Geotechnical Testing Laboratory, Inc.

Engineering and Construction Materials Testing Services

January 23, 2015

Meyer, Meyer, LaCroix & Hixson, LLC
100 Engineer Place
Alexandria, Louisiana 71303

Attention: Mr. Jacob Dillehay, E.I.

RE: Preliminary Geotechnical Investigation Services
LED Site Certification – Town of Olla, Louisiana
Olla, LaSalle Parish, Louisiana
GTL Report No. 01-15-008

Dear Mr. Dillehay:

Geotechnical Testing Laboratory, Inc. is pleased to submit this preliminary report of subsurface exploration for the above referenced project. Included in the report are the results of the exploration and general recommendations concerning the potential design and construction of the foundations.

We appreciate the opportunity to have provided you with our geotechnical engineering services and look forward to assisting you by providing additional investigation services for individual projects during the development of the subject tract. If you have any questions concerning this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Geotechnical Testing Laboratory, Inc.

N. J. Gorsha, P.E.
Louisiana Registration No. 20082

Ken Gorsha
President

1/23/15

STATE OF LOUISIANA
N.J. GORSHA
REG. No. 20082
REGISTERED
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

Distribution: (3) Meyer, Meyer, LaCroix & Hixson, LLC

NJG/krg

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Preliminary Geotechnical Investigation Services
LED Site Certification – Town of Olla, Louisiana
Olla, LaSalle Parish, Louisiana
GTL Report No. 01-15-008

Prepared For:

Meyer, Meyer, LaCroix & Hixson, LLC
100 Engineer Place
Alexandria, Louisiana 71303

Prepared By:

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, Louisiana 71301

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LED Site Certification – Town of Olla, Louisiana
Olla, LaSalle Parish, Louisiana
GTL Report No. 01-15-008

Introduction:

This report transmits the findings of a geotechnical investigation performed for the above-referenced project. The purpose of this investigation was to define and evaluate the general subsurface conditions in the general vicinity of a planned new industrial complex. Specifically, the study was planned to determine the following:

- Subsurface stratigraphy within the limits of our exploratory borings.
- Classification, strength, and compressibility characteristics of the foundation strata.
- Suitable foundation systems and allowable soil bearing pressures.

The purpose of this report is to provide the owner, structural engineer, civil engineer, and other design team professionals with preliminary recommendations to consider for the design and construction of the proposed project. This report should not be used by the contractor in lieu of project plans and specifications.

Project Authorization:

Formal authorization to perform the work was provided by Mr. Glenn A. Turner, P.E., Vice President with Meyer, Meyer, LaCroix & Hixson, LLC (Client), by accepting our December 1, 2014 written proposal. Authorization to proceed was provided on the same day. Field procedures were conducted on January 20, 2015 and were delayed due to inclement weather and soft site conditions. To accomplish the intended purposes, a three-phase study program was conducted which included:

- a field investigation consisting of three exploratory test borings with samples obtained at selected intervals;
- a lab testing program designed to evaluate the expansive and strength characteristics of the subsurface soils; and,
- an engineering analysis of the field and laboratory test data for preliminary foundation design recommendations.

No additional analysis was requested. A brief description of the field and laboratory test procedures are provided in the Appendix.

Project Description:

The project will be the development of an industrial park site. We understand that the industrial park will consist of a number of structures varying from one (1) story to four (4) stories in height. Preliminary structural information was not available at the time this report was prepared. The proposed buildings should consist of either steel or wood framing and could be supported on either shallow foundations, or on drilled shafts bearing at depths sufficient to resist the anticipated loadings. The pavements will most likely consist of light duty pavements for passenger cars and pickup trucks and heavy duty pavements for tractor-trailer trucks.

For the purpose of this report, we have assumed that column loads could be between 25 and 150 kips, and that maximum continuous wall loads will be between one (1) and four (4) kips per linear foot. Grade changes are expected to be nominal with no more than two (2) to three (3) feet of cut or fill.

If any of this information should change significantly or be in error, it should be brought to our attention so that we may review recommendations made in this report.

Site and Subsurface Conditions:

The project site is located on the south frontage of State Highway 124 in Olla, LaSalle Parish, Louisiana. The site was noted to slope downward to the south with estimated elevation differences of approximately 20 feet. The site was vegetated with weeds and grass at the time of drilling. The drilling rig experienced moderate difficulty moving about the site due to a soft subgrade.

Subsurface Stratigraphy:

The subsurface conditions at the proposed building site were explored by drilling a total of three (3) borings to depths between approximately 20 and 60 feet. The borings were located in the field by the drilling crew as shown on the Plan of Borings included in the Appendix of this report.

The stratification of the soils encountered during field drilling operations is presented on the boring logs in the Appendix. The stratification of the subsurface materials shown on the boring logs represents the subsurface conditions encountered at the actual boring locations and variations may occur across the site. The lines of demarcation represent the approximate boundary between the soil types, but the actual transition may be gradual. The following subsurface descriptions are of a generalized nature to highlight the major stratification features. The boring logs should be reviewed for more detailed information.

In order of increasing depth, the borings generally encountered the following soil strata beneath the surface: lean clay (CL) and fat clay (CH).

Groundwater Conditions:

Groundwater seepage was not observed during advancement of the test borings and, after short time lapses, the shallow borings remained dry and un-caved. The 60 foot boring was advanced using rotary wash and a 24 hour water level reading was not included in the scope of work for this project. The subsurface water regime is subject to change with variations in climatic conditions. Future construction activities may also alter the surface and/or subsurface drainage patterns of this site. Therefore, groundwater conditions should be explored at the start of construction by others. If there is a noticeable variance from the observations reported herein, then GTL should be notified immediately to review the effect, if any, such data may have on the design recommendations. It is not possible to predict future ground water conditions based upon short-term observations.

Foundation Recommendations:

Recent area rains are probably responsible for the presence the soft, saturated surface soils. If these wet conditions exist during construction, this can cause extreme difficulty in the preparation of the building pad and pavement areas. *We recommend that the development of the site take place during warmer and drier times during the year(s)*.

The soil parameters presented below are based on single borings placed at irregular intervals across the site. The deviations noted between the boring locations indicate moderately variable subsurface conditions across the site and should not be assumed as representative of the entire site. Thus, the findings presented herein should be considered preliminary in nature and should be confirmed through further investigation prior to development of the subject parcel. Prior to developing any section of the tract, a specific subsurface investigation should be obtained and tailored to the individual project. This report should not be used in lieu of a final geotechnical investigation addressing site specific needs for the intended projects.

Detailed information on structural systems and planned grading was not available to us at the time this report was prepared. Based on the size and type of anticipated structures, as well as the findings from this investigation, a system of shallow footings with on-grade floor slabs, in conjunction with the recommended subgrade preparation is believed to be the most practical and economical means of support. However, heavier building loads could result in the use of deep foundations. The very stiff to hard soil consistencies essentially preclude driven piles. Therefore, deep foundations will be limited to discussion of drilled, underreamed and straight-sided, cast-in-place concrete shafts. Recommendations for both foundation types are discussed separately below followed by general pavement recommendations.

A Potential Vertical Rise (PVR) value of less than one (1) inch was determined for this site. One (1) inch of PVR is generally accepted as the maximum allowable value for design and construction in the geographical area. The surficial soils encountered by the borings are considered to be moderately expansive.

The surficial site soils are characterized as being relatively impermeable. During wet weather periods, the surficial soils may become saturated and unstable. If these wet conditions exist during construction, this can cause extreme difficulty in the preparation of the building pad and pavement areas. It is recommended that the plans and bid documents include a cost item and procedure for removal of wet soils, should they exist at that time, and replacement with properly moisture conditioned select fill. Over-excavation required during wet episodes could extend to depths ranging from one (1) to two (2) feet.

Shallow Foundations:

Shallow foundations may utilize individual or continuous footings bearing within the upper five (5) feet of the surficial zone. The provision of at least one (1) to two (2) feet of select fill should be anticipated to provide a suitable subgrade for the structures. Typical bearing capacity values for shallow spread footings may vary from between approximately 1,500 psf to 1,800 psf for soils with consistencies of medium dense or medium stiff. Strip footings for continuous wall loads may be estimated between 1,150 and 1,350 pounds per linear foot.

The above allowable soil bearing values should result in a total settlement of one (1) inch, with approximately ½ inch occurring differentially (between adjacent individual footings or within 10 feet of a continuous footing). Approximately half of this settlement should occur during construction. The remaining long-term settlement of ½ inch (¼ inch occurring differentially) should be tolerable. These settlement estimates are valid for footings up to five (5) feet in plan dimensions. If footings larger than five (5) feet are required, this office should be contacted to issue additional recommendations to mitigate the potential for higher settlement.

Construction of select fill as specified herein beneath the building should result in the development of a modulus of subgrade reaction (k_s) to range between 125 and 150 pounds per cubic inch based upon empirical equations that estimate the results of a plate load test. For slabs exposed to fork lift loads, the subgrade modulus may be increased to between 300 and 350 pci by placing eight (8) inches of crushed limestone base or equal below the slab.

Select Fill:

Select fill material should be free of organic or other deleterious materials, homogeneous mixture, have a maximum particle size of three (3) inches, have a liquid limit less than 40 and plasticity index between 8 and 20, and consist of silty-clayey sands (SM-SC), low plasticity sandy clays (CL), or clayey sands (SC) as defined by the Unified Soil Classification System. It appears that most of the on-site surficial soils meet the requirement for use as select fill on this project. However, the elevated moisture contents will most likely require processing to remove excess moisture prior to using it as fill. If a fine-grained material is used for fill, very close moisture content control will be required to achieve the recommended degree of compaction.

Fill should be placed in maximum lifts of eight (8) inches of loose materials and should be compacted within the range of one (1) percentage point below to three (3) percentage points above the optimum moisture content value and a minimum of 95% of the maximum density as determined by the Standard Proctor (ASTM D-698) test. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying.

Each lift of compacted soil should be tested and inspected by the soils engineer or his representative prior to placement of subsequent lifts. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 2,500 square feet of surface area per lift or a minimum of four (4) per lift for each tested area for the buildings.

Deep Foundations:

As previously discussed, consideration may be given to placing heavier structural or special equipment loads on drilled, cast-in-place concrete shafts. Shafts founded within the upper 25 feet should be underreamed to resist uplift from swell pressures in the upper 10 to 15 feet of subgrade. Shafts founded at depths of 30 feet or deeper may be straight-sided. Recommendations for each type of shaft are presented separately below.

Underreamed Shafts - The underreamed shafts should have a minimum shaft diameter of 18 inches with a minimum bell-to-shaft diameter ratio of 2.0 to resist uplift forces associated with shrinking and swelling of the site soils that may be created by soil-to-shaft adhesion in the zone of expansive clays. A maximum bell diameter to shaft diameter ratio of 3.0 is also recommended.

Such shafts may be proportioned using a maximum allowable net end bearing pressure of 6,000 lbs/ft^2, plus an average unit allowable skin friction pressure of 200 lbs/ft^2 based on dead load plus live load considerations. Skin friction values for downward capacity should be ignored for the surficial five (5) feet and the bottom portion of the shaft equal to one-half the base diameter above the top of the underream.

Straight-Sided Shafts - Shafts founded at a minimum depth of 30 feet may be straight-sided. The table below presents the estimated allowable single shaft capacities for an 18 inch diameter shaft founded at depths between 30 and 50 feet below present ground surface.

Diameter of	Depth of	Allowable Single Shaft Capacity (kips)	
Shaft (inches)	Shaft (feet)	Compressive	Uplift
18	30	85	50
	35	100	60
	40	110	70
	45	125	80
	50	135	90

The factor of safety for these calculations is estimated to be 2.0. Shafts should have a minimum diameter of 18 inches even if the actual bearing pressure is less than the design value.

Depending upon the time of year that construction takes place, groundwater may be encountered in the drilled shafts. Casing for installing drilled shafts is always a possible necessity when dealing with the unknowns inherent with subsurface conditions. It is prudent for contract documents to include this option.

Walls Below Grade:

The existing site topography may result in the use of retaining walls to support the design grade differences. Walls below grade are subject to lateral pressures from soil and water. Active soils (those with plasticity sufficient to allow shrinkage and expansion, and having access to a source of varying moisture) also influence lateral earth pressures.

Stem walls should be designed for at-rest conditions, as these features will be restrained at the top and bottom. If retaining walls are used to support the exterior design grades, these walls should be designed for active conditions since the tops of these walls are free to rotate. The wall design should include adequate drainage behind the wall to preclude the build-up of hydrostatic forces. Also, surface water should be prevented from entering the free-draining backfill.

A free-draining backfill is preferable to one that is relatively impervious. The following table provides equivalent fluid pressure values for several soil types and loading cases. **Fat clay (CH) soils should not be placed and compacted for backfill.**

EQUIVALENT HYDROSTATIC PRESSURE (Pounds per Square Foot per Foot of Wall Height)				
Backfill	Unit Weight (pcf)	Active (Drained)	Passive (Drained)	At-Rest (Drained)
On-Site Lean Clays (CL)	120	80	175	95
Silty Sand (SM)	115	45	320	60
Washed, Free-Draining Concrete Sand (ASTM 33) (SW or SP)	115	35	375	55
Compacted Select Fill (SC or CL)	120	65	300	70

For walls subjected entirely to soil loading (no water in the backfill), the normal earth pressure diagram is triangular. Surcharge loads such as vehicular traffic, construction equipment, or other anticipated requirements should be added to the pressure diagram.

The ultimate shearing resistance against sliding should be based on the cohesion of the clay, which can be estimated to be approximately 750 psf. If the clay is stiff or hard, its surface should be roughened before the concrete base is placed.

Seismicity:

Based on Section 1613 of the IBC-2012, a Site Class of D has been estimated for this site due to the lack of subsurface information to a depth of 100 feet. According to the USGS website for Seismic Hazard Design Parameters, the project site has a mapped 0.2 second spectral response acceleration (S_s) of 0.176 g. The project also has a mapped 1.0 second spectral response acceleration (S_1) of 0.093. The design spectral response accelerations, S_{DS} and S_{D1}, were determined to be 0.188 g and 0.148 g, respectively. Based on Tables 1613.3.5(1) and 1613.3.5(2), the site has an assigned Seismic Design Category of B for structures classified as Risk Categories I, II, and III. For structures classified as Risk Category IV, site has an assigned Seismic Design Category of C.

OSHA Classification for Excavations:

For excavations deeper than four feet, the side slopes should conform to applicable federal, state and local regulations. The guidelines provided in the construction requirement section should be followed. A review of the boring logs and testing for the site indicates that the soils should be classified as a Type B Soil contingent on monitoring of the excavation to confirm the absence of free water seeping during the time the excavation is open. For this type of excavation, a slope of 1H:1V is allowed if the excavation is 20 feet or less in depth. Federal rules require daily inspection of excavations by a competent person when workers are present.

Underground Storage Tanks

The manufacturer's recommendations should be strictly followed for tank shipment, delivery, unloading and installation of tanks and piping, and in anchoring them against potential uplift forces. As a minimum, the installation should comply with published guidelines of the American Petroleum Institute (API) and the manufacturer's instructions.

We suggest that construction equipment and stockpiled materials should be kept away from the excavation at a minimum distance equal to the excavation depth to avoid surcharging of the excavation slopes. Also, the sequence of construction should be planned so that soil support under and beside foundation elements is not jeopardized by any tank excavations.

It is critical that consideration be given to the risk of floating the tank, both during installation and the service life. Such consequences include damage to the tank system and paving, loss of product and, if a product release occurs, related environmental impacts, including surface cleanup and remediation to soil and groundwater. The tank manufacturer should be contacted regarding proper anchoring, tank-hold fill specifications, and allowable fill and loads over the tanks. Control of runoff into the excavation during backfilling and paving over the tanks is also critically important to preventing flotation.

For flotation calculations, we recommend that the unit weight of the soil above the tank be assumed to be a maximum of 100 pounds per cubic foot. Groundwater was not present in the borings, and it is anticipated that water may seep into open excavations during the construction at some locations. The excavations should be clean and free of loose soil or standing water. The tanks may continue to be susceptible to flotation even after the tank-hold is backfilled with granular materials, until it is ballasted internally by filling, and/or by external tie-down anchors.

Pavements:

In the absence of known traffic volumes, we assume that some areas of the plant will be paved for light vehicular traffic and other areas will receive heavier tractor-trailer loads. We assume that the pavements receiving light traffic could receive asphaltic concrete or Portland cement concrete surfacing. Heavier tractor-trailer traffic could use drives and parking areas surfaced with either crushed stone, asphaltic concrete or Portland cement concrete.

Information for this pavement analysis is inferred from the building borings. Our scope of services did not include extensive sampling and CBR testing of existing subgrade or potential sources of imported base material for the specific purpose of a detailed pavement analysis. Instead, we have assumed pavement related design parameters that are considered to be typical for the area soil types. It has been assumed that the constructed pavement subgrade will consist of well compacted soils. Based on experience, it is anticipated that the compacted native subgrade will yield a California Bearing Ratio (CBR) of approximately 5.0.

Cement Treatment:

A bulk sample of the anticipated subgrade was subjected to standard laboratory tests to determine its compatibility for cement treatment. The results of those tests indicate that the material is unsuitable for cement treatment. A copy of the Determination of Usable Materials for Cement Treatment is included in the Appendix of this report.

Crushed Stone Surfacing:

As previously discussed, some heavy truck areas may consist of crushed stone surfacing. The estimated material thicknesses presented herein assume that the upper eight (8) inches consist of density-approved subgrade and that the drives will receive no more than 10 heavy tractor-trailer trucks with H-20 loading per day.

Prior to placing the crushed stone surfacing, the pavement area should receive a single layer of Tensar TriAx TX160 geogrid or equal. The crushed stone materials should have a minimum compacted thickness of 12 inches and should meet the requirements for Item 1003.04(a) of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, Current Edition. The stone should be placed in loose lifts to result in a six (6) inch compacted thickness.

As an option, Recycled Portland Cement Concrete meeting the requirements for Item 1003.04(c) may be used. The stone surface should be compacted to 95 percent of the maximum density defined by the Modified Proctor (ASTM D-1557). Periodic re-shaping of the gravel surface should be anticipated. Potholes and ruts could develop within several years, depending upon the drainage of the driveway and the frequency of truck loadings. We recommend that a stockpile of the crushed stone surfacing be provided on-site for periodic maintenance of the truck drives.

Base:

Granular base should meet the requirements for Item 1003.03(b) of the LA SSFRB for crushed stone or Item 1003.03(c) for recycled Portland cement concrete. The material should be compacted to 95 percent of the maximum density defined by the Modified Proctor (ASTM D-1557).

Asphaltic Pavement Materials:

Surface or wearing course asphaltic concrete should consist of a Type 3 Wearing Course Mixture contained in Item 501 of the LA SSFRB. Field density results should be based on the Theoretical Maximum Specific Gravity in accordance with DOTD TR 327. Minimum density requirements should be 89.0 percent for parking lots and shoulders and 92.0 percent for Travel Lane Wearing, Binder and Base Courses. Placement and processes should be in strict accordance with Part V of the above referenced specifications.

Portland Cement Concrete:

Concrete compressive strength should be a minimum of 3,000 psi at 28 days. The concrete should be designed with 5 percent (± 1 percent) entrained air to improve workability and durability. The design of steel reinforcement should be in accordance with local or accepted codes.

Proper finishing of concrete pavement requires appropriate construction joints to reduce the potential for cracking. Construction joints (weakened planes) should be designed in accordance with current Portland Cement Association guidelines. These joints should be cut as soon as the concrete will support the machinery. Joints should be sealed to reduce the potential for water infiltration into pavement joints and subsequent infiltration into the supporting soils.

Optional Subbase:

Consideration could be given to using a base below concrete pavements to provide a consistently firm surface upon which to place the concrete and reduce instability. The table below presents the options to reduce the likelihood of a pumping subgrade below the pavements.

REDUCED PUMPING SUBBASES			
Recommended Thickness	**Type Material**	**LA SSFRB Designation**	**Maximum P.I.**
4.0"	Crushed Stone	Item 1003.03(b)	4
4.0"	Clean Sand	Item 1003.02(a)	N/P
6.0"	Sand-Clay-Gravel	Item 1003.04(b)	15

Granular base material should be compacted to 95 percent of the maximum density defined by the Modified Proctor (ASTM D-1557). Clean sand and sand-clay-gravel mixtures should be compacted to 95 percent of Standard Proctor density (ASTM D-698).

Traffic and Design Data:

Commercial pavement sections presented herein are based upon minimum material thickness as recommended by the Asphalt Institute and the Portland Cement Association. These sections are not based upon anticipated traffic loads as these were not available at the time this report was prepared. For the purposes of this report, we assume that the industrial traffic could consist of up to 250 repetitions of light passenger cars and pick-up trucks, 25 medium-sized delivery trucks and vans, and up to 25 heavy tractor-trailer trucks per day.

Recommended Pavement Sections:

The table below presents a summary of both rigid and flexible pavement sections for light and heavy duty applications. It should be noted that the pavement sections as presented below are minimums. If it is desired to reduce potential cracking, greater thickness of select fill and/or greater pavement section thickness could be utilized. In addition, long term pavement performance requires good drainage and performance of periodic maintenance activities.

MINIMUM PAVEMENT RECOMMENDATIONS *		
Pavement Type	**Light Duty (Parking Stalls)**	**Heavy Duty (Entries & Drives)**
Portland Cement Concrete	5.0" Portland Cement Concrete 8.0" Density Approved Subgrade or Imported Fill	7.0" Portland Cement Concrete 8.0" Density Approved Subgrade or Imported Fill
Asphalt Over Crushed Stone Base	2.0" Item 501 Type 3 Surface 6.0" Item 1003.03 (b) Base 8.0" Density Approved Subgrade or Imported Fill	3.0" Item 501 Type 3 Surface 12.0" Item 1003.03 (b) Base 8.0" Density Approved Subgrade or Imported Fill
*Materials should meet general requirements of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, and specific requirements listed herein.		

Concrete thickness at trash receptacles should be a minimum of seven (7) inches. All paving recommendations are based on stable subgrade. Subgrade areas which are unstable should be over-excavated and replaced, or otherwise rendered stable prior to proceeding with base material placement.

Geotechnical Risk:

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitutes GTL's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and GTL's experience in working with these conditions.

Limitations:

The exploration and analysis of the site conditions reported herein are considered preliminary in detail and scope and are not intended to form a basis for pavement and foundation design. The information submitted is based on the available soil information only and not on design details for the intended projects.

The findings, recommendations or professional advice contained herein have been made after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties are implied or expressed.

The scope of services did not include any environmental assessment for 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, or unusual or suspicious items or conditions are strictly for the information of the client. Prior to purchase or development of this site, an environmental assessment is advisable.

The scope of services did not include a geologic investigation to address any faults, large scale subsidence, or other macro geologic features not specifically addressed in this report or the agreement between GTL and the client.

After plans are more complete, it is recommended that the soils and foundation engineer be retained to provided a subsurface investigation tailored to meet the specific needs of the project.

This report has been prepared for the exclusive use of our client for the general application for the referenced project. GTL cannot be responsible for interpretations, opinions, or recommendations made by others based on the data contained in this report.

This report was prepared for general purposes only and should not be considered sufficient for purposes of preparing accurate plans for construction. Contractors reviewing this report are advised that the discussions and recommendations contained herein were provided exclusively to and for use by the project owner.

END OF REPORT TEXT

SEE FOLLOWING APPENDIX w/BORING LOGS & TEST RESULTS

APPENDIX

FIELD AND LABORATORY PROCEDURES
PLAN OF BORINGS
LOG OF BORINGS
LABORATORY ANALYSIS OF SOILS FOR TREATMENT WITH CEMENT
SOIL CLASSIFICATION CHART

Field And Laboratory Procedures

LED Site Certification - Town of Olla Louisiana

Olla, LaSalle Parish, Louisiana

GTL Report Number 01-15-008

I. <u>Field Operations</u>:

Subsurface conditions were evaluated by advancing three (3) intermittent sample borings on January 20, 2015 within the project area. Boring locations were selected and staked in the field by representatives of Geotechnical Testing Laboratory, Inc. An illustration of the approximate boring locations with respect to the areas investigated is provided on the attached Plan of Borings. Descriptive terms and symbols used on the logs are in accordance with the Unified Soil (USCS) Classification System. Surface elevations at the boreholes were not supplied at the time of this investigation.

A truck-mounted rotary drill rig was used to make the test borings. Each boring was rotary washed using flight auger drilling techniques. Intermittent undisturbed samples were obtained in the following manner.

Standard penetration tests were performed in accordance with ASTM D-1586 procedures. This test is conducted by recording the number of blows required for a 140-pound hammer falling 30 inches to drive a split-spoon sampler eighteen inches into the substrata. Depths at which split-spoon samples were taken are indicated by two crossed lines in the "Samples" column on the Log of Boring. The number of blows required to drive the sampler for each 6-inch increment were recorded. The penetration resistance is the number of blows required to drive the split-spoon sampler the final 12-inches of penetration. Information related to the penetration resistance is presented under the "Field Data" heading of the Log of Boring as the Standard Penetration (Blows/Foot). These samples were visually examined, logged, and packaged for transport to our laboratory.

Cohesive strata were sampled in accordance with ASTM D-1587 procedures by means of pushing a thin walled Shelby tube a distance of two feet into the substrata. Consistency of the sample was measured in the field by means of a calibrated hand penetrometer. Such values, in tons per square foot, are provided under the "Field Data" heading on the Log of Boring. Depths which these undisturbed samples were obtained are indicated by a shaded portion in the "Samples" column of the Log of Boring. All samples were prudently extruded in the field were sealed to maintain "in-situ" conditions, labeled, and packaged for transport to our laboratory.

The presence of ground water was monitored during drilling operations. Initial water seepage readings are provided under "Groundwater Information" in the right hand column of the Log of Boring. After boring completion, water levels were allowed to rise and stabilize for several minutes prior to final water readings. These readings are also found under "Groundwater Information". Soil sloughing from the walls of the boring are also recorded here as depth of cave-in.

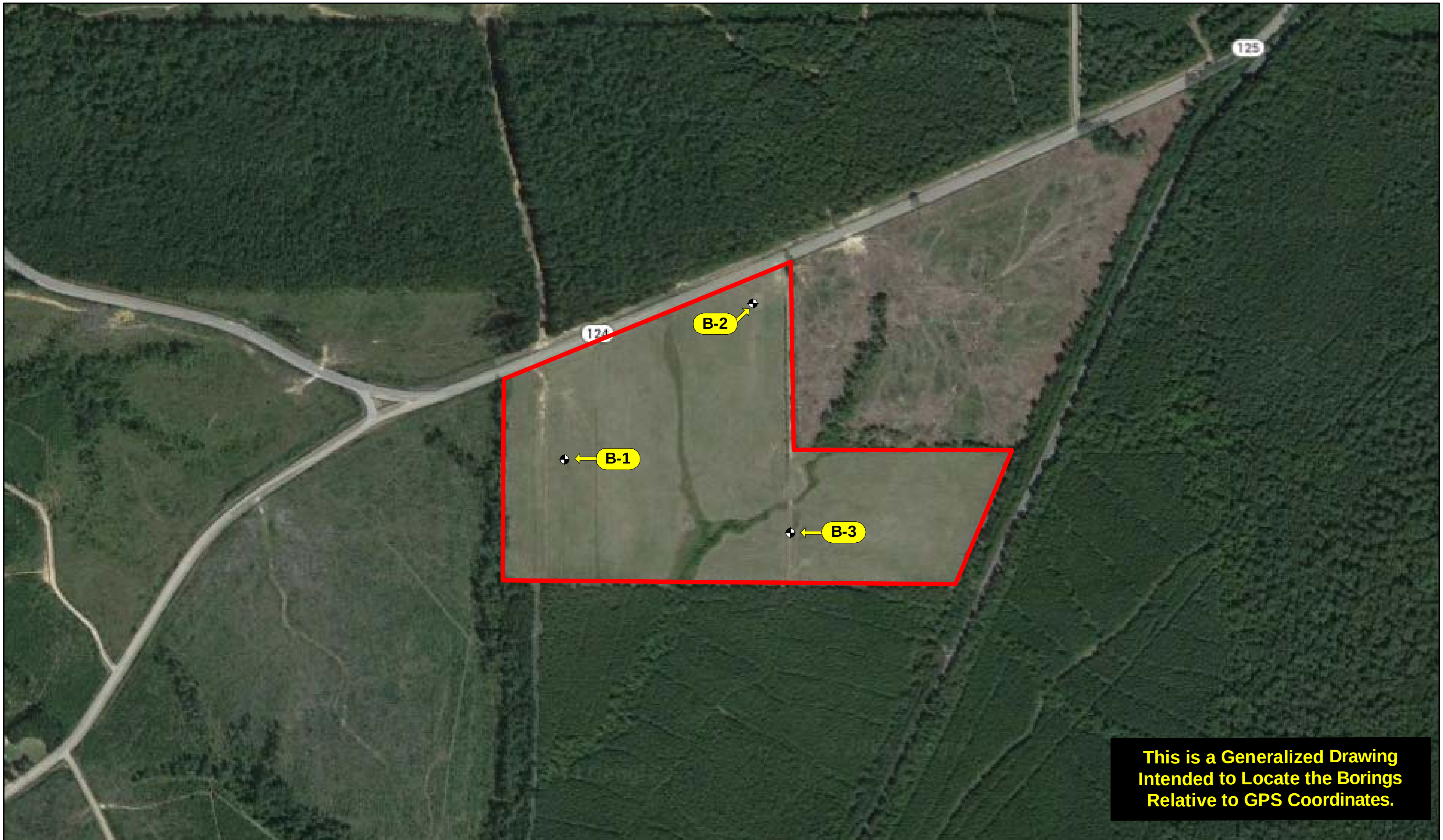
II. <u>Laboratory Studies:</u>

Upon return to the laboratory, all samples were visually examined and representative samples were selected for testing. Tests were performed on selected samples recovered from the test borings to verify classification and to determine pertinent engineering properties of the substrata. Individual test and designations are provided on the following page.

Test	**Designations**
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216
Partial Gradation	ASTM D1140
Unconfined Compression Tests	ASTM D2166

Results for soil classifications are tabulated on the Log of Boring in their respective columns under "Laboratory Data."

Samples obtained during our field studies and not consumed by laboratory testing procedures will be retained free of charge for a period of 30 days. Arrangements for storage beyond that period of time must be made in writing to ***Geotechnical Testing Laboratory, Inc.***



Plan of Borings

PROJECT			
LED Site Certification - Town of Olla, Louisiana, Olla, LaSalle Parish, Louisiana			
SCALE: Not to Scale	DATE: 1/21/2015	FILE NUMBER: 01-15-008	CLIENT: ***Meyer, Meyer, LaCroix & Hixson, LLC***

N

LOG OF BORING B-1

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, LA 71301
Telephone: (318) 443-7429

CLIENT: Meyer, Meyer, LaCroix & Hixson, Inc.
PROJECT: LED Site Certification - Town of Olla, Louisiana
LOCATION: Olla, LaSalle Parish, Louisiana
FILE NO.: 01-15-008
DRILL DATE: 1/20/15

DRILLING METHOD(S):
Diedrich D-50, Rotary Wash

LOGGED BY: R. Leggett   CHECKED BY: K. Gorsha

GROUNDWATER INFORMATION:
No Water Seepage Detected Using Rotary Wash

SURFACE ELEVATION: Not Determined

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	DRY DENSITY (Lbs./Cu.Ft.)	COMPRESSIVE STRENGTH (Lb./Sq. Ft.)	DESCRIPTION OF STRATUM
	N = 4	20							Firm Yellowish Brown & Gray LEAN CLAY (CL) w/silt
	N = 4	23	38	23	15	95			
	P = 4.00	16					102	7741	- very stiff, gray & reddish yellow below 4.0 feet
	P = 4.00	16	41	24	17	97	104	5730	
10	P = 3.50	17					100	4584	12.0'
	P = 2.50	36	83	30	53	93	81	3120	Stiff Yellowish Brown & Gray FAT CLAY (CH) w/silt (ML) laminations
20	P = 2.25	24						**	
	P = 2.50	32					82	4069	- very stiff @ 24.0 feet
30	P = 5.00+	36	79	28	51	94	81	7520	- dark gray below 29.0 feet
	P = 5.00+	32					83	5659	
40	P = 4.25	26					88	3765	- stiff @ 39.0 feet 43.0'
	P = 5.00+	23	42	22	20	70	95	4455	Very Stiff Dark Gray LEAN CLAY (CL) w/sandy silt s(ML) laminations
50	P = 5.00+	24						**	
	P = 5.00+	24	44	24	20	76	93	7390	
60	P = 5.00+	25					93	12495	- hard @ 58.0 feet 60.0'

Boring Terminated @ 60.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
G.P.S. Coordinates - 31° 53' 33.63" N / 92° 15' 38.53" W
Stratification and Groundwater Depths Are Not Exact
** = Disturbed Sample

LOG OF BORING B-2

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, LA 71301
Telephone: (318) 443-7429

CLIENT: Meyer, Meyer, LaCroix & Hixson, Inc.
PROJECT: LED Site Certification - Town of Olla, Louisiana
LOCATION: Olla, LaSalle Parish, Louisiana
FILE NO.: 01-15-008
DRILL DATE: 1/20/15

DRILLING METHOD(S):
Diedrich D-50, Rotary Drill

LOGGED BY: R. Leggett CHECKED BY: K. Gorsha

GROUNDWATER INFORMATION:
No Water Seepage Noted While Drilling
No Water Observed Upon Completion
Boring Walls Remained Open

SURFACE ELEVATION: Not Determined

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	DRY DENSITY (Lbs./Cu.Ft.)	COMPRESSIVE STRENGTH (Lb./Sq. Ft.)	DESCRIPTION OF STRATUM
									Stiff Yellowish Brown & Gray LEAN CLAY (CL) w/silt
	N = 12	20	30	21	9	96			
	P = 1.50	22					94	2643	
									4.0'
									Very Stiff Yellowish Brown & Gray FAT CLAY (CH)
5	P = 3.00	19					101	6782	
	P = 2.25	21	58	24	34	97	101	3782	- stiff @ 7.0 feet
	P = 4.00	23					92	6478	- very stiff, olive brown & gray @ 9.0 feet
10									
	P = 4.50	21	59	26	33	96	94	8372	- hard, reddish yellowish & gray @ 14.0 feet
15									
									17.0'
									Very Stiff Gray & Reddish Yellow Sandy LEAN CLAY s(CL)
	P = 5.00	14					97	5005	
20									20.0'
									Boring Terminated @ 20.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
G.P.S. Coordinates - 31° 53' 41.50" N / 92° 15' 28.80" W
Stratification and Groundwater Depths Are Not Exact
** = Disturbed Sample

LOG OF BORING B-3

Geotechnical Testing Laboratory, Inc.
226 Parkwood Drive
Alexandria, LA 71301
Telephone: (318) 443-7429

CLIENT: Meyer, Meyer, LaCroix & Hixson, Inc.
PROJECT: LED Site Certification - Town of Olla, Louisiana
LOCATION: Olla, LaSalle Parish, Louisiana
FILE NO.: 01-15-008
DRILL DATE: 1/20/15

DRILLING METHOD(S):
Diedrich D-50, Rotary Drill

LOGGED BY: R. Leggett CHECKED BY: K. Gorsha

GROUNDWATER INFORMATION:
No Water Seepage Noted While Drilling
No Water Observed Upon Completion
Boring Walls Remained Open

SURFACE ELEVATION: Not Determined

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	DRY DENSITY (Lbs./Cu.Ft.)	COMPRESSIVE STRENGTH (Lb./Sq. Ft.)	DESCRIPTION OF STRATUM
			N = 2	23							Very Soft Yellowish Brown & Gray LEAN CLAY (CL) w/silt
			P = 1.00	23	36	23	13	92	98	1780	- firm @ 3.0 feet
	5		P = 3.50	20						**	
											7.0'
			P = 3.50	17					105	3110	Stiff Gray & Reddish Yellow FAT CLAY (CH)
			P = 3.00	34	88	31	57	99	82	4467	- very stiff @ 9.0 feet
	10										
			P = 3.50	30					84	3859	- stiff @ 14.0 feet
	15										
			P = 3.75	28	72	29	43	98	88	4250	- very stiff @ 19.0 feet
	20										20.0'
											Boring Terminated @ 20.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
G.P.S. Coordinates - 31° 53' 30.20" N / 92° 15' 27.30" W
Stratification and Groundwater Depths Are Not Exact
** = Disturbed Sample

Laboratory Analysis of Soils For Soil-Cement Treatment

Report Date: 1/22/2015 **Sample Date**: 1/20/2015 **Report No:** 01-15-008

Prepared For: **Meyer, Meyer, Lacroix & Hixson, LLC**
100 Engineer Place
Alexandria, Louisiana 71303
Attention: Mr. Jacob Dillehay, E.I.

Project: LED Site Certification - Town of Olla,, LaSalle Parish, Louisiana

Test Methods: DOTD TR407, TR413, TR423, TR428

Laboratory Results:

Test	Boring B-1 0.0 to 5.0 Feet	Boring B-2 0.0 to 4.0 Feet	Cement Treatment Specifications
Silt, %	71	76	65% Max.
Sand, %	5	4	79% Max.
Clay, %	24	20	
Liquid Limit (LL)	38	30	
Plasticity Index (PI)	15	9	22 Max.
Organic Content, %	1.5	1.0	2.0 Max.
Soil Group	A-6	A-4	
Soil Classification	Lean Clay w/silt	Lean Clay w/silt	
Results	**Unusable**	**Unusable**	

Geotechnical Testing Laboratory, Inc.

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				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS