ECS Southeast, LLC

Geotechnical Engineering Report – Rev. 1.0

Express Oil Change - Farragut

Kingston Pike
Farragut, Tennessee

ECS Project No. 26:6778

June 7, 2024

ECS SOUTHEAST, LLC

Geotechnical • Construction Materials • Environmental • Facilities

June 7, 2024

Mr. Justin Duck
Express Oil Change, LLC
1880 Southpark Drive
Birmingham, AL 35244

ECS Project No. 26:6778

Reference: Geotechnical Engineering Report – Rev. 1.0
Express Oil Change - Farragut
Kingston Pike
Farragut, Tennessee

Dear Mr. Duck:

ECS Southeast, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations. The previously stamped report dated June 5, 2024, is invalid and should NOT be used for construction. The Rev.1.0 version should be followed for construction and supersedes the old report dated June 5, 2024.

It has been our pleasure to be of service to Express Oil Change, LLC during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLC

MARK D. LUSKIN
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 111668
STATE OF TENNESSEE

6-7-24

Elieh Mohtashami, E.I.T.
Geotechnical Staff Project Manager
emohtashami@ecslimited.com

Mark Luskin, P.E., P.G.
Principal Engineer
mluskin@ecslimited.com

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EXECUTIVE SUMMARY

ECS Southeast, LLC (ECS) has completed the subsurface exploration for the proposed Express Oil Change with associated parking/drive lanes at Kingston Pike in Farragut, Tennessee. The project information summarized below is based exclusively on the information made available to us by the client at the time of this report and the results of our subsurface exploration. Our findings, conclusions, and recommendations are summarized below.

PROJECT INFORMATION:

- Site Location: Kingston Pike, Farragut, Tennessee
- Building Scope: Commercial
- Assumed Loads: Max. column loads = 25 kips, Max. wall loads = 2.5 klf
- Earthwork: Unknown at this time; +/- 3 feet cut/fill assumed
- Sitework: Parking lot, drive lanes, SWM facility and underground utilities

SUBSURFACE CONDITIONS:

- Field Exploration: 12 SPT borings in the proposed construction area
- Surface Material: Not encountered in our boring locations.
- Existing Fill: LEAN CLAY and FAT CLAY (CL & CH) and CLAYEY SILT (ML/CL) with varying amounts of gravel and sand to a depth of 3 ½ to 15 feet below the existing ground surface.
- Native Material: FAT CLAY (CH) with varying amounts of gravel and sand
- Refusal Materials: Encountered at two (2) locations, B-04 and B-07 at approximately 14 and 3 ½ feet below the existing ground surface.
- Groundwater: Not encountered in our boring locations.

GEOTECHNICAL CONCERNS:

- Presence of Karst Potential
- Presence of Shallow/irregular Refusal Material
- Presence of Expansive/Compressible Soil

DESIGN & CONSTRUCTION RECOMMENDATIONS:

- Foundations 2,000 psf on approved existing fill or approved structural fill
- Slabs-on-Grade: Modulus of Subgrade Reaction, k = 110 pci/in
- Seismic Design: Seismic Site Class "D-Default"

This Executive Summary is intended as a very brief overview of the primary geotechnical conditions that are expected to affect design and construction. Information gleaned from this Executive Summary should not be utilized in lieu of reading the entire geotechnical report. Details of our conclusions and recommendations are discussed in the report text.

1.0 INTRODUCTION

Our services were provided in accordance with our Proposal No. 26:2024DS, dated April 30, 2024, as authorized by Express Oil Change, LLC on May 1, 2024, which includes our Terms and Conditions of Service.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

The report includes the following items.

- Observations from our site reconnaissance including current site conditions, surface drainage features, and surface topographic conditions.
- A subsurface characterization and a description of the field exploration and laboratory tests were performed. Groundwater concerns relative to the planned construction are summarized. Expected geological or seismic hazards are also addressed.
- Final logs of the soil borings and records of the field exploration prepared in accordance with the standard practice for geotechnical engineering. A boring location plan is included, and the results of the laboratory tests were plotted on the final boring logs and included on a separate test report sheet. Existing approximate elevation were recorded for each top of boring, based on interpolation of approximate locations and contour information.
- Recommendations for allowable bearing pressures for conventional shallow foundation systems and estimates of predicted total and differential foundation settlement.
- Recommendations for floor slab construction, including recommendations for subgrade modulus and subgrade improvements.
- Recommendations for lateral earth pressures likely to develop on below-grade walls, as well as perimeter and underdrainage systems for below-grade walls.
- Evaluation of the on-site soil characteristics encountered in the soil borings. Specifically, we discuss the on-site materials for re-use as engineered fill to support slabs and pavements. We also included compaction requirements and material guidelines.
- Recommended seismic site class in accordance with the International Building Code (IBC 2018) and our knowledge of the site geology.
- Recommended flexible asphalt and rigid concrete pavement sections (light duty and heavy duty) based on assumed loading conditions and assumed California Bearing Ratio (CBR) values.
- Recommendations for additional testing and/or consultation that might be required to complete the geotechnical assessment and related engineering for this project.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE

The project site is located at Kingston Pike in Farragut, Tennessee. The site is currently a vacant lot bounded to Kingston Pike to the south, wooded area to the north, commercial buildings to the east and west. Based on elevations obtained from Google Earth, the site appears to undergo approximately 16 feet of topographic relief from +879 to +895 feet MSL. Based on the historical aerial map obtained from Google Earth and other public resources, it appears that the site was previously occupied by a warehouse. The warehouse occupied the site dating back at least to 1992 and was demolished between 2014 and 2017. It also appears that the site has been mass graded in 2021. ECS was provided with the Testing Records conducted by Engineering & Testing Solutions, LLC.

Figure 2.1.1. Site Location Shown

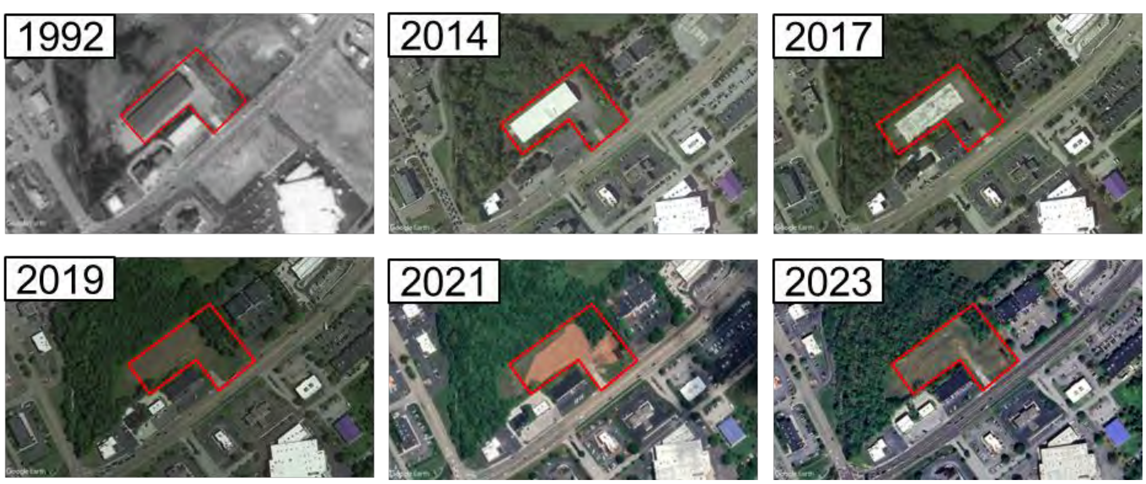


Figure 2.1.2. Historical aerial imagery of the site obtained from Google Earth

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned development including proposed buildings and related infrastructure.

Table 2.2.1 Design Information

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Development Footprint	Approximately 6,500 square feet in plan view
# of Stories	One-story
Usage	Commercial
Assumed Column Loads	25 kips (Full Dead and Factored Live)
Assumed Wall Loads	2.5 kips per linear foot (klf) maximum
Lowest Finish Floor Elevation	Unknown at this time

3.0 FIELD EXPLORATION

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms to assist in developing geotechnical recommendations for the project.

3.1.1 Test Borings

The subsurface conditions were explored by drilling twelve (12) soil test borings within the proposed construction area. A truck-mounted drill rig was utilized to drill the soil test borings. Borings were advanced to a total depth of approximately 3 ½ to 20 feet below the ground surface (the approximate depth of refusal and the expected boring termination depth).

Boring locations were identified in the field by drilling personnel at the time of the mobilization of our drilling equipment. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Ground surface elevations noted on our boring logs were obtained from Google Earth and should be considered approximate.

Standard Penetration Tests (SPT's) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility.

3.1.2 Laboratory Testing Program

A geotechnical engineer classified each SPT soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS, ASTM D 2487). The group symbols for each soil type are indicated in parentheses following the soil descriptions on each boring log. The engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between materials on the exploration records should be considered approximate; in situ, the transitions may be gradual.

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent index properties. The laboratory testing program included:

- Natural moisture content determinations (ASTM D 2216)
- Atterberg Limits tests (ASTM D 4318)
- Percent Passing #200 Sieve (ASTM D 1140)

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition.

3.2 REGIONAL/SITE GEOLOGY

The USGS Geologic Map of the Lovell Quadrangle (2013) indicates this particular site is underlain by the Copper Ridge Dolomite Formation. This formation typically consists of dark-gray spherical, concentrically laminated ooids 1 to 2 millimeters in diameter closely packed in a dense chert matrix along with tabular fragments of fine-grained chert as much as 40 millimeters long over dark grey, massive, and laminated, medium to coarse grained dolomite. The thickness of the Copper Ridge computed from mapped boundaries is about 1000 feet.

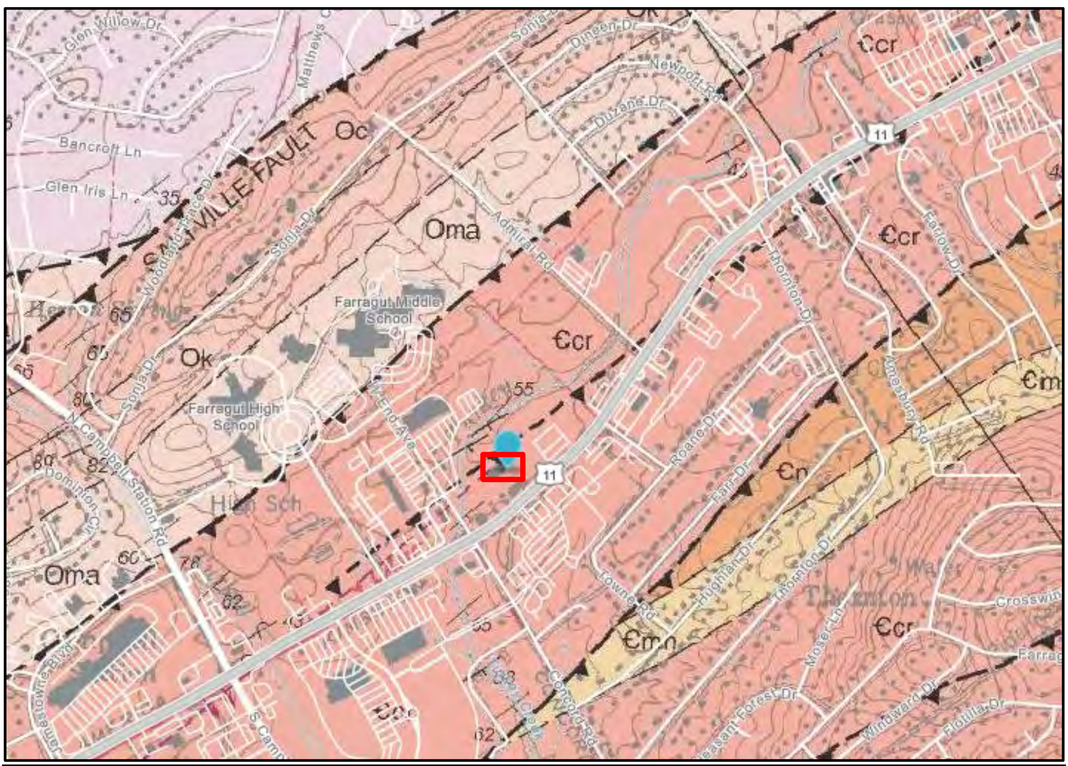


Figure 3.1.1 - USGS Geologic Map of the Lovell Quadrangle (2013)
(approximate site location outlined in red)

3.3 SUBSURFACE CHARACTERIZATION

The site subsurface conditions were evaluated with twelve (12) SPT borings at the approximate locations shown on the Boring Location Diagram in the Appendix. The quantity of borings, boring locations, and drilling depths were discussed with the project team prior to completing this subsurface exploration.

The following tables provides generalized characterizations of the soil and rock strata encountered during our subsurface exploration.

Table 3.3.1 - Summary of Subsurface Conditions

Boring No.	Surface Material	Existing Fill Material		Native Material		End of Boring Depth (ft)
		Depth (ft)	N-Values (bpf)	Depth (ft)	N-Values (bpf)	
B-01	-	0 – 15	9 – 20	15 – 20	20	20
B-02	-	0 – 15	13 – 27	-	-	15
B-03	-	0 – 10	8 – 29	10 – 15	8	15
B-04	-	0 – 10	10 – 24	10 – 15	50/5"	14*
B-05	-	0 – 10	6 – 20	-	-	10
B-06	-	0 – 10	10 – 33	-	-	10
B-07	-	0 – 3 ½	16	-	-	3 ½*
B-08	-	0 – 10	20 – 29	-	-	10
B-09	-	0 – 10	29 – 39	-	-	10
B-10	-	0 – 10	15 – 24	-	-	10
B-11	-	0 – 10	7 – 25	-	-	10
B-12	-	0 – 10	11 – 22	-	-	10

NOTE: bpf – blows per foot
*denoted auger refusal

Two Borings, B-04 and B-07, encountered refusal material at 14 feet to 3 ½ feet below the existing ground surface. "Refusal" is the term applied to materials that cannot be penetrated with soil drilling equipment or where the standard penetration resistance exceeds 100 blows per foot. Refusal is a designation applied to material that cannot be penetrated by the power auger and is normally indicative of a very hard or very dense material, such as large boulders or the upper surface of bedrock. In an area of limestone, refusal can result on slabs of unweathered bedrock suspended in the soil matrix or the upper surface of continuous bedrock. In an area with shotrock fill, refusal can occur on dense shotrock fill or buried boulders. Further, in areas of previous development, refusal can occur on construction materials such as concrete slabs or old foundations.

The subsurface conditions presented in Tables 3.3.1 and shown on the Boring Logs should be considered approximate, based on interpretation of the exploration data using normally accepted geotechnical engineering judgments. It should be noted that transitions between different soil strata are typically less distinct than that shown on the exploration records. Subsurface conditions between the actual boring locations will vary. In addition, surficial material depths may also vary significantly across the site from those we encountered.

3.4 LABORATORY TEST RESULTS

Laboratory index test results indicate the in-situ moisture contents of the tested samples ranged from approximately 9 to 47.5 percent.

Atterberg Limits tests performed on a select soil sample from Borings B-02 and B-04 indicated low plasticity LEAN CLAY (CL) with varying amounts of sand and gravel with Liquid Limits of 34 and 39, and Plasticity Indices of 13 and 17, respectively. These results have been included on the boring logs, separate report sheets, and Laboratory Testing Summary in the Appendix.

3.5 GROUNDWATER OBSERVATIONS

During drilling operations, groundwater was not encountered. A 48-hour reading of groundwater was conducted at Boring B-01 after drilling and no groundwater was encountered in the borehole. However, it is highly possible that surface water due to wet weather conditions on the days of fieldwork as the result of heavy rain and snow infiltrates the borehole. It should be noted that it is possible for perched water to exist within the depths explored for the rest of the borings during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the native material.

Variations in the location of the long-term water table may occur as a result of change in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

4.0 DESIGN RECOMMENDATIONS

4.1 GENERAL

The primary purpose of this geotechnical exploration was to help identify and evaluate the general subsurface conditions relative to the proposed construction. Our recommendations have been developed on the basis of the previously described project information and subsurface conditions identified during this study. The following is a brief discussion of the potential geotechnical hazards encountered during our subsurface exploration.

<u>4.1.1 Presence of Karst Potential:</u> This site is located within karst geology which may be susceptible to sinkhole development. While no apparent signs of potential karst feature were encountered during our subsurface exploration, upon request, ECS can complete additional further geophysical studies at the site to evaluate the potential karst features that may not have been encountered in our discrete boring locations.

<u>4.1.2 Presence of Documented Fill Material:</u> Existing documented fill materials were encountered during our exploration at our boring locations. The samples obtained appeared relatively free of deleterious material. Based on the Testing Records by Engineering & Testing Solutions, LLC. provided by the client, it appears that the fill was placed between May 2021 and December 2021. The fill was placed to 98% compaction of its maximum dry density at depth ranging from subgrade elevation to 12 feet below the subgrade and was evaluated by field density test in general accordance with ASTM D6938.

The existing documented fill materials should be handled in accordance with the recommendations in this report as discussed in Section 4.3.2.

<u>4.1.3 Expansive/Compressible On-Site Soils:</u> Based on the results of our laboratory tests, potential highly expansive and compressible FAT CLAY (CH) soils were encountered on-site during our exploration. It is our opinion that the on-site highly plastic FAT CLAY (CH) soils are not ideal for the direct support of the proposed construction and, depending on final grades, if these soils are encountered at subgrade or bearing elevations, some undercutting will likely be required. Highly plastic soils should be handled as discussed in Section 4.3.3 of this report.

<u>4.1.4 Construction Monitoring:</u> ECS should be on-site full-time during earthwork and foundation construction activities to document that our recommendations are followed and to provide recommendations for remedial activities, where necessary.

4.2 SINKHOLE CONSIDERATIONS

Based on review of the Geologic Hazards Map of Tennessee (1977), this site does fall in a high-risk sinkhole potential zone. Karst terrain is characterized by caves, caverns, voids, soil domes, soil raveling, interrupted drainage, disappearing streams, and topographical features such as sinkholes and closed depressions. These features are the result of the dissolution of soluble bedrock such as limestone, dolomite, and rock-like evaporates by groundwater and/or the infiltration of surface water.

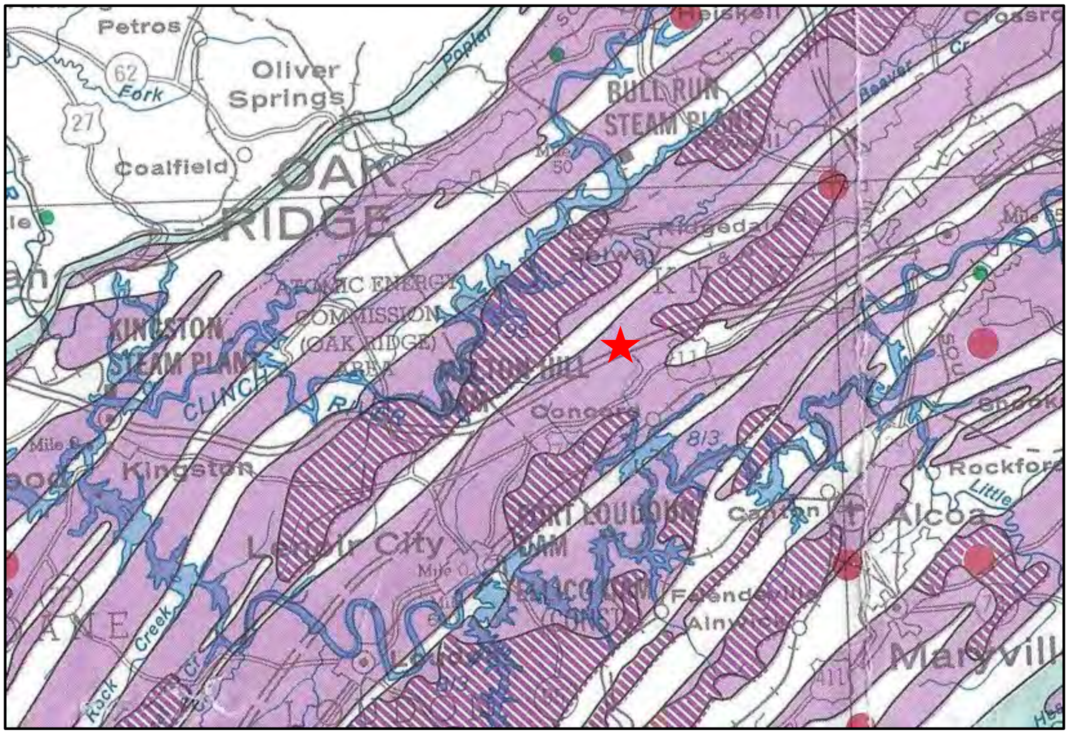


Figure 4.2.1.1 - Geologic Hazards Map of Tennessee 1977 (approximate site location starred in red, karst areas in purple)

The high frequency of sinkholes in the Knoxville area, and similar "karst" regions, is the result of variable solubility of the massive limestone bedrock in water. Water sources are normally twofold:

1) That which infiltrates into the subsurface unit as a result of normal precipitation,
2) Periodic fluctuation of the moving groundwater along joints and bedding planes in the rock.

This "solution weathering" can result in the formation of frequently large cavities along bedding planes and joints in the rock. It is important to note that the rate of development of individual cavities in the rock and resulting sinkholes as described below, is a function of many factors, but likely takes thousands of years to develop fully.

Eventually, open slots develop within the subsurface unit, at joint intersections or other weak locations in the unit. The stiff overburden soils bridge over the voids in the shape of an arch. Rainwater infiltrating the ground surface and flowing downward through the soil and fluctuation of the water table cause progressive spalling at the arched face. The void then expands upward toward the ground surface. When the void becomes large and extends close to the ground surface or when stress changes occur, the soil's shear strength is exceeded. The soil above the arch collapses, creating a surface depression or sinkhole.

Open conduits through the soil or rock through which water can flow freely to the cavities in the bedrock is referred to as the "throat". With continued flow of surface water into the sinkhole, the depression enlarges. Secondary collapse of perimeter soil banks into the sinkhole and raveling of surface soils into the drainage feature also enlarge the depression.

In the natural uncontrolled state, the "throat" of the sinkhole may become plugged, halting drainage, and resulting in deposition of organic materials, unconsolidated soil, or water ponding in the depression.

These natural conditions of low activity in untreated sinkholes are also a hazard, since the throat may re-open or new throats may develop resulting in increased sinkhole activity or size.

Our scope of work did not include a site-specific evaluation of karst activity or incipient sinkhole risk at the site so we cannot adequately comment on the potential risk related to sinkhole activity. Upon request, ECS can complete a full geological karst study that would include the use of geophysical techniques such as Electrical Resistivity to further evaluate the site-specific karst activity and associated sinkhole risk.

4.3 SUBGRADE PREPARATION

The following sections describe our general recommendations for preparing the site subgrade prior to fill placement operations.

4.3.1 Stripping and Grubbing

Surface material was not encountered at our boring locations. The subgrade preparation should consist of stripping the vegetation, rootmat, topsoil, and soft or poor-quality materials from the 10-foot expanded building and 5-foot expanded pavement limits, and 5 feet beyond the toe of structural fills. ECS should be retained to verify that surficial materials have been removed prior to the placement of structural fill or construction of structures.

The site was previously occupied with a structure that has been demolished between 2014 and 2017. The buried (below grade) components associated with previous structures (e.g., foundations, utilities, grease traps, buried basements, etc.) can cause new construction to behave poorly for many reasons, including stress concentrations resulting from point loading and poor support caused by old backfill. These components are required to be removed and addressed properly. Also, Cosmetic, and structural damage to the overlying construction can result if the demolished building components are not removed and properly addressed during construction. It is important that subgrades are carefully evaluated during construction for poorly compacted backfill associated with buried or removed building components and improved as recommended by ECS during construction.

4.3.2 Existing Documented Fill

Fill Content: Based on the visual assessment of soil samples collected during drilling, apparent fill was observed in the boring locations to depths of approximately 15 feet below the ground surface. Based on the Testing Records by Engineering & Testing Solutions, LLC. provided by the client, it appears that the fill was placed between May 2021 and December 2021. The fill was placed to 98% compaction of its maximum dry density at depth ranging from subgrade elevation to 12 feet below the subgrade and was evaluated by field density test in general accordance with ASTM D6938. Based on the available information, the existing fill can remain in-place if it is handled in the foundation, slab, and pavement area as below:

Foundations: Where the existing fill materials are encountered at the foundation bearing levels, ECS recommends Dynamic Cone Penetrometer (DCP) testing be performed to further evaluate the existing fill soils. Where FAT CLAY (CH) soils are encountered at bearing levels, they should be addressed as discussed in Section 4.3.3.

Slab-on-Grade Areas: It is recommended that the existing fill should be proofrolled and/or tested using a DCP. The fill materials that are found to yield or rut when proofrolled should be removed and replaced with structural fill soils. In addition, should the foundation or slab subgrade consist of high plasticity soil, the fat clays should be removed and replaced in accordance with Section 4.3.3.

Pavement Areas: For the parking/drive lanes, existing fill may be left as-is if it can pass a proofroll as detailed in Section 4.3.5 of this report.

Re-Use of Fill: Based on the results of the laboratory testing indicating the soils are a low plasticity clay, it appears that the majority of this fill may be re-used as engineered fill at the site in structural fill areas.

4.3.3 High Plasticity Soils Subgrade

High plasticity soils are those soil materials classified as Fat CLAY (CH). Potential high plasticity soils were encountered during our field exploration across the site. Depending on grading, where these high plasticity soils (PI > 30) are present within 2 feet of the slab-on-grade subgrade, they will require the subgrade to be undercut 2 feet and grades restored with approved structural fill (low plasticity Lean CLAY (CL) or granular materials. Where high plasticity soils are encountered at foundation bearing elevations, the foundation excavation should be lowered an additional 1 foot below the design footing subgrade elevation and the design elevation restored by backfilling the excavation with graded aggregate base and compacted with a vibratory plate compactor in maximum 12-inch lifts or with flowable fill having a minimum 28-day compressive strength of 1,000 psi. Lean CLAY (CL) materials may also be used, provided that the excavation is lowered 1 foot below the design subgrade elevation.

Structural Fills: High plasticity soils do not satisfy the specification criteria for structural fill materials. The Owner can consider allowing soils with a Plasticity Index of greater than 35 to be used as structural fill at depths greater than 4 feet below pavement subgrades outside the expanded building limits and within non-structural areas.

Difficulty During Construction: Moderate to high plasticity soils have a tendency to absorb water much faster than lower plasticity clay materials. Therefore, if these materials are left open to rain events during the construction process, they can quickly deteriorate and can take a significant amount of time and effort to be dried back out to an adequate moisture content range. If these materials are not capped with low plasticity clays, well graded stone, or chemically stabilized during the construction process and left open to the elements, significant undercuts or drying times will likely occur.

4.3.4 Excavation Considerations

The soil encountered within the borings should generally be excavatable with conventional earth moving equipment such as pans/scrapers, loaders, bulldozers, rubber-tired backhoes, etc. However, large boulders which may be present within the existing fill will require large tack-hoes or dozers and/or hoe-ramming for excavation.

Areas of mass excavation, trenches and pits should meet the requirements of the most current Occupational Safety and Health Administration (OSHA) 29 CFR Part 1926, “Occupational Safety and Health Standards-Excavations”. Site excavation safety should be solely the responsibility of the contractor and his subcontractors.

4.3.5 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying localized yielding materials. If the existing cut subgrade materials consist of bedrock, proofrolling will not be required.

Where proofrolling identifies areas that are yielding or “pumping” subgrade those areas should be repaired prior to the placement of subsequent structural fill or other construction materials. Undercut areas may be backfilled with compacted shotrock fill, engineered fill, compacted dense-grade aggregate base, or flowable fill once adequate subgrade soils have been encountered. If soft or yielding subgrade soils are not encountered after the initial 3 to 4 feet of undercut in pavement or slab-on-grade areas, the backfill recommendations in Table 4.3.5.1 may be utilized.

Table 4.3.5.1. Maximum Undercut Remediation Recommendations

Maximum Undercut Depth	Backfill Requirements
No Undercut	Cement treat upper 12 inches of subgrade
3 feet	Layer of Tensar TX 140 grid or equivalent and 3 feet of granular stone or shotrock fill
4 feet	4 feet of granular material or shotrock fill

4.4 EARTHWORK OPERATIONS

4.4.1 Structural Fill

Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. The fill should exhibit a maximum dry density of at least 90 pounds per cubic foot, as determined by a Standard Proctor compaction test (ASTM D 698). Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Structural Fill Materials: Materials for use as structural fill should consist of inorganic soils with the following engineering properties and compaction requirements.

Table 4.4.1.1. Structural Fill Recommendations

Material Type	Subject	Property
Soil Fill	Building and Pavement Areas	LL < 45, PI<25
	Building and Pavement Areas Below upper 2 feet	LL < 60, PI<35
	Max. Particle Size	4 inches
	Max. organic content	5% by dry weight
Shotrock Fill	Max. Amount of Fines (Pass No. 4 sieve)	20% by weight
	Max. Particle Size	18 inch

Table 4.4.1.2. Structural Fill Compaction Recommendations

Subject	Requirement
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction	95% of Max. Dry Density
Moisture Content	-2 to +3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. Filling operations should be observed on a full-time basis by ECS to document that the minimum compaction requirements are being achieved. Field density testing of fills should be performed at the frequencies shown in Table 4.4.1.3, but not less than 2 tests per lift.

Table 4.4.1.3. Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of structural fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, fill areas should be graded to facilitate drainage of precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to reduce the likelihood ponding of water which has a tendency to degrade subgrade soils.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

4.5 FOUNDATION DESIGN

Provided subgrades and structural fills are prepared as discussed herein, the proposed structure can be supported by conventional shallow foundations consisting of individual column footings and continuous wall footings. The design of the foundation should utilize the following parameters:

Table 4.5.1. Foundation Design

Design Parameter	Column Footing	Wall Footing
Foundation Type	Shallow Footings	Shallow Footings
Net Allowable Bearing Pressure (1)	2,000 psf – Approved Existing Fill and/or Approved Structural Fill	2,000 psf – Approved Existing Fill and/or Approved Structural Fill
Minimum Width	24 inches	18 inches
Minimum Exterior Frost Depth (below final exterior grade)	18 inches	18 inches
Sliding Friction Coefficient	0.3	0.3
Passive Soil Resistance	295 psf	295 psf
Estimated Total Settlement (2)	Less than 1-inch	Less than 1-inch
Estimated Differential Settlement (3)	Less than ½ inches between columns	Less than ½ inches along 50 feet

Notes:

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) Based on assumed structural loads. If final loads are different, ECS must be contacted to confirm foundation recommendations and settlement calculations.
(3) Based on assumed or provided column/wall loads and variability in the borings. Differential settlement can be re-evaluated once the foundation plans are more complete.

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick “mud mat” of “lean” concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be adequate for support of the proposed structure. It will be important to have the geotechnical engineer of record observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are capable of supporting the design bearing pressures. If soft or poor-quality soils are observed at the footing bearing elevations, these soils should be undercut and removed. Undercuts should be backfilled with lean concrete ($f'_c \geq 1{,}000$ psi at 28 days) or dense graded aggregate fill up to the original design bottom of footing elevation; the original footing should be constructed on top of the hardened lean concrete or aggregate fill.

4.6 SLABS ON GRADE

Assuming the existing fill in the building areas can pass a proofroll as discussed in section 4.3.5, the soil appears to be adequate to support a typical slab on grade construction. Should the slab subgrade consist of high plasticity soil, the fat clays should be removed and replaced in accordance with Section 4.3.3. The following graphic depicts our supported slab recommendations:

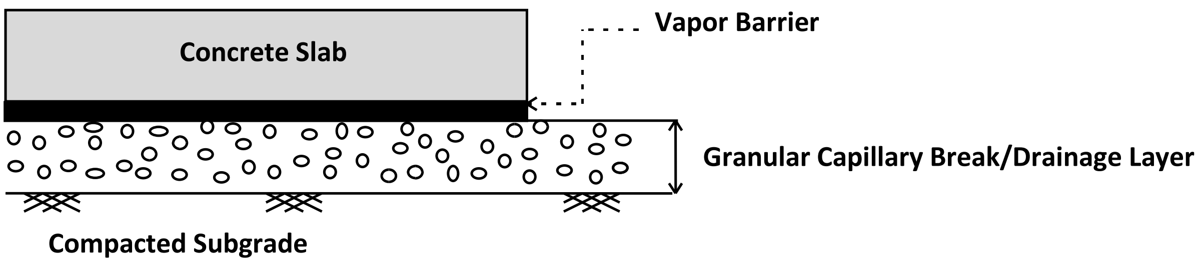


Figure 4.6.1

1. Drainage Layer Thickness: 4 inches
2. Drainage Layer Material: GRAVEL (GP, GW), SAND (SP, SW)

Slab Subgrade Verification: Prior to placement of a drainage layer, the subgrade should be observed through proofrolling as discussed in Section 4.2.4.

Subgrade Modulus: Provided the slab will bear on approved soils, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 110 pci (lbs./cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test basis.

Vapor Barrier: Before the placement of concrete, a vapor barrier may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor barrier is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the structural engineer and/or the architect may choose to eliminate the vapor barrier.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration does not allow the use of a free-floating slab such as in a drop-down footing/monolithic slab configuration, the slab should be designed with adequate reinforcement and load transfer devices to avoid overstressing of the slab.

4.7 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The Chapter 16 of the International Building Codes (IBC) 2018 is utilized by structural engineers to calculate the acceleration response spectra from earthquake motions in the design of the lateral force resistant members of structures.

At least two methods are utilized in classifying sites, namely the shear wave velocity (v_s) method and the Standard Penetration Resistance (N-value) method. The second method (N-Value) was used in classifying this site.

The seismic site class definitions based on the average N-value in the upper 100 feet of the subsurface profile are presented in Table 1613.5.2 of the Code and are summarized below.

Table 4.7.1. Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, Vs, (ft./s)	N value (bpf)
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 60
E	Soft Soil Profile	Vs < 600 fps	<15

Based upon our interpretation of the subsurface conditions, the appropriate Seismic Site Classification is "**D**" as shown in the preceding table.

Ground Motion Parameters: In addition to the seismic site classification, ECS has determined the design spectral response acceleration parameters following the IBC methodology. The Mapped Reponses were estimated from the USGS website https://earthquake.usgs.gov/ws/designmaps/. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far-right end of the following table.

Table 4.7.2. Ground Motion Parameters "Class D" ***(IBC 2018 Method)***

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.647	F_a	1.282	$S_{MS}=F_aS_s$	0.83	$S_{DS}=2/3\ S_{MS}$	**0.553**
1.0	S_1	0.137	F_v	2.326	$S_{M1}=F_vS_1$	0.319	$S_{D1}=2/3\ S_{M1}$	**0.213**

The Site Class definition should not be confused with the Seismic Design Category designation which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, we can provide additional testing methods that may yield more favorable results.

4.8 PAVEMENTS

The final grading plan was not provided at the time of this report. Based on the results of our borings and our expected final grades, it appears that the pavement subgrades will consist mainly of approved existing fill material, or a structural fill material. CBR testing was not performed as part of this study. Therefore, we have assumed a CBR value of 3 for preliminary design purposes.

We were not provided traffic loading information, so we have assumed loadings typical of this type of project in the following table assuming a 20-year design life and 90% reliability:

Table 4.8.1. Pavement Loading Assumptions

Vehicle Description	Light Duty (15,000 ESAL)		Heavy Duty (50,000 ESAL)	
	Number of Trips per Day	Days Per Week	Number of Trips	Days Per Week
Passenger Car	250	7	250	7
Package Delivery Truck	2	7	2	7
Garbage Truck	1	2	1	2
Semi-tractor trailer	-	-	1	7

The preliminary pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

Table 4.8.2. Proposed Pavement Sections

MATERIAL	FLEXIBLE PAVEMENT		RIGID PAVEMENT	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Portland Cement Concrete (f'_c = 4000 psi)	-	-	5 in.	6 in.
Asphaltic Surface Course	1 in.	1 in.	-	-
Asphaltic Binder Course	2 in.	2 ½ in.	-	-
Crushed Stone Base[1]	6 in.	8 in.	5 in.	5 in.

In general, heavy-duty sections are areas that will be subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas.

Large, front loading trash dumpsters frequently impose concentrated front wheel loads on pavements during loading. This type of loading typically results in rutting of asphalt pavement and ultimately pavement failures. For preliminary design purposes, we recommend that the pavement in trash pickup areas consist of a 6-inch thick, 4,000 psi, reinforced concrete slab over 6-inches of dense graded aggregate. When traffic loading becomes available ECS or the Civil Engineer can design the pavements.

Pavement Maintenance: Regular maintenance and occasional repairs should be implemented to keep pavements in a serviceable condition. In addition, to help reduce water infiltration to the pavement section and within the base course layer resulting in softening of the subgrade and deterioration of the pavement, we recommend the timely sealing of joints and cracks using proper sealants. We recommend exterior pavements be reviewed for distress/cracks twice a year, once in the spring and once in the fall.

Sound maintenance programs should help maintain and enhance the performance of pavements and attain the design service life. A preventative maintenance program should be implemented early in the pavement life to be effective. The "standard in the industry" supported by research indicates that preventative maintenance should begin within 2 to 5 years of the pavement construction. Failure to perform preventative maintenance will reduce the service life of the pavement and increase the costs for both corrective maintenance and full pavement rehabilitation.

4.9 BELOW GRADE WALLS

We recommend that permanent below grade walls be designed to withstand lateral earth pressures and surcharge loads from soil, adjacent building foundations, or streets. We recommend that walls that are restrained from movement at the top be designed for a linearly increasing lateral earth pressure.

The following Figure depicts the suggested lateral earth pressure condition for an "undrained condition" with restrained wall tops:

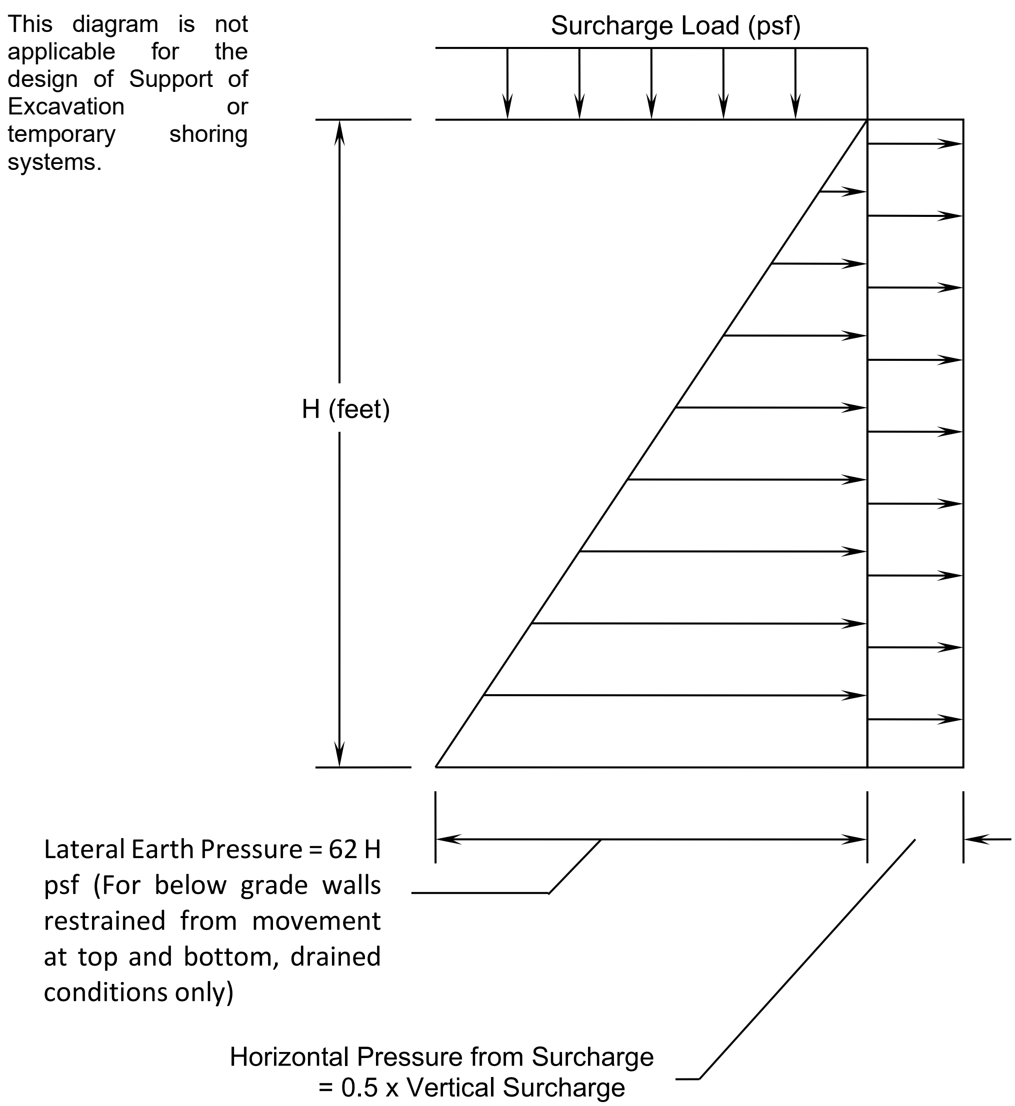


Figure 4.9.1

Surcharge loads imposed within a 45-degree slope of the base of the wall should be considered in the below grade wall design. The influence of these surcharge loads on the below grade walls should be based on an at-rest pressure coefficient, k_0, of 0.5 in the case of restrained walls.

<u>Lateral Earth Pressures</u>: Below grade walls should be designed to withstand the lateral earth pressures exerted by the backfill. The pressure diagram is triangular. For design of below grade retaining wall

structures, the following soil parameters can be utilized. These parameters assume that "drained" granular soils meeting the requirements recommended herein for retaining wall backfill will comprise the backfill in the critical zone. The critical zone is defined as the area between the back of the retaining wall structure and an imaginary line projected upward and rearward from the bottom back edge of the wall footing at a 45-degree angle.

Table 4.9.1. Retaining Wall Backfill in the Critical Zone

Soil Parameter	Estimated value Select Granular Fill	Estimated value 57 or 67 Stone
Coefficient of Earth Pressure at Rest (K_o)	0.47	0.35
Coefficient of Active Earth Pressure (K_a)	0.31	0.22
Coefficient of Passive Earth Pressure (K_p)	3.25	4.6
Retained Soil Moist Unit Weight (γ)	130 pcf	105 pcf
Cohesion (C)	0 psf	0 psf
Angle of Internal Friction (ϕ)	32°	40°
Friction Coefficient (μ)	0.50	0.50
At-rest Equivalent Fluid Pressure	62H (psf)	38H (psf)
Active Equivalent Fluid Pressure	40H (psf)	23H (psf)
Passive Equivalent Fluid Pressure	425H (psf)	485H (psf)

<u>Retaining Wall Backfill</u>: Backfill of below-grade walls may consist of well-graded granular materials (SC, SM, SW, GC, GM or GW) may be used. Select granular backfill should consist of clean sands or gravel. ECS's geotechnical engineer should review the laboratory data for the proposed backfill material, prior to backfill placement, to determine whether the material is consistent with the recommended lateral earth pressures. The first layer of fill should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils. The backfill materials should be placed in 8-inch thick loose layers and compacted to at least 95 percent of the Standard Proctor maximum dry density. We recommend that backfill directly behind the walls be compacted with hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 5 to 10 feet of the wall during backfilling to avoid developing excessive temporary lateral soil pressures.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally adequate for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Loose or poor-quality materials encountered should be removed and replaced with adequately compacted structural fill, or pipe stone bedding material.

Utility Backfilling: The granular bedding material (often #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for structural fill and fill placement.

5.2 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to reduce construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to reduce the likelihood of the infiltration of surface water.

Excavation Safety: Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or reduce the potential for slope failures. Contractors should be familiar with applicable OSHA codes to ensure that adequate protection of the excavations and trench walls is provided.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. Erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by Express Oil Change. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

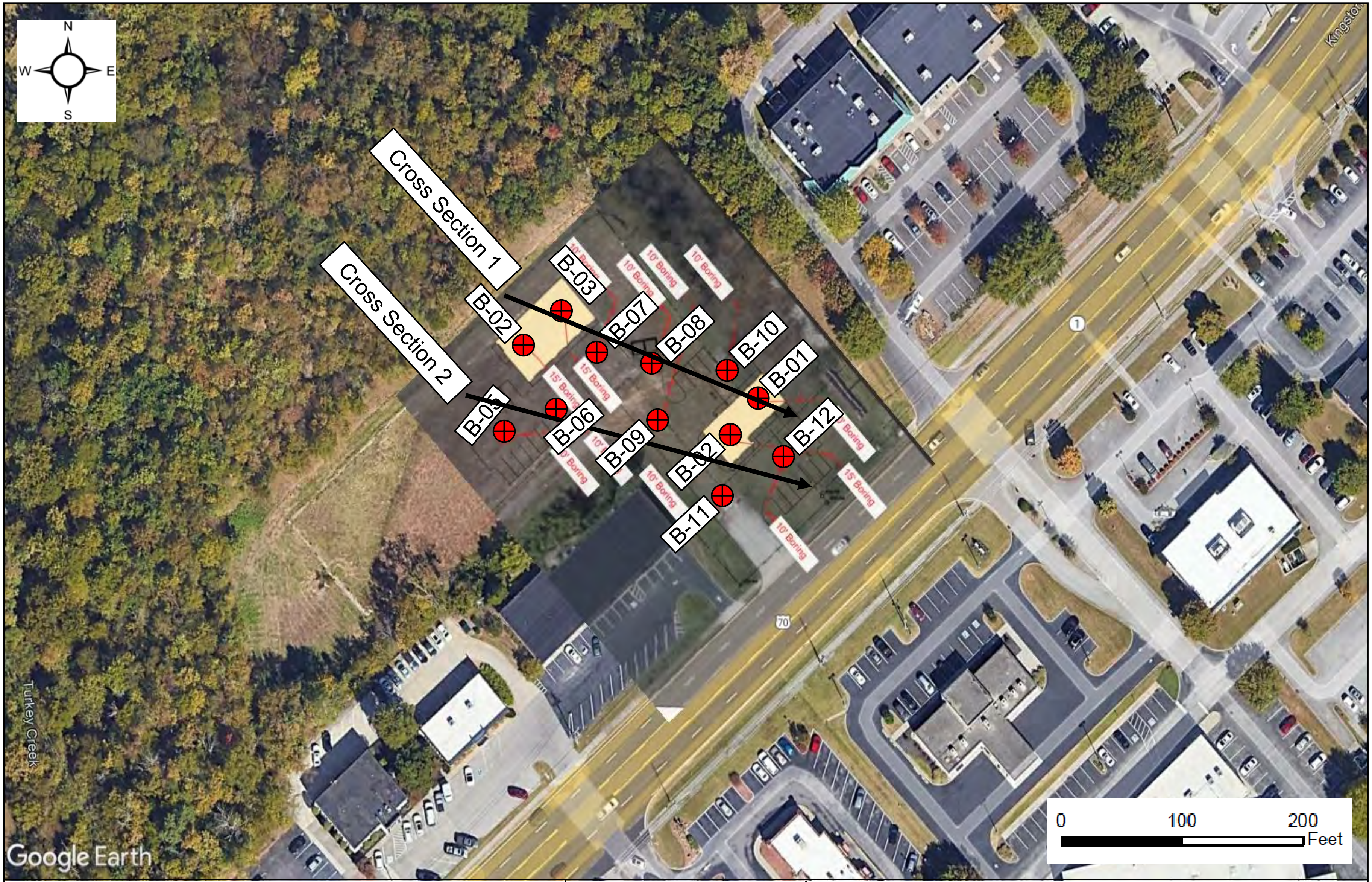
Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

Appendix A - Drawings and Reports

Boring Location Diagram(s)
Subsurface Cross-Section(s)

Express Oil Change - Farragut Kingston Pike Farragut, Tennessee ECS Project No. 26:6778	ECS	Site Location Diagram (approximate site location is outlined in red)

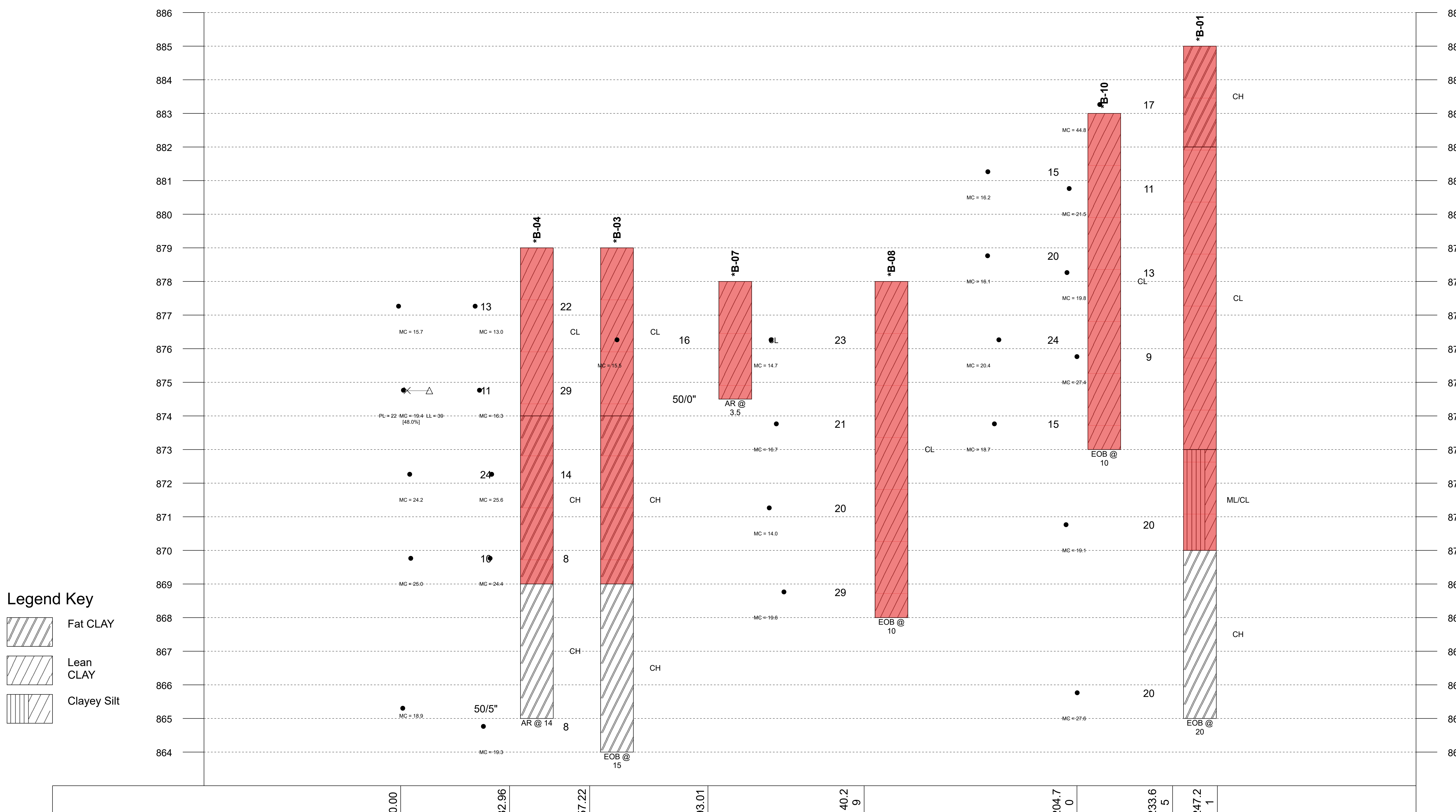


Express Oil Change - Farragut

Kingston Pike
Farragut, Tennessee
ECS Project No. 26:6778

Boring Location Diagram

Approximate Boring Location



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit	WL (First Encountered)	Fill	
[FINES CONTENT %]	WL (Completion)	Possible Fill	
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill	
LOSS OF CIRCULATION			
CALIBRATED PENETROMETER	WL (Stabilized)	Rock	

GENERALIZED SUBSURFACE SOIL PROFILE

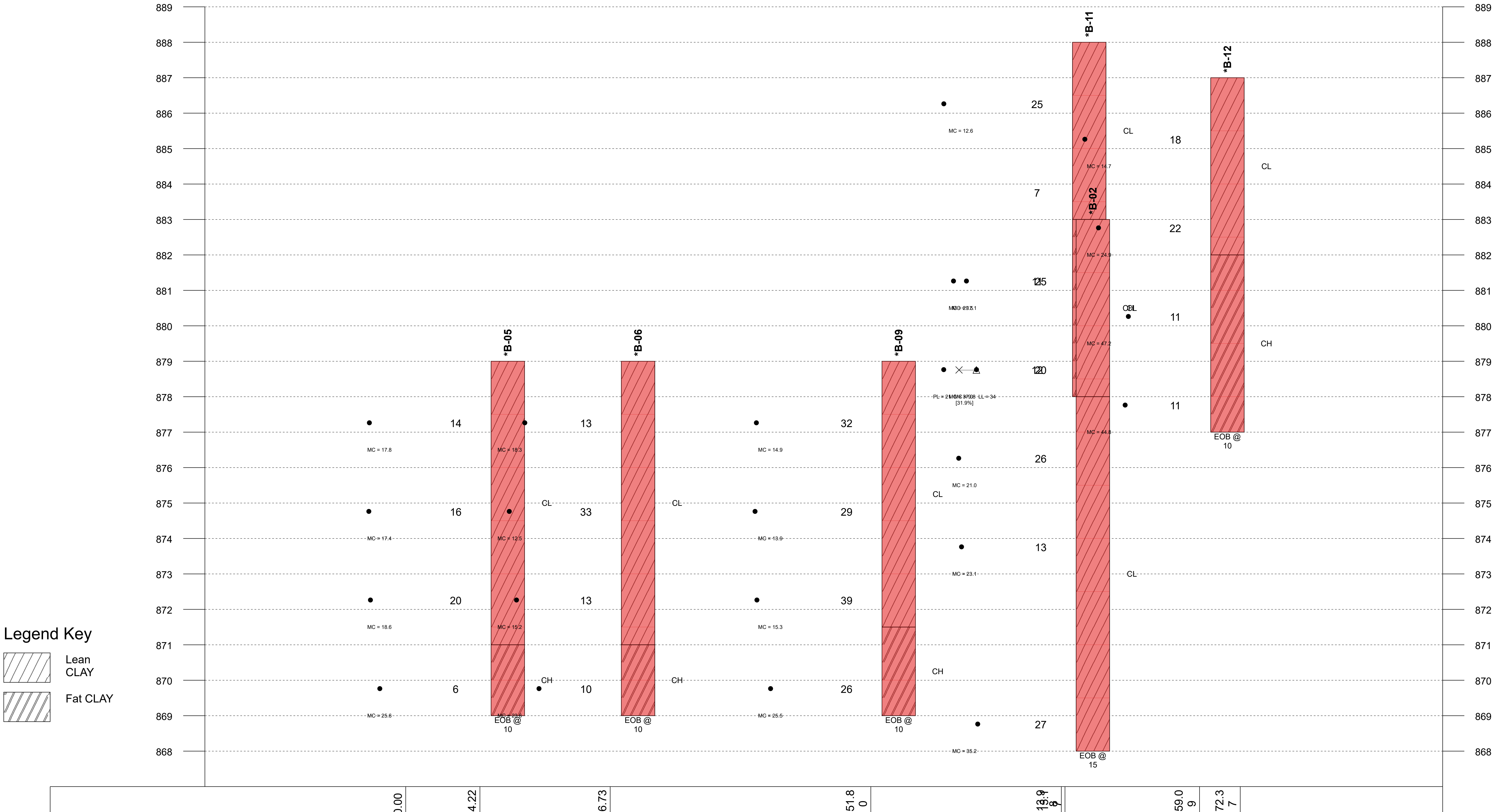
Section line 1

Express Oil Change - Farragut

Express Oil Change, LLC

11153/57 Kingston Pike, Farragut, Tennessee, 37934

Project No: 26:6778 Date: 06/05/2024



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit X	Water Content ● Liquid Limit △
[FINES CONTENT %]	
BOTTOM OF CASING	
LOSS OF CIRCULATION	
CALIBRATED PENETROMETER	

WL (First Encountered)	Fill
WL (Completion)	Possible Fill
WL (Estimated Seasonal High Water)	Probable Fill
WL (Stabilized)	Rock

GENERALIZED SUBSURFACE SOIL PROFILE

Section line 2

Express Oil Change - Farragut

Express Oil Change, LLC

11153/57 Kingston Pike, Farragut, Tennessee, 37934

Project No:	26:6778	Date:	06/05/2024

Appendix B – Field Operations

Reference Notes
Boring Logs

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

Symbol	Material
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
GW	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GP	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GM	**SILTY GRAVEL** gravel-sand-silt mixtures
GC	**CLAYEY GRAVEL** gravel-sand-clay mixtures
SW	**WELL-GRADED SAND** gravelly sand, little or no fines
SP	**POORLY-GRADED SAND** gravelly sand, little or no fines
SM	**SILTY SAND** sand-silt mixtures
SC	**CLAYEY SAND** sand-clay mixtures
ML	**SILT** non-plastic to medium plasticity
MH	**ELASTIC SILT** high plasticity
CL	**LEAN CLAY** low to medium plasticity
CH	**FAT CLAY** high plasticity
OL	**ORGANIC SILT or CLAY** non-plastic to low plasticity
OH	**ORGANIC SILT or CLAY** high plasticity
PT	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	<u><</u>5	<u><</u>5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

- WL (First Encountered)
- WL (Completion)
- WL (Seasonal High Water)
- WL (Stabilized)

FILL AND ROCK

FILL — POSSIBLE FILL — PROBABLE FILL — ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

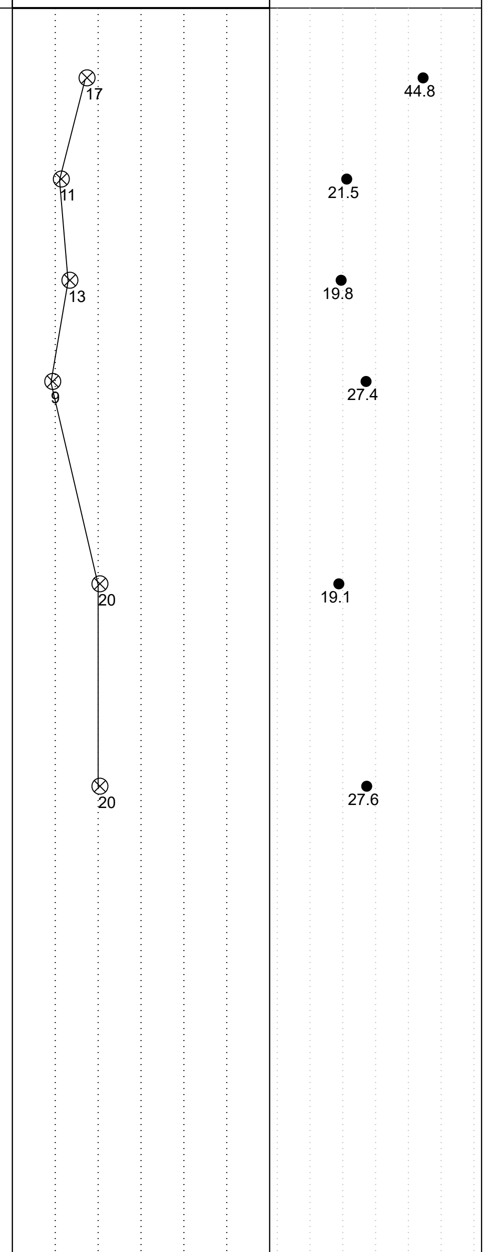
CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-01**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Express Oil Change - Farragut	**Master Drillers, Inc.**		

SITE LOCATION:	
11153/57 Kingston Pike, Farragut, Tennessee, 37934	LOSS OF CIRCULATION
	BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886095	**-84.151653**		**885.0**

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100): RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	WATER CONTENT %
0–3					(CH FILL) FILL, FAT CLAY, trace gravel, trace sand, orangish brown, moist				
	S-1	SS	18	18				7-8-9 (17)	44.8
3–12					(CL FILL) FILL, LEAN CLAY, trace gravel, trace sand, orangish brown to reddish brown, moist, stiff to very stiff				
5	S-2	SS	18	18			880	6-6-5 (11)	21.5
	S-3	SS	18	18				4-6-7 (13)	19.8
10	S-4	SS	18	18			875	5-5-4 (9)	27.4
12–15					(ML/CL FILL) FILL, CLAYEY SILT, dark orange to tan, moist				
15	S-5	SS	18	18			870	7-9-11 (20)	19.1
15–20					(CH) FAT CLAY, trace sand, dark brown, moist, very stiff				
20	S-6	SS	18	18			865	3-3-17 (20)	27.6
					END OF BORING AT 20 FT				
25							860		
30							855		



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**Dry**	BORING STARTED:	**May 16 2024**	CAVE IN DEPTH:	
WL (Completion)	**Dry**	BORING COMPLETED:	**May 16 2024**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT: Express Oil Change, LLC	PROJECT NO.: 26:6778	BORING NO.: B-02	SHEET: 1 of 1
PROJECT NAME: Express Oil Change - Farragut	DRILLER/CONTRACTOR: Master Drillers, Inc.		
SITE LOCATION: 11153/57 Kingston Pike, Farragut, Tennessee, 37934			LOSS OF CIRCULATION
LATITUDE: 35.886018	LONGITUDE: -84.151727	STATION:	SURFACE ELEVATION: 883.0 / BOTTOM OF CASING

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100); RQD; REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	SPT N	WATER CONTENT % / LIMITS
0–5					(CL FILL) FILL, LEAN CLAY WITH GRAVEL, trace sand, dark brown to greenish orange, moist					
	S-1	SS	18	18				7-11-14 (25)	25	17.1
	S-2	SS	18	18				7-10-10 (20)	20	9.8; PL 21; LL 34; [31.9%]
5					(CL FILL) FILL, LEAN CLAY, trace gravel, dark brown to greenish orange brownish red, moist		878			
	S-3	SS	18	18				9-12-14 (26)	26	21.0
	S-4	SS	18	18				6-7-6 (13)	13	23.1
10							873			
	S-5	SS	18	18				8-11-16 (27)	27	35.2
15					**END OF BORING AT 15 FT**		868			
20							863			
25							858			
30							853			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) Dry	BORING STARTED: May 16 2024		CAVE IN DEPTH:
WL (Completion) Dry	BORING COMPLETED: May 16 2024		HAMMER TYPE: Auto
WL (Seasonal High Water)	EQUIPMENT: Truck	LOGGED BY:	DRILLING METHOD: HSA/SPT
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-03**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

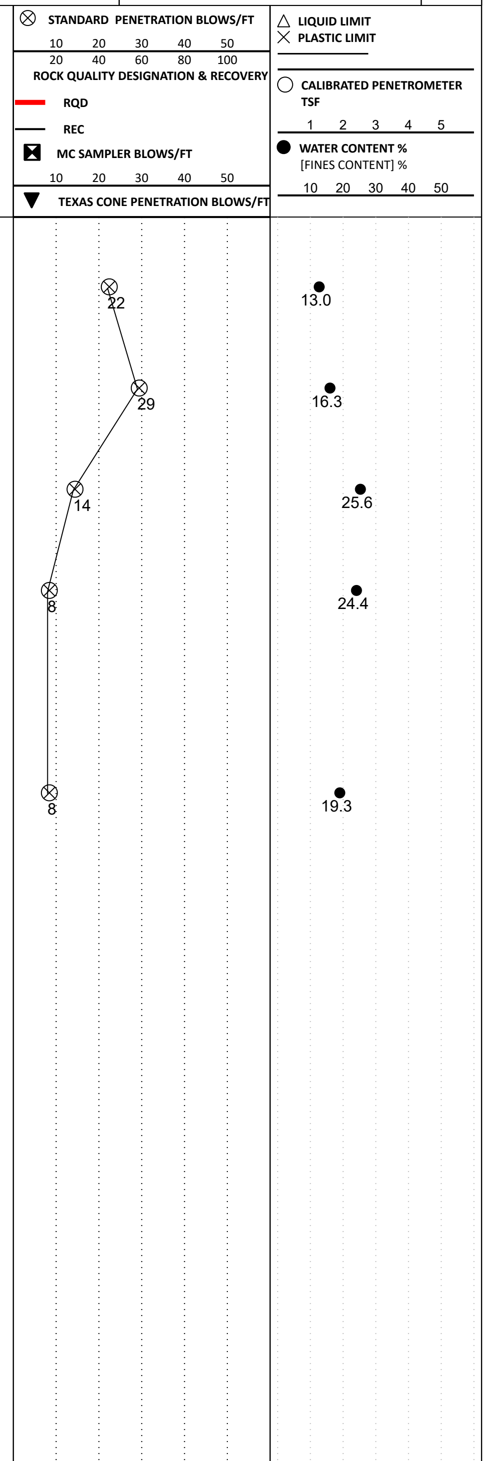
SITE LOCATION:
11153/57 Kingston Pike, Farragut, Tennessee, 37934

LOSS OF CIRCULATION

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886289	**-84.152209**		**879.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	WATER CONTENT %
	S-1	SS	18	18	(CL FILL) FILL, LEAN CLAY, trace sand, dark brown to greenish orange, moist			6-10-12 (22)	13.0
	S-2	SS	18	18				12-12-17 (29)	16.3
5					(CH FILL) FILL, FAT CLAY, trace gravel, brownish orange to brownish red, moist		874		
	S-3	SS	18	18				3-7-7 (14)	25.6
	S-4	SS	18	18				5-4-4 (8)	24.4
10					(CH) FAT CLAY, trace sand, dark brownish gray, moist, firm		869		
	S-5	SS	18	18				1-1-7 (8)	19.3
15					**END OF BORING AT 15 FT**		864		
20							859		
25							854		
30							849		



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **Dry**	BORING STARTED: **May 16 2024**		CAVE IN DEPTH:
WL (Completion) **Dry**	BORING COMPLETED: **May 16 2024**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-04**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886216	**-84.152314**		**879.0**

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100): RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	SPT N	WATER CONTENT % / LIMITS
0					(CL FILL) FILL, LEAN CLAY WITH GRAVEL, trace sand, dark brown to greenish orange brownish red, moist		879			
	S-1	SS	18	18				5-6-7 (13)	13	15.7
	S-2	SS	18	18				7-6-5 (11)	11	19.4; 22 (PL); 39 (LL); [48.0%]
5					(CH FILL) FILL, FAT CLAY, trace gravel, brownish orange to brownish red, moist		874			
	S-3	SS	18	18				6-13-11 (24)	24	24.2
	S-4	SS	18	18				5-5-5 (10)	10	25.0
10					(CH) FAT CLAY, trace sand, dark brownish gray, moist, firm		869			
	S-5	SS	5	5				50/5" (50/5")	50/5"	18.9
14					**AUGER REFUSAL AT 14 FT**					
15							864			
20							859			
25							854			
30							849			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **Dry**	BORING STARTED: **May 16 2024**		CAVE IN DEPTH:
WL (Completion) **Dry**	BORING COMPLETED: **May 16 2024**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

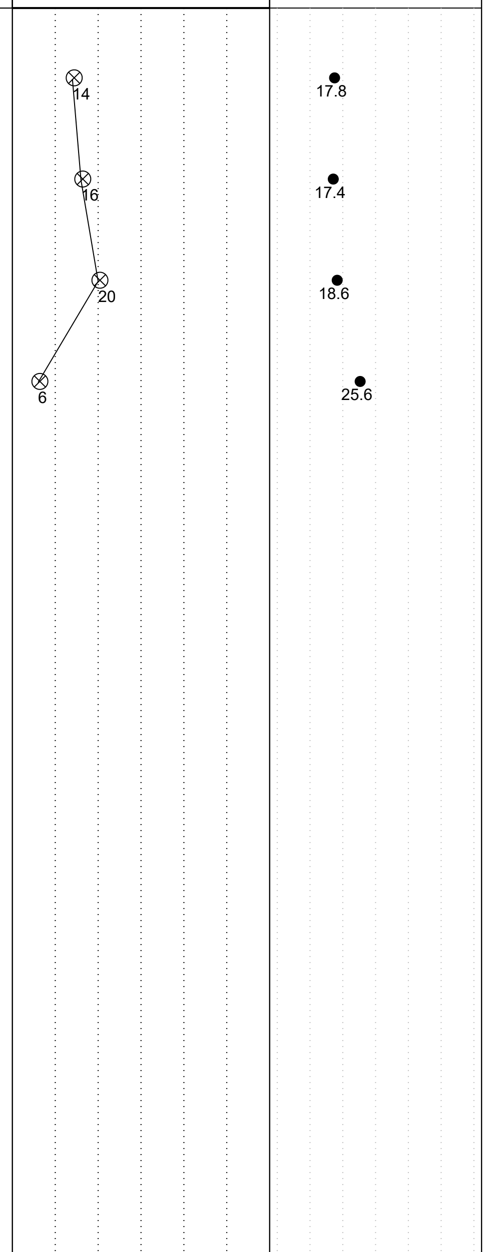
GEOTECHNICAL BOREHOLE LOG

CLIENT: **Express Oil Change, LLC**	PROJECT NO.: **26:6778**	BORING NO.: **B-05**	SHEET: **1 of 1**
PROJECT NAME: **Express Oil Change - Farragut**	DRILLER/CONTRACTOR: **Master Drillers, Inc.**		
SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**		LOSS OF CIRCULATION	
LATITUDE: **35.886024**	LONGITUDE: **-84.152376**	STATION:	SURFACE ELEVATION: **879.0**
		BOTTOM OF CASING	

STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100): RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT

LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	SPT N	WATER CONTENT %
0					(CL FILL) FILL, LEAN CLAY, trace sand, dark orangish brown, moist		879			
	S-1	SS	18	18				6-7-7 (14)	14	17.8
	S-2	SS	18	18				9-8-8 (16)	16	17.4
5							874			
	S-3	SS	18	18				7-9-11 (20)	20	18.6
					(CH FILL) FILL, FAT CLAY, trace gravel, dark brownish red, moist					
	S-4	SS	18	18				5-3-3 (6)	6	25.6
10					**END OF BORING AT 10 FT**		869			
15							864			
20							859			
25							854			
30							849			



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	Dry	BORING STARTED:	May 16 2024	CAVE IN DEPTH:
WL (Completion)	Dry	BORING COMPLETED:	May 16 2024	HAMMER TYPE: **Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)				

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-06**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

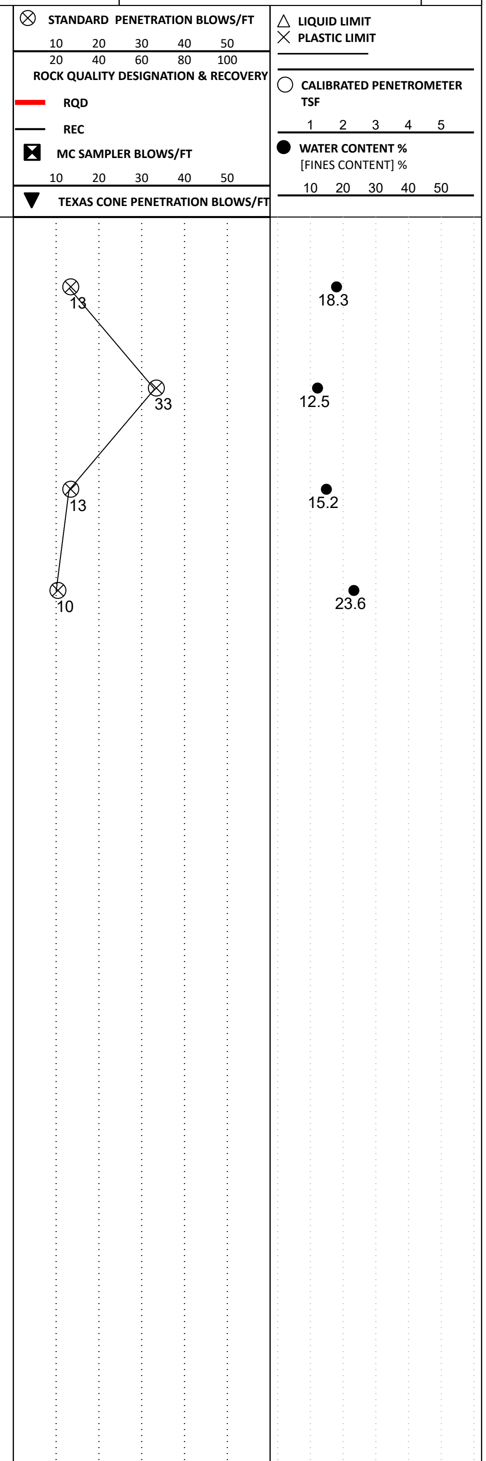
SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**

LOSS OF CIRCULATION

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886070	**-84.152224**		**879.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
					(CL FILL) FILL, LEAN CLAY, trace gravel, dark orangish brown, moist			
	S-1	SS	18	18				7-7-6 (13)
5	S-2	SS	18	18			874	7-16-17 (33)
	S-3	SS	18	18				4-5-8 (13)
					(CH FILL) FILL, FAT CLAY, trace gravel, dark brownish red, moist			
10	S-4	SS	18	18			869	6-5-5 (10)
					END OF BORING AT 10 FT			
15							864	
20							859	
25							854	
30							849	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**Dry**	BORING STARTED:	**May 16 2024**	CAVE IN DEPTH:	
WL (Completion)	**Dry**	BORING COMPLETED:	**May 16 2024**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-07**	**1 of 1**
PROJECT NAME: **Express Oil Change - Farragut**	DRILLER/CONTRACTOR: **Master Drillers, Inc.**		
SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**			

LOSS OF CIRCULATION

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886205	**-84.152109**		**878.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	STANDARD PENETRATION BLOWS/FT	WATER CONTENT %
	S-1	SS	18	18	(CL FILL) FILL, LEAN CLAY, trace sand, dark orangish brown, moist			8-8-8 (16)	16	15.5
	~~S-2~~	~~SS~~	~~0~~	~~0~~	**AUGER REFUSAL AT 3.5 FT**			50/0" (50/0")	50/0"	
5							873			
10							868			
15							863			
20							858			
25							853			
30							848			

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100); RQD; REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**Dry**	BORING STARTED:	**May 16 2024**	CAVE IN DEPTH:	
WL (Completion)	**Dry**	BORING COMPLETED:	**May 16 2024**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-08**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

SITE LOCATION:	LOSS OF CIRCULATION
11153/57 Kingston Pike, Farragut, Tennessee, 37934	BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886174	**-84.151954**		**878.0**

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100): RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	STANDARD PENETRATION BLOWS/FT	WATER CONTENT %
0					(CL FILL) FILL, LEAN CLAY, trace gravel, dark orangish brown, moist		878			
	S-1	SS	18	18				11-11-12 (23)	23	14.7
	S-2	SS	18	18				6-8-13 (21)	21	16.7
5							873			
	S-3	SS	18	18				12-12-8 (20)	20	14.0
	S-4	SS	18	18				6-15-14 (29)	29	19.6
10					**END OF BORING AT 10 FT**		868			
15							863			
20							858			
25							853			
30							848			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**Dry**	BORING STARTED:	**May 16 2024**	CAVE IN DEPTH:	
WL (Completion)	**Dry**	BORING COMPLETED:	**May 16 2024**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-09**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

SITE LOCATION:
11153/57 Kingston Pike, Farragut, Tennessee, 37934

LOSS OF CIRCULATION

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.886054	**-84.151937**		**879.0**

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50
ROCK QUALITY DESIGNATION & RECOVERY: 20 40 60 80 100
RQD
REC
MC SAMPLER BLOWS/FT: 10 20 30 40 50
TEXAS CONE PENETRATION BLOWS/FT

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF: 1 2 3 4 5
WATER CONTENT % [FINES CONTENT] %: 10 20 30 40 50

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	STANDARD PENETRATION BLOWS/FT	WATER CONTENT %
					(CL FILL) FILL, LEAN CLAY, trace sand, dark orangish brown, moist					
	S-1	SS	18	18				7-12-20 (32)	32	14.9
	S-2	SS	18	18				8-14-15 (29)	29	13.9
5							874			
	S-3	SS	18	18				7-20-19 (39)	39	15.3
					(CH FILL) FILL, FAT CLAY, trace gravel, dark brownish red, moist					
	S-4	SS	18	18				10-14-12 (26)	26	25.5
10					**END OF BORING AT 10 FT**		869			
15							864			
20							859			
25							854			
30							849			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **Dry**	BORING STARTED: **May 16 2024**		CAVE IN DEPTH:
WL (Completion) **Dry**	BORING COMPLETED: **May 16 2024**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT: **Express Oil Change, LLC**	PROJECT NO.: **26:6778**	BORING NO.: **B-10**	SHEET: **1 of 1**
PROJECT NAME: **Express Oil Change - Farragut**	DRILLER/CONTRACTOR: **Master Drillers, Inc.**		
SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**		LOSS OF CIRCULATION	
LATITUDE: **35.886159**	LONGITUDE: **-84.151735**	STATION:	SURFACE ELEVATION: **883.0**
		BOTTOM OF CASING	

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	STANDARD PENETRATION BLOWS/FT	WATER CONTENT %
					(CL FILL) FILL, LEAN CLAY, trace sand, dark orangish brown, moist					
	S-1	SS	18	18				5-7-8 (15)	15	16.2
5	S-2	SS	18	18			878	10-10-10 (20)	20	16.1
	S-3	SS	18	18				13-13-11 (24)	24	20.4
10	S-4	SS	18	18			873	5-6-9 (15)	15	18.7
					END OF BORING AT 10 FT					
15							868			
20							863			
25							858			
30							853			

Legend: STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100) — RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT; LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **Dry**	BORING STARTED: **May 16 2024**		CAVE IN DEPTH:
WL (Completion) **Dry**	BORING COMPLETED: **May 16 2024**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-11**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Express Oil Change - Farragut	**Master Drillers, Inc.**

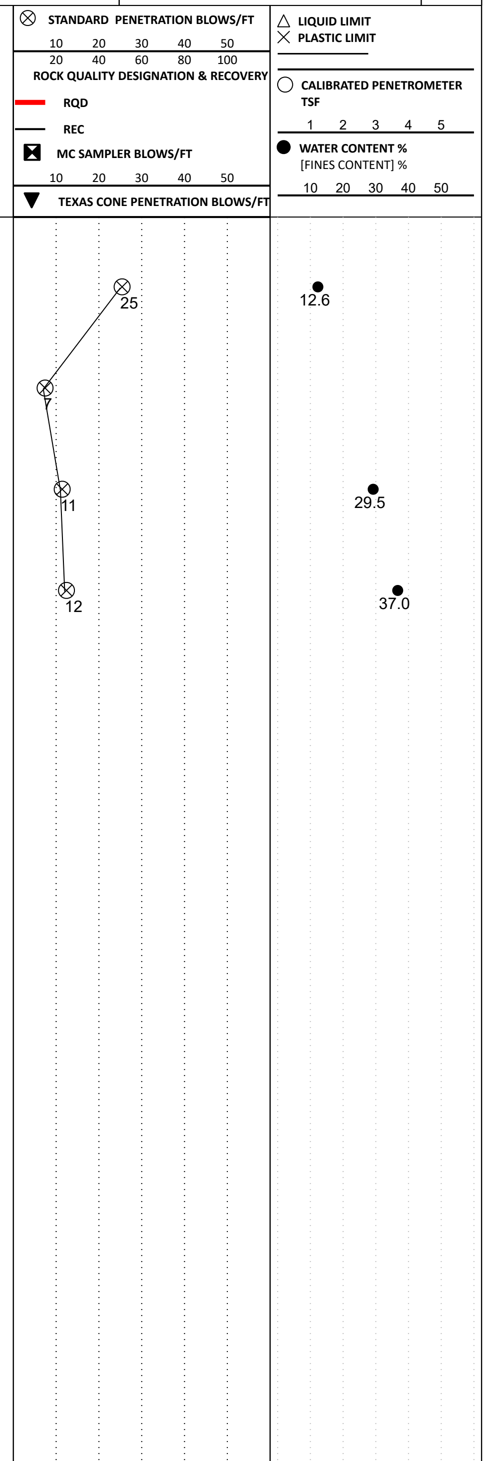
SITE LOCATION:
11153/57 Kingston Pike, Farragut, Tennessee, 37934

LOSS OF CIRCULATION

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
35.885892	**-84.151751**		**888.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
					(CL FILL) FILL, LEAN CLAY, trace sand, dark orangish brown, moist			
	S-1	SS	18	18				10-15-10 (25)
	S-2	SS	18	18				2-3-4 (7)
5					(CH FILL) FILL, FAT CLAY, trace gravel, dark brownish red, moist		883	
	S-3	SS	18	18				4-5-6 (11)
	S-4	SS	18	18				3-5-7 (12)
10					**END OF BORING AT 10 FT**		878	
15							873	
20							868	
25							863	
30							858	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**Dry**	BORING STARTED:	**May 16 2024**	CAVE IN DEPTH:	
WL (Completion)	**Dry**	BORING COMPLETED:	**May 16 2024**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Express Oil Change, LLC	**26:6778**	**B-12**	**1 of 1**
PROJECT NAME: **Express Oil Change - Farragut**	DRILLER/CONTRACTOR: **Master Drillers, Inc.**		
SITE LOCATION: **11153/57 Kingston Pike, Farragut, Tennessee, 37934**		LOSS OF CIRCULATION	
LATITUDE: **35.885977**	LONGITUDE: **-84.151584**	STATION:	SURFACE ELEVATION: **887.0**
		BOTTOM OF CASING	

STANDARD PENETRATION BLOWS/FT (10 20 30 40 50); ROCK QUALITY DESIGNATION & RECOVERY (20 40 60 80 100): RQD, REC; MC SAMPLER BLOWS/FT (10 20 30 40 50); TEXAS CONE PENETRATION BLOWS/FT

LIQUID LIMIT; PLASTIC LIMIT; CALIBRATED PENETROMETER TSF (1 2 3 4 5); WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*	SPT N	WATER CONTENT %
					(CL FILL) FILL, LEAN CLAY, trace gravel, dark orangish brown, moist					
	S-1	SS	18	18				4-8-10 (18)	18	14.7
	S-2	SS	18	18				5-9-13 (22)	22	24.9
5					(CH FILL) FILL, FAT CLAY, trace gravel, dark brownish red, moist		882			
	S-3	SS	18	18				6-6-5 (11)	11	47.2
	S-4	SS	18	18				3-5-6 (11)	11	44.8
10					**END OF BORING AT 10 FT**		877			
15							872			
20							867			
25							862			
30							857			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

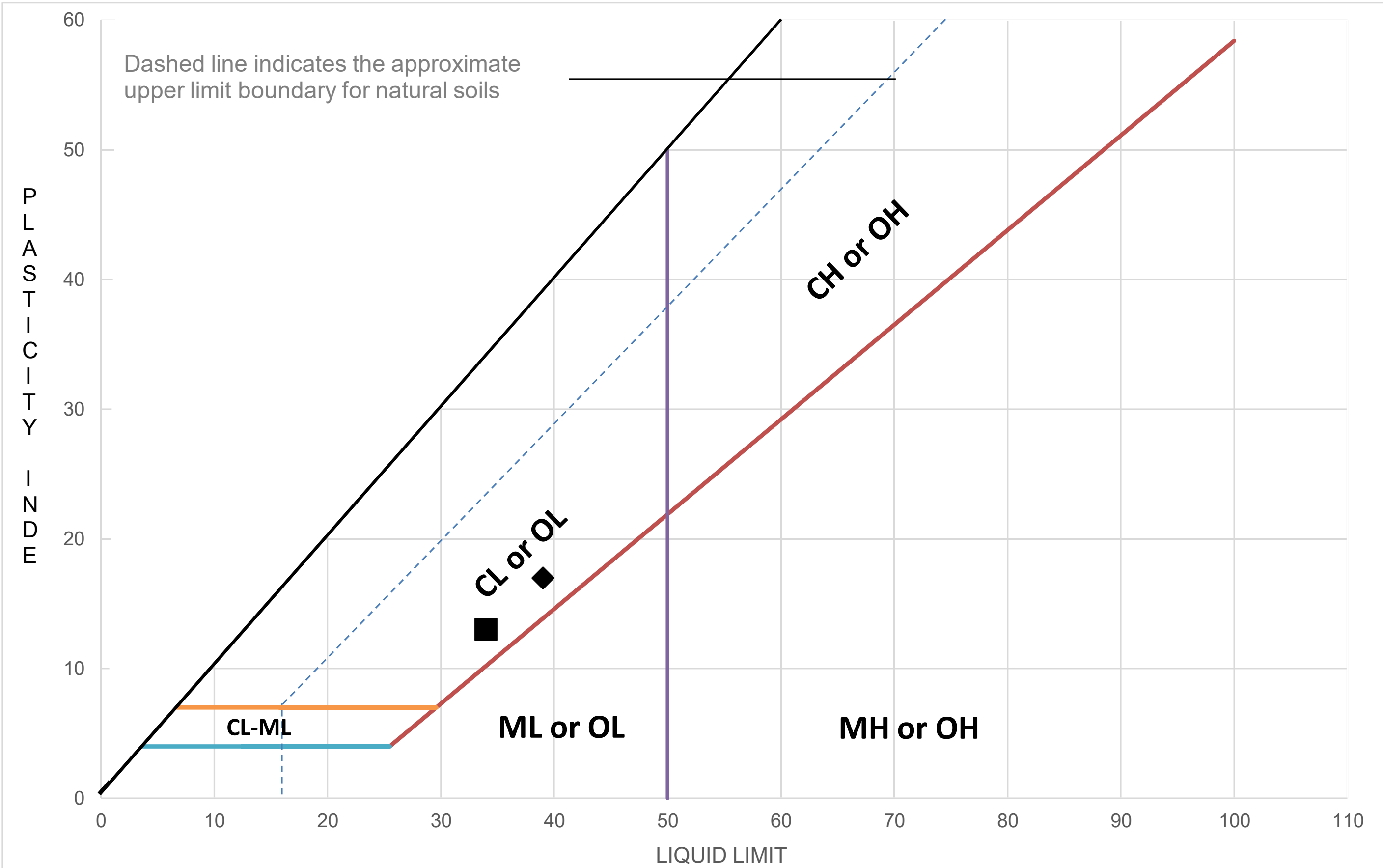
WL (First Encountered) **Dry**	BORING STARTED: **May 16 2024**		CAVE IN DEPTH:
WL (Completion) **Dry**	BORING COMPLETED: **May 16 2024**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **Truck**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

Appendix C – Laboratory Testing

Plasticity Chart(s)
Laboratory Testing Summary

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	B-02	S-2	3.50-5.00	34	21	13		31.9			
◆	B-04	S-2	3.50-5.00	39	22	17		48.0			

Project: Express Oil Change - Farragut
Client:

Project No.: 26:6778
Date Reported: 6/3/2024

Office / Lab: ECS Southeast LLC - Knoxville

Address: 4708 Middlecreek Lane Knoxville, TN 37921

Office Number / Fax: (865)281-1840

Tested by	Checked by	Approved by	Date Received
adusheck	LMinella	LMinella	5/28/2024

Laboratory Testing Summary

Sample Location	Sample Number	Depth (ft)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-01	S-1	1.0-2.5	44.8										
B-01	S-2	3.5-5.0	21.5										
B-01	S-3	6.0-7.5	19.8										
B-01	S-4	8.5-10.0	27.4										
B-01	S-5	13.5-15.0	19.1										
B-01	S-6	18.5-20.0	27.6										
B-02	S-1	1.0-2.5	17.1										
B-02	S-2	3.5-5.0	9.8		34	21	13	31.9					
B-02	S-3	6.0-7.5	21.0										
B-02	S-4	8.5-10.0	23.1										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

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					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-02	S-5	13.5-15.0	35.2										
B-03	S-1	1.0-2.5	13.0										
B-03	S-2	3.5-5.0	16.3										
B-03	S-3	6.0-7.5	25.6										
B-03	S-4	8.5-10.0	24.4										
B-03	S-5	13.5-15.0	19.3										
B-04	S-1	1.0-2.5	15.7										
B-04	S-2	3.5-5.0	19.4		39	22	17	48.0					
B-04	S-3	6.0-7.5	24.2										
B-04	S-4	8.5-10.0	25.0										

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					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-04	S-5	13.5-13.9	18.9										
B-05	S-1	1.0-2.5	17.8										
B-05	S-2	3.5-5.0	17.4										
B-05	S-3	6.0-7.5	18.6										
B-05	S-4	8.5-10.0	25.6										
B-06	S-1	1.0-2.5	18.3										
B-06	S-2	3.5-5.0	12.5										
B-06	S-3	6.0-7.5	15.2										
B-06	S-4	8.5-10.0	23.6										
B-07	S-1	1.0-2.5	15.5										

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					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-08	S-1	1.0-2.5	14.7										
B-08	S-2	3.5-5.0	16.7										
B-08	S-3	6.0-7.5	14.0										
B-08	S-4	8.5-10.0	19.6										
B-09	S-1	1.0-2.5	14.9										
B-09	S-2	3.5-5.0	13.9										
B-09	S-3	6.0-7.5	15.3										
B-09	S-4	8.5-10.0	25.5										
B-10	S-1	1.0-2.5	16.2										
B-10	S-2	3.5-5.0	16.1										

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					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-10	S-3	6.0-7.5	20.4										
B-10	S-4	8.5-10.0	18.7										
B-11	S-1	1.0-2.5	12.6										
B-11	S-3	6.0-7.5	29.5										
B-11	S-4	8.5-10.0	37.0										
B-12	S-1	1.0-2.5	14.7										
B-12	S-2	3.5-5.0	24.9										
B-12	S-3	6.0-7.5	47.2										
B-12	S-4	8.5-10.0	44.8										

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Appendix D – Supplemental Documents

Other Supplemental Documents

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

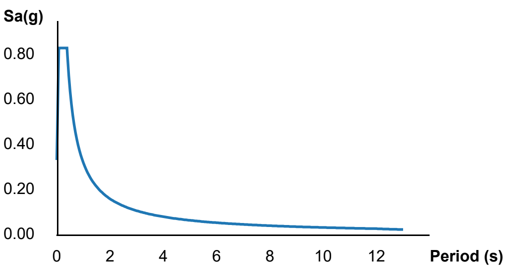
The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

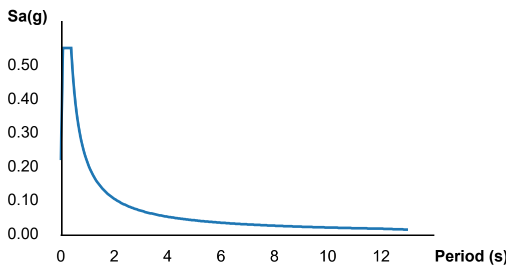
Search Information

Coordinates:	35.88618212665755, -84.15179624966277
Elevation:	881 ft
Timestamp:	2024-06-05T14:07:02.493Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.647	MCE_R ground motion (period=0.2s)
S_1	0.137	MCE_R ground motion (period=1.0s)
S_{MS}	0.83	Site-modified spectral acceleration value
S_{M1}	0.319	Site-modified spectral acceleration value
S_{DS}	0.553	Numeric seismic design value at 0.2s SA
S_{D1}	0.213	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1.282	Site amplification factor at 0.2s
F_v	2.326	Site amplification factor at 1.0s
CR_S	0.896	Coefficient of risk (0.2s)
CR_1	0.934	Coefficient of risk (1.0s)
PGA	0.442	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.531	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	0.647	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.723	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.137	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.147	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)

PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Appendix E – Other Information

GBA - Geotechnical Engineering Report Information Sheet

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will <u>not</u> likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will <u>not</u> be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do <u>not</u> rely on an executive summary. Do <u>not</u> read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org