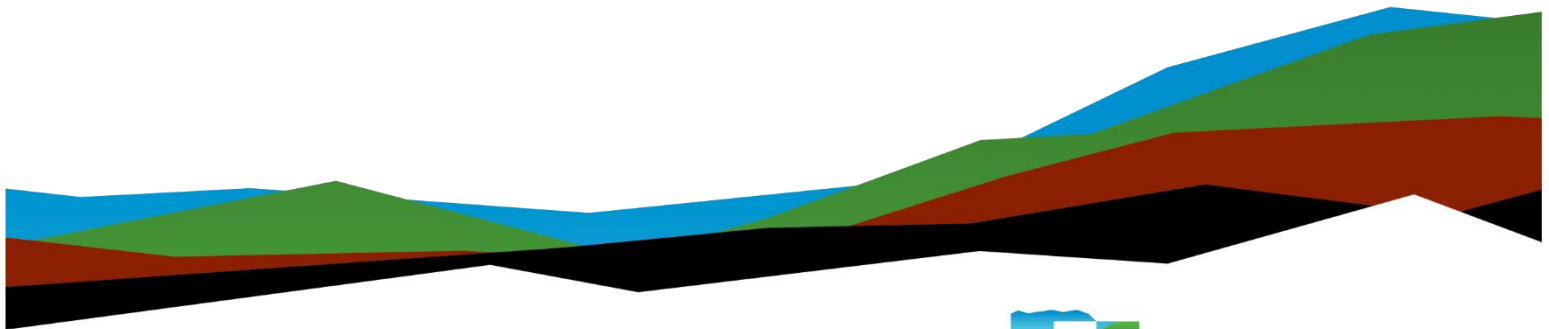


# Athens Estates Pavement Geotechnical Engineering Report

January 21, 2025 | Terracon Project No. CM245107

## Prepared for:

L.R. Land Company Ltd.  
P.O. Box 425  
Terrell, Texas



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January 21, 2025

L.R. Land Company Ltd.  
P.O. Box 425  
Terrell, Texas

Attn: Mr. Kenneth Lane  
P: (817) 583 1799  
E: kenneth@lrlandco.com

Re: Geotechnical Engineering Report  
Athens Estates Pavement  
311 Wood Street  
Athens, Texas  
Terracon Project No. CM245107

Dear Mr. Lane:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. PCM245107 dated December 17, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and 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**  
(Texas Firm Registration No. F-3272)



A handwritten signature in cursive script that reads "Sutton Spencer".

Sutton Spencer, E.I.T.  
Staff Engineer

A handwritten signature in cursive script that reads "Will. M. Martin".

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



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- Exploration and Testing Procedures
- Site Location and Exploration Plans
- Exploration and Laboratory Results
- Supporting Information

**Note:** This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  Terracon logo will bring you back to this page. For more interactive features, please view your project online at [client.terracon.com](http://client.terracon.com). Refer to each individual Attachment for a listing of contents.

## Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Athens Estates Pavement project to be located at 311 Wood Street in Athens, Texas. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

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

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the [Site Location](#) and [Exploration Plan](#), respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the [Exploration Results](#) section.

## 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                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Description</b> | The project consists of the construction of about 6,000 linear feet of residential street. We understand our scope of services are limited to the residential streets planned for the project as described herein.                                                                                                                                                                                                                                          |
| <b>Pavements</b>           | We assume both rigid (concrete) and flexible (asphalt) pavement sections will be considered for the planned pavement. We understand that the traffic classification will consist of: <ul style="list-style-type: none"><li>■ Autos and pickup trucks: 1,000 vehicles per day</li><li>■ Light delivery and trash collection vehicles: 10 per week</li><li>■ Tractor-trailer trucks: &lt; 5 trucks per week</li></ul> The pavement design period is 20 years. |

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

## 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                                                                                                                                                    |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Parcel Information</b>    | The project is located at 311 Wood Street in Athens, Texas.<br>Latitude/Longitude (approximate): 32.2110°, -95.8381°                                           |
| <b>Existing Improvements</b> | Undeveloped land                                                                                                                                               |
| <b>Current Ground Cover</b>  | Scattered tree coverage, grass, and exposed subgrade soil                                                                                                      |
| <b>Existing Topography</b>   | Based on a preliminary grading plan, the site topography slopes from El. 490 feet in the southeast corner of the site to El. 460 feet in the northwest corner. |

## 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 the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

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

| Model Layer | Layer Name | General Description                                                                   |
|-------------|------------|---------------------------------------------------------------------------------------|
| 1           | Sand       | Silty sand, clayey sand, and silty-clayey sand:<br>Generally very loose to very dense |
| 2           | Clay       | Lean clay with varying amounts of sand:<br>Generally soft to hard                     |

## Groundwater Conditions

The boreholes were observed while drilling and immediately after completion for the presence and level of groundwater. However, groundwater was not observed in the borings while drilling or immediately after completion of drilling.

The absence of groundwater in 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.

Mapping by the NRCS indicates that shallow groundwater may be encountered on a seasonal basis with a minimum depth of about 4 to 6.5 feet. 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 structure 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

A preliminary grading plan dated November 2024 was provided. If any changes are made to the grading plan, Terracon should be notified so that our recommendations can be reviewed and revised, if needed.

If the existing surface material is removed, then the near surface soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be established 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.

A rigid or flexible pavement system may be used for this site. The [Pavements](#) section addresses the design of pavement systems.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the [Exploration Results](#)), engineering analyses, and our current understanding of the proposed project. The [General Comments](#) section provides an understanding of the report limitations.

## Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for pavements.

### Site Preparation

Prior to placing fill, existing vegetation, topsoil, root mats, and all loose soil should be removed. Complete stripping of the topsoil should be performed in the proposed pavement areas.

The subgrade should be proof rolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proof rolling should be performed under the observation of the Geotechnical Engineer or representative. All our borings drilled at the project site indicate very weak soil within the upper 2 to 6 feet across the site. Areas excessively deflecting under the proof roll should be delineated and subsequently addressed on a case by case basis by the Geotechnical Engineer. Such areas should either be removed or modified by stabilizing with lime or lime-flyash. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Weak soils that extend below 2 feet over large areas may require additional overexcavation and/or bridging to provide a working platform for subsequent fill placement at a depth of 2 feet. Methods of subgrade improvement, as described below, could include removal of unstable materials and replacement with pavement or other granular fill (with or without geosynthetics), bridging with crushed stone or chemical stabilization. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during

warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

In areas where weak soil extends below 2 feet, after removal of at least 2 feet of existing weak soils, the exposed subgrade could be bridged using one of the methods outlined below.

- **Crushed Stone** - The use of crushed stone or crushed gravel is a common procedure to improve subgrade stability. One additional foot of undercut may be required below the bottom of the excavation to facilitate placement of 12-inches of crushed stone. A test strip could be used to indicate the thickness of crushed stone required to provide a suitable working platform. The use of high modulus geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the fabric or geogrid, we recommend that all below grade construction, such as utility line installation, be completed to avoid damaging the fabric or geogrid. Equipment should not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1-1/2 inches.
- **Chemical Modification** - Improvement of subgrades with portland cement. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, the presence of sulfates in the soil, and freeze-thaw durability of the subgrade.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the subsurface conditions are exposed.

If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

## Excavation

We anticipate that excavations for the proposed pavement can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly

cleaned of loose soils and disturbed materials prior to backfill placement and/or construction. See **Earthwork Construction Considerations** for additional information pertaining to excavations.

## Fill Material Types

Fill required to achieve design grade should be classified as pavement fill. Pavement fill is material used below pavements.

**Imported Fill Materials:** Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris.

| Soil Type <sup>1</sup> | USCS Classification and Parameters                                 | Acceptable Placement Location                                                                                                                   |
|------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Pavement Fill          | Clayey Sand (SC)<br>or Sandy Lean Clay (CL)<br>$4 \leq PI \leq 25$ | Recommended for fill beneath pavements. Silty soils are sensitive to moisture content and might have constructability issues during compaction. |

1. Pavement fill should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

**Reuse of On-Site Soil:** Qualifying near surface excavated on-site soil (clayey sand) may be selectively reused as pavement fill provided the material is free of organic matter and is evaluated prior to use.

## Fill Placement and Compaction Requirements

Pavement fill should meet the following compaction requirements.

| Item                                                    | Pavement Fill                                                                                                                                                                                             |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Maximum Lift Thickness</b>                           | 8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used<br>4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used |
| <b>Minimum Compaction Requirements <sup>1,2,3</sup></b> | 95% of maximum<br>98% of maximum below 5-foot depth where fill thickness is greater than 5 feet                                                                                                           |

| Item                                    | Pavement Fill         |
|-----------------------------------------|-----------------------|
| <b>Water Content Range</b> <sup>1</sup> | -3% to +3% of optimum |

1. Maximum 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% 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). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

## Earthwork Construction Considerations

Shallow excavations are expected 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 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 desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompact prior to pavement construction.

During seasons of significant rainfall, the groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps may be necessary to achieve the recommended depth of overexcavation depending on groundwater conditions at the time of construction. Groundwater should be maintained at least 2 feet below the bottom of excavations to help maintain stability during construction.

As a minimum, excavations 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.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

## Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation and topsoil), evaluation and remediation of any existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended 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. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

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.

## Subgrade Soil Treatment

Pavement design grades may require cuts and fills. Following stripping and cutting to design grade, and prior to placement of any fill, the pavement subgrade should be proof rolled to detect any soft areas. After design subgrade elevation is achieved by cutting and filling, we recommend that the top 12 inches of the finished subgrade soils directly beneath the pavement be chemically treated. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. We recommend that Terracon observe the subgrade soils following cut and fill to the design pavement subgrade elevation in order to determine the type of chemical(s) that would be the most appropriate for treatment of the subgrade soil. We anticipate that lime or lime-flyash would be the most appropriate chemicals for treatment of the upper pavement subgrade soils that exist at this site. Recommended specifications for treatment of the subgrade soil with lime and lime-flyash 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 | Rigid Pavement ESALs |
| Heavy Duty              | 2,500,000               | 3,250,000            |
| Medium Duty             | 150,000                 | 250,000              |
| Light Duty              | 30,000                  | 50,000               |

## Pavement Section Thicknesses

The following table provides our opinion of minimum thickness for AC sections:

| Asphaltic Concrete Design               |                         |                          |                         |
|-----------------------------------------|-------------------------|--------------------------|-------------------------|
| Layer                                   | Thickness (inches)      |                          |                         |
|                                         | Light Duty <sup>1</sup> | Medium Duty <sup>1</sup> | Heavy Duty <sup>1</sup> |
| Asphaltic Concrete Surface <sup>2</sup> | 2                       | 3                        | 2.5                     |
| Asphaltic Concrete Base <sup>2</sup>    | 0                       | 0                        | 5                       |
| Aggregate Base <sup>3</sup>             | 6                       | 7                        | 8                       |
| Chemically Treated Subgrade Soil        | 12                      | 12                       | 12                      |

1. See [Project Description](#) for more specifics regarding traffic assumptions.
2. All materials should meet the current TxDOT specifications.
  - Asphaltic Surface – TxDOT Item 340, Type D Fine Surface
  - Asphaltic Base – TxDOT Item 340, Type B Fine Base
3. Aggregate base per TxDOT Item 247, Grades 1 or 2.

The following table provides our estimated minimum thickness of PCC pavements.

| Portland Cement Concrete Design       |                         |                          |                           |
|---------------------------------------|-------------------------|--------------------------|---------------------------|
| Layer                                 | Thickness (inches)      |                          |                           |
|                                       | Light Duty <sup>1</sup> | Medium Duty <sup>1</sup> | Heavy Duty <sup>1,3</sup> |
| Portland Cement Concrete <sup>2</sup> | 5                       | 6                        | 8                         |
| Chemically Treated Subgrade Soil      | 12                      | 12                       | 12                        |

1. See [Project Description](#) for more specifics regarding traffic classifications.
2. All materials should meet the current TxDOT specifications.
  - Concrete Pavement – TxDOT Item 360, minimum 28-day compressive strength of 4,000 psi
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g. dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.

## 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."

Asphaltic Concrete: We recommend that the hot mix asphaltic concrete surface comply with the requirements of Type D Fine Surface, Item 340 of the previously-noted TxDOT Specifications. Asphaltic concrete base should comply with the requirements of Type B Fine Base, Item 340. This asphaltic concrete should be compacted so that the air voids content is within the range recommended in the applicable specification.

Aggregate Base: We recommend that aggregate base meet the requirements of Type A, Grades 1 or 2 crushed aggregate, Item 247 of the TxDOT Specifications. This material should be compacted to at least 95 percent of the material's maximum dry unit weight determined by ASTM D 1557 Modified Effort. Moisture content should be maintained within 3 percent of the material's optimum moisture content. Crushed stone base should be placed directly on the chemically treated subgrade. After compaction, the base should be protected until the asphalt surface is constructed.

Lime-Flyash Treated Subgrade: 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 2 percent lime and 8 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 21 pounds lime and 86 pounds flyash per square yard, per 12-inch depth. 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: Cohesive soils (Atterberg plasticity index  $\geq 15$ ) may be treated with lime. We recommend that about 5 percent lime by dry weight of soil (equal to about 54 pounds per square yard per 12-inch depth) 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.

Portland Cement Concrete Surface: Portland cement concrete pavement surfacing should be constructed directly on the chemically treated subgrade soil. Concrete for the

pavement should be designed for a 28-day compressive strength of 4,000 pounds per square inch. An air entraining admixture is recommended to increase durability of the concrete. Item 360 of the TxDOT Specifications may be used as a technical specification for reinforced concrete pavement.

Steel reinforcement will not prevent the concrete pavement from cracking. Nevertheless, we recommend that steel reinforcement be used to help hold cracks together. Guidelines developed by the American Concrete Institute may be used to prepare technical specifications for steel reinforcement.

Concrete pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with American Concrete Institute (ACI 330R-01 and ACI 325R.9-91). PCC pavements should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330R-01. A sand leveling course beneath concrete pavements should not be permitted.

Where practical, we recommend early-entry cutting of crack-control joints in concrete pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

## 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 upkeep should be anticipated. 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. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation 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 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 12 inches of the finished subgrade soils directly beneath the pavement be chemically treated. The 12 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.

Pavement design methods are intended to provide structural sections with adequate thickness over a subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of a potentially expansive clay subgrade such as the soils encountered at this site. 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. It is, therefore, important to minimize moisture changes in the subgrade to reduce shrink/swell movements.

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. 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 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 effect 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. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. 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.

## Geotechnical Engineering Report

Athens Estates Pavement | Athens, Texas

January 21, 2025 | Terracon Project No. CM245107

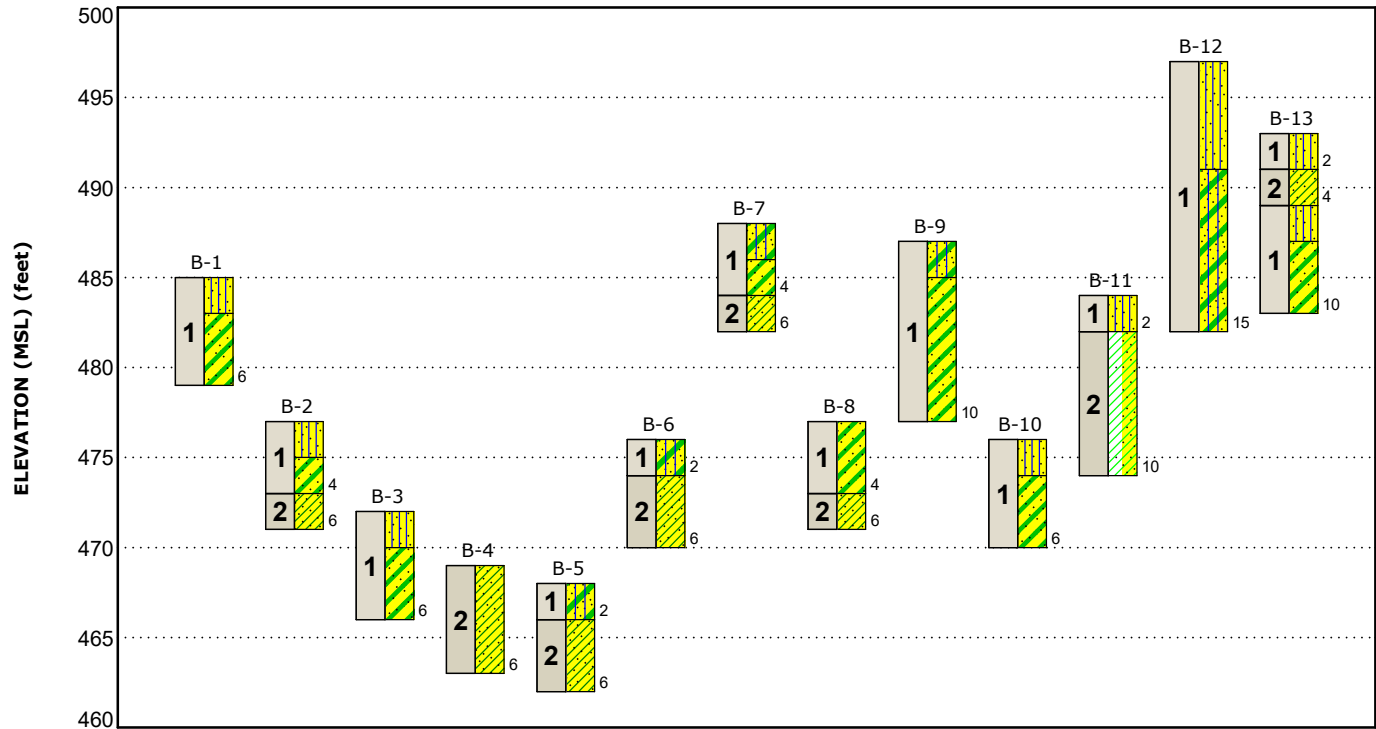


# Figures

## Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name | General Description                                                      | Legend              |                   |
|-------------|------------|--------------------------------------------------------------------------|---------------------|-------------------|
| 1           | Sand       | Silty sand, clayey sand, and silty-clayey sand: very loose to very dense | Silty Sand          | Clayey Sand       |
| 2           | Clay       | Lean clay with varying amounts of sand: soft to hard                     | Sandy Lean Clay     | Silty Clayey Sand |
|             |            |                                                                          | Lean Clay with Sand |                   |

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.

## Geotechnical Engineering Report

Athens Estates Pavement | Athens, Texas

January 21, 2025 | Terracon Project No. CM245107



## Attachments

# Exploration and Testing Procedures

## Field Exploration

| Boring Designation       | Approximate Boring Depth (feet) | Location                                                        |
|--------------------------|---------------------------------|-----------------------------------------------------------------|
| B-1 through B-8 and B-10 | 6                               | Along Proposed Road Alignment (Approximately 6,000 linear feet) |
| B-9 & B-11               | 10                              |                                                                 |
| B-12                     | 15                              |                                                                 |

**Boring Layout and Elevations:** Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth. If more precise elevations and a more precise boring layout are desired, we recommend borings be surveyed.

**Subsurface Exploration Procedures:** We advanced the borings with a truck-mounted, rotary drill rig using continuous flight augers (solid stem). Five 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 is 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. For safety purposes, all borings were backfilled with auger cuttings after their completion and capped with asphalt as applicable.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was not observed at these times in the boreholes.

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 observed 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. The laboratory testing program included the following types of tests:

- Moisture Content
- Percent Passing No. 200 Sieve
- Atterberg Limits

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

## Site Location and Exploration Plans

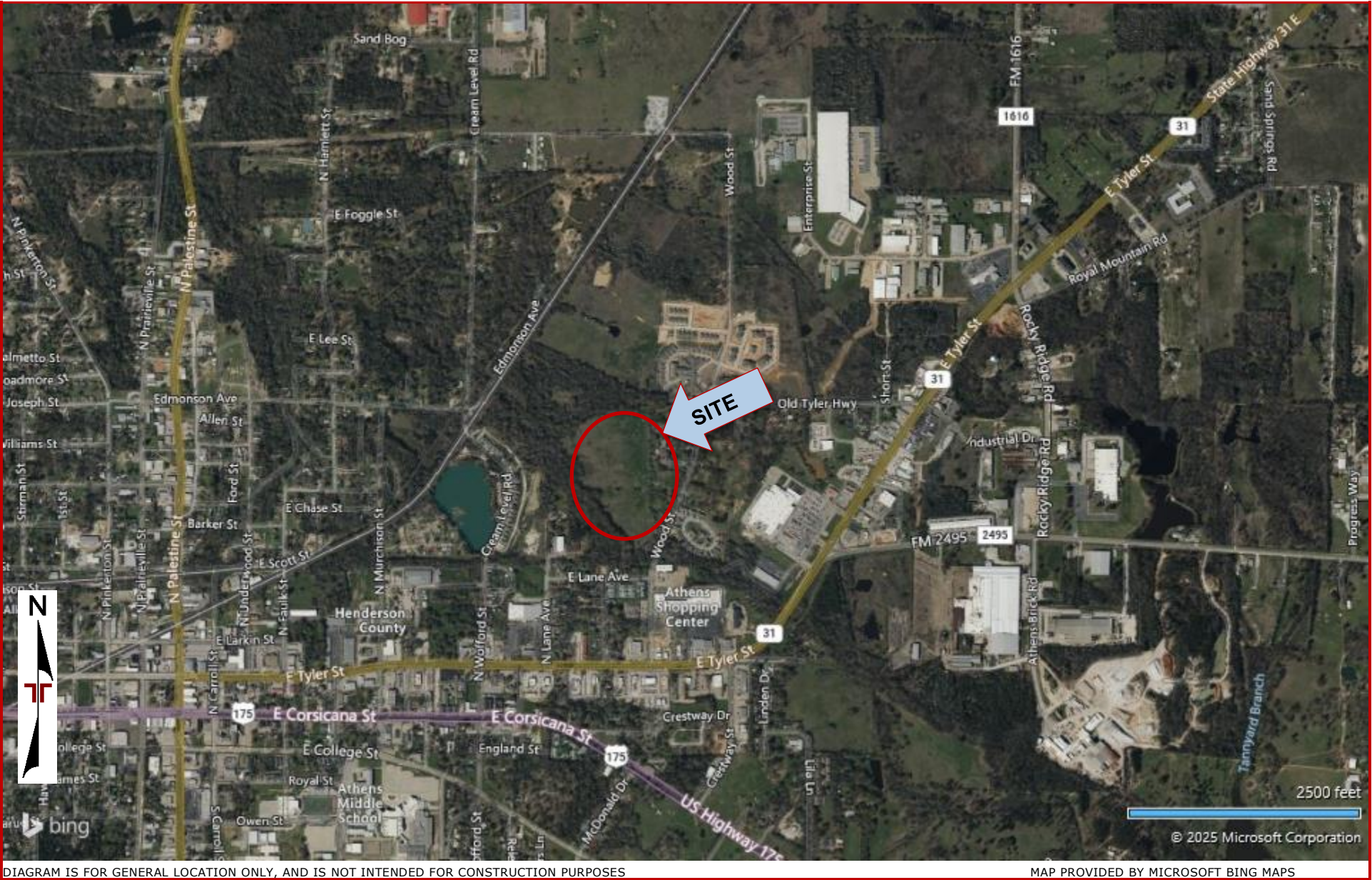
### **Contents:**

Site Location Plan

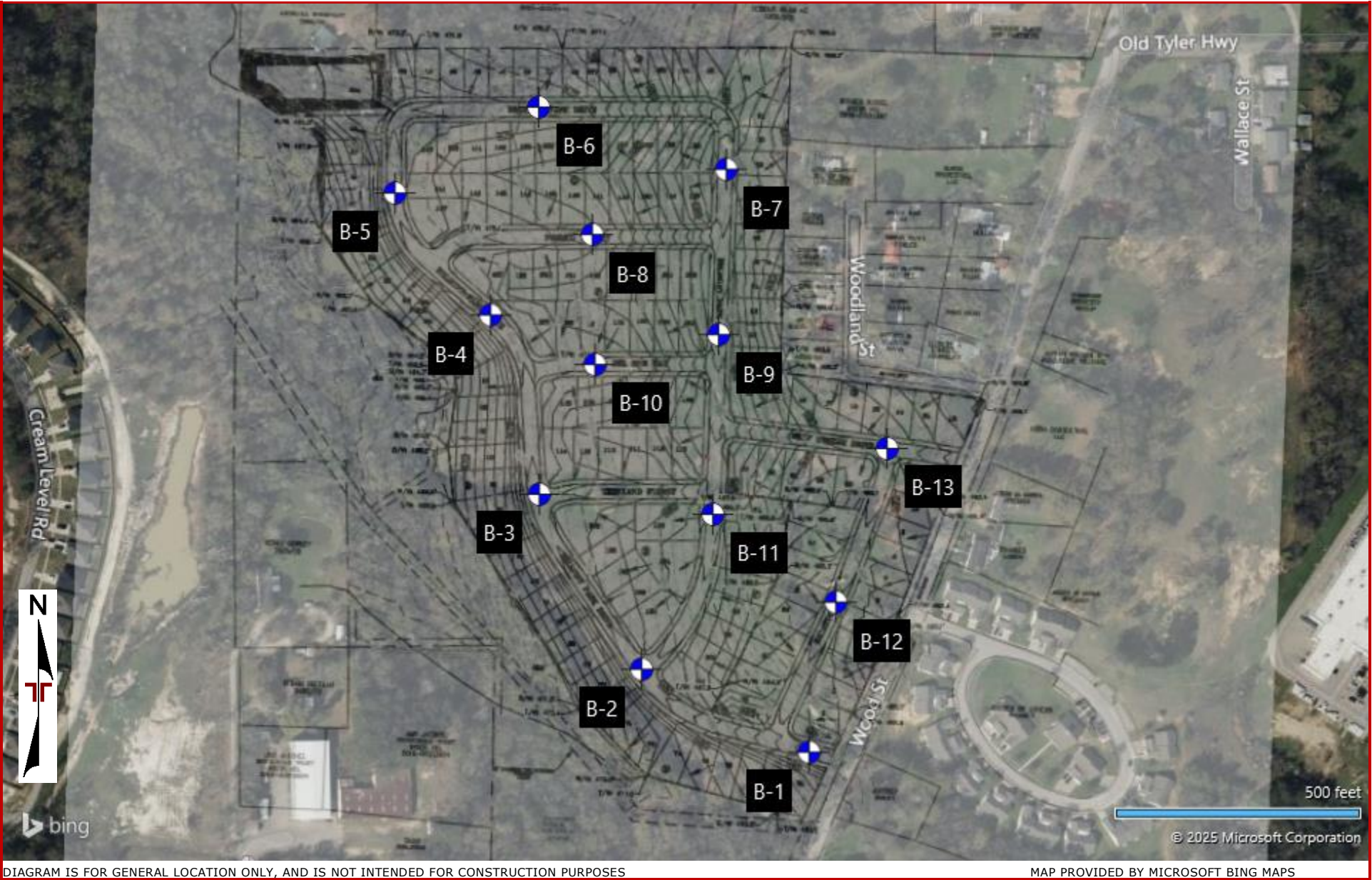
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location



Exploration Plan



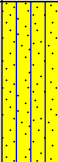
## **Exploration and Laboratory Results**

### **Contents:**

Boring Logs (B-1 through B-13)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2095° Longitude: -95.8371°<br>Depth (Ft.) Approximate Elevation: 485 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type                                                                       | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------------------------------------------------------------------------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY SAND (SM)</b> , tan, very loose, with organics and roots                                                         | 2.0         | 483                      |  | 0-2-0<br>N=2       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   | 7-9-9<br>N=18      |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   | 9-10-10<br>N=20    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |  | <b>CLAYEY SAND (SC)</b> , tan and red, medium dense                                                                       | 6.0         | 479                      |  |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                        |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |

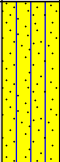
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | Water Level Observations<br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | Drill Rig<br>Geoprobe 3100gt<br><br>Hammer Type<br>Automatic<br><br>Driller<br>B. Reed<br><br>Logged by<br>O. Perez<br><br>Boring Started<br>12-20-2024<br><br>Boring Completed<br>12-20-2024 |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Advancement Method<br>Dry auger to completion                                                     |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Abandonment Method<br>Boring backfilled with auger cuttings upon completion.                      |                                                                                                                                                                                               |

Boring Log No. B-2

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 32.2100° Longitude: -95.8382°<br>Depth (Ft.) Approximate Elevation: 477 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |             |                                                                                                                           |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |             | <b>SILTY SAND (SM)</b> , brown, very loose                                                                                | 2.0         | 475                      |             | 1-1-1<br>N=2       |               |                            |            | 13.0              |                       | NP               | 38.6          |
|             |             | <b>CLAYEY SAND (SC)</b> , tan and red, loose                                                                              |             |                          |             | 1-2-3<br>N=5       |               |                            |            |                   |                       |                  |               |
| 2           |             | <b>SANDY LEAN CLAY (CL)</b> , brown, medium stiff, with organics and roots                                                | 4.0         | 473                      |             |                    |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                           |             |                          |             | 2-3-3<br>N=6       |               |                            |            |                   |                       |                  |               |
|             |             | <b>Boring Terminated at 6 Feet</b>                                                                                        | 6.0         | 471                      |             |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                                                                 |                                                                                                                                                                                                                                         |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet                                        | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez<br><br><b>Boring Started</b><br>12-20-2024<br><br><b>Boring Completed</b><br>12-20-2024 |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion<br><br><b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion. |                                                                                                                                                                                                                                         |

Boring Log No. B-3

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2109° Longitude: -95.8389°<br>Depth (Ft.) Approximate Elevation: 472 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type                                                                       | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------------------------------------------------------------------------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY SAND (SM)</b> , brown, loose                                                                                     | 470         |                          |  | 1-2-2<br>N=4       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | 2.0                                                                                                                       |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>CLAYEY SAND (SC)</b> , brown, loose to medium dense                                                                    |             |                          |                                                                                   | 1-3-3<br>N=6       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | -tan and red below 4 feet                                                                                                 |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |  |                                                                                                                           | 5           |                          |  | 4-5-6<br>N=11      |               |                            |            | 13.3              |                       | 32-19-13         | 46.8          |
|             |                                                                                   | 6.0                                                                                                                       | 466         |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                        |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                          |                                                                                                                                                 |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                     | <b>Boring Started</b><br>12-20-2024                                                                                                             |
|       |                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion.                      | <b>Boring Completed</b><br>12-20-2024                                                                                                           |

Boring Log No. B-4

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2120° Longitude: -95.8392°<br>Depth (Ft.) Approximate Elevation: 469 (Ft.)<br><b>SANDY LEAN CLAY (CL)</b> , brown, soft to stiff | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                                                                                 |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 2           |  |                                                                                                                                                                                 | 5           |                          |             | 1-1-1<br>N=2       |               |                            |            | 14.8              |                       | 25-13-12         | 59.2          |
|             |                                                                                   |                                                                                                                                                                                 |             |                          |             | 3-4-6<br>N=10      |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                                                                                 |             |                          |             |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                                                                                 |             |                          |             | 5-6-6<br>N=12      |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | 6.0 463<br><b>Boring Terminated at 6 Feet</b>                                                                                                                                   |             |                          |             |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                          |                                                                                                                                                 |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                     | <b>Boring Started</b><br>12-20-2024                                                                                                             |
|       |                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion.                      | <b>Boring Completed</b><br>12-20-2024                                                                                                           |

Boring Log No. B-5

| Model Layer | Graphic Log                                                                       | Location: See <a href="#">Exploration Plan</a><br><br>Latitude: 32.2126° Longitude: -95.8399°<br><br>Depth (Ft.)                      Approximate Elevation: 468 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                                                                        |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY CLAYEY SAND (SC-SM)</b> , brown, very loose                                                                                                                   | 2.0         |                          |             | 1-1-2<br>N=3       |               |                            |            |                   |                       |                  |               |
| 2           |  | <b>SANDY LEAN CLAY (CL)</b> , tan and red, medium stiff to very stiff<br><br>-with iron ore gravel fragments below 4 feet                                              | 466         |                          |             | 2-3-4<br>N=7       |               |                            |            | 13.7              |                       | 36-17-19         | 54.7          |
|             |                                                                                   |                                                                                                                                                                        | 5           |                          |             | 6-12-12<br>N=24    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                                                                     | 6.0         |                          |             |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                                                            |                                                                                                          |                                                                                                                                                                                                                                         |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any).<br>See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez<br><br><b>Boring Started</b><br>12-20-2024<br><br><b>Boring Completed</b><br>12-20-2024 |
|       |                                                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                     |                                                                                                                                                                                                                                         |
|       |                                                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion.                      |                                                                                                                                                                                                                                         |

Boring Log No. B-6

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2131° Longitude: -95.8389°<br>Depth (Ft.) Approximate Elevation: 476 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                           |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY CLAYEY SAND (SC-SM)</b> , brown, loose                                                                           | 2.0 474     |                          |             | 1-1-3<br>N=4       |               |                            |            |                   |                       |                  |               |
| 2           |  | <b>SANDY LEAN CLAY (CL)</b> , tan and red, stiff to very stiff                                                            | 6.0 470     |                          |             | 3-4-8<br>N=12      |               |                            |            | 11.6              |                       | 35-20-15         | 61.4          |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                        |             |                          |             | 6-6-10<br>N=16     |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                          |                                                                                                                                                 |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                     | <b>Boring Started</b><br>12-20-2024                                                                                                             |
|       |                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion.                      | <b>Boring Completed</b><br>12-20-2024                                                                                                           |

Boring Log No. B-7

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2128° Longitude: -95.8377°<br>Depth (Ft.) Approximate Elevation: 488 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type                                                                       | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------------------------------------------------------------------------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY CLAYEY SAND (SC-SM)</b> , brown, very loose                                                                      | 2.0         |                          |  | 0-2-0<br>N=2       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>CLAYEY SAND (SC)</b> , tan, medium dense                                                                               |             |                          |                                                                                   | 8-7-6<br>N=13      |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>SANDY LEAN CLAY (CL)</b> , tan and red, stiff                                                                          |             |                          |                                                                                   | 8-7-7<br>N=14      |               |                            |            |                   |                       |                  |               |
| 2           |  | <b>Boring Terminated at 6 Feet</b>                                                                                        | 482         |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | Water Level Observations<br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | Drill Rig<br>Geoprobe 3100gt<br><br>Hammer Type<br>Automatic<br><br>Driller<br>B. Reed<br><br>Logged by<br>O. Perez<br><br>Boring Started<br>12-20-2024<br><br>Boring Completed<br>12-20-2024 |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |

Boring Log No. B-8

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2124° Longitude: -95.8386°<br><br>Depth (Ft.) Approximate Elevation: 477 (Ft.) | Depth (Ft.) | Water Level Observations                                                          | Sample Type                                                                       | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                               |             |                                                                                   |                                                                                   |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>CLAYEY SAND (SC)</b> , brown, very loose to loose<br><br>-brown and red below 2 feet<br><br>4.0 473                        | 5           |  |  | 1-1-2<br>N=3       |               |                            |            | 14.2              |                       | 28-20-8          | 48            |
|             |                                                                                   |                                                                                                                               |             |                                                                                   |                                                                                   | 1-2-3<br>N=5       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                               |             |                                                                                   |                                                                                   | 4-6-8<br>N=14      |               |                            |            |                   |                       |                  |               |
| 2           |  | <b>SANDY LEAN CLAY (CL)</b> , red and gray, stiff<br><br>6.0 471                                                              |             |                                                                                   |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                            |             |                                                                                   |                                                                                   |                    |               |                            |            |                   |                       |                  |               |

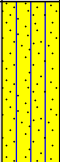
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | Water Level Observations<br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | Drill Rig<br>Geoprobe 3100gt<br><br>Hammer Type<br>Automatic<br><br>Driller<br>B. Reed<br><br>Logged by<br>O. Perez<br><br>Boring Started<br>12-20-2024<br><br>Boring Completed<br>12-20-2024 |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Advancement Method<br>Dry auger to completion                                                     |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Abandonment Method<br>Boring backfilled with auger cuttings upon completion.                      |                                                                                                                                                                                               |

Boring Log No. B-9

| Model Layer | Graphic Log                                                                        | Location: See Exploration Plan<br>Latitude: 32.2118° Longitude: -95.8377°<br>Depth (Ft.) Approximate Elevation: 487 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                    |                                                                                                                           |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY CLAYEY SAND (SC-SM)</b> , brown, loose                                                                           |             |                          |             |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                    | 2.0                                                                                                                       | 485         |                          |             | 1-1-5<br>N=6       |               |                            |            |                   |                       |                  |               |
|             |                                                                                    | <b>CLAYEY SAND (SC)</b> , red, loose to dense                                                                             |             |                          |             | 3-4-4<br>N=8       |               |                            |            |                   |                       |                  |               |
|             |                                                                                    |                                                                                                                           | 5           |                          |             | 5-7-10<br>N=17     |               |                            |            | 11.0              |                       | 32-19-13         | 44.2          |
|             |                                                                                    | -tan and red below 6 feet<br>-with iron ore gravel fragments from 6 to 8 feet                                             |             |                          |             | 9-23-24<br>N=47    |               |                            |            |                   |                       |                  |               |
|             |                                                                                    | 10.0                                                                                                                      | 477         |                          |             | 12-13-13<br>N=26   |               |                            |            |                   |                       |                  |               |
|             |                                                                                    | <b>Boring Terminated at 10 Feet</b>                                                                                       | 10          |                          |             |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                           |                                                                                                                                                 |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 10 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                      | <b>Boring Started</b><br>12-20-2024                                                                                                             |
|       |                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with Auger Cuttings and/or Bentonite                       | <b>Boring Completed</b><br>12-20-2024                                                                                                           |

Boring Log No. B-10

| Model Layer | Graphic Log                                                                       | Location: See Exploration Plan<br>Latitude: 32.2117° Longitude: -95.8385°<br>Depth (Ft.) Approximate Elevation: 476 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type                                                                       | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------------------------------------------------------------------------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |  | <b>SILTY SAND (SM)</b> , brown, very loose                                                                                | 2.0474      |                          |  | 1-2-1<br>N=3       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   | 1-2-2<br>N=4       |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |
|             |                                                                                   |                                                                                                                           |             |                          |                                                                                   | 1-2-4<br>N=6       |               |                            |            | 13.8              |                       | 21-13-8          | 45.7          |
|             |                                                                                   | <b>Boring Terminated at 6 Feet</b>                                                                                        | 6.0470      |                          |                                                                                   |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | Water Level Observations<br>Groundwater not observed while drilling<br><br>Dry and open to 6 feet | Drill Rig<br>Geoprobe 3100gt<br><br>Hammer Type<br>Automatic<br><br>Driller<br>B. Reed<br><br>Logged by<br>O. Perez<br><br>Boring Started<br>12-20-2024<br><br>Boring Completed<br>12-20-2024 |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            |                                                                                                   |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Advancement Method<br>Dry auger to completion                                                     |                                                                                                                                                                                               |
|       |                                                                                                                                                                                                            | Abandonment Method<br>Boring backfilled with auger cuttings upon completion.                      |                                                                                                                                                                                               |

| Model Layer | Graphic Log | <div>Location: See Exploration Plan<br/>Latitude: 32.2108° Longitude: -95.8378°<br/><br/>Depth (Ft.)                  Approximate Elevation: 484 (Ft.)</div> | Depth (Ft.) | Water Level Observations | Sample Type  | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits |               |
|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|--------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |             |                                                                                                                                                              |             |                          |              |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         | Percent Fines |
| 1           |             | SILTY SAND (SM), brown, very loose                                                                                                                           | 2.0         | 482                      | X            | 2-1-1 N=2          |               |                            |            |                   |                       |                  |               |
| 2           |             | LEAN CLAY WITH SAND (CL), brown and red, stiff to hard                                                                                                       |             |                          | X            | 6-6-5 N=11         |               |                            |            |                   |                       |                  |               |
|             |             | -red and gray from 4 to 8 feet                                                                                                                               |             |                          | X            | 5-6-3 N=9          |               |                            | 12.5       |                   | 32-15-17              | 80               |               |
|             |             |                                                                                                                                                              |             |                          |              |                    |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                                                              |             |                          |              |                    |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                                                              |             |                          |              |                    |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                                                              |             |                          |              |                    |               |                            |            |                   |                       |                  |               |
|             |             | gray below 8 feet                                                                                                                                            |             |                          | HP=4.5+      |                    |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                                                              |             |                          | 6-21-23 N=44 |                    |               |                            |            |                   |                       |                  |               |
|             |             | Boring Terminated at 10 Feet                                                                                                                                 | 10.0        | 474                      |              |                    |               |                            |            |                   |                       |                  |               |

Boring Log No. B-12

| Model Layer | Graphic Log | Location: See <span>Exploration Plan</span><br>Latitude: 32.2103° Longitude: -95.8369°<br><br>Depth (Ft.) <span>Approximate Elevation: 497 (Ft.)</span> | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |                 |
|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|-----------------|
|             |             |                                                                                                                                                         |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |                 |
| 1           |             | <b>SILTY SAND (SM)</b> , brown, very loose to medium dense<br><br>6.0 <span>491</span>                                                                  | 5           |                          |             | 0-2-0<br>N=2       |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             | 3-4-5<br>N=9       |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             | 3-5-7<br>N=12      |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             | 5-8-13<br>N=21     |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             | 8-13-15<br>N=28    |               |                            |            |                   |                       |                  |               |                 |
|             |             | <b>SILTY CLAYEY SAND (SC-SM)</b> , red and gray, medium dense to very dense<br><br>-brown and gray below 12 feet<br><br>15.0 <span>482</span>           | 10          |                          |             |                    |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             |                    |               |                            |            |                   |                       |                  |               | 9-18-36<br>N=54 |
|             |             |                                                                                                                                                         |             |                          |             |                    |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             |                    |               |                            |            |                   |                       |                  |               |                 |
|             |             |                                                                                                                                                         |             |                          |             |                    |               |                            |            |                   |                       |                  |               |                 |
|             |             | <b>Boring Terminated at 15 Feet</b>                                                                                                                     |             | 15                       |             |                    |               |                            |            |                   |                       |                  |               |                 |

|       |                                                                                                                                                                                                            |                                                                                                           |                                                                                                                                                                                                                                         |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 15 feet | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez<br><br><b>Boring Started</b><br>12-20-2024<br><br><b>Boring Completed</b><br>12-20-2024 |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion                                                      |                                                                                                                                                                                                                                         |
|       |                                                                                                                                                                                                            | <b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion.                       |                                                                                                                                                                                                                                         |

Boring Log No. B-13

| Model Layer | Graphic Log | Location: See Exploration Plan<br>Latitude: 32.2112° Longitude: -95.8366°<br>Depth (Ft.) Approximate Elevation: 493 (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test |                            |            | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits | Percent Fines |
|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------|---------------|
|             |             |                                                                                                                           |             |                          |             |                    | Test Type     | Compressive Strength (tsf) | Strain (%) |                   |                       | LL-PL-PI         |               |
| 1           |             | <b>SILTY SAND (SM)</b> , brown, loose                                                                                     | 2.0<br>491  |                          |             | 2-2-2<br>N=4       |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                           |             |                          |             |                    |               |                            |            |                   |                       |                  |               |
| 2           |             | <b>SANDY LEAN CLAY (CL)</b> , brown and red, soft                                                                         | 4.0<br>489  |                          |             | 1-2-2<br>N=4       |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                           |             |                          |             |                    |               |                            |            |                   |                       |                  |               |
| 1           |             | <b>SILTY SAND (SM)</b> , gray, medium dense                                                                               | 5<br>487    |                          |             | 4-6-8<br>N=14      |               |                            |            | 12.7              |                       | NP               | 41.9          |
|             |             |                                                                                                                           |             |                          |             |                    |               |                            |            |                   |                       |                  |               |
|             |             | <b>CLAYEY SAND (SC)</b> , brown, medium dense                                                                             |             |                          |             | 6-7-9<br>N=16      |               |                            |            |                   |                       |                  |               |
|             |             |                                                                                                                           |             |                          |             | 8-9-10<br>N=19     |               |                            |            |                   |                       |                  |               |
|             |             | <b>Boring Terminated at 10 Feet</b>                                                                                       | 10<br>483   |                          |             |                    |               |                            |            |                   |                       |                  |               |

|       |                                                                                                                                                                                                            |                                                                                                                                                 |                                                                                                                                                                                                                                         |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).<br>See Supporting Information for explanation of symbols and abbreviations. | <b>Water Level Observations</b><br>Groundwater not observed while drilling<br><br>Dry and open to 10 feet                                       | <b>Drill Rig</b><br>Geoprobe 3100gt<br><br><b>Hammer Type</b><br>Automatic<br><br><b>Driller</b><br>B. Reed<br><br><b>Logged by</b><br>O. Perez<br><br><b>Boring Started</b><br>12-20-2024<br><br><b>Boring Completed</b><br>12-20-2024 |
|       |                                                                                                                                                                                                            | <b>Advancement Method</b><br>Dry auger to completion<br><br><b>Abandonment Method</b><br>Boring backfilled with auger cuttings upon completion. |                                                                                                                                                                                                                                         |

## **Supporting Information**

### **Contents:**

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

| Sampling                                                                                                                                                                                                                        | Water Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Field Tests                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> Shelby Tube</div> <div> Standard Penetration Test</div> | <div> Water Initially Encountered</div> <div> Water Level After a Specified Period of Time</div> <div> Water Level After a Specified Period of Time</div> <div> Cave In Encountered</div> <p>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.</p> | <div>N Standard Penetration Test Resistance (Blows/Ft.)</div> <div>(HP) Hand Penetrometer</div> <div>(T) Torvane</div> <div>(DCP) Dynamic Cone Penetrometer</div> <div>UC Unconfined Compressive Strength</div> <div>(PID) Photo-Ionization Detector</div> <div>(OVA) Organic Vapor Analyzer</div> |

| Descriptive Soil Classification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment. |

| Location And Elevation Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. 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<br>(More than 50% retained on No. 200 sieve.)<br>Density determined by Standard Penetration Resistance |                                             | Consistency of Fine-Grained Soils<br>(50% or more passing the No. 200 sieve.)<br>Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance |                                          |                                             |
| Relative Density                                                                                                                                | Standard Penetration or N-Value (Blows/Ft.) | 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                                        |

| Relevance of Exploration and Laboratory Test Results                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document. |

Unified Soil Classification System

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                      |                                                         |                                                             | Soil Classification |                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------|---------------------|--------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         |                                                             | Group Symbol        | Group Name <sup>B</sup>                                                  |
| Coarse-Grained Soils:<br>More than 50% retained on No. 200 sieve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Gravels:<br>More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels:<br>Less than 5% fines <sup>C</sup>       | Cu≥4 and 1≤Cc≤3 <sup>E</sup>                                | GW                  | Well-graded gravel <sup>F</sup>                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | Cu<4 and/or [Cc<1 or Cc>3.0] <sup>E</sup>                   | GP                  | Poorly graded gravel <sup>F</sup>                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      | Gravels with Fines:<br>More than 12% fines <sup>C</sup> | Fines classify as ML or MH                                  | GM                  | Silty gravel <sup>F, G, H</sup>                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | Fines classify as CL or CH                                  | GC                  | Clayey gravel <sup>F, G, H</sup>                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Sands:<br>50% or more of coarse fraction passes No. 4 sieve          | Clean Sands:<br>Less than 5% fines <sup>D</sup>         | Cu≥6 and 1≤Cc≤3 <sup>E</sup>                                | SW                  | Well-graded sand <sup>I</sup>                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | Cu<6 and/or [Cc<1 or Cc>3.0] <sup>E</sup>                   | SP                  | Poorly graded sand <sup>I</sup>                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      | Sands with Fines:<br>More than 12% fines <sup>D</sup>   | Fines classify as ML or MH                                  | SM                  | Silty sand <sup>G, H, I</sup>                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | Fines classify as CL or CH                                  | SC                  | Clayey sand <sup>G, H, I</sup>                                           |
| Fine-Grained Soils:<br>50% or more passes the No. 200 sieve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Silts and Clays:<br>Liquid limit less than 50                        | Inorganic:                                              | PI > 7 and plots above “A” line <sup>J</sup>                | CL                  | Lean clay <sup>K, L, M</sup>                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | PI < 4 or plots below “A” line <sup>J</sup>                 | ML                  | Silt <sup>K, L, M</sup>                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      | Organic:                                                | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$ | OL                  | Organic clay <sup>K, L, M, N</sup><br>Organic silt <sup>K, L, M, O</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         |                                                             |                     |                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Silts and Clays:<br>Liquid limit 50 or more                          | Inorganic:                                              | PI plots on or above “A” line                               | CH                  | Fat clay <sup>K, L, M</sup>                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         | PI plots below “A” line                                     | MH                  | Elastic silt <sup>K, L, M</sup>                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      | Organic:                                                | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$ | OH                  | Organic clay <sup>K, L, M, P</sup><br>Organic silt <sup>K, L, M, Q</sup> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                      |                                                         |                                                             |                     |                                                                          |
| Highly organic soils:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Primarily organic matter, dark in color, and organic odor            |                                                         |                                                             | PT                  | Peat                                                                     |
| <sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.<br><sup>B</sup> If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.<br><sup>C</sup> 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.<br><sup>D</sup> 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.<br><sup>E</sup> $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$<br><sup>F</sup> If soil contains ≥ 15% sand, add “with sand” to group name.<br><sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.<br><sup>H</sup> If fines are organic, add “with organic fines” to group name.<br><sup>I</sup> If soil contains ≥ 15% gravel, add “with gravel” to group name.<br><sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.<br><sup>K</sup> If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.<br><sup>L</sup> If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.<br><sup>M</sup> If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.<br><sup>N</sup> PI ≥ 4 and plots on or above “A” line.<br><sup>O</sup> PI < 4 or plots below “A” line.<br><sup>P</sup> PI plots on or above “A” line.<br><sup>Q</sup> PI plots below “A” line. |                                                                      |                                                         |                                                             |                     |                                                                          |

