSOLIDATED UNDRAINED

NOTE: PLOT INDICATES SHEAR STRENGTH AS OBTAINED BY ABOVE TESTS

▼ DELAYED GROUNDWATER LVL

∇ LEVEL GROUNDWATER ENCOUNTERED

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6" | 3" | 3/4" | 4 | 10 | 40 | 200

BOUL--DERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

152 | 76.2 | 19.1 | 4.76 | 2.0 | 0.42 | 0.075 | 0.002

GRAIN SIZE IN MM