EXHIBIT # 15

GEOTECHNICAL REPORT

Geotechnical Testing Laboratory, Inc.
Engineering and Construction Materials Testing Services

April 2, 2014

City of Natchitoches, Louisiana
c/o Cothren, Graff, Smoak Engineering, Inc.
6305 Westport Avenue
Shreveport, Louisiana 71129-2499

Attention: Mr. Randal Smoak, P.E.

RE: Preliminary Geotechnical Investigation Services
Natchitoches Industrial Park Site Qualification
Natchitoches Parish, Louisiana
GTL Report No. 03-14-041

Dear Mr. Smoak:

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 # 20082

4/2/14
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Preliminary Geotechnical Investigation Services

Natchitoches Industrial Park Site Qualification

Natchitoches Parish, Louisiana
GTL Report No. 03-14-041

Prepared For:

City of Natchitoches, Louisiana
C/o Cothren, Graff, Smoak Engineering, Inc.
6305 Westport Avenue
Shreveport, Louisiana 71129-2499

Prepared By:

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

TABLE OF CONTENTS

APPENDIX

Preliminary Geotechnical Investigation Services
Natchitoches Industrial Park Site Qualification
Natchitoches Parish, Louisiana
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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.
- Preliminary recommendations for rigid and flexible pavements below unspecified traffic.

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 considerations 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 the Honorable Lee Posey, Mayor of the City of Natchitoches, Louisiana (client), by accepting our May 26, 2013 written proposal. Authorization to proceed was provided on January 28, 2014. Field procedures were conducted on March 20, 2014. The delay between project authorization and the field operations was due to the pending 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. Maximum uniform and isolated concentrated floor loads are expected to be 125 psf and five (5) kips, respectively. Grade changes are expected to be nominal with no more than two (2) to three (3) feet of cut or fill.

Information pertaining to anticipated traffic loads and volumes was not available. For the purpose of our pavement analysis of this report, we assume that the industrial traffic could consist of up to 500 repetitions of light passenger cars and pick-up trucks, 50 medium-sized delivery trucks and vans, and up to 50 heavy tractor-trailer trucks per day.

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 north of State Highway and at the east end of Industrial Drive in Natchitoches, north of State Highway and at the east end of Industrial Drive in Natchitoches Parish, Louisiana. The site was noted to be relatively level with estimated maximum elevation differences of no more than one (1) to two (2) 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:

In accordance with your request, general subsurface conditions across the site were explored by drilling a total of three (3) borings to depths between approximately 30 and 100 feet. The borings were located in the field by the drilling crew by measuring approximate distances from existing features 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: slightly clayey silt (CL-ML), fat clay (CH), lean clay (CL), lean to fat clay (CL-CH), sandy lean clay (CL), and poorly graded sand (SP-SM).

Groundwater Conditions:

Seepage was observed only in Borings B-1 and B-3 at depths of four (4) and five (5) feet during advancement of the test borings. Groundwater was measured at depths of three (3) to 20 feet below existing ground surface upon completion of the borings. We feel that the shallow seepage in both borings was due to a perched water table and that the level is expected to fluctuate with seasonal rainfall. 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:

The soil parameters presented below are based on single borings placed at large and irregular intervals across the site. The deviations between the boring locations indicate variable subsurface conditions across the site and should not be assumed as representative of the individual borings. 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.

A review of the boring logs indicates that soft to very soft soils are present in all three borings and will probably be encountered during grading operations for shallow foundations. Recent area rains are probably responsible for the presence the soft, saturated surficial soils. If these wet conditions exist during construction, this can cause extreme difficulty in the preparation of the building pad areas. *We recommend that the construction take place during warmer and drier time of year.*

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.

If instability persists within the exposed subgrades, the recommendations presented in our Wet Weather and Soft Ground Considerations section of this report should be reviewed.

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 an on-grade floor slab, 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. Recommendations for both foundation types are discusses separately below.

Potential Vertical Rise (PVR) values were estimated to vary between less than one (1) inch and approximately two (2) inches 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.

Shallow Foundations:

To remediate variable soil conditions in the surficial zone, provide a consistent subgrade for slab support, and reduce the potential for active soils to affect the foundations where active clays are present at the surface, GTL recommends that a uniform layer of density-approved select fill be provided beneath the floor slabs. The select fill for the building pads should extend at least five (5) feet beyond the perimeter of the buildings. The table below indicates the estimated undercut and select fill pad thickness to limit the PVR to a value of one (1) inch or less for the individual building pads in the vicinity of the boring locations.

Boring No.	Estimated PVR (inches)	Estimated Thickness of Select Fill Pad (feet)
1	2.0	3.0
2	> 1.0	1.0
3	1.5	2.0

If instability persists within the exposed subgrade at the bottom of the building pad excavation, the area may require over-excavation of the wet material to provide a single over-sized bridge lift of drier material. The fill for this layer should consist of silty or sandy clay with a plasticity index between 25 and 35 and a moisture content no more than four (4) percent below optimum moisture content. Over-excavation for a bridge lift could extend to depths ranging from 1.5 to two (2) feet. To prevent moisture from migrating into the bridge lift from below, compaction levels for the bridge lift should be between 90 and 95 percent of Standard Proctor density.

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 three (3) feet of select fill should be anticipated to be necessary 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 2,500 psf for soils with consistencies of medium dense or medium stiff. Strip footings for continuous wall loads may be estimated between 1,150 and 2,000 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 (1/4 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 warehouse slabs exposed to fork lift loads, the subgrade modulus may be increased to between 250 and 300 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. 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:

We understand that deep foundations may be considered for use at this site due to special equipment or building loads. 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. Once the final site investigations are performed, the estimated values for other diameters of deep foundations may be provided at that time.

Diameter of Shaft (inches)	Depth of Shaft (feet)	Allowable Single Shaft Capacity (kips)	
		Compressive	Uplift
18	30	25	20
	35	30	25
	40	35	30
	45	50	35
	50	55	40
	55	65	45
	60	70	50
	65	110	60
	70	115	75
	75	135	85

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. Groundwater will most likely 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.

Driven Piles:

The bearing capacity of the naturally occurring soil was evaluated from the results of the Standard Penetration Tests (SPT) and the Unified Soil Classifications. These test results indicate that the existing soil has a range from low to moderate bearing capacity with respect to shear strength. The superstructure loads for the commercial structures may be supported on Class B creosote treated timber piles founded at a minimum depth of 25 feet below the existing ground surface. The final depth of the piles may be selected from the following table after considering the estimated structural total loads.

Depth (feet)	Estimated Allowable Load (kips)	
	Compressive	Uplift
25	12	9
30	15	10
35	18	12
40	22	14
45	25	16
50	30	20

If the above allowable timber pile loads are found to be inadequate for the actual structural loads, consideration may be given to using 12-inch square per-cast, pre-stressed concrete piles. Such piles may be selected from the following table.

Depth (feet)	Estimated Allowable Load (kips) Compressive	Uplift
25	23	14
30	26	16
35	29	18
40	33	20
45	39	22
50	46	26

The factor of safety for these calculations is at least 2.0. Total settlement is estimated to be on the order of one (1) inch or less for foundation units designed in accordance with recommendations provided herein. Differential settlements (between adjacent piles or clusters) are estimated to be on the order of 0.5 inch or less.

The recommended pile capacities are based on field and laboratory tests and/or empirical data. The magnitude of this project should include a pile testing program to determine if the pile capacities are adequate, or if shorter piles are warranted.

Seismicity:

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 0.116 g. The project also has a mapped 1.0 second spectral response acceleration (S_1) of 0.065. Based on Section 1613 of the IBC-2012, a Site Class of E has been estimated for this site. Using Tables 1613.3.3(1) and 1613.3.3(2), the mapped spectral accelerations, and Site Class E; the site coefficients F_a and F_v have been determined to be 2.5 and 3.5, respectively. The design spectral response accelerations, S_{DS} and S_{D1}, were determined to be 0.194 g and 0.152 g, respectively. Based on Tables 1613.3.5(1) and 1613.3.5(2), the site has an assigned Seismic Design Category of C 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 D.

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 C 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 1.5H: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 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 between 5.0 and 8.0.

The general pavement design information presented in this report is based on subsurface conditions inferred by the test borings, information published by The Asphalt Institute, the Portland Cement Association, and past experience in the locale. The published information was utilized in conjunction with the available field and laboratory test data to develop general pavement designs based on the AASHTO structural numbering system.

Pavements to be utilized by light vehicular traffic may be either flexible or rigid pavement sections supported on well-compacted subgrade or select fill. However, Portland cement concrete pavements should be utilized where large loads (i.e. waste disposal containers, etc.) are located. Both flexible and rigid pavement sections have been designed using general engineering design criteria referenced above.

Subgrade:

It is paramount to the satisfactory performance of pavements that the subgrade be stable under loads and compacted prior to deployment of flexible base or concrete. All pavement subgrade should be proof rolled prior to beginning placement of pavement section materials. Stable subgrade is especially critical to the successful performance of flexible pavement sections. The surficial soils within the proposed paving limits should be tested to determine the average plasticity index (PI) value. If the average PI of the subgrade is above a value of 20, the upper eight (8) inches of subgrade should be either removed and replaced with select fill, or treated with lime to reduce the PI to an acceptable limit.

If fill is imported to complete the pavement grading, the material may consist of usable soils as determined by Section 203 of the *Louisiana Standard Specifications for Roads and Bridges, 2006 Edition.* If the fill has 50 percent or more silt, the material should have a maximum liquid limit of 45 with a plasticity index between 11 and 25. For fill with a silt content less than 50 percent, the plasticity index should be between 0 and 25.

The subgrade 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. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 5,000 square feet of surface area per lift or a minimum of four per lift for each tested area for the pavement.

Subgrade may be, or become, wet and unstable under paving areas, depending on several factors, including construction season, groundwater fluctuations, contractor's maintenance of positive drainage, routing of equipment, weather, and scheduling constraints. Flexible base and concrete should be placed only on subgrade that has passed both stability and compaction requirements. Also, it is prudent for contract documents to accommodate over-excavation and replacement as needed or, more typically, to anticipate such remedial activity through the change order process. In any event, the owner should be advised that this risk is inherent in practically every construction project that involves site work.

Cement Treatment:

Research data obtained from the Louisiana DOTD indicates satisfactory pavement performance has been realized utilizing Cement Treated Base Course. This process is widely used, and consists of treating usable soils to a depth of 12 inches with not less than six (6) percent by volume Portland cement. Usable soils typically contain plasticity indices of 22 or less, and normally can be pulverized to acceptable limits. The treatment also permits generating a minimum compressive strength of 150 psi in seven days in lieu of 300 psi or greater. Pulverization and compaction requirements should apply to treated soil in accordance with the *Louisiana Standard Specifications for Roads and Bridges,* 2006 Edition.

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 usable for cement treatment. A copy of the Determination of Usable Materials for Cement Treatment is included in the Appendix of this report.

The cement-treated base should be compacted to at least 95 percent of Standard Proctor density at, or near the optimum moisture content as defined by ASTM D-698. As a guideline, it is recommended that field density tests be taken at a frequency of not less than one (1) test per 5,000 square feet of surface area of the pavements.

Shrinkage Cracks:

Performance evaluations of soil cement mixtures have repeatedly found that the major problem with the process is not strength or durability, but shrinkage cracking. The shrinkage of cement treated materials results from the loss of water by drying and from self-desiccation during the hydration of the cement. The factors which influence the severity and amount of cracking may include the amount of cement used, the water content used in the field, the aggregate properties, the adequacy of the curing procedures, weather conditions, the degree of subgrade restraint on the base, and the type and time of placement of the final surfacing.

Shrinkage cracks can result in reflective cracks in the asphaltic wearing course relatively soon after installation since soil-cement mixtures typically generate tensile strengths equal to approximately 20 percent of the compressive strength of the mixture. Consequently, additional cracking may occur from subbase stresses, poor drainage or slope failures. These cracks are aesthetically unsightly and invariably permit water intrusion of the soil subgrade. This intrusion regularly results in higher maintenance costs and reduces overall pavement life if the cracks are not sealed once they appear and exceed approximately 1/8 inch in width.

Shrinkage cracks cannot be eliminated, but may be significantly reduced in the treated base by compacting the mixture at or below optimum moisture content, and be adequately cured. The extent and severity of reflective cracking in the asphalt surface may be reduced by delaying placement of the hot-mixed asphalt (HMA) surface. This concept could involve placing a chip seal on the cured section and the final HMA surface two to four months later.

Micro-cracking (or pre-cracking) of the treated mixture should be considered. This process consists of making a maximum of four passes of a steel wheel vibratory roller applied two to four days after finishing. The vibration will introduce a network of hairline cracks into the base early in its' life with the idea that these "micro-cracks" will minimize the major shrinkage cracks associated with soil-cement bases. Studies have been conducted on bases ranging in thickness from six to eight inches, and generating a minimum compressive strength of 500 psi in seven days.

The borings indicate the subgrade soils beneath some of the areas of treated roads could consist of high plasticity clays. The high PI's are indicative of a highly compressible and high shrink-swell susceptible material. Consequently, subgrade movements in the clays may cause tension cracking. This volume change by very high PI's will express itself also at the edge of the pavement where higher moisture contents and less density exist.

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 20 heavy tractor-trailer trucks with H-20 loading per day.

The subgrade should be crowned along the centerline to shed surface water off to the sides of the roadway where drainage ditches or swales collect the runoff and drain it away as rapidly as possible. At a minimum, the drainage for the roadbed should consist of shallow gravity ditches cut on both sides of the roadway. The bottom of the ditch should be a minimum of 18 inches below finished pavement elevation and the side slopes should be cut at a maximum 3H:1V. The slopes for the ditch bottoms should be checked to ensure rapid drainage of runoff away from the sides of the roadbed. Water must not be allowed to pond or stand in the ditches near the perimeter of the roadways.

Prior to placing crushed stone surfacing, the entire roadway should receive a single layer of Tensar TriAx TX160 Geogrid or equal. A Tensar BX1200 geogrid may also be considered. The crushed stone materials should have a minimum compacted thickness of eight (8) inches and should meet the requirements for Item 1003.04(a) of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, Current Edition. 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.

Portland cement concrete should be provided at trash receptacles and approach pads and concrete thickness should be a minimum of seven (7) inches. 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.

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. As previously discussed, we assume that the industrial traffic could consist of up to 500 repetitions of light passenger cars and pick-up trucks, 50 medium-sized delivery trucks and vans, and up to 50 heavy tractor-trailer trucks per day.

Asphaltic Pavement Materials:

Surface or wearing course asphaltic concrete should consist of Item 501, Type 3. Surface course asphalt should be compacted to a minimum of 95 percent of the density of the laboratory molded specimen, or a minimum of 92% of the maximum theoretical density. The placement temperature and compacted thickness of Hot Mix Asphaltic Concrete (HMAC) should be determined during placement. Samples for extraction and gradation analysis should be obtained at the rate of at least one sample for each day's operation, for each pavement course, with at least one sample for each 600 tons.

Granular base should meet the requirements for Item 1003.03(b) 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). Cohesive (clay) subgrade soils should be compacted to a minimum of 95% of maximum density defined by the Standard Proctor (ASTM D-698). Non-cohesive (sand) subgrade soils should be compacted to 100% of maximum density defined by the Standard Proctor (ASTM D-698).

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. Subgrade (and subbase, if specified) should be compacted to a minimum of 95% of the maximum density defined by the Standard Proctor (ASTM D-698). The design of steel reinforcement, if advised by the structural engineer, should be in accordance with local or accepted codes. (Although reinforcement is not normally required by design, it is customary to provide minimum reinforcement of 6 x 6 x No. 6 welded wire flat mesh or No. 3 deformed steel bars spaced on 18-inch centers each way.)

Recommended Pavement Sections:

The table below presents a summary of both rigid and flexible pavement sections for standard 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. Refer to the text for qualification of the designs and further discussion and limitations.

<table>
<tr><th colspan="3">MINIMUM PAVEMENT RECOMMENDATIONS *</th></tr>
<tr><th>Pavement Type</th><th>Light Duty
(Parking Lot Entries & Drives)</th><th>Heavy Duty
(Truck Entries & Drives)</th></tr>
<tr><td>Portland Cement Concrete</td><td>5.0" Portland Cement Concrete
4.0" Item 1003.03 (b) Base
8.0" Density-Approved Subgrade
or Imported Fill</td><td>7.0" Portland Cement Concrete
4.0" Item 1003.03 (b) Base
8.0" Density-Approved Subgrade
or Imported Fill</td></tr>
<tr><td>Asphalt Over Crushed Stone Base</td><td>2.0" Item 501 Type 3 Surface
6.0" Item 1003.03 (b) Base
8.0" Density-Approved Subgrade
or Imported Fill</td><td>3.0" Item 501 Type 3 Surface
12.0" Item 1003.03 (b) Base
8.0" Density-Approved Subgrade
or Imported Fill</td></tr>
<tr><td>Asphalt Over Cement Treated Subgrade</td><td>2.0" Item 501 Type 3 Surface
12.0" Density Approved Cement Treated Subgrade</td><td>4.0" Item 501 Type 3 Surface
12.0" Density Approved Cement Treated Subgrade</td></tr>
<tr><td colspan="3">*Materials shall meet general requirements of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, and specific requirements listed herein.</td></tr>
</table>

The pavement section for the parking stalls may consist of either five (5) inches of Portland cement concrete, or two (2) inches of HMAC over six (6) inches of compacted stone base. 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.

Wet Weather and Soft Ground Considerations:

The soils encountered in the surficial zone at this site are expected to be relatively sensitive to disturbances caused by construction traffic when wet. The contractor should be cognizant of the importance of proper maintenance of surface drainage. Depending on weather-related ground conditions, contractor's maintenance of drainage during construction, and other factors, some difficulty may be encountered by the contractor in achieving compaction on initial lifts of fill placed on loose or soft subgrade. This will be exacerbated by wet weather, particularly if the contractor allows surface drainage to enter and pond in the excavations.

Fine-grained soils are expected to be relatively sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support characteristics. In addition, fine-grained soil that becomes 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. Earthwork activities performed during cooler, wetter months may certainly offer more difficulties than if performed during warmer, drier periods.

If construction is performed during wet conditions, work platforms may be necessary; these can be created for earthwork by mixing soil and hydrated lime, cement, or combinations of these additives. Quicklime may also be used in areas where dusting is of concern, if proper worker safety considerations are observed. *"Pumping" (unstable) subgrades are possible at this site and it is recommended that bid documents incorporate this possibility into the bid schedule.*

It is advisable to obtain unit prices in the bid schedule for remedial subgrade preparation options, should these become necessary. The following lists several subgrade preparation options; the best option will depend upon the specific soil and groundwater conditions encountered. All items should be bid "in-place, complete", on a pre-approved, as-needed basis only. Only the necessary quantity should be approved, usually as recommended (and later confirmed) by the geotechnical engineer's representative. Over-excavation presumes that the contractor must dispose of unsuitable (unusable) materials off-site. The contract documents should carefully and specifically state that such options will be allowed only when the work cannot be successfully prosecuted using ordinary or normal construction skill, efforts and equipment. (descriptive wording only; not necessarily to be used for contract language).

Over-excavation and replacement with Select Fill	(Cubic Yard)
Over-excavation and replacement with clay bridging layer (drier than optimum, 18<P.I.<35 (or as otherwise approved), attainable compaction as specified by geotechnical engineer's representative	(Cubic Yard)
Provide and deploy geogrid (Tensar TriAx or approved equal), cover with minimum 6-inch thick (compacted with plate compactor) layer of minimum one (1) inch durable, crushed gravel (LDOTD Item 1003.03.b Base or approved alternate).	(Square Yard)
Provide and deploy light-duty non-woven drainage geotextile	(Square Yard)
Provide and install subsurface ("French") drain; drain media of washed, durable one (1) inch crushed stone, 36 inch wide by 18 to 48 inch high, with minimum four (4) inch diameter perforated PVC or HDPE pipe (contractor to submit pipe manufacturer's assurance of "non-crushing" under depth of planned cover), non-woven geotextile layer across top of gravel	(Cubic Yard)
Lime-stabilize upper 12 inches (compacted thickness) with minimum 40 lbs hydrated lime per square yard	(Square Yard)
Construction de-watering well, including periodic pumping as required	(Each, or per vertical foot from surface to bottom)

The above are suggested options; the site civil engineer should adopt these or similar, standardized bid items as deemed appropriate.

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

Field And Laboratory Procedures
Natchitoches Industrial Park Site Qualification
Natchitoches, Natchitoches Parish, Louisiana
GTL Report Number 03-14-041

I. Field Operations:

Subsurface conditions were evaluated by advancing three (3) intermittent sample borings on March 20, 2014 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 area investigated is provided on the attached Plan of Borings. Descriptive terms and symbols used on the logs are in accordance with the Unified Soil Classification System (USCS). Surface elevations at the boreholes was 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.

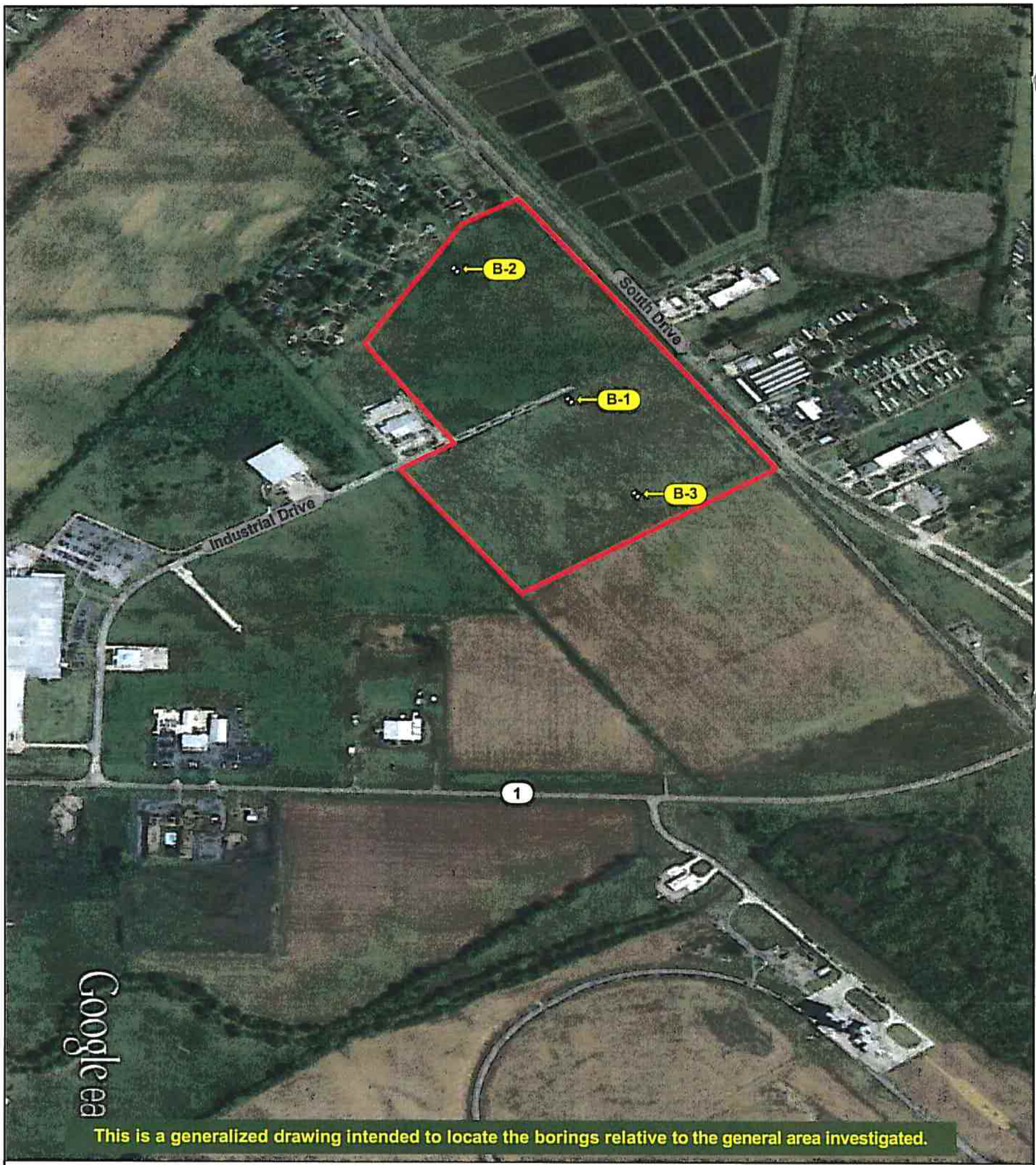
II. Laboratory Studies:

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.***



This is a generalized drawing intended to locate the borings relative to the general area investigated.

Plan of Borings

(Not to Scale)

PROJECT Natchitoches Site Qualification, Natchitoches Parish, Louisiana			N
DATE 3/26/2014	FILE NUMBER 03-14-041	***City of Natchitoches, LA***	

LOG OF BORING B-1

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

CLIENT: **City of Natchitoches**
PROJECT: **Natchitoches Industrial Park Site Qualification**
LOCATION: **Natchitoches, Natchitoches Parish, Louisiana**
FILE No.: **03-14-041**
DATE DRILLED: **3/20/14**
DRILLING METHOD(S): **Diedrich D-50, Rotary Drill**
LOGGED BY: **R. Leggett** CHECKED BY: **H. Carroll, E.I.**

GROUNDWATER INFORMATION:
Water Seepage Noted @ 5.0 Feet While Drilling
Water Observed @ 20.0 Upon Completion
Boring Walls Collapsed @ 58.0 Feet

SURFACE ELEVATION: **Not Determined**

FIELD DATA				LABORATORY DATA							
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS 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	24	19	5	95			Loose Yellowish Brown, Slightly Clayey, SILT (CL-ML) 2.0'
▨		☒	N = 3	32							Soft Yellowish Brown FAT CLAY (CH)
	5	☒	N = 3 ∇	32							
		☒	N = 4	42	71	28	43	99			- firm @ 6.0'
		■	P = 1.00	26					97	2572	- stiff below 7.5'
	10	■	P = 1.00	26	56	24	32	98	98	2012	- yellowish brown & gray below 9.5'
	15	■	P = 1.00	28					94	2409	17.0'
▨	20	■	P = 0.50 ▼	27	30	22	8	87	87	1115	Firm Yellowish Brown LEAN CLAY (CL) w/occasional sandy silt s(ML) layers
	25	☒	N = 6	32							
	30	☒	N = 3	33							- soft @ 29.0' 31.5'
▨	35	■	P = 0.50	43					78	1193	Firm Yellowish Brown FAT CLAY (CH)
	40	■	P = 1.00	40	82	30	52	99	82	1210	- SLS @ 39.0'
	45	■	P = 1.50	29					100	2833	- stiff below 44.0'
	50	■	P = 1.50	24					102	2315	
	55	■	P = 2.50	21					100	3438	57.0'
▨	60	■	P = 2.00	19	39	18	21	51	109	2456	Stiff Yellowish Brown Sandy LEAN CLAY s(CL)

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
Stratification and Groundwater Depths Are Not Exact
SLS = Slickensided Sample

LOG OF BORING B-1

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

CLIENT: **City of Natchitoches**
PROJECT: **Natchitoches Industrial Park Site Qualification**
LOCATION: **Natchitoches, Natchitoches Parish, Louisiana**
FILE No.: **03-14-041**
DATE DRILLED: **3/20/14**
DRILLING METHOD(S): **Diedrich D-50, Rotary Drill**

LOGGED BY: **R. Leggett** CHECKED BY: **H. Carroll, E.I.**

GROUNDWATER INFORMATION:
Water Seepage Noted @ 5.0 Feet While Drilling
Water Observed @ 20.0 Upon Completion
Boring Walls Collapsed @ 58.0 Feet

Not Determined

	FIELD DATA			LABORATORY DATA							
					ATTERBERG LIMITS						
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
▨											Stiff Yellowish Brown Sandy LEAN CLAY s(CL) *(continued)* 63.0'
░	65	☒	N = 35	19							Dense Yellowish Brown, Poorly Graded, SAND (SP-SM) w/silt
░	70	☒	N = 23	15							- medium dense @ 69.0'
░	75	☒	N = 27	15	NP	NP	NP	7			
░	80	☒	N = 44	12							- dense w/gravel below 79.0'
░	85	☒	N = 44	27							87.0'
▨	90	☒	N = 44	25	65	24	41	70			Hard Gray & Brown FAT CLAY (CH)s w/sand
▨	95	☒	N = 50	27							
▨	100	☒	N = 55	26							100.0' Boring Terminated @ 100.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
Stratification and Groundwater Depths Are Not Exact
SLS = Slickensided Sample

LOG OF BORING B-2

SHEET 1 of 1

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

CLIENT: **City of Natchitoches**
PROJECT: **Natchitoches Industrial Park Site Qualification**
LOCATION: **Natchitoches, Natchitoches Parish, Louisiana**
FILE No.: **03-14-041**
DATE DRILLED: **3/20/14**
DRILLING METHOD(S): **CME 45B, 4.5" Hollow Stem Auger**
LOGGED BY: **J. Bennett** CHECKED BY: **H. Carroll, E.I.**

GROUNDWATER INFORMATION:
Water Seepage Noted @ 4.0 Feet While Drilling
Water Observed @ 3.0 Upon Completion
Boring Walls Remained Uncaved

SURFACE ELEVATION: **Not Determined**

FIELD DATA				LABORATORY DATA							
					ATTERBERG LIMITS						
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
▨		■	P = 1.00	22	34	18	16	75			Firm Yellowish Brown LEAN CLAY (CL)s w/sand
▨		☒	N = 3 ▼	26							- soft @ 2.5' 3.5'
▨		☒	N = 2 ▽	35							Very Soft Yellowish Brown FAT CLAY (CH)
▨	5										
▨		■	P = 0.25	40	58	24	34	97	80	912	- soft below 6.0'
▨		■	P = 1.25	34					88	865	
▨	10										12.0'
▒											Stiff Yellowish Brown LEAN CLAY (CL) w/occasional sandy silt s(ML) layers
▒		■	P = 2.00	27					98	3040	
▒	15										
▒		☒	N = 8	30	37	22	15	86			
▒	20										
▒		☒	N = 3	28							- soft @ 24.0'
▒	25										
▒		☒	N = 1	30	NP	NP	NP	76			- very soft @ 28.5' (split sample) 30.0'
	30										Boring Terminated @ 30.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
Stratification and Groundwater Depths Are Not Exact

LOG OF BORING B-3

SHEET 1 of 1

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

CLIENT: **City of Natchitoches**
PROJECT: **Natchitoches Industrial Park Site Qualification**
LOCATION: **Natchitoches, Natchitoches Parish, Louisiana**
FILE No.: **03-14-041**
DATE DRILLED: **3/20/14**
DRILLING METHOD(S): **CME 45B, 4.5" Hollow Stem Auger**
LOGGED BY: **J. Bennett** CHECKED BY: **H. Carroll, E.I.**

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

SURFACE ELEVATION: **Not Determined**

	FIELD DATA			LABORATORY DATA							
					ATTERBERG LIMITS						
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 = 4	26							Firm Yellowish Brown LEAN CLAY (CL)s w/sand
▨		■	P = 1.00	32	38	23	15	95			
▨	5	☒	N = 3	29							- soft @ 4.5'
▨											6.0'
▧		☒	N = 3	34	53	25	28	98			Stiff Yellowish Brown LEAN to FAT CLAY (CL-CH)
▧		☒	N = 4	32							- firm @ 9.0'
▧	10										
▧											13.5'
▨		☒	N = 6	29							Firm Yellowish Brown LEAN CLAY (CL) w/occasional sandy silt s(ML) layers
▨	15										
▨		☒	N = 5	28	37	22	15	94			
▨	20										
▨		☒	N = 3	30							- soft below 24.0'
▨	25										
▨		☒	N = 3	31							30.0'
	30										Boring Terminated @ 30.0 Feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE

NOTES:
See Plan of Borings for Location
Stratification and Groundwater Depths Are Not Exact

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