Geotechnical Engineering Report

Lake Fork Pavement Reconstruction
Quitman - Tyler - Gladewater, Texas
February 22, 2023
Terracon Project No. CM235000

Prepared for:
Sabine River Authority of Texas
Orange, Texas

Prepared by:
Terracon Consultants, Inc.
Tyler, Texas

February 22, 2023

Sabine River Authority of Texas
P.O. Box 579
Orange, Texas 77632

Attn: Mr. Mark Mann, P.E.
P: (409) 746 2192
E: mmann@sratx.org

Re: Geotechnical Engineering Report
Lake Fork Pavement Reconstruction
Various Locations
Quitman - Tyler - Gladewater, Texas
Terracon Project No. CM235000

Dear Mr. Mann:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCM235000 dated January 7, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning the design and construction of pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
(Texas Firm Registration No. F-3272)

Graham Welch, E.I.T.
Staff Engineer

William M. Martin, P.E, APMP
Senior Geotechnical Engineer

REPORT TOPICS

Note: For interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Lake Fork Pavement Reconstruction

Various Locations

Quitman - Tyler - Gladewater, Texas

Terracon Project No. CM235000

February 22, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed pavement reconstruction to be located at Various Locations in Quitman - Tyler - Gladewater, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of fifteen test borings to a depth of approximately 6 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project comprises of four different sites located in Quitman, Tyler, and Gladewater, Texas. The site locations are described below: **Site No. 1 (LFD Office) – 353 Private Road 5183 Quitman, Texas** ■ GPS: 32.82410°, -95.52734° **Site No. 2 (LFD Cabin) – Pipeline Row Quitman, Texas** ■ GPS: 32.83538°, -95.60943° **Site No. 3 (Hawkins Boat Ramp) – State Park Highway Tyler, Texas** ■ GPS: 32.55895°, -95.20897° **Site No. 4 (Gladewater Boat Ramp) – Highway 271 Gladewater, Texas** ■ GPS: 32.52739°, -94.95874°

Item	Description
Existing Improvements	Existing distressed asphalt pavement at each site
Current Ground Cover	Distressed asphalt pavement
Existing Topography	Based on Google Earth Pro imaging, the topography at each site is described below: ■ **Site No. 1 (LFD Office):** About 27 feet of elevation change across the pavement reconstruction alignment ■ **Site No. 2 (LFD Cabin):** About 14 feet of elevation change across the pavement reconstruction alignment ■ **Site No. 3 (Hawkins Boat Ramp):** About 18 feet of elevation change across the pavement reconstruction alignment ■ **Site No. 4 (Gladewater Boat Ramp):** About 20 feet of elevation change across the pavement reconstruction alignment

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Information	The project consists of the reconstruction of existing asphalt paved two-way single lane roads. The length of roadways that will be reconstructed at each site is as follows: ■ **Site No. 1 (LFD Office):** Reconstruction of about 2,400 linear feet of asphalt pavement ■ **Site No. 2 (LFD Cabin):** Reconstruction of about 1,500 linear feet of asphalt pavement ■ **Site No. 3 (Hawkins Boat Ramp):** Reconstruction of about 600 linear feet of asphalt pavement ■ **Site No. 4 (Gladewater Boat Ramp):** Reconstruction of about 300 linear feet of asphalt pavement

Item	Description
Pavements	We understand the existing asphaltic concrete pavement at each site will be pulva-mixed and overlaid with Type D surface course. Anticipated traffic is as follows: ■ Autos/light trucks: 1,000 vehicles per day ■ Light delivery and trash collection vehicles: 100 vehicles per week ■ Tractor-trailer trucks: <50 vehicles per week The pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and pavement options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile for each site. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel for each site.

GeoModel – Site No.1 (LFD Office – B-O1 through B-O6)

Model Layer	Layer Name	General Description
1	**Asphalt**	Asphalt; approximately 2 to 4 inches thick
2	**Base**	Base; approximately 3 to 7 inches thick
3	**Clay**	Sandy Silty Clay; Lean Clay with various amounts of Sand; Fat Clay with various amounts of Sand; generally soft to very stiff

GeoModel – Site No. 2 (LFD Cabin – B-C1 through BC-4)

Model Layer	Layer Name	General Description
1	**Asphalt**	Asphalt; approximately 1 to 3 inches thick
2	**Base**	Base; approximately 3 to 8 inches thick
3	**Clay**	Lean Clay with various amounts of Sand; Fat Clay with various amounts of Sand; generally soft to very stiff

GeoModel – Site No. 3 (Hawkins Boat Ramp – B-H1 through B-H3)

Model Layer	Layer Name	General Description
1	**Asphalt**	Asphalt; approximately 2 to 3 inches thick
2	**Base**	Base; approximately 3 to 7 inches thick
3	**Sand**	Clayey Sand; generally very loose to loose
4	**Silt**	Sandy Elastic Silt; generally stiff to very stiff
5	**Clay**	Sandy Fat Clay; generally stiff to very stiff

GeoModel – Site No. 4 (Gladewater Boat Ramp – B-G1 and B-G2)

Model Layer	Layer Name	General Description
1	**Asphalt**	Asphalt; approximately 1 to 3 inches thick
2	**Base**	Base; approximately 4 to 12 inches thick
3	**Silt**	Sandy Silt; generally loose
4	**Sand**	Silty Clayey Sand; Poorly Graded Sand with Silt; generally loose to medium dense

Groundwater Conditions

The boreholes were observed while drilling and immediately after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results** and are summarized below.

Site	Boring Number	Approximate Boring Depth (feet) [1]	Approximate Depth to Groundwater while Drilling (feet) [1]	Approximate Depth to Groundwater after Drilling (feet) [1]
LFD Office	B-O1	6	6	6 and open to 6
	B-O2	6	Not observed	Dry and open to 6
	B-O3	6	Not observed	Dry and open to 6
	B-O4	6	Not observed	Dry and open to 6
	B-O5	6	Not observed	Dry and open to 6
	B-O6	6	Not observed	Dry and open to 6
LFD Cabin	B-C1	6	Not observed	Dry and open to 6
	B-C2	6	Not observed	Dry and open to 6
	B-C3	6	Not observed	Dry and open to 6
	B-C4	6	Not observed	Dry and open to 6

1. Below ground surface

Site	Boring Number	Approximate Boring Depth (feet) [1]	Approximate Depth to Groundwater while Drilling (feet) [1]	Approximate Depth to Groundwater after Drilling (feet) [1]
Hawkins Boat Ramp	B-H1	6	Not observed	Dry and open to 6
	B-H2	6	Not observed	Dry and open to 6
	B-H3	6	Not observed	Dry and open to 6
Gladewater Boat Ramp	B-G1	6	Not observed	Dry and open to 6
	B-G2	6	Not observed	Dry and open to 6

1. Below ground surface

The absence of groundwater in most of the borings does not necessarily mean the borings terminated above groundwater, or the water levels summarized above are stable groundwater levels. A relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the pavement may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The final grading plan for each site was not available at the time of this report. That information should be provided to Terracon so that our recommendations can be reviewed and revised if necessitated by the proposed grading plan.

Once any surface material is removed, the near surface soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

We understand the existing asphaltic concrete pavement at each site will be pulva-mixed and overlaid with Type D surface course. The **Pavements** section addresses the design of pavement systems.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Site Preparation

The existing asphalt, base, and possibly a few inches of subgrade soil should be milled and pulva-mixed to a depth of 10 inches and treated with lime-flyash or cement.

Following milling and pulva-mixing existing pavement components, the subgrade should be proofrolled to detect any weak areas. Proofrolling will require temporary blading of pulverized materials to expose the underlying subgrade soils. Weak areas should be either removed and replaced with compacted pavement fill or chemically treated.

Fill Material Types

Fill required to achieve design grade should be classified as pavement fill. Pavement fill is fill material used below pavements. Earthen materials used for fill should meet the following material property requirements:

Soil Type [1]	USCS Classification and Parameters	Acceptable Placement Location
Pavement Fill [2,3]	Clayey Sand (SC) or Sandy Lean Clay (CL) 4≤PI≤25	Recommended for pavement fill. Silty sands and sandy silts are sensitive to moisture content, and might have constructability issues during compaction.

1. Prior to any filling operations, samples of the proposed fill materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. Terracon should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.
2. Imported pavement fill that does not meet the above criteria should not be used, unless approved by the project team.
3. On-site cut soils at this site should not be used as pavement fill, unless approved by the project team.

Fill Compaction Requirements

Pavement fill should meet the following compaction requirements.

Item	Pavement Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used

Item	Pavement Fill
Minimum Compaction Requirements [1, 2, 3]	95% of maximum 98% of maximum below 5-foot depth where fill thickness is greater than 5 feet
Water Content Range [1]	-3% to +3% of optimum

1. Maximum dry density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. High plasticity cohesive fill should not be compacted to more than 100 percent of standard Proctor maximum dry density.
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).

Earthwork Construction Considerations

Shallow excavations required to mitigate weak areas or achieve design grade for the proposed project are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to pavement construction.

During seasons of significant rainfall events, the groundwater table could affect overexcavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

As a minimum, any excavations required to mitigate weak subgrade conditions should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet in pavement areas.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Support characteristics of subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

The project consists of the reconstruction of existing asphalt pavement at each site. The reconstruction may be accomplished by pulva-mixing and chemically treating the existing pavement materials (asphalt, crushed stone base, and possibly a few inches of subgrade soil), then placement of hot mix asphaltic concrete.

Pulva-Mixing

Following pulva-mixing the existing asphalt, underlying pavement materials, and possibly a few inches of subgrade soil to a depth of at least 10 inches, the exposed pavement subgrade should be proof rolled to detect any weak areas. Proof rolling will require temporary blading of pulverized materials to expose the underlying subgrade soils. Weak areas should be either removed and replaced with compacted pavement fill or chemically treated.

Upper subgrade materials in the existing pavement areas are expected to include predominantly a mixture of pulva-mixed asphaltic concrete, base material, and a few inches of underlying native soils. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils.

Lime fly-ash or cement may be used for treatment of the subgrade soils mixed with existing crushed stone base and milled hot mix asphaltic concrete pavement. We recommend that Terracon observe the pulva-mixed material following filling, milling, and grading to the design pavement subgrade elevation in order to determine which type(s) of chemical should be used for treatment. Recommendations and specifications for treatment of the pulva-mixed material with lime fly-ash and cement are presented subsequently in this report.

Pavement Design Parameters

Design of pavements for the project has been based on the guidelines outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993).

The following table summarizes the minimum design ESALs used for the pavement classifications for this project.

Minimum ESAL Values	
Pavement Classification	**Flexible Pavement ESALs**
Heavy Duty	2,500,000
Medium Duty	150,000
Light Duty	30,000

Pavement Section Thicknesses

The following tables provide our recommendations for minimum thicknesses of asphaltic concrete over pulvamixed pavement for different categories of traffic:

Asphaltic Concrete Over Pulvamixed Pavement			
Layer	**Thickness (inches)**		
	Light Duty [1]	**Medium Duty** [1]	**Heavy Duty** [1]
Asphaltic Concrete Surface [2]	2	2.5	3
Chemically Treated Pulvamixed Material	10	10	10

1. See **Project Description** for more specifics regarding anticipated traffic.
2. All materials should meet the current TxDOT Specifications.
   - Asphaltic Surface - TxDOT Item 340, Type D Fine Surface

Pavement Construction Specifications

The following information may be used to prepare technical specifications for construction of the pavement. Specifications referred to herein are the Texas Department of Transportation (TxDOT) 2014 "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges."

Hot Mix Asphaltic Concrete Courses – The asphaltic concrete surface and base courses should be plant mixed, hot laid Types A or D, as appropriate, meeting the specifications requirements in TxDOT Item 340. Specific criteria for the job specifications should include compaction to within an air void range of 5 to 9 percent, calculated using the maximum theoretical gravity mix measured by TxDOT Tex-227-F. The asphalt cement content by percent of total mixture weight should be within ± 0.5 percent asphalt cement from the job mix design.

Chemically Treated Pulva-Mixed Material – If cement treatment is utilized, 3.5 percent cement by dry weight of pulverized material should be mixed into the asphaltic concrete/crushed stone mixture. This percentage is typically equivalent to about 37 pounds cement per square yard per 10-inch depth. Cement treatment can be the source of shrinkage cracks in the treated asphaltic concrete/crushed stone layer, which can reflect through the asphaltic concrete surface. Therefore, the cement treated layer should be microcracked to minimize reflective cracking and improve pavement performance. Microcracking involves application of several vibratory roller passes to the cement treated layer, one to two days after final compaction, to create a fine network of thin cracks. Practical experience has shown that 5 passes of a 12-ton steel wheel roller operating at a speed of about 2 to 3 mph with the vibrator set to maximum amplitude leads to satisfactory results.

The cement and water to be used in the mix as well as cement application, mixing, compaction, finishing, and curing should meet the requirements as specified in TxDOT 2004 Standard Specifications Item 275.

Other preventative measures that should be taken to reduce the likelihood that wide cracks will occur in a cement treated layer are as follows:

- Provide a stress relief layer in the pavement structure to prevent the cracks in the cement treated layer from causing stress concentrations in the asphaltic concrete surface. This can be accomplished by using a bituminous surface treatment (chip seal) between the cement treated layer and the asphaltic concrete surface course.
- Take effective steps for curing immediately after final compaction so that the surface of cement treated layer is moist until a permanent moisture barrier is in place. The moisture barrier can be a bituminous emulsion Prime Coat which should be used to treat the newly constructed surface in accordance with TxDOT 2004 Standard Specifications Item 310.
- Delay paving as long as practical following the placing of the prime coat. The idea is to place the surface layer after most of the shrinkage cracks have already occurred.

Lime-Flyash Treated Pulva-Mixed Material: Low-plasticity soils (Atterberg plasticity index < 15) may be treated with lime-flyash in accordance with TxDOT Item 265. Based on our local experience, we recommend that about 3 percent lime and 7 percent flyash by dry weight be used for planning and estimating. The quantity of lime and flyash required is computed as a percent of dry soil weight, and those percentages are typically equal to about 26 pounds lime and 60 pounds flyash per square yard, per 10-inch depth for treated pulva-mixed material. The subgrade should be compacted to a minimum of 95 percent of the material's maximum dry unit weight as determined by ASTM D 698 Standard Effort at a moisture content within 2 percent of the material's optimum moisture content.

Lime Treated Subgrade: Weak cohesive soils (Atterberg plasticity index > 15) detected during proofrolling may be treated with lime. We recommend that about 5 percent lime by dry weight of soil be used for estimating and planning of subgrade treatment. That amount of lime should be verified by the use of pH tests at the time of construction. Lime treatment of the subgrade soil should be in accordance with provisions of TxDOT Item 260. After the specified initial mixing, moist curing, and final mixing, lime treated subgrade soil should be compacted to at least 95 percent of the material's maximum dry unit weight determined by ASTM D 698 Standard Effort at a moisture content at, or within 4 percent above, the material's optimum moisture content.

Type C quicklime meeting the requirements of TxDOT Item 260 could be used in lieu of hydrated lime. In no case should waste lime or by-product lime material (sometimes called carbide lime or blue lime) be approved for use. The surface of the lime treated subgrade should be protected until the concrete or crushed stone base is placed.

Pavement Drainage

Positive drainage of the construction areas should be maintained at all times. Rainfall and stormwater on the open subgrade soil should be removed immediately. The exposed subgrade soil should not be allowed to dry out or become saturated. Trafficability of raw subgrade soil on this site will be poor if that soil becomes saturated.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase, if applicable.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low-permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge

drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

Pavement Design and Construction Considerations

After the pavement subgrade has been prepared to a firm, unyielding condition, as evidenced by proof rolling, and after any fill has been placed and compacted, we recommend that the top 10 inches of pulva-mixed materials directly beneath the surface course be chemically treated. The 10 inches of chemical treatment is a required part of the pavement design and is not a part of site and subgrade preparation for wet/soft subgrade conditions.

It is possible that new underground utility lines may cross the proposed pavement areas. Settlement of utility line backfill could result in pavement distress and failures. We recommend

that utility trenches in pavement areas be backfilled with cement treated sand in order to reduce the potential for settlement of the backfill.

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Dishing in parking lots surfaced with ACC is usually observed in frequently-used parking stalls (such as near the front of buildings), and occurs under the wheel footprint in these stalls. The use of higher-grade asphaltic cement, or surfacing these areas with PCC, should be considered. The dishing is exacerbated by factors such as irrigated islands or planter areas, sheet surface drainage to the front of structures, and placing the ACC directly on a compacted clay subgrade.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for

third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
6	6	LFD Office pavement reconstruction alignment
4	6	LFD Cabin pavement reconstruction alignment
3	6	Hawkins Boat Ramp pavement reconstruction alignment
2	6	Gladewater Boat Ramp reconstruction alignment

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet). If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using continuous flight augers (solid stem). Three samples were obtained in each boring. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt.

An automatic SPT hammer was used in advancing the split-barrel sampler in all the borings. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT N-values and soil properties are based on the lower efficiency cathead and rope method. The higher efficiency of an automatic SPT hammer affects the SPT N-value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between

samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- Standard Test Method for Determining the Amount of Material Finer than No. 200 Sieve in Soils by Washing

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

EXHIBIT - SITE LOCATION PLAN

Lake Fork Pavement Reconstruction ■ Quitman – Tyler – Gladewater, Texas
February 22, 2023 ■ Terracon Project No. CM235000

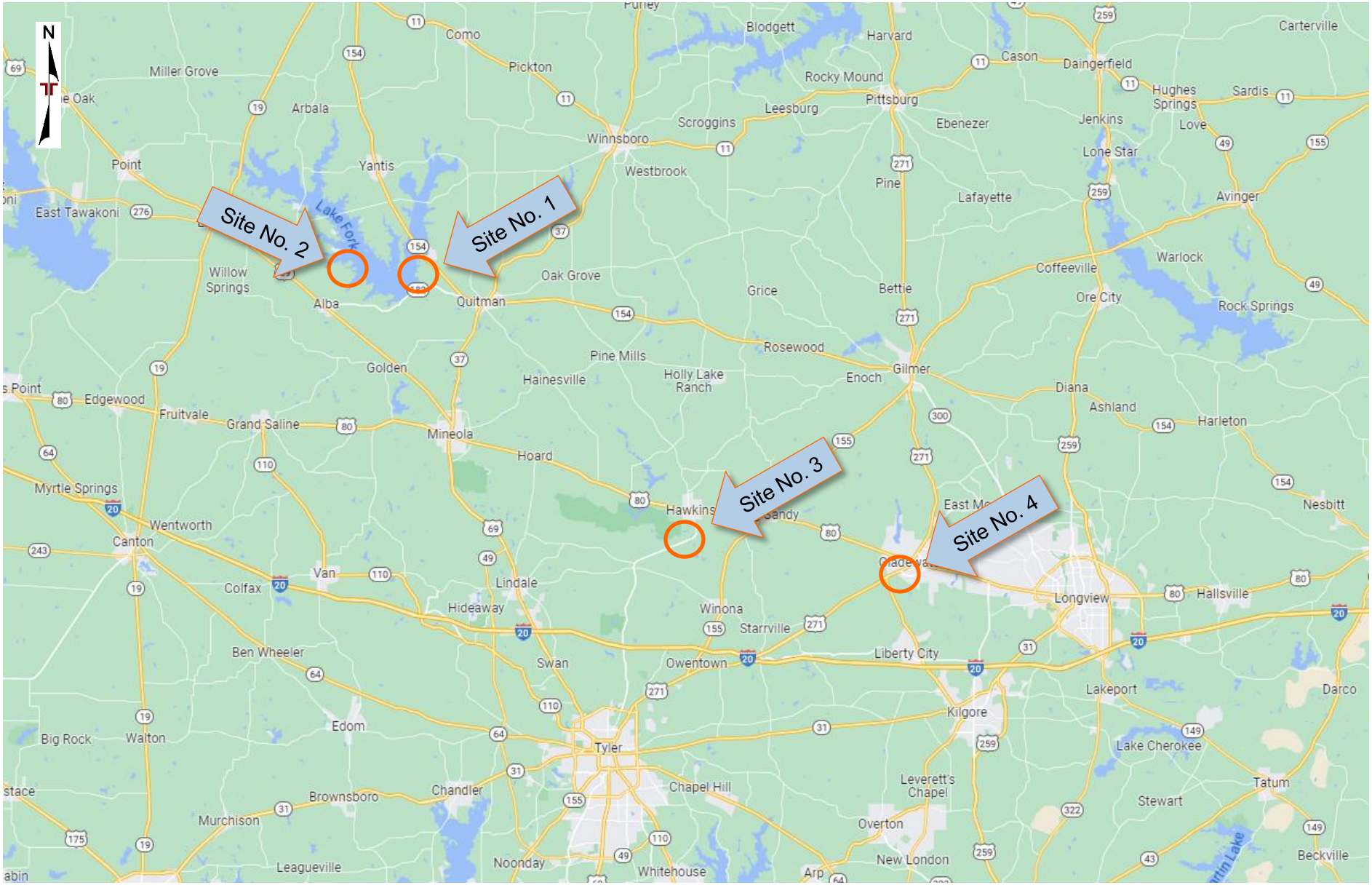


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT – EXPLORATION PLAN (SITE NO. 1 - LFD Office)
Lake Fork Pavement Reconstruction ■ Quitman, Texas
February 22, 2023 ■ Terracon Project No. CM235000

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

EXHIBIT – EXPLORATION PLAN (SITE NO. 2 - LFD Cabin)
Lake Fork Pavement Reconstruction ■ Quitman, Texas
February 22, 2023 ■ Terracon Project No. CM235000

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

EXHIBIT – EXPLORATION PLAN (SITE NO. 3 - Hawkins Boat Ramp)
Lake Fork Pavement Reconstruction ■ Tyler, Texas
February 22, 2023 ■ Terracon Project No. CM235000

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

EXHIBIT – EXPLORATION PLAN (SITE NO. 4 - Gladewater Boat Ramp)
Lake Fork Pavement Reconstruction ■ Gladewater, Texas
February 22, 2023 ■ Terracon Project No. CM235000

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-O1

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8251° Longitude: -95.5245°

Approximate Surface Elev.: 424 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	424+/-											
2		0.5	423.5+/-											
3			**ASPHALT**, approximately 3 inches											
			BASE, approximately 3 inches											
			SANDY SILTY CLAY (CL-ML), brown, soft				4-2-1 N=3				16.6		20-14-6	52
		2.0	422+/-											
			LEAN CLAY WITH SAND (CL), red, tan and gray, medium stiff				1-3-3 N=6							
				5	▽		2-3-5 N=8				24.1		49-24-25	74
		6.0	418+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

▽ *At completion of drilling*

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-O2

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8251° Longitude: -95.5260°

Approximate Surface Elev.: 427 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	426.5+/-											
2		0.7	426.5+/-											
3			**SANDY FAT CLAY (CH)**, brown, red, and gray, soft to very stiff				1-2-2 N=4							
							4-7-10 N=17				17.9		57-21-36	53
		4.0	423+/-											
			SANDY SILTY CLAY (CL-ML), brown, medium stiff	5			5-3-3 N=6							
		6.0	421+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-O3

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8248° Longitude: -95.5272°

Approximate Surface Elev.: 425 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.2	425+/-											
2		0.4	424.5+/-											
3			**ASPHALT**, approximately 2 inches											
			BASE, approximately 3 inches											
			SANDY LEAN CLAY (CL), brown, medium stiff				3-3-4 N=7							
							2-2-3 N=5							
		4.0	421+/-											
			FAT CLAY WITH SAND (CH), red and tan, medium stiff	5			2-3-4 N=7				26.6		91-24-67	81
		6.0	419+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-O4

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8240° Longitude: -95.5283°

Approximate Surface Elev.: 430 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	430+/-											
2		0.8	429.5+/-											
3		2.3	427.5+/-				2-2-2 N=4				25.4		41-22-19	52
							2-2-3 N=5							
				5			2-4-7 N=11							
		6.0	424+/-											

ASPHALT, approximately 3 inches

BASE, approximately 6 inches

SANDY LEAN CLAY (CL), brown and red, soft to medium stiff

FAT CLAY WITH SAND (CH), red, tan, and gray, medium stiff to stiff

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-O5

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8240° Longitude: -95.5273°

Approximate Surface Elev.: 423 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	423+/-											
2		0.5	422.5+/-											
3		2.0	421+/-				2-2-2 N=4							
							2-2-3 N=5				27.1		77-21-56	73
				5			2-4-4 N=8							
		6.0	417+/-											

BASE, approximately 3 inches

SANDY LEAN CLAY (CL), brown and gray, soft to medium stiff

FAT CLAY WITH SAND (CH), red, tan, and gray, medium stiff to stiff

-tan and gray below 4 feet

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-O6

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Office - 353 Private Road 5183
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8228° Longitude: -95.5273°

Approximate Surface Elev.: 408 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	408+/-											
2		0.8	407+/-											
3		2.3	405.5+/-				2-5-7 N=12				24.5		59-24-35	73
							3-6-7 N=13							
				5			5-7-10 N=17							
		6.0	402+/-											

ASPHALT, approximately 3 inches

BASE, approximately 7 inches

FAT CLAY WITH SAND (CH), tan and gray, stiff

SANDY LEAN CLAY (CL), brown, stiff to very stiff

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-C1

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Cabin - Pipeline Row
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8336° Longitude: -95.6101°

Approximate Surface Elev.: 417 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1 2		0.1	417+/-											
		ASPHALT, approximately 1 inch												
		0.8	416.5+/-											
		BASE, approximately 8 inches												
		LEAN CLAY WITH SAND (CL), gray, medium stiff to stiff					2-4-4 N=8				17.3		41-16-25	83
		2.3	414.5+/-											
3		**FAT CLAY WITH SAND (CH)**, gray, medium stiff					2-3-4 N=7							
				5			2-3-4 N=7							
		6.0	411+/-											
		Boring Terminated at 6 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-C2

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Cabin - Pipeline Row
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8351° Longitude: -95.6095°

Approximate Surface Elev.: 407 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.2	407+/-											
2		0.4	406.5+/-											
3		2.0	405+/-				2-6-7 N=13				16.2		55-15-40	86
		6.0	401+/-	5			4-6-10 N=16							
							6-11-16 N=27							

ASPHALT, approximately 2 inches

BASE, approximately 3 inches

FAT CLAY (CH), gray, stiff

FAT CLAY WITH SAND (CH), gray and brown, very stiff

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-C3

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Cabin - Pipeline Row
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8365° Longitude: -95.6093°

Approximate Surface Elev.: 409 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.2	409+/-											
2		**ASPHALT**, approximately 2 inches												
		0.8	408.5+/-											
		BASE, approximately 7 inches												
3		**FAT CLAY WITH SAND (CH)**, gray and tan, very stiff					4-9-11 N=20							
							6-9-10 N=19				14.7		52-15-37	83
				5			6-9-13 N=22							
		6.0	403+/-											
		Boring Terminated at 6 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-C4

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: LFD Cabin - Pipeline Row
Quitman, Texas

LOCATION See Exploration Plan

Latitude: 32.8371° Longitude: -95.6082°

Approximate Surface Elev.: 413 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	413+/-											
2		0.6	412.5+/-											
3		2.0	411+/-				1-1-1 N=2				18.8		24-15-9	73
		6.0	407+/-	5			2-2-4 N=6							
							3-5-6 N=11							

ASPHALT, approximately 3 inches

BASE, approximately 4 inches

LEAN CLAY WITH SAND (CL), brown and gray, soft

FAT CLAY WITH SAND (CH), gray, medium stiff to stiff

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-H1

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: Hawkins Boat Ramp - State Park Highway
Tyler, Texas

LOCATION See Exploration Plan

Latitude: 32.5590° Longitude: -95.2090°

Approximate Surface Elev.: 316 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	316+/-											
2		0.8	315+/-											
3			**ASPHALT**, approximately 3 inches											
			BASE, approximately 7 inches											
			CLAYEY SAND (SC), tan and red, very loose to loose				2-2-3 N=5				17.0		39-14-25	41
			-with iron ore gravel fragments below 2 feet				3-4-3 N=7							
				5			1-1-1 N=2							
		6.0	310+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-H2

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: Hawkins Boat Ramp - State Park Highway
Tyler, Texas

LOCATION See Exploration Plan

Latitude: 32.5593° Longitude: -95.2083°

Approximate Surface Elev.: 308 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.2	308+/-											
2		0.4	307.5+/-											
			ASPHALT, approximately 2 inches											
			BASE, approximately 3 inches											
			SANDY ELASTIC SILT (MH), brown, red, and gray, stiff to very stiff, with iron ore gravel fragments				6-7-3 N=10							
4							2-4-7 N=11				38.1		69-34-35	49
				5			5-10-13 N=23							
		6.0	302+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-H3

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: Hawkins Boat Ramp - State Park Highway
Tyler, Texas

LOCATION See Exploration Plan

Latitude: 32.5594° Longitude: -95.2073°

Approximate Surface Elev.: 297 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	297+/-											
2		0.5	296.5+/-											
5			**ASPHALT**, approximately 3 inches											
			BASE, approximately 3 inches											
			SANDY FAT CLAY (CH), brown and red, stiff to very stiff				3-4-6 N=10				18.9		51-18-33	62
			-with iron ore gravel fragments below 2 feet				4-9-7 N=16							
				5			4-6-12 N=18							
		6.0	291+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 01-30-2023 | Boring Completed: 01-30-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-G1

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: Gladewater Boat Ramp - Highway 271
Gladewater, Texas

LOCATION See Exploration Plan

Latitude: 32.5276° Longitude: -94.9585°

Approximate Surface Elev.: 295 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.1	295+/-											
2			**ASPHALT**, approximately 1 inch **BASE**, approximately 12 inches											
		1.1	294+/-											
3			**SANDY SILT (ML)**, gray, loose				2-3-2 N=5				16.9		20-17-3	56
		2.6	292.5+/-											
4			**SILTY CLAYEY SAND (SC-SM)**, tan, loose to medium dense				3-3-4 N=7							
				5			2-5-7 N=12				14.8		24-17-7	42
		6.0	289+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

BORING LOG NO. B-G2

PROJECT: Lake Fork Pavement Reconstruction

CLIENT: Sabine River Authority of Texas
Orange, Texas

SITE: Gladewater Boat Ramp - Highway 271
Gladewater, Texas

LOCATION See Exploration Plan

Latitude: 32.5272° Longitude: -94.9591°

Approximate Surface Elev.: 278 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1		0.3	278+/-											
2		0.6	277.5+/-											
4			**ASPHALT**, approximately 3 inches											
			BASE, approximately 4 inches											
			SILTY CLAYEY SAND (SC-SM), brown, loose				4-4-3 N=7							
		2.0	276+/-											
			POORLY GRADED SAND WITH SILT (SP-SM), tan, loose				4-5-4 N=9				4.6		NP	10
				5			3-4-5 N=9							
		6.0	272+/-											
			Boring Terminated at 6 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry auger to completion at 6 feet

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Boring elevations obtained from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed while drilling

Dry and open to 6 feet upon completion

Terracon
13145 Kallan Ave
Tyler, TX

Boring Started: 02-03-2023 | Boring Completed: 02-03-2023

Drill Rig: Geoprobe 3100 GT | Driller: J. Lewis

Project No.: CM235000

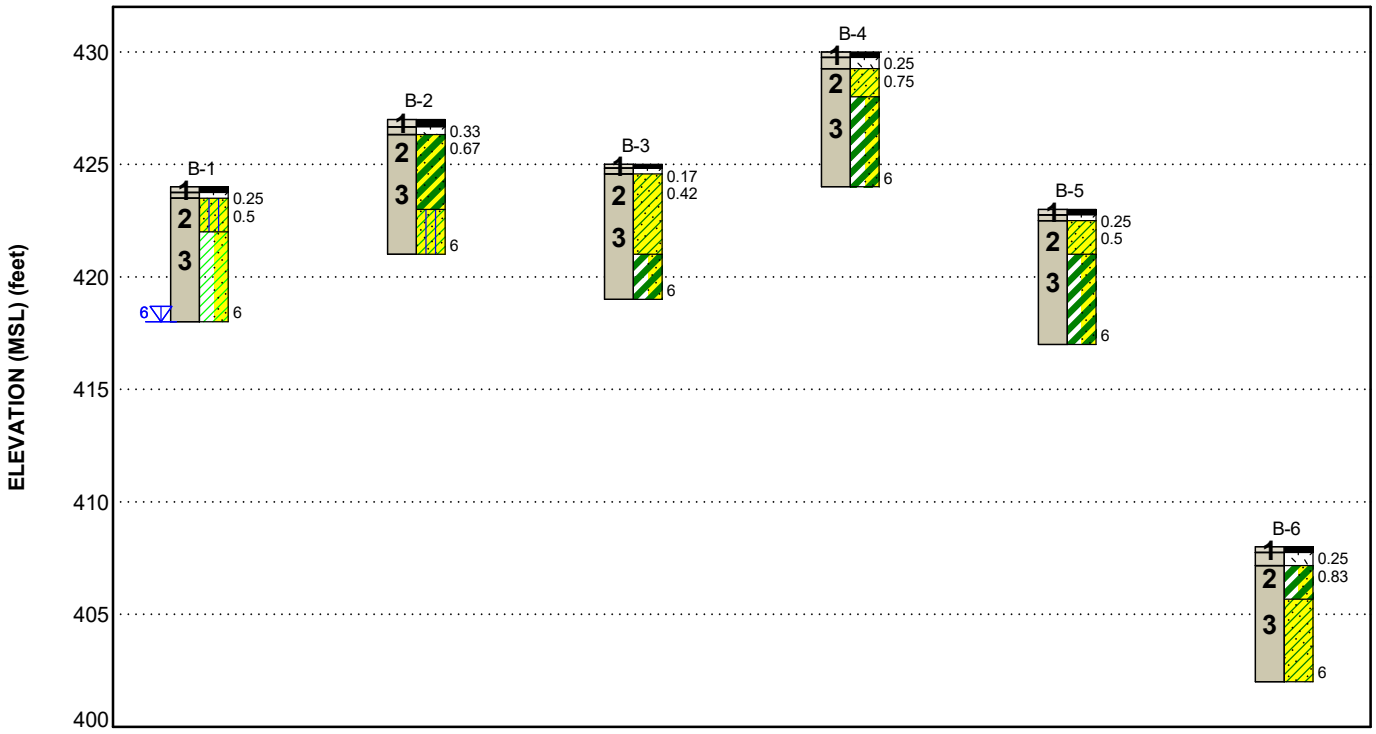
FIGURES

Contents:

Note: All attachments are one page unless noted above.

GEOMODEL - SITE NO. 1 (LFD Office)

Lake Fork Pavement Reconstruction ■ Quitman, Texas
Terracon Project No. CM235000



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions. Approximate boring elevations obtained from Google Earth.

Model Layer	Layer Name	General Description
1	**Asphalt**	Approximately 2 to 4 inches thick
2	**Base**	Aproximately 3 to 7 inches thick
3	**Clay**	Sandy Silty Clay; Lean Clay with various amounts of Sand; Fat Clay with various amounts of Sand; generally soft to very stiff

LEGEND

- Asphalt
- Base
- Sandy Silty Clay
- Lean Clay with Sand
- Sandy Fat Clay
- Sandy Lean Clay
- Fat Clay with Sand

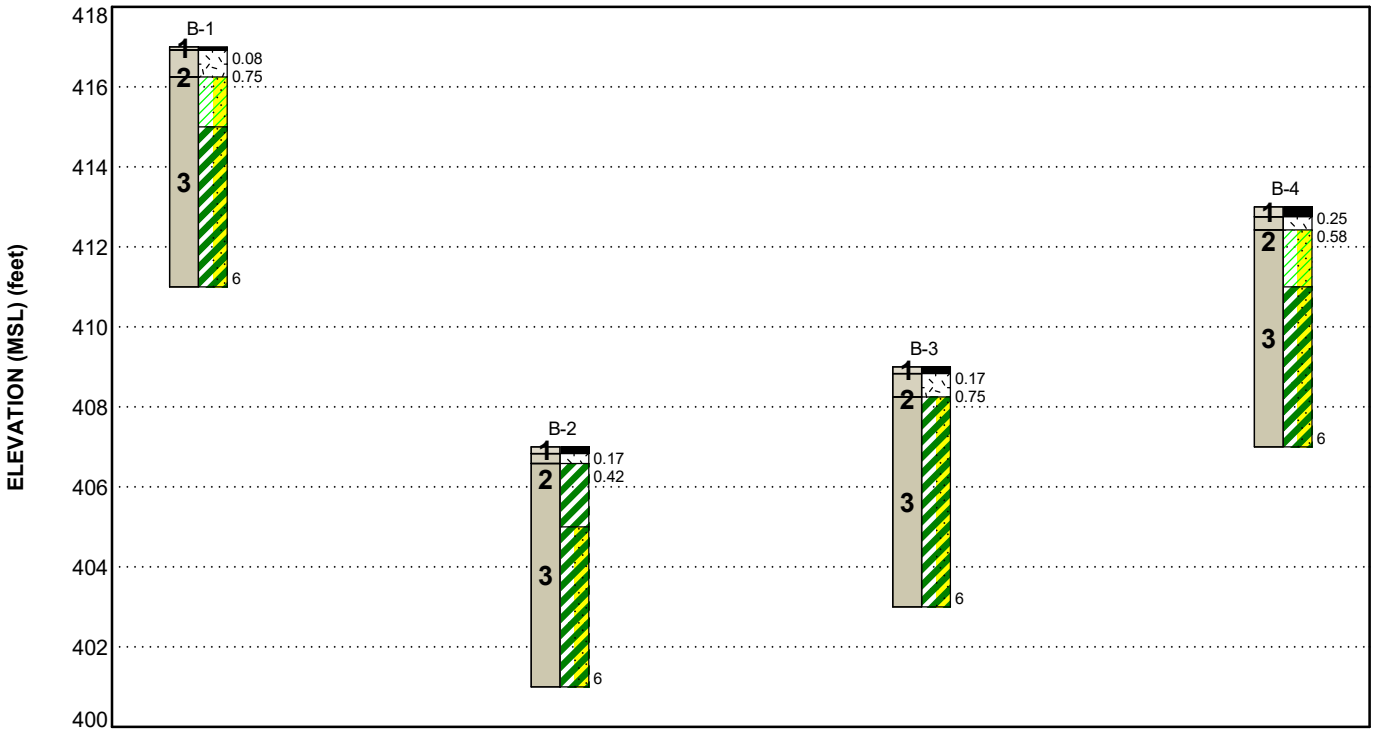
▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL - SITE NO. 2 (LFD Cabin)

Lake Fork Pavement Reconstruction ■ Quitman, Texas
Terracon Project No. CM235000



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions. Approximate boring elevations obtained from Google Earth.

Model Layer	Layer Name	General Description
1	**Asphalt**	Approximately 1 to 3 inches thick
2	**Base**	Aproximately 3 to 8 inches thick
3	**Clay**	Lean Clay with various amounts of Sand; Fat Clay with various amounts of Sand; generally soft to very stiff

LEGEND

- Asphalt
- Base
- Lean Clay with Sand
- Fat Clay with Sand
- Fat Clay

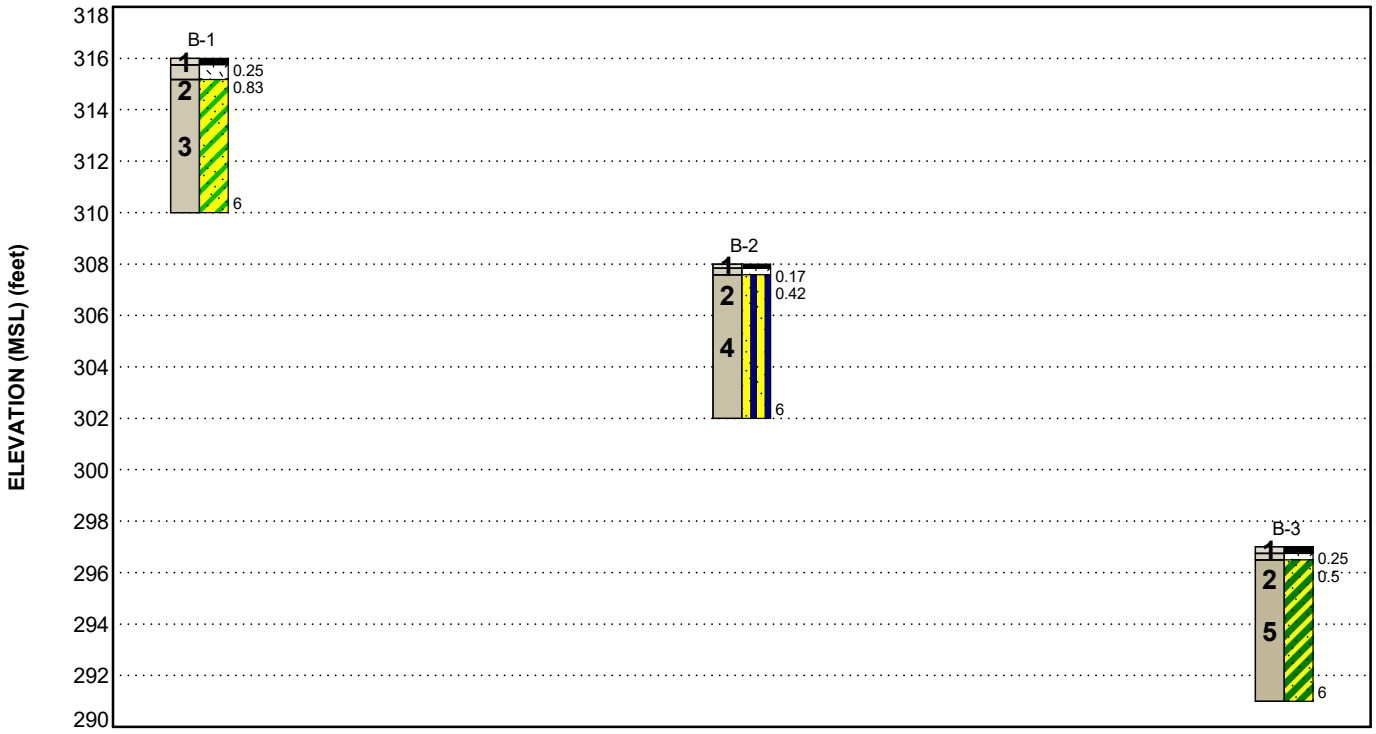
▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL - SITE NO. 3 (Hawkins Boat Ramp)

Lake Fork Pavement Reconstruction ■ Tyler, Texas
Terracon Project No. CM235000



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions. Approximate boring elevations obtained from Google Earth.

Model Layer	Layer Name	General Description
1	**Asphalt**	Approximately 2 to 3 inches thick
2	**Base**	Aproximately 3 to 7 inches thick
3	**Sand**	Clayey Sand; generally very loose to loose
4	**Silt**	Sandy Elastic Silt; generally stiff to very stiff
5	**Clay**	Sandy Fat Clay; generally stiff to very stiff

LEGEND

- Asphalt
- Base
- Clayey Sand
- Sandy Elastic Silt
- Sandy Fat Clay

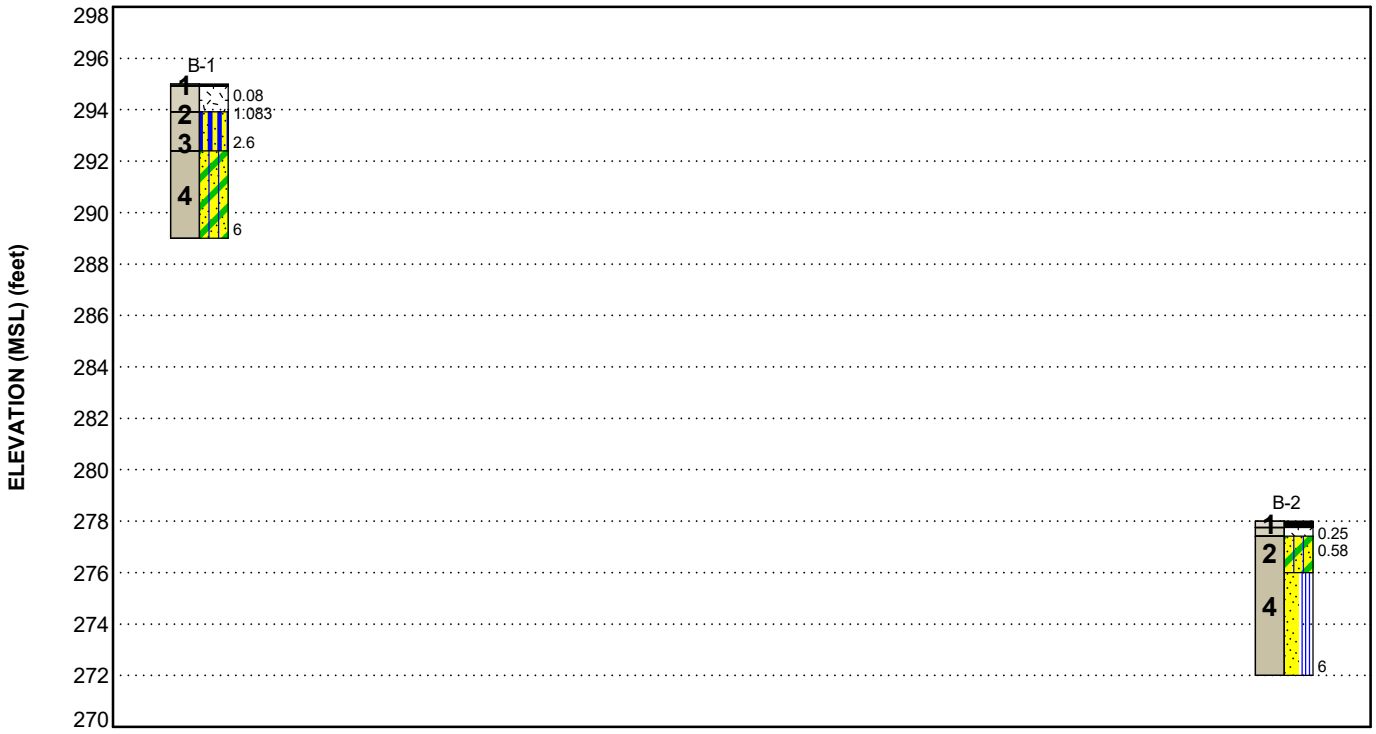
▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL - SITE NO. 4 (Gladewater Boat Ramp)

Lake Fork Pavement Reconstruction ■ Gladewater, Texas
Terracon Project No. CM235000



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions. Approximate boring elevations obtained from Google Earth.

Model Layer	Layer Name	General Description
1	**Asphalt**	Approximately 1 to 3 inches thick
2	**Base**	Aproximately 4 to 12 inches thick
3	**Silt**	Sandy Silt; generally loose
4	**Sand**	Silty Clayey Sand; Poorly Graded Sand with Silt; generally to loose to medium dense

LEGEND

- Asphalt
- Base
- Sandy Silt
- Silty Clayey Sand
- Poorly-graded Sand with Silt

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Lake Fork Pavement Reconstruction ■ Quitman - Tyler - Gladewater, Texas

February 22, 2023 ■ Terracon Project No. CM235000

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Shelby Tube Standard Penetration Test	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.