GeoConsultants, LLC of Louisiana
Geotechnical and Forensic Engineering Services

May 30, 2012

England Economic and Industrial Development District
c/o Pan American Engineers, Inc.
P.O. Box 89
Alexandria, Louisiana 71309-0089

Attention: Mr. Kyle Randall

RE: Preliminary Geotechnical Engineering Services Report
Cleco Industrial Site Certification Program
Alexandria, Louisiana
Report No. 05-12-089

Dear Mr. Randall:

Geo*Consultants*, LLC of Louisiana 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,
Geo*Consultants*, LLC of Louisiana

N. J. Gorsha, P.E.

NJG/krg

5/30/12
N.J. GORSHA
REG. No. 20082

Distribution: (3) Addressee

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PRELIMINARY GEOTECHNICAL ENGINEERING SERVICES REPORT
FOR
CLECO INDUSTRIAL SITE CERTIFICATION PROGRAM
ALEXANDRIA, LOUISIANA
REPORT NO. 05-12-089

Prepared For:

England Economic and Industrial Development District
c/o Pan American Engineers, Inc.
P.O. Box 89
Alexandria, Louisiana 71309-0089

Prepared By:

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226 Parkwood Drive
Alexandria, Louisiana 71301

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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 immediate vicinity of a proposed 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, architect, civil engineer, and other design team professionals with recommendations 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 Jon Grafton, Executive Director of the England Economic and Industrial Development District (client), by accepting our May 2, 2012 written proposal. Authorization to proceed was provided on May 8, 2012. Field procedures were conducted on May 18 and 22, 2012. To accomplish the intended purposes, a three-phase study program was conducted which included:

- a field investigation consisting of four 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 possibly four (4) stories in height. Preliminary structural information is not available. The proposed buildings should consist of either steel or wood framing and may 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 purposes 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 10 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 a 34.07-acre tract of land located on the south frontage of State Highway 1 west of Cappel Road in Rapides Parish, Alexandria, Louisiana. The site was noted to be relatively level with estimated maximum elevation differences of no more than one (1) to three (3) feet. The site has been cultivated in recent times. The site was a furrowed field and was void of vegetation at the time of drilling. The drilling rig experienced no difficulty moving about the site.

Subsurface Stratigraphy:

In accordance with your request, the general subsurface conditions across the site were explored by drilling a total of five (5) 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: lean to fat clay (CL/CH), fat clay (CH), slightly clayey silt (CL-ML), silty lean clay (CL), and silty sand (SM).

Groundwater Conditions:

Seepage was observed at depths of 5.5 to 10 feet during advancement of the test borings. Groundwater was measured at depths of five (5) to 12.5 feet with cave-in depths between 5.5 and 14.5 feet below existing ground surface upon completion of the borings. 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 Geo*Consultants* 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 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.

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 approximately 1.25 and 1.75 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 to highly 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, Geo*Consultants* 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	1.25	1.0
2	1.50	2.0
3	1.75	2.0
4	1.25	1.0

The fill should be used to elevate the building pads so that positive drainage is provided away from the buildings. Where feasible, elevating the building pads with fill is generally desirable because this aids in providing positive drainage away from the floor slabs and foundations and helps prevent water from collecting in the filled areas.

Shallow foundations may utilize individual or continuous footings bearing within the upper five (5) feet of the surficial zone. 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.

Fill areas may be required to provide a level building pad for the proposed structures. These fill areas should be composed of density controlled select fill (compacted to 95% Standard Proctor ASTM D-698). These constructed fills, even though placed in a density controlled and monitored manner, can be expected to settle between 1% and 2% throughout the fill thickness. This contribution to settlement can be significant on sites with constructed fill depths exceeding three (3) or four (4) feet, and should be accounted for in the design of the building. Usually the most effective means to minimize deleterious effects of this settlement is to simply provide a relatively constant fill thickness, or accommodate a gradual transition from cut to fill.

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.

Deep Foundations:

We understand that deep foundations may be considered for use at this site, if required due to special equipment or building loads. Due to the presence of soft soils at a depth of 20 feet in Boring B-3, deep foundations should extend to a minimum depth of 25 feet. Loads for the proposed facilities may be supported on drilled piers with underreams. The underreamed piers should have a minimum bell diameter 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-pier adhesion in the zone of expansive clays. A maximum bell diameter to shaft diameter ratio of 3.0 is also recommended.

As previously discussed, shafts should be founded at a minimum depth of 25 feet existing ground surface. Such shafts may be proportioned using a maximum allowable net end bearing pressure of 3,000 lbs/ft^2, plus an average unit allowable skin friction pressure of 150 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.

If the drilled shafts penetrate to a minimum depth of 30 feet, the underream may be omitted. The design charts below present preliminary estimates for drilled, cast-in-place concrete shafts and driven timber and concrete piles. These values are based on the average conditions encountered within the borings. Therefore, prior to developing any structure within this tract of land, we strongly recommend a specific site investigation to determine the actual soil parameters for deep foundations.

The actual building configurations and loads were not estimated at the time this report was prepared. The chart below represents the design curves for a single size drilled shaft having a minimum diameter of 18 inches. Information for depths below 30 feet was inferred from the log of Boring B-1.

The driven piles were assumed to be a class B creosote treated timber pile and the concrete pile dimensions were limited to a 12 inch square pre-cast, pre-stressed concrete pile. Once the final site investigations are performed, the estimated values for other diameters of deep foundations may be provided at that time.

The table below presents the estimated allowable single shaft capacities for an 18 inch diameter shaft founded at depths between 30 and 40 feet below present ground surface.

Diameter of Shaft (inches)	Depth of Shaft (feet)	Allowable Compressive Single Shaft Capacity (kips)
18	25	20
	30	25
	35	35
	40	65

The factor of safety for these calculations is estimated to be 2.0. 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.

Drilled Shaft Considerations

Due to the presence of a shallow groundwater table with a hydrostatic head, consideration should be given to installing the drilled shafts using a slurry method which maintains a constant slurry level equal to or slightly above the hydrostatic water level. If the shafts can be sealed from water intrusion using casing, the slurry option may be eliminated.

It is recommended that the design and construction of drilled piers should generally follow methods outlined in the manual titled Drilled Shafts: Construction Procedures and Design Methods (Publication No: FHWA-IF-99-025, August 1999).

We emphasize that close engineering supervision is essential during installation of the drilled pier foundations in order to assure that construction is performed in accordance with the plans and specifications. Also, to insure proper construction of the drilled piers at this site, close coordination between the drilling and concreting operations is considered to be of great importance. Detailed inspection of drilled shaft construction should be made to verify that the shafts are vertical and founded in the proper bearing stratum and to verify that all loose materials have been removed prior to concrete placement.

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 office building may be supported on Class B creosote treated timber piles founded at a minimum depth of 30 feet below the existing ground surface in the underlying silty sand stratum. The final depth of the piles may be selected from the following table after considering the estimated structural total loads.

Depth (feet)	Allowable Compressive Load (kips)
30	30
35	40
40	50
45	70
50	80

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)	Allowable Compressive Load (kips)
30	50
35	60
40	80
45	95
50	100

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.

Driven Pile Considerations

It is recommended that the installation of driven piles should generally follow methods outlined in Section 804 of the Louisiana Standard Specifications for Roads and Bridges, 1993 Edition. LaDOTD specifications may vary and clarifications may be necessary where this information conflicts with LaDOTD requirements.

Detailed inspection of driven pile construction should be made to verify that the piles are driven vertically and founded in the proper bearing stratum. The installation of all piling should be monitored by personnel familiar with the construction techniques required to install pre-cast, pre-stressed concrete piles.

Pre-drilling for the piles may be necessary to stabilize the driven piles to prevent lateral drifting of the piles prior to achieving their final depth. Pilot holes may extend to a depth no deeper than 10 feet. The piling should be driven below the depth of the pilot hole to depths shown on the final plans, but not less than the required bearing resistance shown on the plans. In any case, wood piling should not be driven beyond the point where the blow count exceeds 30 blows per foot. If damage to the pile is apparent, driving should cease.

All pile driving should be performed with power hammers. Approval of the contractor's pile driving equipment should be based on the wave equation analysis computer program FHWA-WEAP87 or newer version. A wave equation analysis should be performed for each pile type and size required in the plans. Approval of the pile driving system does not relinquish the contractor's responsibility from driving the piles to the required pile tip elevation without damage. The criteria the engineer should use to evaluate the pile driving equipment from the wave equation should be the pile driving resistance. The required number of hammer blows at the required end-of-driving pile capacity should be from 36 to 146 blows per foot. The pile driving resistance at any depth above the required pile tip elevation should be achieved with a reasonable driving resistance of less than 30 blows per foot for timber piles and 300 blows per foot for concrete piles. All piles, including test pile, should be driven with the same hammer.

If the piles are to be driven in clusters, they should be driven at a minimum center-to-center spacing of 2.5 times the pile diameter. Piles driven at spacings greater than this should be designed to act as single piles.

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 0.128 g. The project also has a mapped 1.0 second spectral response acceleration (S_1) of 0.060. Based on Section 1615.1.1 of the IBC2003, a Site Class of D has been designated for this site. Using Tables 1615.1.2(1) and 1615.1.2(2), the mapped spectral accelerations, and Site Class D; the site coefficients F_a and F_v have been determined to be 1.6 and 2.4, respectively. The design spectral response accelerations, S_{DS} and S_{D1}, were determined to be 0.137 g and 0.096 g, respectively.

Underground Storage Tanks

Below-grade storage tanks and related piping may be placed underground at this location. It is typical and customary for the tanks and lines to be supplied and installed by a specialty contractor experienced in such installations. However, appropriate precautions should be observed regarding safety of personnel in excavations, and in protecting the tanks from damage during installation. 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.

Petroleum products are lighter than water. Tanks even completely filled with such products may be buoyant under the influence of high groundwater levels. The excavated tank pits must be protected from accumulating surface runoff and filling during installation, to ensure against floating the empty tanks. For partially or completely filled tanks, buoyant forces are equal to the weight of water displaced by air or product (below the groundwater or free surface), offset by the weight of product and tank.

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. The groundwater observations reported herein should be carefully reviewed by the tank installation contractor in determining anchorage requirements. As stated above, 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. Consequently, the groundwater level may vary seasonally, 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. If water seepage cannot be handled by pumping from sumps, Geo*Consultants* should be contacted for the appropriate dewatering system. Runoff into the excavation at a critical time (empty tanks set and excavation only partially backfilled) represents a critical consideration. Depending upon allocation of liability for protecting the tanks, we suggest considering an equivalent groundwater depth of six (6) feet below the existing surface for ballasting. Below the assumed water surface, the submerged unit weight of 38 pounds per cubic foot should be assumed to be in effect. A safety factor should be applied to the use of these parameters in the calculations for resisting flotation. 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.

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.

De-Watering Excavations:

Some excavations could result in the need to de-water or lower the water table in some areas. The water level should be a minimum of three (3) feet lower than the planned excavation. The design of the de-watering system should be the responsibility of the contractor. Pumping tests should be performed to determine the actual depth and quantity of groundwater. Piezometers should be placed around the planned excavation to determine the actual groundwater levels at the time of construction. If the water level is to be lowered using a sump, the sump should be placed outside of the excavation.

The lowering of the water table may result in a risk of settlement of structures adjacent to or near the excavation. The water level should not be lowered any further than necessary and any adjacent structure should be surveyed and monitored during the entire de-watering process.

Once the excavation has reached the final elevation, the bottom may remain unstable. If desired, the excavation bottom may be lined with a mud slab to provide a firm working surface for the workers and for the placement of the manhole. The mud slab may consist of three to four inches of lean, unreinforced concrete. In lieu of providing a mud slab, the excavation bottom could be reinforced by placing and compacting stone cobbles into the unstable soils to form a false bottom.

Walls Below Grade:

The proposed site grading 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. Retaining 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. In order to utilize the estimated pressures below for a free-draining backfill, the backfill should be placed in a zone starting at the base of the wall and proceeding upward at a 45 degree angle away from the back of the wall.

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)				
Material	Unit Weight (pcf)	Active (Drained)	Passive (Drained)	At-Rest (Drained)
On-Site Lean Clays (CL)	120	100	150	100
On-Site Fat Clays (CH)	120	120	120	120
Silty Sand (SM)	115	45	275	65
Washed, free-draining concrete sand (ASTM 33) (SW or SP)	115	35	375	55
Compacted low swell potential fill (SC or CL)	120	80	175	95

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.

Pavements:

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 no more than 2.0.

The satisfactory performance of pavements for parking and drive areas depends upon several factors including (1) the characteristics of the supporting soil; (2) the magnitude and frequency of wheel load applications; (3) quality of construction materials; (4) the contractor's placement and workmanship abilities, (5) good drainage, and (6) the desired period of design life.

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.

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.

Lime Treatment:

A review of the boring logs indicates that the subgrade below the pavements will consist of highly plastic clays. Normally, these materials are considered to have poor support characteristics for pavements unless they are chemically treated to improve their engineering properties. Generally, soils with a PI value greater than 22 should be either removed to a depth of eight (8) inches and replaced with density approved select fill, or lime-treated as discussed below.

Clayey soils with excessive plasticity are subject to loss in support value with increases in moisture, as well as volumetric changes (shrinking and swelling) accompanying moisture changes. They chemically react with hydrated lime, becoming more stable. Clayey soils should be free of organics and other deleterious materials. Lime treatment should be performed in accordance with the applicable provisions of Section 304 of the *Louisiana Standard Specifications for Roads and Bridges,* 2006 Edition.

A bulk sample of the surficial clays was submitted to the laboratory for testing. Based on the results of our laboratory tests, it appears that the fat clay subgrade should be treated with a minimum of four (4) percent by dry weight of hydrated lime. Assuming an average dry unit soil weight of 95 pounds per cubic foot, the estimated weight of lime for field purposes should be 2.85 pounds per square yard per inch of compacted thickness. A copy of the Using pH to Estimate the Soil-Lime Proportion Requirement for Soil Stabilization is included in the Appendix of this report.

If dusting of dry hydrated lime is anticipated to be problematic, whether due to loss of lime or due to local air emissions restrictions, the lime may be slurried with water and applied, if soil conditions are dry. In wet weather, pelletized quick lime may be used, if appropriate worker safety precautions are followed. The use of quick lime will reduce the amount of lime required by about 20% on a weight basis, as compared to hydrated lime.

The lime-treated clay should be compacted at a moisture content not less than optimum, nor more than four (4) percent above the optimum as defined by ASTM D 698 (Standard Proctor). Compaction should be at least 95 percent of the maximum dry density defined by this standard. The required moisture content and density of the compacted material should be maintained until construction is complete.

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 10 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 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.)

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. It is recommended that such "weakened plane" joints be spaced no more than 15' c-c, or as specified by the structural engineer. Depth of such joints should be 1/3 of the pavement thickness. 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.

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.

MINIMUM PAVEMENT RECOMMENDATIONS *		
Pavement Type	**Light Duty (Parking Lots & Drives)**	**Heavy Duty (Truck Entries & Drives)**
Portland Cement Concrete	6.0" Portland Cement Concrete 8.0" Lime Treated Subgrade or Density Controlled Select Fill	7.0" Portland Cement Concrete 8.0" Lime Treated Subgrade or Density Controlled Select Fill
Asphalt Over Crushed Stone Base	2.0" Item 501 Type 3 Surface 7.0" Item 1003.03 (b) Base 8.0" Lime Treated Subgrade or Density Controlled Select Fill	4.0" Item 501 Type 3 Surface 12.0" Item 1003.03 (b) Base 8.0" Lime Treated Subgrade or Density Controlled Select Fill

Materials in Minimum Pavement Recommendations shall meet general requirements of the Louisiana DOTD Standard Specifications for Construction of Roads & Bridges, and specific requirements listed herein.

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.

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 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 Geo*Consultants* 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. Geo*Consultants* 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
LIME TREATMENT RESULTS

FIELD AND LABORATORY PROCEDURES
FOR
CLECO SITE CERTIFICATION PROGRAM
ALEXANDRIA, LOUISIANA
REPORT NUMBER 05-12-089

I. FIELD OPERATIONS:

Subsurface conditions were defined by four (4) intermittent sample borings drilled on May 18 & 22, 2012 within the project area. Boring locations were selected and stake 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.

A truck-mounted rotary drill rig was used to make the test borings. Each boring was advanced in the dry 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 "Stratum Description" at the bottom 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 found at the bottom of the Log of Boring under "Water Observations, Feet." Soil sloughing from the walls of the boring are also recorded here as depth of cave-in.

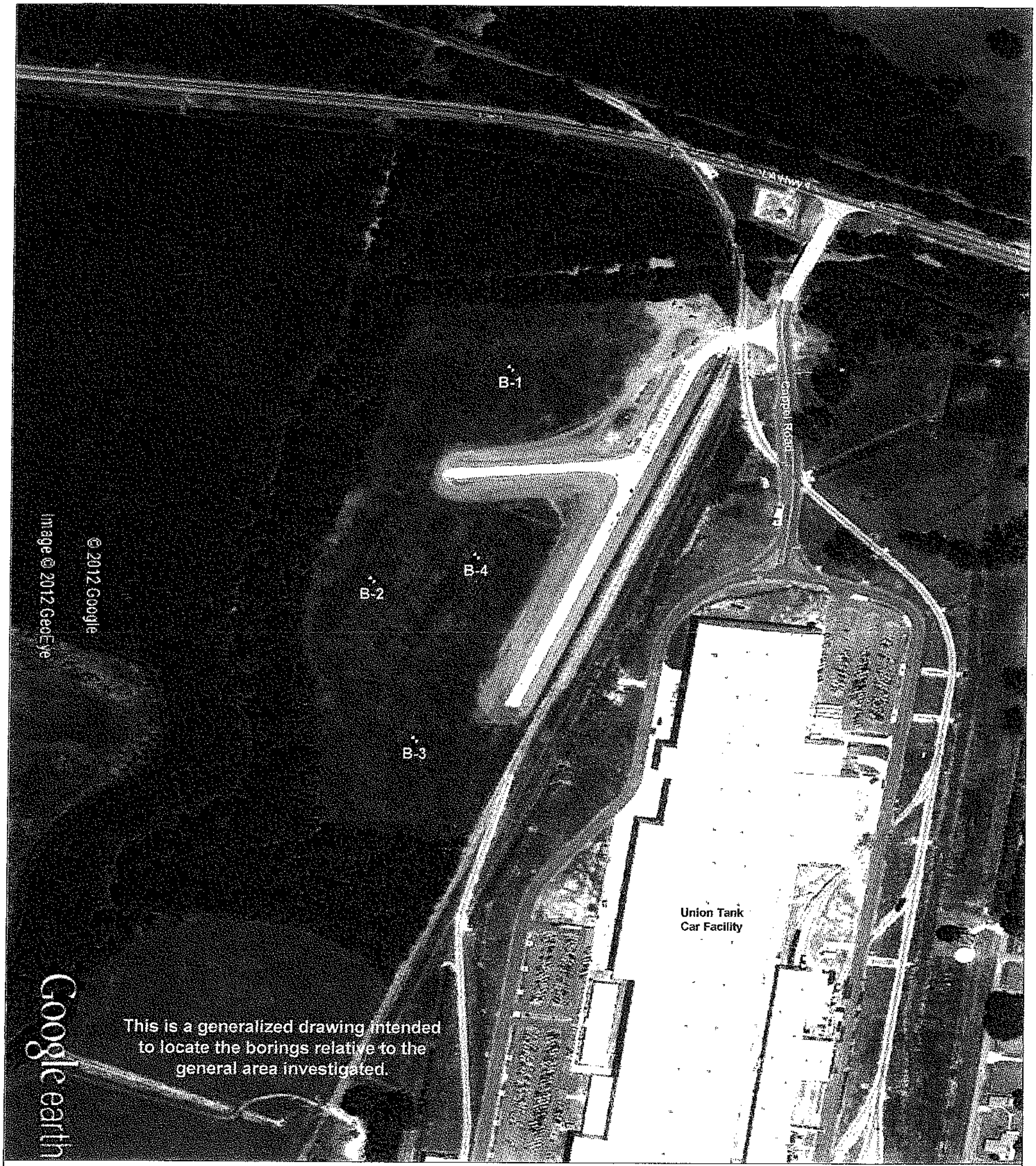
II. LABORATORY STUDIES:

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 ASTM designations are provided below:

Type of Test	Test Designations
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216
Partial Gradation	ASTM D1140
Unconfined Compression Tests	ASTM D2166
Soil-Lime Determination	ASTM D6276-99a

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

(Approximate Scale: 1" = 762')

PROJECT

CLECO Industrial Site Certification Program, Alexandria, Louisiana

DATE	FILE NUMBER	
5/22/2012	05-12-089	***GEOTECHNICAL TESTING LABORATORY, INC.***

N

LOG OF BORING

PROJECT : CLECO Industrial Site Certification Program
BORING No. : B- 1
LOCATION: Alexandria, Louisiana
FILE No. : 05-12-089
CLIENT : EEIDD
DATE : 5/18/12
Sheet 1 of 1

☒ Split Spoon ■ Shelby Tube ▨ No Recovery

DRILL METHOD: Rotary Drill

SURFACE ELEVATION: ND

FIELD DATA				STRATUM DESCRIPTION		LABORATORY DATA						
Depth (Feet)	Samples	Hand Penetrometer (Tons/Sq. Ft.)	Standard Penetration (Blows/Foot)	Graphic Log		Moisture Content (%)	Unit Dry Weight (Lbs./Cu. Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unconfined Compression (Lbs./Sq. Ft.)
	☒		12	▨	Stiff Red LEAN TO FAT CLAY (CL/CH) 1.5'	20		53	24	29	98	
	■	1.50	Push	▨	Stiff Red FAT CLAY (CH) 4.0'	25	91					2825
5	☒		4	▨	Firm Red Silty LEAN CLAY (CL)	23		33	20	13	95	
	☒		3	▨	- soft @ 6.0 FEET	23						
	☒		4	▨	- firm @ 7.5 feet	24		33	21	12	96	
10	☒		5	▨	- w/occasional clayey SILT (CL-ML) layers below 9.0 feet4 12.5'	24						
				▨	Firm Red & Gray FAT CLAY (CH)							
	☒		6	▨		26		68	25	43	99	
15	■	1.25	Push	▨	- stiff @ 16.0 feet	30	92					2269
	■	1.75	Push	▨		30	90					3056
20				▨								
	■	0.75	Push	▨	- firm below 24.0 feet	42	78	93	29	64	99	1297
25				▨								
	■	0.75	Push	▨	30.0'	41	79					1436
30					Water Seepage Noted @ 10.0 Feet While Drilling							
35												

COMPLETION DEPTH, FEET:
30.0

WATER OBSERVATIONS, FEET:
12.0' @ 10 Mins., Caved @ 13.0'

NOTES:
See Plan of Borings for Location
ND = Not Determined
Strata Boundaries May Not Be Exact

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : CLECO Industrial Site Certification Program
BORING No. : B- 2
LOCATION: Alexandria, Louisiana
FILE No. : 05-12-089
CLIENT : EEIDD
DATE : 5/18/12
Sheet 1 of 1

☒ Split Spoon ■ Shelby Tube ▧ No Recovery

DRILL METHOD: Rotary Drill

SURFACE ELEVATION: ND

FIELD DATA				STRATUM DESCRIPTION		LABORATORY DATA						
Depth (Feet)	Samples	Hand Penetrometer (Tons/Sq. Ft.)	Standard Penetration (Blows/Foot)	Graphic Log		Moisture Content (%)	Unit Dry Weight (Lbs./Cu. Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unconfined Compression (Lbs./Sq. Ft.)
	■	1.00	Push	▨	Firm Red FAT CLAY (CH)	28	90					1343
	■	1.00	Push	▨	4.0'	30	85	60	26	34	99	1482
5	☒		1	▧	Very Soft Red Silty LEAN CLAY (CL) w/occasional sandy SILT (ML) layers	26						
	☒		5	▧	- firm below 6.0 feet	24		35	20	15	90	
	☒		5	▧	- w/clayey SILT (CL-ML) layers below 8.0 feet	23						
10				▧	11.0'							
				▨	Stiff Red FAT CLAY (CH)							
	■	1.00	Push	▨		34	83	82	27	55	99	1389
15				▨								
	■	1.25	Push	▨		29	93					1667
20				▨								
	■	1.50	Push	▨	- stiff below 24.0 feet	41	78	86	29	57	99	2408
25				▨								
	■	1.25	Push	▨	30.0'	40	81					2176
30					Water Seepage Noted @ 6.5 Feet While Drilling							
35												

COMPLETION DEPTH, FEET:
30.0

WATER OBSERVATIONS, FEET:
12.5' @ 10 Mins., Caved @ 14.5'

NOTES:
See Plan of Borings for Location
ND = Not Determined
Strata Boundaries May Not Be Exact

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : CLECO Industrial Site Certification Program
BORING No. : B- 3
LOCATION: Alexandria, Louisiana
FILE No. : 05-12-089
CLIENT : EEIDD
DATE : 5/18/12
Sheet 1 of 1

☒ Split Spoon ■ Shelby Tube ◿ No Recovery

DRILL METHOD: Rotary Drill

SURFACE ELEVATION: ND

FIELD DATA				STRATUM DESCRIPTION		LABORATORY DATA						
Depth (Feet)	Samples	Hand Penetrometer (Tons/Sq. Ft.)	Standard Penetration (Blows/Foot)	Graphic Log		Moisture Content (%)	Unit Dry Weight (Lbs./Cu. Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unconfined Compression (Lbs./Sq. Ft.)
	■	3.50	Push	▨	Very Stiff Red FAT CLAY (CH)	24	99	66	27	39	98	7502
	■	1.25	Push	▨	- stiff @ 3.0 feet	27	94					2084
				▨	4.5'							
5	☒		4	▧	Firm Red Silty LEAN CLAY (CL) w/sandy SILT (ML) layers	25						
	☒		5	▧		24		34	18	16	73	
	☒		6	▧		25						
10				▧	11.0'							
				▨	Stiff Red FAT CLAY (CH)							
	■	1.50	Push	▨		27	94	64	26	38	99	2269
15				▨	17.0'							
				▧	Soft Red Silty LEAN CLAY (CL) w/sandy SILT (ML) layers							
	■	0.25	Push	▧		28	91	32	19	13	81	648
20				▧	21.5'							
				▨	Firm Red & Gray FAT CLAY (CH)							
	■	0.75	Push	▨		33	88					1297
25				▨								
	■	1.75	Push	▨	- stiff @ 29.0 feet 30.0'	24	102	61	25	36	99	3612
30					Water Seepage Noted @ 5.5 Feet While Drilling							
35												

COMPLETION DEPTH, FEET:
30.0

WATER OBSERVATIONS, FEET:
5.0' @ 24 Hours, Caved @ 5.5'

NOTES:
See Plan of Borings for Location
ND = Not Determined

Strata Boundaries May Not Be Exact

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : CLECO Industrial Site Certification Program
BORING No. : B- 4
LOCATION: Alexandria, Louisiana
FILE No. : 05-12-089
CLIENT : EEIDD
DATE : 5/21/12
Sheet 1 of 2

☒ Split Spoon ■ Shelby Tube ▨ No Recovery

DRILL METHOD: Rotary Drill

SURFACE ELEVATION: ND

FIELD DATA				STRATUM DESCRIPTION		LABORATORY DATA						
Depth (Feet)	Samples	Hand Penetrometer (Tons/Sq. Ft.)	Standard Penetration (Blows/Foot)	Graphic Log		Moisture Content (%)	Unit Dry Weight (Lbs./Cu. Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unconfined Compression (Lbs./Sq. Ft.)
	■	4.25	Push		Hard Red FAT CLAY (CH)	18	104	59	24	35	98	12873
	■	2.00	Push		- stiff @ 2.0 feet	26	93					3380
					4.5'							
5	☒		5		Loose Red, Slightly Clayey, SILT (CL-ML) w/sand	27		25	19	6	81	
	☒		6			24						
	☒		5			24						
10					11.0'							
					Stiff Red FAT CLAY (CH)							
	■	1.50	Push			29	94	65	27	38	99	2593
15												
	■	1.50	Push			30	94					2362
20												
	■	1.25	Push		- red & gray below 23.0 feet	42	87					2130
25												
	■	2.25	Push			26	99	65	27	38	99	3751
30												
	■	2.00	Push			25	100					3380
35												
					37.0'							
					Medium Dense Yellowish Red Silty SAND (SM)							
	☒		25			24		NP	NP	NP	27	
40												
	☒		33		- dense @ 44.0 feet	26						
45												
	☒		25		- medium dense @ 49.0 feet	24		NP	NP	NP	15	
50												
	☒		38		- dense @ 54.0 feet	22						
55												
					57.0'							
					Firm Red & Gray FAT CLAY (CH)							
	☒		7			33						
60												

Continued Next Page

COMPLETION DEPTH, FEET:
100.0

WATER OBSERVATIONS, FEET:
5.0' @ 30 Minutes, Caved @ 5.5'

NOTES:
See Plan of Borings for Location
ND = Not Determined
Strata Boundaries May Not Be Exact

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : CLECO Industrial Site Certification Program
BORING No. : B- 4
LOCATION: Alexandria, Louisiana
FILE No. : 05-12-089
CLIENT : EEIDD
DATE : 5/21/12
Sheet 2 of 2

☒ Split Spoon ■ Shelby Tube ⧄ No Recovery

FIELD DATA				STRATUM DESCRIPTION		LABORATORY DATA						
Depth (Feet)	Samples	Hand Penetrometer (Tons/Sq. Ft.)	Standard Penetration (Blows/Foot)	Graphic Log	(Continued)	Moisture Content (%)	Unit Dry Weight (Lbs./Cu. Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unconfined Compression (Lbs./Sq. Ft.)
				▨	Firm Red & Gray FAT CLAY (CH)							
	■	1.25	Push	▨		38	83	64	26	38	99	1806
65				▨								
	■	1.50	Push	▨	- STIFF @ 69.0 FEET	30	94					2547
70				▨								
	■	1.50	Push	▨		36	91					2362
75				▨								
	■	2.75	Push	▨	- very stiff below 79.0 feet	30	94	77	28	49	99	5186
80				▨								
	■	2.50	Push	▨	- w/wood @ 84.0 feet	51	81					4492
85				▨								
	■	2.75	Push	▨	- gray @ 89.0 feet	24	104					4677
90				▨								
				▨	93.5'							
	☒		19	⁘	Medium Dense Gray SILTY SAND (SM)	27		NP	NP	NP	22	
95				⁘								
	☒		25	⁘	100.0'	28						
100					Water Seepage Noted @ 6.0 Feet While Drilling							
105												
110												
115												
120												

COMPLETION DEPTH, FEET:
100.0

WATER OBSERVATIONS, FEET:
5.0' @ 30 Minutes, Caved @ 5.5'

NOTES:
See Plan of Borings for Location
ND = Not Determined

Strata Boundaries May Not Be Exact

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

Using pH to Estimate the Soil-Lime Proportion Requirement for Soil Stabilization

Report Date: 5/22/2012 **Sample Date:** 5/18/2012 **Project No:** 05-12-089

Client: EEIDD
C/o Pan American Engineers, Inc.
P.O. Box 89
Alexandria, LA 71309-0089
Attn: Mr. Kyle Randall

Project: CLECO Site Certification Program, Alexandria, Louisiana

Test Method: ASTM D4318; D6276-99a

Scope: This test method provides a means for estimating the soil-lime proportion requirements for stabilization of a soil. The optimum soil-lime proportion is selected by determining the lowest percentage of lime that results in a soil-lime pH of 12.4.

Laboratory Results:

Material Origin	Pavement Subgrade
Material Description	Fat Clay (CH) (A-7-6)
Average Liquid Limit (LL)	62
Average Plasticity Index (PI)	38

Lime Quantity	**2.0%**	**3.0%**	**4.0%**	**5.0%**	**6.0%**
pH Readings	10.87	12.12	12.45	12.56	12.70

Recommended, % by weight:	4.0
Spread Rate:	2.85 pounds per square yard per inch of compacted thickness

Comments: The spread rate is based off of an average dry unit soil weight of 95 pounds per cubic foot.

GEOTECHNICAL TESTING LABORATORY, INC.