May 8, 2023

University of Tennessee
Department of Capital Projects
505 Summer Place, UT Tower 9th Floor
Knoxville, Tennessee 37902

ATTENTION: Mr. Jared Murrell
JMurrell5@tennessee.edu

Subject: REPORT OF GEOTECHNICAL EXPLORATION
G10 Parking Garage Addition
University of Tennessee – Knoxville
Knoxville, Tennessee 37916
GEOServices Project No. 21-23360

Dear Mr. Murrell:

We are submitting the results of the geotechnical exploration performed for the subject project. The geotechnical exploration was performed, in accordance with our Proposal No. 11-23213R1, dated March 10, 2023. The following report presents our findings and recommendations for the proposed project. Should you have any questions regarding this report, or if we can be of any further assistance, please contact us at your convenience.

Sincerely,
GEOServices, LLC

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REPORT OF
GEOTECHNICAL EXPLORATION

UTK G10 Parking Garage
University of Tennessee
Knoxville, Tennessee

GEOServices Project No. 21-23360

Submitted to:
University of Tennessee
Department of Capital Projects
505 Summer Place, UT Tower 9th Floor
Knoxville, Tennessee 37902

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  APPENDIX A – Figures, General Notes, Boring Summary Table, and Boring Logs
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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of our geotechnical exploration was to explore the subsurface conditions for the proposed addition to the existing G10 Parking Garage on the University of Tennessee Campus in Knoxville, Tennessee and provide geotechnical recommendations for site preparation and grading and for the design and construction of the foundation systems.

1.2 PROJECT INFORMATION AND SITE DESCRIPTION

Project information was provided via a Request for Proposal letter from the University of Tennessee. Enclosed with the letter was a map indicating the proposed area of construction. Based on the provided information, renovations and additions are planned to the existing G10 parking garage on the University of Tennessee campus in Knoxville, Tennessee. Based on the provided information provided at this time, we understand the project will consist of a new “tabletop” addition over the existing 5-story parking garage and consist of steel and concrete. At this time, loading information has not been provided; however, due to the size and potential lateral loads, we anticipate the addition will likely need to be supported on some form of deep foundation system.

The site is bordered by Thompson Boling Arena to the south, an existing rail line/Neyland Drive to the east, a parking lot to the north, and Philip Fulmer Way/additional parking to the west. Based on site observations, the western portion of the site is limited due to the existing large slope while minimal access is noted along the eastern portion due to the rail line.

Based on the available KGIS topographic maps, existing elevations range from approximately 890 feet Mean Sea Level (MSL) to 830 feet MSL, sloping downwards from west to east. We note the majority of the grade change occurs on the western side of the parking garage with elevations sloping from 890 to 840 feet MSL and an approximate Floor Elevation of 840 feet MSL of the existing garage. While finalized grading information has not been provided, we anticipate that much of the expansion will remain at current grades with cuts/fills of less than 5 feet.
Once structural and grading information becomes available, GEOServices should be allowed to review and revise the recommendations contained herein, if necessary.

1.3 SCOPE OF STUDY

This geotechnical exploration involved site reconnaissance, field drilling, laboratory testing, and engineering analysis. The following sections of this report present discussions of the field exploration, site conditions, conclusions, and recommendations. Following the text of this report, Appendices A and B present the figures, test boring records, boring summary table, laboratory test results, and rock core photographs. The scope of our geotechnical engineering services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air, on, or below, or around this site. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 EXPLORATION AND TESTING PROGRAMS

2.1 FIELD EXPLORATION

As requested, the site subsurface conditions have been explored by drilling the twelve (12) soil test borings along the exterior of the existing parking garage in accessible areas. The boring locations were staked by GEOServices personnel using the provided location plan and a hand-held GPS unit. Subsurface utilities were also identified and marked in the area of each boring by a subcontractor prior to our mobilization using ground penetrating radar equipment and other subsurface utility location devices. The soil test borings were drilled between April 12 and 17, 2023.

The borings were advanced using 3½-inch hollow stem augers and a track-mounted drill rig. The approximate locations of the soil test borings are shown in Figure 2 of Appendix A of this report. The depths in this report reference the ground surface that existed at the time of the exploration. The elevations shown on the boring logs and referenced in this report were obtained by interpolation using the KGIS topographic maps and should be considered approximate. Detailed logs for soil test borings can also be found in Appendix A.
Within each boring, Standard Penetration Testing (SPT) and split-spoon sampling were performed at 2½-foot intervals in the upper 10 feet and at 5-foot intervals thereafter. SPT and split-spoon sampling were performed in accordance with ASTM D1586. In split-spoon sampling, a standard 2-inch O.D. split-spoon sampler is driven into the soil at the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the last 12 inches of the standard 18 inches of total penetration (or second and third 6-inch increments when sampling 24 inches) is recorded as the SPT resistance (N-value). These N-values are indicated on the boring logs at the test depth and provide an indication of the consistency or relative density of the soil.

Upon encountering refusal materials, rock coring was performed at five locations (B-1, B-5, B-8, B-9, and B-11) using a rotary drill rig utilizing an NQ2 core barrel equipment in general accordance with ASTM D2113. The core barrel is rotated at high speeds and is capable of cutting hard rock. Samples of cored material from the swivel-mounted inner barrel are removed, then classified and the recovery ratio (REC) and Rock Quality Designation (RQD) are determined. The sample recovery ratio (REC) is defined as the length of core retained divided by the total length cored expressed as a percent. The rock quality (RQD) is defined as the cumulative sum of recovered hard core pieces 4 inches and longer divided by the total length cored. The sample recovery and RQD are a measure of the character and continuity of the material penetrated and are indications of the quality of the rock.

A log of the rock core material encountered at the performed boring locations was prepared in the field. After recovery, each sample was removed from the sampler and the full sections of extracted rock were placed in sturdy core boxes for transport to the laboratory facility for visual classification.

### 2.2 LABORATORY TEST PROGRAM

After completion of the field drilling and sampling phase of this project, the soil and rock samples were returned to our laboratory where they were visually-manually classified in general accordance with the Unified Soil Classification System (USCS – ASTM D2487) by a GEOServices geotechnical professional. Laboratory testing of selected split-spoon soil samples included natural moisture content (ASTM D2216) and Atterberg limits (ASTM D4318) tests. The laboratory testing on the samples obtained during the current exploration was ongoing as of this writing and will be submitted under transmittal cover level once completed.
3.0 SUBSURFACE CONDITIONS

3.1 GEOLOGIC CONDITIONS

The site lies within the Appalachian Valley and Ridge Physiographic Province of East Tennessee. This Province is characterized by elongated, northeasterly-trending ridges formed on highly resistant sandstone and shale. Between ridges, broad valleys and rolling hills are formed primarily on less resistant limestone, dolomite, and shale.

Published geologic information indicates that this site is underlain by bedrock from the Newala Formation of the Knox Group. The Newala is made up of the Mascot Dolomite and Kingsport Formations, which are generally composed of fine-grained, siliceous dolomite inter-bedded with limestone. These formations typically weather to produce a thick reddish or orangish-brown clay overburden soil. Silica in the form of chert is resistant to weathering and typically scattered throughout the residuum.

Site geology may also have been influenced by water-deposited (alluvial) materials within the flood plain of nearby Tennessee River. Alluvial materials are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden. Alluvial materials composed of sandy clays were encountered underlying existing fill materials at this site.

Since the bedrock formation underlying this site contains carbonate rock (e.g., limestone/dolomite), the site is susceptible to the carbonate hazards of irregular weathering, cave and cavern conditions, and overburden sinkholes. Carbonate rock, while appearing very hard and resistant, is soluble in slightly acidic water. This characteristic, plus differential weathering of the bedrock mass is responsible for the hazards. Of these hazards, the occurrence of sinkholes is potentially the most damaging to overlying soil-supported structures. Sinkholes primarily occur due to differential weathering of the bedrock and flushing or raveling of overburden soils into the cavities in the bedrock. The loss of solids creates a cavity or dome in the overburden. Growth of the dome over time or excavation over the dome can create a condition in which rapid, local subsidence or collapse of the roof of the dome occurs.
A certain degree of risk with respect to sinkhole formation and subsidence should be considered at any site located within this geologic setting. While a rigorous effort to assess the potential for sinkhole development at this site was beyond our scope of services, we did not observe any obvious surficial signs of sinkhole activity. However, numerous closed depressions, which are indicative of past sinkhole activity, were observed on the United States Geological Survey (USGS – Knoxville Quadrangle, TN) topographic map in the vicinity of this site. Further, several void intervals were encountered during rock coring which is consistent with bedrock solutioning.

It is our opinion that the risk of sinkhole development at this site is no greater than at other sites located within similar geologic settings which have been developed successfully. However, the owner must be willing to accept the risk of future sinkhole development at this site. The risk of sinkhole development can likely be reduced by following the recommendations provided in the following sections of this report along with supporting larger structures on the underlying bedrock.

3.2 SOIL STRATIGRAPHY

The following subsurface description is of a generalized nature to highlight the subsurface stratification features and material characteristics at the boring locations. The boring logs included in Appendix A of this report should be reviewed for specific information at each boring location. Information on actual subsurface conditions exists only at the specific boring locations and is relevant only to the time that this exploration was performed. Variations may occur and should be expected at the site.

**Surficial & Fill Materials**

During our field exploration measurable amounts of topsoil were not encountered in the boring locations. However, based on onsite observations, we anticipate organic-laden material and/or topsoil will be encountered and recommend the contractor evaluate the surficial material depth in areas away from our boring locations for bidding purposes.

Beneath the surficial materials, each location encountered variable fill materials generally consisting of gray, brown, orangish brown, reddish brown, black, to tan low plasticity (lean) and high plasticity (fat) clayey soils with varying amounts of gravel, sand, silt, and organics. Cinders were also encountered in four locations (B-2, B-6, B-7, and B-9) while construction debris consisting of brick, asphalt, plastic, and metal were encountered in three locations (B-2, B-6, and B-9). In addition, apparent layers of gravel were noted.
in six locations (B-1 and B-7 through B-11) at depths ranging from the existing surface to 17 feet below existing grade.

These materials extended to depths ranging between 5.2 and 22.6 feet below existing grade, including auger refusal in five locations (B-5, B-7 through B-9, and B-11). Where confirmation of refusal materials was not completed, refusal may have been upon denser debris and the depth of fill may be greater.

The SPT N-value of the existing fill ranged from 4 blows per foot (bpf) to 50/3” (50 blows per 3 inches), indicating a soft to hard consistency in the fine-grained soils and very loose to very dense relative density in the coarse-grained sands. We note that the N-values greater than about 20 bpf were likely influenced by the presence of the upper surface of bedrock or gravel within the soil matrix. More typically, the fill soils were firm, or worse.

Alluvium
Beneath the fill materials, alluvial materials were encountered in three locations (B-1, B-3, and B-4) consisting of brown, orangish brown, gray, and reddish brown low plasticity (lean) sandy clay and sand with varying amounts of rounded rock fragments which extended from approximately 5 ½ feet below existing grade to 15 and 12 feet below existing grade, respectively.

Residuum
Underlying fill materials and/or alluvial soils in seven locations (B-1 through B-4, B-6, B-10, and B-12), apparent residual materials were encountered and generally consisted of brown, orangish brown, tan, to reddish brown low plasticity (lean) and high plasticity (fat) clayey soils with varying amounts of chert fragments, manganese staining, sand, and silt.

The exceptions to the general stratigraphy include boring B-4 which encountered a layer of clayey sand at a depth of approximately 37 to 42 feet below existing grade and boring B-12 which encountered a layer of weathered rock, classified as brown dolomite, just beneath the fill materials (8 feet below grade) and extended to auger refusal.

The SPT N-values within the alluvial and residual materials encountered generally ranged from 0 bpf to 50/1”, indicating very soft to hard consistencies in the fine-grained materials and loose to medium dense
relative densities in the coarse-grained materials. Similar to the fill materials, we note that SPT N-values greater than 20 bpf were influenced by denser materials, such as chert fragments, within the soil matrix, weathered rock, or the upper surface of bedrock.

Auger Refusal

Auger refusal on apparent bedrock was encountered at depths ranging from approximately 5.2 to 65.6 feet below the existing grade (~863.8 to 810.2 feet MSL). As previously mentioned, locations where fill materials extended to refusal and rock was not verified (via rock coring) may have been upon denser fill materials. Auger refusal is a designation applied to any material that cannot be penetrated by the power auger and is normally indicative of very hard or dense materials, such as the upper surface of bedrock.

Upon encountering refusal materials, rock coring was performed in five locations (B-1, B-5, B-8, B-9, and B-11). The cores were extended to depths of approximately 30.2 to 85.1 feet below the existing grade using rock coring techniques. The rock materials were classified as bluish green, maroon, tan, brown, black, and light gray to dark gray dolomite with limestone and varying amounts of partially healed to healed calcium seams, soil seams, sandstone seams, shale seams, quartz seams, vugs, and iron-stained joints. In addition, each coring location, with the exception of boring B-9, encountered voids, ranging between approximately 7 inches to 5.6 feet thick. We note boring B-1 was able to verify rock at a depth of 85.1 feet below existing grade, beneath the large clay/void zone; however, we were unable to continue drilling due to loss of verticality.

Recoveries of the encountered bedrock ranged from 0 to 100 percent with Rock Quality Designation (RQD) values between 0 to 100 percent, indicating very poor to excellent quality from an engineering standpoint. We note relatively large clay filled voids and open voids were encountered in boring B-1 from depths of 72.1 to 85.1 and boring B-5 from 13.9 to 23.6 feet along with weathered rock in the upper couple feet in several locations. Therefore, the recovery and RQD of the rock outside of these areas was generally between 58 to 100 percent and 58 to 100 percent, indicating fair to excellent quality.

Groundwater

Groundwater was not encountered during or upon completion of drilling activities. Stabilized water levels can sometimes be difficult to obtain as the encountered soils are known to be relatively impermeable. We note that water is introduced during rock coring to extend drilling equipment further, which may
obscure the actual groundwater level in rock coring locations. In addition, the borings were backfilled upon completion in consideration of safety.

It is still possible for discontinuous zones of perched water to exist within the overburden materials and/or at contact with bedrock. The groundwater information presented in this report is the information that was collected at the time of our field activities. We recommend that the contractor determine the actual groundwater level at the site at the time of the construction activities. We have provided a table in Appendix A of this report which includes approximate surficial materials’ thickness and approximate depths of fill and refusal depths along with rock coring data relative to the estimated ground surface elevation of each boring location.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 SITE ASSESSMENT

Based on the results of our geotechnical exploration, it is our opinion that the site is generally adaptable for the proposed construction. However, certain geotechnical challenges will likely present themselves during site development, which we have outlined in the following sections.

4.1.1 Existing Utilities & Onsite Materials

Prior to our mobilization, GEOServices subcontracted a private utility locator to locate existing utilities using ground penetrating radar equipment and other subsurface utility location devices. Based on these scans, the area is heavily developed with underground utilities. Prior to construction, we recommend utilities not to be incorporated into the renovation/addition be removed and replaced with properly compacted structural fill and re-routed outside of structural elements.

During our exploration, apparent fill materials were encountered generally consisting of lean and fat clayey soils with varying amounts of gravel, sand, silt, and organics. which extended to depths ranging between approximately 5.2 and 22.6 feet below existing grade, including auger refusal in five locations (B-5, B-7 through B-9, and B-11). Where confirmation of refusal materials was not completed, refusal may have been upon denser debris and depth of fill may be greater. In addition, we note construction debris (asphalt, brick, plastic, metal, cinders) were encountered in four locations along with gravel layers in six locations (B-1 and B-7 through B-11) at various depths.
Where confirmation of refusal materials was not completed, refusal may have been upon denser debris and depth of fill may be greater. It is also possible that deeper zones or pockets of fill may be encountered between our widely spaced borings. Beyond the fill materials, seven locations (B-1 through B-4, B-6, B-10, and B-12) encountered apparent residual soils consisting of lean and fat clays, with some clayey sands, which were highly variable in consistency.

Due to the highly variable depth and consistency of the existing fill and residual soils along with the anticipated significant loads associated with the structures, GEOServices recommends that the existing soils encountered on-site not be utilized for direct foundation support of the proposed scoreboard, three-story structure, or two-story structure.

While some of the existing materials may be suitable for slab support or support of lightly loaded ancillary structures (if necessary), each location encountered lower consistency materials at depths ranging from the existing surface to auger refusal depths. Therefore, remediation of these materials will be required. The amount will be dependent on the final grade and time of year construction is to begin.

In addition, the majority of our borings encountered soils classified as high plasticity (fat) clays at depths ranging from the existing surface to refusal depths. Therefore, we anticipate these materials will be encountered during construction activities and are marginally suitable for lightly-loaded foundation or slab support and may impede site grading activities as they are susceptible to moisture changes. As indicated by laboratory testing, the onsite soils will have a slight to high potential for volume change. As such, we recommend that the material directly beneath any slabs-on-grade, pavements, or sidewalks, undergo rigorous plasticity testing during placement to ensure that it meets the requirements outlined previously for structural soil fill.

4.1.2 Foundation and Subgrade Support

Based on our understanding of the project, the anticipated axial and lateral loads, and materials encountered, we anticipate that the “tabletop” structure will require a rock-supported foundation system, consisting of drilled shafts, micropiles, or a combination thereof.
Smaller ancillary structures, if incorporated into this addition, can likely be supported by either suitable residual soils or properly compacted engineered fill but may require some undercut of unsuitable fill materials. We have provided recommendations in the following sections for support utilizing the mentioned support systems.

For slabs on grade, subgrade support correction measures will likely still be required to form a stable subgrade unless a structural slab is completed. Subgrades for lightly loaded slabs can typically be supported on materials that proofroll successfully. Proofrolling should be observed by a geotechnical engineer or by a qualified representative in order to help identify areas requiring subgrade support correction. Where the subgrade does not pass proofrolling, remediation should be performed. Given the conditions encountered in the borings, we recommend the project budget include an allowance for subgrade stabilization across the site.

Based on GEOServices’ understanding of the proposed development, it may be beneficial to the client, design team, and contractor(s) to perform an additional exploration consisting of rock cores at individual column locations and other structurally critical elements. The intent of this additional exploration would be to help determine the depth to competent bearing material at each foundation location and assist with foundation bearing estimates. This work should be performed once the structural design has been finalized.

4.1.3 Work Near Existing Structures
Due to the proximity of the proposed renovations to the existing stadium structure(s) and roadway, care should be taken to protect existing structures and streets adjacent to the site from construction induced vibrations and/or undermining during construction and excavation of any below-grade levels or foundation elements. Due to the age of the surrounding structures, the client may benefit from pre-construction surveys of the neighboring structures to document their existing condition and evaluate the extent of potential damage or claims.
Care should be taken by the contractor when working adjacent to existing structures/roadways. We recommend backfilling excavations adjacent the existing foundations as soon as possible after establishing proposed grades. When undercutting unsuitable materials or constructing new foundations, we recommend the contractor work in short segments as to not compromise the existing walls, foundations, or subgrades. Typically, these segments should be less than 8 feet; however, the structural engineer should determine the maximum segment length based on their assessment of the structural integrity of the existing structure. In addition, the contractor should not undercut more than 2 feet in areas near the existing structure without on-site observation by a representative of the geotechnical engineer.

Once additional information concerning the design and desired construction approach have been developed, the contractor is likely to require additional information and recommendations. At that time, GEOServices would be pleased to provide a proposal for this additional work.

We strongly encourage the client to confer with the design team and a contractor with regard to the recommendations contained in this report, in an effort to assess potential costs and schedule. Once proposed grading and structural loading have been determined and finalized, GEOServices should be allowed to review to confirm the design recommendations from this report.

4.2 SITE PREPARATION RECOMMENDATIONS

4.2.1 Subgrade
Any demolition of existing structures should include the complete removal of below grade items (including concrete foundations and slabs) and pavements (including basestone). Existing sumps, basements or pits, if present, should be excavated with a 2H:1V side slope and the excavation backfilled using structural soil fill or compacted dense graded aggregate. Additionally, utilities to be abandoned should be completely removed and their trenches backfilled using structural soil fill. If utilities are to remain in use, they should be rerouted outside of the proposed building areas.

Site stripping within the proposed construction areas (building and pavement) should include the removal of vegetation, topsoil, rock fragments greater than 6 inches, asphalt, gravel, concrete, and other debris. The stripping operations should extend a minimum of 5 feet beyond the limits of proposed pavement areas and 10 feet beyond building footprints.
After the completion of stripping operations and excavation to reach the planned subgrade elevation, we recommend that the subgrade be proofrolled with a fully-loaded, tandem-axle dump truck or other pneumatic-tired construction equipment of similar weight. Areas to receive structural soil fill should also be proofrolled prior to the placement of new fill. The geotechnical engineer or his representative should observe the proofrolling.

Given the presence of low consistency materials and uncontrolled fill, it is likely measures will also be required to correct subgrade support for potential slabs or small ancillary structures. Alternatives to improve subgrades may consist of undercutting and replacement, the use of a biaxial geogrid, tracking surge stone into soft soil, or combinations thereof. Generally, subgrade improvement for pavement areas consists of undercutting and replacing a minimum of 2 feet below the subgrade elevation with structural soil fill or compacted dense graded aggregate. The depth of undercutting should be determined based upon observations and tests performed at the time of construction. Given the conditions encountered in the borings, we recommend the project budget include an allowance for subgrade stabilization across the site.

4.2.2 Structural Soil Fill

Material considered suitable for use as structural fill should be clean soil free of organics, trash, and other deleterious material, containing no rock fragments greater than 6 inches in dimension. Preferably, structural soil fill material should have a standard Proctor maximum dry density of 90 pounds per cubic foot (pcf), or greater, and a PI value of 35 percent, or less. The material to be used as structural fill should be tested by the geotechnical engineer to confirm that it meets the project requirements before being placed.

Based on our exploration, we anticipate some of the onsite materials may be suitable for re-use as structural soil fill beneath slabs or lightly-loaded structural areas. Further assessment of the onsite materials can be made during observation of earthwork activities performed on site or prior to construction using test pits. It is possible that the higher plasticity materials may be mixed with lower plasticity materials during earthwork grading to produce a material which meets the recommended criteria, or the material treated using lime or cement to lower the soil plasticity.
Structural fill should be placed in loose, horizontal lifts not exceeding 8 inches in thickness. Each lift should be compacted to at least 98 percent of the soil’s maximum dry density per the standard Proctor method (ASTM D698) and within the range of minus (-) 2 percent to plus (+) 3 percent of the optimum moisture content. Each lift should be tested by geotechnical personnel to confirm that the contractor’s method is capable of achieving the project requirements before placing subsequent lifts. Areas that have become soft or frozen should be removed before the additional structural fill is placed.

4.2.3 Dense Graded Aggregate

Dense graded aggregate (DGA) fill may be used as a backfill in undercut excavations and in utility trench excavations. The DGA used for this section should be Type A and Grading D or E in accordance with Section 903.05 of the Tennessee Department of Transportation (TDOT) specifications. The DGA fill should be placed in loose, horizontal lifts not exceeding 8 inches in loose thickness. Each lift should be compacted to at least 98 percent of maximum dry density per the standard Proctor method (ASTM D698). Each lift should be compacted, tested by geotechnical personnel, and approved before placing subsequent lifts.

4.3 FOUNDATION RECOMMENDATIONS

As previously mentioned, the overall project has several components. Based on our exploration and understanding, we have provided two options (Drilled Shafts and Micropiles) to transfer the large structural loads to rock to limit differential settlement. We have also provided soil supported foundations for small ancillary structures or the proposed maintenance areas.

The design team should consider a variety of factors when selecting the appropriate foundation system including, but not limited to: subsurface conditions, structural loading, performance requirements, project economics, and owner’s risk tolerance. Each option will have varying installation methods and materials and may also require input from the structural engineer. The client should confer with the design team and contractor with regards to the foundation alternatives contained in this report, in an effort to assess potential costs and schedule for implementing the anticipated course of action.
4.3.2 Micropiles

For the tabletop structure, the client may elect to support utilizing micropiles, depending on lateral loading. Micropiles are installed by drilling a steel pipe (i.e., casing) to the underlying bedrock. The hole is then extended, through competent bedrock creating a socket (the pile bond length). Once the appropriate socket is penetrated (a function of rock quality and design bond strength), a steel reinforcing bar is often centered in the casing which extends from the bottom of the socket to the pile cut-off length. Finally, the entire pile is filled with grout using tremie methods. Upon grouting, the casing is typically lifted within the rock socket to allow for the grout to flow outside the casing and pushed back down to the bottom of the hole (i.e., pulled and plunged).

Construction techniques and methods associated with micropiles are very flexible and may vary from this general description in some ways. However, given the subsurface conditions encountered and our experience with projects in the geologic setting, we recommend all piles be fully cased. Using uncased piles could result in collapse (or necking) of the drilled excavation, resulting in an unsatisfactory pile as well as unwarranted cost overruns due to free-flowing grout.

The casing used for the design of micropiles is typically 5.5 to 9 5/8-inch diameter steel that meets ASTM standards (ASTM A 252), and which has a typical yield strength of 80 kips per square inch (ksi). GEOServices recommends an allowable bond strength of 100 pounds per square inch (psi) between the grout and bedrock along the socket in hard, continuous bedrock. The refusal depths encountered during the subsurface exploration were variable and ranged from approximately 5 to 65 feet in the borings. Therefore, the project budget should include contingencies for such variances during construction.

The borings explored by rock coring typically encountered a zone of weathered and/or discontinuous rock overlying the hard, continuous bedrock recommended for the micropile socket. For this reason, an allowance should be made for several feet of weathered rock/soil seam penetration to reach competent bedrock where the micropile socket will bear.
The rock socket lengths shall be taken as the length of pile installed in competent bedrock. Fractured, friable, or otherwise unsuitable rock encountered during the installation shall not be included in the required rock socket lengths. Only horizontally continuous, hard bedrock layers 18 inches in thickness or greater shall be utilized as contributing to the required rock socket length provided that the rock socket is terminated in a horizontally continuous bedrock layer that is a minimum of 5 feet thick.

Allowable axial capacities of micropiles vary depending on the size of the selected pile and the applicable design standards. In general, a 5 ½ inches, 7 inches, and 9 5/8-inch diameter micropiles have typical allowable capacities of approximately 200, 300, and 500 kips, respectively. Axial capacities will need to be significantly reduced accordingly for cases involving lateral loading of the micropiles.

Lateral capacities of up to 1 kip per inch of diameter can be reasonably resisted by micropiles (with a reduced axial load). Larger magnitude lateral loads can be resisted if the micropile connection to the pile cap can be designed as a fixed-head. This condition can typically be achieved with 24-inches of pile embedment into the cap but the transfer of the moment to the cap needs to be evaluated by the structural engineer. The number of piles at each location should be determined using axial and lateral demands provided by the structural engineer and be in accordance with the applicable building codes.

Micropiles are often installed successfully in this geologic setting for foundation support and since these foundations bear into competent rock, there is a very low risk of foundation disturbance due to solution activity or sinkhole development.

We suggest that the design and construction of micropiles be performed by a contractor specializing in this type of construction with experience in this geologic setting. Once the final design plans have been prepared, we request the opportunity to review the design plans to assure that our recommendations have been properly implemented. The design recommendations contained herein are contingent upon the observation and testing of the pile installation procedures in the field at the time of construction by GEOServices.
4.3.2 Drilled Shafts

As an alternative to micropiles and depending on the lateral loads for the structure, the client may consider drilled shafts (drilled caissons) bearing in competent bedrock should be considered for support of the proposed structure. On the basis of our drilling and visual evaluation of the underlying bedrock obtained; we recommend an allowable end bearing pressure of 150 kips per square foot (ksf) for shafts founded on hard, continuous bedrock. An ultimate concrete to rock bond strength of 10ksf for the section of shafts socketed into hard, continuous bedrock can be used for side friction resistance. Drilled shafts will develop capacity through end bearing upon competent bedrock or by a combination of end bearing and side resistance, if the shaft is socketed into competent bedrock.

The drilled shafts should be installed only by a specialty contractor with proven experience in the installation of drilled shafts in similar geologic conditions. The shafts should be cased at all times as required by the Occupational Safety and Health Administration (OSHA) for the protection of workers entering the shaft. The bottom of all drilled shafts should be observed and probed to evaluate the suitability of the given bearing capacity and to determine the competence of the underlying bedrock. This is accomplished by drilling a 2-inch diameter (minimum) probe hole in the bottom of the shaft to a minimum depth of 2 times the shaft diameter or a maximum depth of 10 feet.

As an alternative to performing probe holes, drilled shafts can be pre-drilled to determine the appropriate bearing elevations which would allow for the elimination of downhole inspection and potential schedule delays during installation. GEOServices can provide more details and prices, if requested.

The bottom of the drilled shaft, socket (if required), and probe hole should be examined by a GEOServices engineer, or qualified staff professional, to verify the depth of penetration and competency of bedrock. Should unsuitable conditions be observed, the shaft should be deepened so as to bear in suitable material. The bottom of the hole should be free of all mud, broken rock or other loose debris. We recommend that the drilled shafts have a minimum diameter of 30 inches to allow room for drilling the test hole and evaluation of the rock.
As aforementioned, based upon refusal depths and the conditions encountered in rock coring, the bedrock surface in this geologic setting is highly variable and the project budget should include contingencies for such variances during construction. Additionally, in this geologic setting weathered rock tends to overlay competent bedrock. This may include soil-filled or open voids, which were encountered in each of our four core locations. It is likely that 10 to 15 feet (in some cases more due to larger diameter shafts) of weathered rock/soil seam/discontinuous rock penetration will be required to reach the hard, continuous bedrock upon which the drilled shafts will bear. Depending on structural loads, socketing the drilled shaft into the bedrock may be necessary. The socket depth could increase, based on the slope, orientation, and surface of the bedrock.

We note that based on the rock core data it is likely significant voids may be encountered during drilled shaft construction. For example, several voids of up to 5 ½ feet were encountered during our exploration. In cases where larger voids are encountered, it may be required to leave the drilled shaft temporary steel casing in place to reduce the potential for excessive concrete loss into the voids and prevent raveling of materials into the shaft concrete. We recommend potential deep foundation contractors be provided with the results of this exploration so they are aware of materials likely to be encountered during foundation construction and the recommendations contained herein as well as our original geotechnical exploration.

If water is encountered during shaft construction, it should be removed from the excavation to a depth of no greater than 2 inches prior to the placement of concrete. Water pumped (if required) from the shafts should be routed to an approved outfall, away from the construction area. If it is not possible to adequately remove this water, concrete should be placed using the tremie method. The concrete should be placed in a manner to prevent segregation of the aggregate or the creation of honeycomb structures or other voids in the completed shaft. A qualified geotechnical engineer should observe all aspects of the installation. If installed following all standard practices for cleaning and concreting, the total and differential settlements of drilled shaft foundations bearing in the recommended materials, using the recommended bearing pressure, should be ½-inch or less.
Prior to entry of the drilled shafts, testing should be performed of the atmosphere within the confined space to ensure adequate oxygen levels and to monitor for the presence of flammable, explosive, or toxic vapors or substances, in accordance with OSHA standards. Air monitoring should be performed at representative intervals through the full depth of the drilled shaft to confirm the safety of personnel. Other OSHA requirements will also apply such as safety harnesses, lifelines, continuous monitoring of down-hole personnel by an attendant at the surface, ventilation, and other requirements, as applicable. Please refer to the most current OSHA guidelines regarding drilled shaft construction. As previously mentioned, downhole inspections may be eliminated by pre-drilling of the shaft locations are completed to establish appropriate bearing elevations.

Once the shaft section(s) and/or group(s) have been selected and the lateral loads, axial loads, and moments been determined, GEOServices may be retained to perform a detailed lateral load analysis. The purpose of the additional analysis would be to provide pile-head deflections and shear and moment distributions with depth for the selected pile foundation to assist the structural engineer to design the foundations.

4.3.3 Shallow Foundations (One-Story and Other Small Future Structures)
At this time, we anticipate some small ancillary structures (Site walls, signage, patios, canopies, etc.) may be incorporated into the overall site development. Compared to the larger structure, we anticipate these will be relatively lightly loaded structures (maximum column and wall loads of 50 kips and 3 kips per linear foot).

Upon completion of site preparation, as previously recommended, it is our opinion lightly loaded structures can be supported on conventional spread footing foundations bearing on approved properly compacted structural soil fill or approved existing materials, with the recommendations of this report. The recommended allowable soil bearing capacity for the design of the foundations for the lightly loaded structures is 2,000 psf.

We recommend that if lower consistency soils are encountered during footing excavations, they be undercut and backfilled with compacted structural soil fill in the building area. Areas to receive more than 5 feet of structural soil fill, if any, should be stripped and proof-rolled to determine if additional undercutting may be necessary. The undercut areas should be backfilled using structural soil fill and extend at least 10 feet laterally beyond the building footprint in areas where the overexcavation is necessary. Where undercut and
replacement is performed, we recommend excavations be backfilled the same day to reduce the risk of sidewall collapse.

Even if design loads would allow smaller sizes, we recommend that continuous (wall) foundations be a minimum of 18 inches wide and isolated spread foundations be a minimum of 24 inches wide to reduce the possibility of a localized punching shear failure. The estimated maximum frost penetration depth for the site is 12 inches; however, exterior foundations should be designed to bear at least 18 inches below finished exterior grade to develop the design bearing pressure, provide a protective embedment and to protect against frost heave.

The available lateral capacity of shallow foundations includes a soil lateral pressure and coefficient of friction as described in the IBC, Section 1806. Footings will be embedded in material similar to those described as Class 5 in Table 1806.2. Where footings are cast neat against the sides of excavations, an allowable lateral bearing pressure of 100 psf per foot depth below natural grade may be used in computations. Resistance to lateral sliding represented by a value of adhesion of 130 psf may be used for clays similar to those described as soil Class 5. An increase of one-third in the allowable lateral capacity may be considered for transient load combinations, including wind or earthquake, unless otherwise restricted by design code provisions.

GEOServices should be retained to perform foundation subgrade observations at the time of construction to confirm that the recommendations provided in this report are consistent with actual site conditions. A hand auger and dynamic cone penetrometer (DCP) are commonly utilized to provide information that is compared to the data obtained in this geotechnical report. Where unacceptable materials are encountered, the material should be remediated at the geotechnical engineer's direction.

Based on the known subsurface conditions, geology, and past experience, we estimate foundations supported on recommended structural soil fill or other approved soils should experience maximum total and differential settlements of 1 inch and ¾ inch, respectively. The settlement information provided was with maximum column and continuous foundation loads on the order of 50 kips and 3 kpf, respectively, and an allowable bearing pressure of 2,000 psf. Additionally, this information assumes that the site is prepared in accordance with our recommendations provided in this report. If these parameters are determined to be incorrect, we should be notified to reevaluate the settlements for the building.
4.3.4 Slabs-on-Grade

Following the recommended site preparation activities, as previously recommended, it is our opinion the slab may be supported by structural soil fill or approved residual soils. Observing proofrolling of the subgrade, as discussed earlier in this report, should be accomplished to identify soft or unstable soils which should be removed from the floor slab area prior to fill placement and/or floor slab construction. Based on our exploration, the client should anticipate and budget for some remediation of the existing materials, soft residual and fill materials.

A structural slab may be considered which would derive support from rock supported foundations and grade beams and not from the underlying soil subgrade. By electing to utilize a structural slab, the exposed subgrade will only support construction traffic and any existing fill materials will not be relied upon for slab support and therefore may remain in place. Typically, structural slabs are thicker and include more reinforcing steel than slabs bearing on grade, which may translate to a higher cost. Another advantage to the use of a structural slab for this development would be the underlying soils may not require remediation or additional removal as they function as a form for the slab and are not relied upon for support.

We recommend that a minimum 4-inch-thick granular mat be placed beneath the floor slab to enhance drainage and provide a capillary break. The subgrade should be proofrolled and approved prior to the placement of the crushed stone. Based on the conditions encountered on this site, we recommend that the floor slabs be designed using a subgrade modulus of 100 pounds per cubic inch (pci). This modulus is appropriate for small diameter loads (i.e. a 1ft x 1ft plate) and should be adjusted for wider loads.

Based on our experience in the East Tennessee area, soils with plasticity indices (PI) less than 30 percent have a slight potential for volume changes with changes in moisture content, and soils with a PI greater than 50 percent are highly susceptible to volume changes. Between these values, we consider the soils to be moderately susceptible to volume changes. While laboratory testing is ongoing at the time of issuance of this report, we anticipate the onsite soils will have a slight to high potential for volume change. As such, we recommend that the material directly beneath any slabs-on-grade, pavements, or sidewalks, undergo rigorous plasticity testing during placement to ensure that it meets the requirements outlined previously for structural soil fill.
4.4 SEISMIC DESIGN CRITERIA

In accordance with the International Building Code (IBC 2012), we are providing the following seismic design information. After evaluating the SPT N-value data from the soil test borings and considering the changes to the site and foundation types, it was determined that the subsurface conditions at the site most closely matched the description for “Seismic Site Class D” or “Stiff Soil”. Table 1 provides the spectral response accelerations for both short and 1-second periods, which may be used for design.

<table>
<thead>
<tr>
<th>Structure</th>
<th>$S_s$</th>
<th>$S_1$</th>
<th>$S_{ds}$</th>
<th>$S_{d1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>G10 Parking Garage Addition – Knoxville, TN</td>
<td>0.416</td>
<td>0.125</td>
<td>0.407</td>
<td>0.191</td>
</tr>
</tbody>
</table>

The short and 1-second period values indicate the structure should be assigned a Seismic Design Category “C” using the published information. The provided values are based on the results of our field exploration and the assumption that the structure will be designed utilizing a Risk Category I, II or III. If these assumptions are incorrect, we should be contacted to reevaluate the seismic design information.

We have provided a discussion on the following geologic and seismic hazards: slope instability, liquefaction, total/differential settlement, and surface displacement due to faulting or seismically induced lateral spread or lateral flow.

Liquefaction occurs when soil, primarily saturated cohesionless soils, undergoes a loss in strength due to monotonic, transient, or repeated disturbance that commonly occurs during a seismic event (Kramer 1996). This loss of strength occurs due to increased pore water pressures caused by an undrained condition. The increase in pore water pressure decreases the effective stress in the soil, thus reducing the soil’s ability to support any applied loads. For liquefaction to occur, there must be an increase in pore pressure meaning the soil must be saturated and be able to behave in an undrained condition. According to the NHI 2011 Reference Manual on LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations, if any of the following criteria are satisfied then a significant liquefaction hazard does not exist:
• The geologic materials underlying the site are either bedrock or have very low liquefaction susceptibility according to the relative susceptibility ratings shown in the Estimated Susceptibility of Sedimentary Deposits to Liquefaction During Strong Ground Motion table presented by Youd and Perkins in 1978.

• The soils below the groundwater table at the site are one of the following:
  - Clayey soils which have a clay content greater than 15%, liquid limit greater than 35%, or natural water content less than 90% of the liquid limit.
  - Sand with a minimum corrected SPT (N₁₀₀) value of 30 blows/foot.
  - The water table is deeper than 50 feet below the ground surface or proposed finished grade at the site.

We note that the borings encountered plastic soils having clay contents likely above 15 percent. Additionally, based on experience in this geologic region and the immediate vicinity of the site, it is our opinion that a liquefaction hazard does not exist for the subject development. As such, we do not expect significant additional total and differential settlement, lateral soil movement, reduction in bearing capacity or lateral soil reaction, permanent increase in soil lateral pressure, or flotation of buried structures.

We also noted mapped faults in the vicinity of the site on the geologic maps we reviewed for this project. However, the known faults are generally ancient, with no known active faults reaching the surface. Therefore, it is our opinion that surface displacement due to faulting or seismically induced lateral spreading or lateral flow is not a seismic hazard that will affect the subject development. In addition, seismically induced slope instability is also not expected to be a seismic hazard that will affect the subject development.
5.0 CONSTRUCTION CONSIDERATIONS

5.1 SHALLOW FOUNDATION CONSTRUCTION

Foundation excavations should be opened, the subgrade evaluated, remedial work performed (if required), and concrete placed in an expeditious manner. Exposure to weather often reduces foundation support capabilities, thus necessitating remedial measures prior to concrete placement. It is also important that proper surface drainage be maintained both during construction (especially in terms of maintaining dry footing trenches) and after construction. Soil backfill for footings should be placed in accordance with the recommendations for structural fill presented herein.

5.2 EXCAVATIONS

During our exploration, auger refusal was encountered in each of the borings at depths ranging from approximately 5.2 to 65.6 feet below existing grade (~863.8 to 810.2 feet MSL). Auger refusal conditions generally correspond to materials that require hoe-ramming and/or blasting for removal. Typically, soils penetrated by augers can be removed with conventional earthmoving equipment. However, excavation equipment varies, and field refusal conditions may vary. Generally, the weathering process is erratic and variations in the rock profile can occur at small lateral distances.

While finalized grading information has not been provided, we anticipate that much of the expansion will remain at current grades with cuts/fills of less than 5 feet. Therefore, we do not anticipate difficult excavation will be encountered across the majority of the site; however, some isolated areas may encounter partially weathered rock and/or rock pinnacles or ledges requiring difficult excavation techniques. We anticipate that if a shallow rock (or chert layers) is encountered, it can be removed with hydraulic hammers or other conventional construction equipment methods. Once grading plans are available, GEOServices should be allowed to review and revise recommendations, as necessary.

Excavations should be sloped or shored in accordance with local, state, and federal regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. The contractor is usually solely responsible for site safety. This information is provided only as a service, and under no circumstances should GEOServices be assumed responsible for construction site safety.
The design of stabilization measures during construction is beyond the scope of our services and is typically performed by the contractor, who should employ a registered engineer or specialty contractor for their design. The proposed shoring design, means, and methods should be submitted to the design team for review prior to proceeding with the excavation. Shoring installation should also be closely monitored during construction for compliance with project drawings. The planning and building authorities should be consulted if excavation or shoring systems are anticipated to extend beyond the project property.

### 5.3 MOISTURE-SENSITIVE SOILS

The plastic fine-grained soils encountered at this site will be sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause a significant reduction in the soil strength and support capabilities. Construction traffic patterns should be varied to prevent the degradation of previously stable subgrade. In addition, the soils at this site that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. We caution if site grading is performed during the wet weather season; increases in the undercut volumes should be expected.

Further, for site fills, methods such as discing and allowing the material to dry will be required to meet the required compaction recommendations. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather. However, November through March is typically the difficult grading period due to the limited drying conditions which exist.

### 5.4 DRAINAGE AND SURFACE WATER CONCERNS

To reduce the potential for undercutting and construction induced sinkholes, water should not be allowed to collect in the foundation excavation, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slabs. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.
Significant construction dewatering is not anticipated for site grading based on our limited understanding of the proposed grading. However, seasonal fluctuations and runoff from adjacent properties may occur once construction begins. If seepage or runoff is encountered at shallow depths, it is anticipated that it can be controlled by simple means such as pumping from sumps or the use of perimeter trenches to collect and discharge the water away from the work area. We recommend all excavations where groundwater is encountered be observed on an individual basis to determine if interior drain systems are required. Dewatering for drilled shaft construction may be required and has been discussed in previous sections of this report.

5.5 HIGH PLASTICITY SOIL CONSIDERATIONS

Based on our experience in the East Tennessee area, soils with plasticity indices (PI) less than 30 percent have a slight potential for volume changes with changes in moisture content, and soils with a PI greater than 50 percent are highly susceptible to volume changes. Between these values, we consider the soils to be moderately susceptible to volume changes. Based on the laboratory testing completed, we anticipate the onsite soils will have a slight to high potential for volume change.

Plastic soils have the potential to shrink or swell with significant changes in moisture content. Unlike other areas of the country where high plasticity soils cause considerable foundation problems, Tennessee does not typically endure long periods of severe drought or wet weather. However, in recent years drought conditions have been sufficient to cause soil shrinkage and related structural distress of buildings and floor slabs at sites underlain by high plasticity soils.

At sites that have high plasticity soils, certain precautions should be considered to minimize or eliminate the potential for volume changes. The most effective way to eliminate the potential for volume changes is to remove highly plastic soils and replace them with a compacted fill of non-expansive material. Testing and recommendations for the required depth of removal can be provided if needed. If removal of the highly plastic soils is not desirable, then measures should be taken to protect the soils from excessive amounts of wetting or drying. In addition, modification of the soil by lime or cement treatment can be utilized to reduce the soil’s plasticity.
Several construction considerations may reduce the potential for volume changes in the subgrade soils. Foundations should be excavated, checked, and concreted on the same day to prevent excessive wetting or drying of the foundation soils. The floor subgrade should be protected from excessive drying and wetting by covering the subgrade prior to slab construction. The site should be graded in order to drain surface water away from the building both during and after construction.

Installing moisture barriers around the perimeter of the slab will help limit the moisture variation of the soil and reduce the potential for shrinking or swelling. In addition, roof drains should discharge water away from the building area and foundations. Heat sources should be isolated from foundation soils to minimize drying of the foundation soils. Trees and large shrubs can draw large amounts of moisture from the soil during dry weather and should be kept well away from the building to prevent excessive drying of the foundation soils. Watering of lawns or landscaped areas should be performed to maintain moisture levels during dry weather. Structural details to make the building flexible should be considered to accommodate potential volume changes in the subgrade. Floor slabs should be liberally jointed to control cracking, and the floor slab should not be structurally connected to the walls. Walls should incorporate sufficient expansion/contraction joints to allow for differential movement.

5.6 SINKHOLE RISK REDUCTION AND CORRECTIVE ACTIONS

Based on our experience, corrective actions can also be performed to reduce the potential for sinkhole development at this site. These corrective actions would decrease but not eliminate the potential for sinkhole development. Much can be accomplished to decrease the potential of future sinkhole activity by proper grade selection and positive site drainage.

In general, the portions of a site that are excavated to achieve the desired grades will have a higher risk of sinkhole development than the areas that are filled, because of the exposure of relic fractures in the soil to runoff. On the other hand, those portions of a site that receive a modest amount of fill (or that have been filled in the past) will have a decreased risk of sinkhole development caused by rainfall or runoff because the placement of a cohesive soil fill over these areas effectively caps the area with a relatively impervious blanket of remolded soil. Therefore, the recommendations that follow incorporate a modest remedial treatment program designed to make the surface of the soil in excavated areas less permeable.
It is our opinion that the risk of ground subsidence associated with sinkhole formation cannot be eliminated, we have found that several measures are useful in site design and development to reduce this potential risk. These measures include:

- Maintaining positive site drainage to route surface waters well away from structural areas both during construction and for the life of the structure.
- The scarification and re-compaction of the upper 6 to 10 inches of soil in earthwork cut areas.
- Verifying that subsurface piping beneath structures is carefully constructed and pressure tested prior to its placement in service.
- The use of pavement or lined ditches, particularly in cut areas, to collect and transport surface water to areas away from structures.

Site grades in areas prone to sinkhole development should provide positive surface drainage of water away from the proposed building and parking areas both during and after construction. The risk of sinkhole development will be greater if water is allowed to pond. Backfill in utility trenches or other excavations should consist of compacted, well-graded material such as dense graded aggregate or compacted on-site soils. The use of an open-graded stone (such as No. 57 stone) is not recommended unless the stone backfill is provided an exit path and not allowed to pond. If sinkhole conditions are observed, the type of corrective action is most appropriately determined by GEOServices on a case-by-case basis.

6.0 LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. This report is for our geotechnical work only, and no environmental assessment efforts have been performed. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.
The analyses and recommendations submitted herein are based, in part, upon the data obtained from the exploration. The nature and extent of variations between the borings will not become evident until construction. We recommend that GEOServices be retained to observe the project construction in the field. GEOServices cannot accept responsibility for conditions that deviate from those described in this report if not retained to perform construction observation and testing. If variations appear evident, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed, and conclusions modified or verified in writing. Also, if the scope of the project should change significantly from that described herein, these recommendations may need to be re-evaluated.
APPENDICES
APPENDIX A
Figures, General Notes, Boring Summary Table & Boring Logs
NOTE:

1.) BASE MAP: USGS QUADRANGLE (KNOXVILLE, TENNESSEE)
1.) BORING LOCATIONS ARE SHOWN IN GENERAL ARRANGEMENT ONLY.
2.) DO NOT USE BORING LOCATIONS FOR DETERMINATIONS OF DISTANCES OR QUANTITIES.
3.) BASE MAP PROVIDED BY: Google Earth

NOTES:
N.T.S. 21-23360
G10 PARKING GARAGE ADDITION
LOCATION OF SOIL TEST BORINGS
UNIVERSITY OF TENNESSEE

Fax: 865-539-8252
Office: 865-539-8242
2561 Willow Point Way, Knoxville, TN 37931
GENERAL NOTES

FINE AND COARSE GRAINED SOIL PROPERTIES

<table>
<thead>
<tr>
<th>PARTICLE SIZE</th>
<th>COARSE GRAINED SOILS (SANDS &amp; GRAVELS)</th>
<th>FINE GRAINED SOILS (SILTS &amp; CLAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOULDERS:</td>
<td>GREATER THAN 300 mm</td>
<td>N-VALUE</td>
</tr>
<tr>
<td>COBBLES:</td>
<td>75 mm to 300 mm</td>
<td>0 - 4</td>
</tr>
<tr>
<td>GRAVEL:</td>
<td>4.74 mm to 75 mm</td>
<td>5 - 10</td>
</tr>
<tr>
<td>COARSE SAND:</td>
<td>2 mm to 4.74 mm</td>
<td>11 - 30</td>
</tr>
<tr>
<td>MEDIUM SAND:</td>
<td>0.425 mm to 2 mm</td>
<td>31 - 50</td>
</tr>
<tr>
<td>FINE SAND:</td>
<td>0.075 mm to 0.425 mm</td>
<td>OVER 50</td>
</tr>
<tr>
<td>SILTS &amp; CLAYS:</td>
<td>LESS THAN 0.075 mm</td>
<td>OVER 31</td>
</tr>
</tbody>
</table>

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

<table>
<thead>
<tr>
<th>PERCENT</th>
<th>QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 TO 100</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>75 TO 90</td>
<td>GOOD</td>
</tr>
<tr>
<td>50 TO 75</td>
<td>FAIR</td>
</tr>
<tr>
<td>25 TO 50</td>
<td>POOR</td>
</tr>
<tr>
<td>0 TO 25</td>
<td>VERY POOR</td>
</tr>
</tbody>
</table>

STANDARD PENETRATION TEST (ASTM D1586)


BLOWS/FOOT (N-VALUE) DESCRIPTION

25.................................................. 25 BLOWS DROVE SAMPLER 12" AFTER INITIAL 6" SEATING
75/10"........................................... 75 BLOWS DROVE SAMPLER 10" AFTER INITIAL 6" SEATING
50/PR............................................ PENETRATION REFUSAL OF SAMPLER AFTER INITIAL 6" SEATING

SAMPLING SYMBOLS

ST: UNDISTURBED SAMPLE
SS: SPLIT SPOON SAMPLE
CORE: ROCK CORE SAMPLE
AU: AUGER OR BAG SAMPLE

SOIL PROPERTY SYMBOLS

N: STANDARD PENETRATION, BPF
M: MOISTURE CONTENT %
LL: LIQUID LIMIT %
P: PLASTICITY INDEX %
Qp: POCKET PENETROMETER VALUE, TSF
Qu: UNCONFINED COMPRESSIVE STRENGTH, TSF
DUW: DRY UNIT WEIGHT, PCF

ROCK HARDNESS

VERY SOFT: ROCK DISINTEGRATES OR EASILY COMPresses TO TOUCH: CAN BE HARD TO VERY HARD SOIL.
SOFT: ROCK IS COHERANT BUT BREAKS EASILY TO THUMB PRESSURE AT SHARP EDGES AND IT CRUMBLES WITH FIRM HAND PRESSURE.
MODERATELY HARD: SMALL PIECES CAN BE BROKEN OFF ALONG SHARP EDGES BY CONSIDERABLE HARD THUMB PRESSURE: CAN BE BROKEN BY LIGHT HAMMER BLOWS.
HARD: ROCK CAN NOT BE BROKEN BY THUMB PRESSURE, BUT CAN BE BROKEN BY MODERATE HAMMER BLOWS.
VERY HARD: ROCK CAN BE BROKEN BY HEAVY HAMMER BLOWS.
# Lithological Symbols

(Uniform Soil Classification System)

- **ASPHALT**: Asphalt
- **CH**: USCS High Plasticity Clay
- **CL**: USCS Low Plasticity Clay
- **CL-ML**: USCS Low Plasticity Silty Clay
- **CONCRETE**: Concrete
- **DOLOMITE**: Dolomite
- **GRAVEL**: Gravel / Basestone
- **LIMESTONE**: Limestone
- **ML**: USCS Silt
- **SANDSTONE**: Sandstone
- **SC**: USCS Clayey Sand
- **SC-SM**: USCS Silty Clayey Sand
- **SHALE**: Shale
- **SLATE**: Slate
- **SM**: USCS Silty Sand
- **SW**: USCS Well-graded Sand
- **SP**: USCS Poorly-graded Sand
- **TOPSOIL**: Topsoil
- **WEATHERED ROCK**: Weathered Bedrock
- **WOOD**: Wood / Mulch

## Sample Symbols

- **Grab Sample**
- **No Recovery**
- **Rock Core**
- **Shelby Tube**
- **Split Spoon**

## Color Codes for Lithological Symbols

- **RED**: Fill
- **GREEN**: Cultivated
- **BLUE**: Residuum
- **MAGENTA**: Alluvium
- **PINK**: Colluvium
- **LIGHT GRAY**: Weathered Rock
- **ORANGE**: Loess
- **DARK GRAY**: Rock Core
- **YELLOW**: Void
- **TEAL**: Glacial Outwash / Glacial Till
- **PURPLE**: Marine

## Abbreviations

- **LL**: Liquid Limit (%)
- **PI**: Plastic Index (%)
- **W**: Moisture Content (%)
- **DD**: Dry Density (PCF)
- **NP**: Non Plastic
- **-200**: Percent Passing No. 200 Sieve
- **PP**: Pocket Penetrometer (TSF)
- **TV**: TORVANE
- **PID**: Photoionization Detector
- **UC**: Unconfined Compression
- **ppm**: Parts Per Million

Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After 24 Hours, or as Shown
<table>
<thead>
<tr>
<th>Boring #</th>
<th>Location (Side of Existing Garage)</th>
<th>Estimated Existing Surface Elevation (feet MSL)</th>
<th>Approximate Depth of Fill (feet)</th>
<th>Approximate Refusal Depth (feet)</th>
<th>Approximate Auger Refusal Elevation (feet MSL)</th>
<th>Rock Core Data</th>
<th>NOTES</th>
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<tbody>
<tr>
<td>B-1</td>
<td>West</td>
<td>882.0</td>
<td>12.0</td>
<td>65.6</td>
<td>816.4</td>
<td>0 - 83</td>
<td>0 - 81</td>
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<td>B-2</td>
<td>West</td>
<td>883.0</td>
<td>8.0</td>
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<td>B-3</td>
<td>West</td>
<td>879.0</td>
<td>5.5</td>
<td>24.7</td>
<td>854.3</td>
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<td>NC</td>
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<td>B-4</td>
<td>West</td>
<td>880.0</td>
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<td>49.5</td>
<td>830.5</td>
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<td>B-5</td>
<td>South</td>
<td>869.0</td>
<td>5.2</td>
<td>5.2</td>
<td>863.8</td>
<td>16 - 92</td>
<td>11 - 92</td>
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<tr>
<td>B-6</td>
<td>South</td>
<td>866.0</td>
<td>5.5</td>
<td>8.9</td>
<td>857.1</td>
<td>NC</td>
<td>NC</td>
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<td>B-7</td>
<td>East</td>
<td>845.0</td>
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<td>837.3</td>
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<td>B-8</td>
<td>East</td>
<td>839.0</td>
<td>17.1</td>
<td>17.1</td>
<td>821.9</td>
<td>62 - 100</td>
<td>12 - 100</td>
</tr>
<tr>
<td>B-9</td>
<td>East</td>
<td>836.0</td>
<td>22.6</td>
<td>22.6</td>
<td>813.4</td>
<td>91 - 100</td>
<td>91 - 100</td>
</tr>
<tr>
<td>B-10</td>
<td>East</td>
<td>835.0</td>
<td>22.0</td>
<td>24.8</td>
<td>810.2</td>
<td>NC</td>
<td>NC</td>
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<tr>
<td>B-11</td>
<td>East</td>
<td>836.0</td>
<td>20.2</td>
<td>20.2</td>
<td>815.8</td>
<td>58 - 100</td>
<td>58 - 95</td>
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<td>B-12</td>
<td>North</td>
<td>836.0</td>
<td>8.0</td>
<td>11.1</td>
<td>824.9</td>
<td>NC</td>
<td>NC</td>
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</table>

**NOTE:** Existing surface elevations interpolated from KGIS topographic map. Values should be considered approximate.
**PROJECT NAME**: G10 Parking Garage Addition - University of Tennessee  
**DATE**: 4/17/23  
**PROJECT LOCATION**: 1411 TN-158, Knoxville, TN 37916

**DRILLING CONTRACTOR**: Tri-State Drilling  
**DRILLING METHOD**: Mobile B-59 & NQ Rock Coring  
**GROUND ELEVATION**: 882 ft  
**PROPOSED FFE**: ---

**REFUSAL**: Depth 65.6 ft / Elev 816.4 ft  
**TOP OF ROCK**: Depth 65.6 ft / Elev 816.4 ft  
**BEGAN CORING**: Depth 65.6 ft / Elev 816.4 ft  
**FOOTAGE CORED (LF)**: 19.5 ft  
**BOTTOM OF HOLE**: Depth 85.1 ft / Elev 796.9 ft

**GROUND WATER LEVELS**:  
AT END OF DRILLING --- Dry  
AFTER 1 HOUR --- Backfilled  
AFTER 24 HOURS --- Backfilled

### Depth (ft) | Elevation (ft) | Graphic Log | Material Description | Sample Type | Recovery % (RQD) | Blow Counts (N Value) | Moisture Content (%) | Liquid Limit | Plasticity Index | Atterberg Limits
---|---|---|---|---|---|---|---|---|---|---|---
0 | 882.0 | | (CL) Sandy Lean CLAY - with trace gravel - dark gray, dark brown and orangish brown - moist (FILL) | SS 1 | 3-4-5 (9) | | | | | |
| 5 | 877.0 | | (CH) Sandy Fat CLAY - with mica and gravel at depth - reddish brown, gray, dark brown and tan - moist (FILL) | SS 2 | 4-5-5 (10) | | | | | |
| | | No Sample Recovery | Driller Notes: Gravel fill with trace amounts of clay | SS 3 | 3-50/3" | | | | | |
| 10 | 872.0 | | | NR 4 | 50/5" | | | | | |
| 15 | 867.0 | | (CL) Sandy Lean CLAY - micaceous with trace rounded rock fragments - reddish brown, orangish brown and brown - moist - firm (ALLUVIUM) | SS 5 | 3-4-3 (7) | | | | | |
| | | | (CH) Fat CLAY - with chert fragments and black manganese staining - reddish brown, brown, orangish brown and tan - moist - firm to stiff (RESIDUUM) | SS 6 | 3-4-3 (7) | | | | | |

**NOTES**: 0 = Weight of Hammer

(Continued Next Page)
**PROJECT NAME:** G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT #:** 21-23360  
**DATE:** 4/17/23  
**DRILLING CONTRACTOR:** Tri-State Drilling  
**DRILLING METHOD:** Mobile B-59 & NQ Rock Coring  
**GROUND ELEVATION:** 882 ft  
**PROPOSED FFE:** ---  
**REFUSAL:** Depth 65.6 ft / Elev 816.4 ft  
**TOP OF ROCK:** Depth 65.6 ft / Elev 816.4 ft  
**BEGAN CORING:** Depth 65.6 ft / Elev 816.4 ft  
**FOOTAGE CORED (LF):** 19.5 ft  
**BOTTOM OF HOLE:** Depth 85.1 ft / Elev 796.9 ft  

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>862.0</td>
<td></td>
<td>(CH) Fat CLAY - with chert fragments and black manganese staining - reddish brown, brown, orangish brown and tan - moist - firm to stiff (RESIDUUM) (continued)</td>
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<tr>
<td>25</td>
<td>857.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>852.0</td>
<td></td>
<td>(CL) Sandy Lean CLAY - tan and brown - moist - stiff (RESIDUUM)</td>
</tr>
<tr>
<td>35</td>
<td>847.0</td>
<td></td>
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</tr>
<tr>
<td>40</td>
<td>842.0</td>
<td></td>
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**NOTES:** 0 = Weight of Hammer  

(Continued Next Page)
Sandy Lean CLAY - tan and brown - moist - stiff (RESIDUUM)

Lean CLAY - with silt and trace chert fragments - brown, gray and tan - moist to very moist - firm to very soft (RESIDUUM)
**PROJECT NAME**: G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT #**: 21-23360

**DATE**: 4/17/23  
**PROJECT LOCATION**: 1411 TN-158, Knoxville, TN 37916

**DRILLING CONTRACTOR**: Tri-State Drilling  
**DRILLING METHOD**: Mobile B-59 & NQ Rock Coring

**GROUND ELEVATION**: 882 ft  
**PROPOSED FFE**: ---

**REFUSAL**: Depth 65.6 ft / Elev 816.4 ft

**TOP OF ROCK**: Depth 65.6 ft / Elev 816.4 ft

**BEGAN CORING**: Depth 65.6 ft / Elev 816.4 ft

**FOOTAGE CORED (LF)**: 19.5 ft

**BOTTOM OF HOLE**: Depth 85.1 ft / Elev 796.9 ft

**GROUND WATER LEVELS**:  
**AT END OF DRILLING**: --- Dry

**AFTER 1 HOUR**: --- Backfilled

**AFTER 24 HOURS**: --- Backfilled

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>822.0</td>
<td></td>
<td>(Cl) Lean CLAY - with silt and trace chert fragments - brown, gray and tan - moist to very moist - firm to very soft (RESIDUUM) <strong>(continued)</strong></td>
</tr>
<tr>
<td>65</td>
<td>817.0</td>
<td></td>
<td><strong>Auger Refusal at 65.6 Feet (Began Coring)</strong></td>
</tr>
<tr>
<td>70</td>
<td>812.0</td>
<td></td>
<td>DOLOMITE - fine-grained with limestone, shale seams, partially healed calcium seams and trace vugs - dark gray, maroon and light gray - slightly weathered and slightly fractured - 5.0 to 20.0 degree dip angle - hard - moderate HCl reaction</td>
</tr>
</tbody>
</table>
| 75         | 807.0          |             | Clay Filled Void  
**From 72.1 Feet to 72.9 Feet** |
| 80         | 802.0          |             | DOLOMITE (continued) |
| 83(81)     | 83             | RC 1        | RECOVERY % (RQD) |
| 39(39)     | 39(39)         | RC 2        | MOISTURE CONTENT (%) |
| 63(54)     | 63             | RC 3        | PROPOSED FFE |

**NOTES**: 0 = Weight of Hammer

*(Continued Next Page)*
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY % (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>MOISTURE CONTENT (%)</th>
<th>ATTERBERG LIMITS</th>
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<tr>
<td>80</td>
<td>802.0</td>
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<td>Open Void</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>From 79.5 Feet to 84.9 Feet (continued)</td>
<td>RC 4</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>797.0</td>
<td></td>
<td>Clay Filled Void</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>From 84.9 Feet to 85.1 Feet</td>
<td></td>
<td></td>
<td></td>
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</table>

Refusal at 65.6 feet. Bottom of borehole at 85.1 feet.

NOTES: 0 = Weight of Hammer
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>883.0</td>
<td></td>
<td>(CL) Lean CLAY - with sand, cinders, gravel, trace organics and organic odor - black, dark brown and reddish brown - dry (FILL)</td>
</tr>
<tr>
<td>5</td>
<td>878.0</td>
<td></td>
<td>(CH) Fat CLAY - with sand, trace gravel, trace mica and asphalt fragments at depth - reddish brown - moist (FILL)</td>
</tr>
<tr>
<td>10</td>
<td>873.0</td>
<td></td>
<td>(CH) Fat CLAY - with chert fragments at depth - reddish brown, brown and orangish brown - moist - stiff to very stiff (RESIDUUM)</td>
</tr>
<tr>
<td>15</td>
<td>868.0</td>
<td></td>
<td>(CL) Lean CLAY - with silt and trace chert fragments - brown, reddish brown, orangish brown and tan - moist to very moist - stiff (RESIDUUM)</td>
</tr>
</tbody>
</table>

**NOTES:** 0 = Weight of Hammer
### Lean CLAY
- with silt and trace chert fragments - brown, reddish brown, orangish brown and tan - moist to very moist - stiff (RESIDUUM)

### Sandy Lean CLAY
- orangish brown and brown - very moist - very soft (RESIDUUM)

### Lean CLAY
- with chert fragments - orangish brown, reddish brown, tan and bluish gray - moist to very moist - stiff to firm (RESIDUUM)

#### DEPTH (ft) | ELEVATION (ft) | MATERIAL DESCRIPTION
---|---|---
20 | 863.0 | (CL) Lean CLAY - with silt and trace chert fragments - brown, reddish brown, orangish brown and tan - moist to very moist - stiff (RESIDUUM) (continued)
25 | 858.0 | (CL) Sandy Lean CLAY - orangish brown and brown - very moist - very soft (RESIDUUM)
30 | 853.0 | (CL) Lean CLAY - with chert fragments - orangish brown, reddish brown, tan and bluish gray - moist to very moist - stiff to firm (RESIDUUM)
35 | 848.0 |
40 | 843.0 |

#### DEPTH (ft) | ELEVATION (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION
---|---|---|---
20 | 863.0 |  | 
25 | 858.0 | SS 7 | 4-5-6 (11)
30 | 853.0 | SS 8 | 6-6-7 (13)
35 | 848.0 | SS 9 | 0-0-0 (0)
40 | 843.0 | SS 10 | 5-8-7 (15)

#### NOTES:

0 = Weight of Hammer

(Continued Next Page)
**Lean CLAY** - with chert fragments - orangish brown, reddish brown, tan and bluish gray - moist to very moist - stiff to firm (RESIDUUM) *(continued)*

**Lean CLAY** - with silt - orangish brown and tan - very moist to wet - soft to hard (RESIDUUM)

Refusal at 54.1 feet.
Bottom of borehole at 54.1 feet.
**MATERIAL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE NUMBER</th>
<th>RECOVERY %</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTICITY INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>879.0</td>
<td>(CL) Sandy Lean CLAY - with mica, trace organics and trace gravel at depth - reddish brown, dark brown, tan and gray - moist to dry (FILL)</td>
<td>SS 1</td>
<td>6-7-10 (17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>874.0</td>
<td>(CL) Sandy Lean CLAY - micaceous with trace small rounded rock fragments - brown, orangish brown and reddish brown - moist - firm (ALLUVIUM)</td>
<td>SS 2</td>
<td>5-7-7 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>869.0</td>
<td>(SP) Fine-Grain SAND - micaceous with large rounded rock fragments - dark reddish brown - moist - medium dense (ALLUVIUM)</td>
<td>SS 3</td>
<td>4-4-3 (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>864.0</td>
<td>(CH) Fat CLAY - with chert fragments - brown, reddish brown, orangish brown and tan - moist - stiff to hard (RESIDUUM)</td>
<td>SS 5</td>
<td>7-14-16 (30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>859.0</td>
<td></td>
<td>SS 6</td>
<td>3-4-5 (9)</td>
<td></td>
<td></td>
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**NOTES:** Original auger refusal at 17.3 feet. Boring was offset 5.0 feet east and refused at 24.7 feet.
<table>
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<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
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<tbody>
<tr>
<td>20</td>
<td>859.0</td>
<td></td>
<td>(CH) Fat CLAY - with chert fragments - brown, reddish brown, orangish brown and tan - moist - stiff to hard (RESIDUUM) (<em>continued</em>)</td>
</tr>
</tbody>
</table>

Refusal at 24.7 feet.
Bottom of borehole at 24.7 feet.

**NOTES:** Original auger refusal at 17.3 feet. Boring was offset 5.0 feet east and refused at 24.7 feet.
**MATERIAL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>880.0</td>
<td></td>
<td><strong>(CL) Lean CLAY</strong> - with mica, sand and trace organics - reddish brown, dark brown and gray - moist (FILL)</td>
</tr>
<tr>
<td>5</td>
<td>875.0</td>
<td></td>
<td><strong>(CL) Sandy Lean CLAY</strong> - micaceous - gray, orangish brown and reddish brown - moist - stiff (ALLUVIUM)</td>
</tr>
<tr>
<td>10</td>
<td>870.0</td>
<td></td>
<td><strong>(CH) Fat CLAY</strong> - with black manganese staining and trace chert fragments - reddish brown, brown and tan - moist - stiff (RESIDUUM)</td>
</tr>
<tr>
<td>15</td>
<td>865.0</td>
<td></td>
<td><strong>(CL) Lean CLAY</strong> - with significant black manganese staining and silt - brown, reddish brown and tan - moist - stiff (RESIDUUM)</td>
</tr>
<tr>
<td>20</td>
<td>860.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
### Lean Clay
- Description: significant black manganese staining and silt - brown, reddish brown and tan - moist - stiff
- Depth: 20 ft / Elev 860.0 ft
- Sample Number: SS 7
- Atterberg Limits: 7-12

### Fat Clay
- Description: with silt and trace chert fragments - tan, reddish brown, orangish brown and brown - moist - stiff to firm
- Depth: 25 ft / Elev 855.0 ft
- Sample Number: SS 8
- Atterberg Limits: 13-7-7

### Clayey Sand
- Description: orangish brown and brown - moist - loose
- Depth: 30 ft / Elev 850.0 ft
- Sample Number: SS 9
- Atterberg Limits: 3-4-2

### Additional Information
- **Ground Water Levels:**
  - AT END OF DRILLING: Dry
  - AFTER 1 HOUR: Backfilled
  - AFTER 24 HOURS: Backfilled

---

(Continued Next Page)
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elevation (ft)</th>
<th>Graphic Log</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>840.0</td>
<td></td>
<td>(SC) Clayey SAND - orangish brown and brown - moist - loose (RESIDUUM) <em>(continued)</em></td>
</tr>
<tr>
<td>45</td>
<td>835.0</td>
<td></td>
<td>(CH) Fat CLAY - with silt, black manganese staining and trace chert fragments at depth - tan, reddish brown, orangish brown and brown - moist - firm to hard (RESIDUUM)</td>
</tr>
</tbody>
</table>

Refusal at 49.5 feet. Bottom of borehole at 49.5 feet.
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
<th>Sample Type</th>
<th>Recovery % (RQD)</th>
<th>Blow Counts (N Value)</th>
<th>Moisture Content (%)</th>
<th>Plasticity Index</th>
<th>Atterberg Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>869.0</td>
<td>(CH)</td>
<td>Gravelly Fat CLAY - with strong organic odor - reddish brown, gray, orangish brown, dark brown and tan - moist (FILL)</td>
<td>SS</td>
<td>6-6-8 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>864.0</td>
<td>Auger Refusal at 5.2 Feet (Began Coring)</td>
<td>DOLOMITE - fine-grained with limestone, shale seams, iron stained joints, trace partially healed calcium seams and trace vugs - gray, tan, brown, and light gray - slightly weathered and moderately fractured - no discernible degree dip angle - hard - moderate HCl reaction</td>
<td>RC</td>
<td>59 (31)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>859.0</td>
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<td>RC</td>
<td>91 (72)</td>
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</tr>
<tr>
<td>15</td>
<td>854.0</td>
<td>Clay Filled Void</td>
<td>From 13.9 Feet to 17.5 Feet</td>
<td>RC</td>
<td>16 (11)</td>
<td></td>
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<td>20</td>
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<td>DEPTH (ft)</td>
<td>ELEVATION (ft)</td>
<td>MATERIAL DESCRIPTION</td>
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<td>20</td>
<td>849.0</td>
<td>Clay Filled Void</td>
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<td><em>From 20.2 Feet to 23.6 Feet</em></td>
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</tr>
<tr>
<td>25</td>
<td>844.0</td>
<td>DOLOMITE - fine-grained with limestone, shale seams, iron stained joints,</td>
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<td>trace partially healed calcium seams and trace vugs - gray, tan, brown, and</td>
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<td></td>
<td></td>
<td>light gray - slightly weathered and moderately fractured - no discernible degree</td>
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<td></td>
<td>dip angle - hard - moderate HCl reaction</td>
<td></td>
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<tr>
<td>30</td>
<td>839.0</td>
<td>Clay Filled Void</td>
<td></td>
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<td></td>
<td></td>
<td><em>From 26.1 Feet to 27.2 Feet</em></td>
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<tr>
<td></td>
<td></td>
<td>DOLOMITE - fine-grained with limestone, shale seams, and trace quartz seams</td>
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<td></td>
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<td>- maroon, light gray, tan and dark gray - moderately weathered and moderately</td>
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<td>fractured - no discernible degree dip angle - hard - moderate HCl reaction</td>
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<tr>
<td></td>
<td></td>
<td>DOLOMITE - fine-grained with limestone, sandstone seams, iron stained joints and</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>trace large vugs - tan, light gray, white, maroon and bluish gray - slightly</td>
<td></td>
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<td></td>
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<tr>
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<td></td>
<td>weathered and slightly fractured - 5.0 to 30.0 degree dip angle - hard -</td>
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<td></td>
<td></td>
<td>moderate HCl reaction</td>
<td></td>
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</tr>
</tbody>
</table>

Refusal at 5.2 feet.
Bottom of borehole at 33.1 feet.
**PROJECT NAME:** G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT #:** 21-23360  

**DATE:** 4/13/23  
**DRILLING CONTRACTOR:** Mobile B-59  
**GROUND ELEVATION:** 866 ft  
**PROPOSED FFE:** ---  
**REFUSAL:** Depth 8.9 ft / Elev 857.1 ft  

**GROUNDED WATER LEVELS:**  
**AT END OF DRILLING:** --- Dry  
**AFTER 1 HOUR:** --- Backfilled  
**AFTER 24 HOURS:** --- Backfilled  

**LOGGED BY:** KSR  
**ON-SITE REP.:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**GROUND WATER LEVELS:**  
**AT END OF DRILLING:** --- Dry  
**AFTER 1 HOUR:** --- Backfilled  
**AFTER 24 HOURS:** --- Backfilled  

**DRILLING METHOD:** Mobile B-59  
**DRILLING CONTRACTOR:** Tri-State Drilling  
**DATE:** 4/13/23  

**LOGGED BY:** KSR  
**ON-SITE REP.:** ---  

**LOGGED BY:** KSR  
**ON-SITE REP.:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**PROJECT LOCATION:** 1411 TN-158, Knoxville, TN 37916  
**NORTHING / EASTING:** ---  

**PROJECT NAME:** G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT #:** 21-23360  

**DATE:** 4/13/23  
**DRILLING CONTRACTOR:** Mobile B-59  
**GROUND ELEVATION:** 866 ft  
**PROPOSED FFE:** ---  
**REFUSAL:** Depth 8.9 ft / Elev 857.1 ft  

**GROUNDED WATER LEVELS:**  
**AT END OF DRILLING:** --- Dry  
**AFTER 1 HOUR:** --- Backfilled  
**AFTER 24 HOURS:** --- Backfilled  

**LOGGED BY:** KSR  
**ON-SITE REP.:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**PROJECT LOCATION:** 1411 TN-158, Knoxville, TN 37916  
**NORTHING / EASTING:** ---  

**PROJECT NAME:** G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT #:** 21-23360  

**DATE:** 4/13/23  
**DRILLING CONTRACTOR:** Mobile B-59  
**GROUND ELEVATION:** 866 ft  
**PROPOSED FFE:** ---  
**REFUSAL:** Depth 8.9 ft / Elev 857.1 ft  

**GROUNDED WATER LEVELS:**  
**AT END OF DRILLING:** --- Dry  
**AFTER 1 HOUR:** --- Backfilled  
**AFTER 24 HOURS:** --- Backfilled  

**LOGGED BY:** KSR  
**ON-SITE REP.:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**GROUND ELEVATION:** 866 ft  
**LATITUDE / LONGITUDE:** ---  

**PROJECT LOCATION:** 1411 TN-158, Knoxville, TN 37916  
**NORTHING / EASTING:** ---  

---

**NOTES:** Auger refusal at 8.9 feet. Boring was offset 5.0 feet east and refused at 5.7 feet.

---

**DEPTH (ft)** | **ELEVATION (ft)** | **GRAPHIC LOG** | **MATERIAL DESCRIPTION** | **SAMPLE TYPE NUMBER** | **RECOVERY % (RQD)** | **BLOW COUNTS (N VALUE)** | **MOISTURE CONTENT (%)** | **LIQUID LIMIT** | **PLASTICITY INDEX** | **ATTERBERG LIMITS** |
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
0 | 866.0 | | (CH) Fat CLAY - with silt, gravel and trace brick fragments - tan, orangish brown, dark brown and gray - moist (FILL) | SS 1 | | | | | | | |
5 | 861.0 | | (CL) Lean CLAY - with gravel, cinders, plastic fragments and trace brick fragments - orangish brown, dark brown and black - dry (FILL) | SS 2 | | | | | | | |
| | | | (CH) Fat CLAY - with trace chert fragments - reddish brown, brown and tan - moist - hard (RESIDUUM) | SS 3 | | | | | | | NR 4 | 50/1" | | |

Refusal at 8.9 feet.  
Bottom of borehole at 8.9 feet.
**BORING NUMBER B-7**

**PROJECT NAME**  G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT#**  21-23360

**DATE**  4/13/23  
**PROJECT LOCATION**  1411 TN-158, Knoxville, TN 37916

**DRILLING CONTRACTOR**  Tri-State Drilling  
**LOGGED BY**  KSR  
**DRILLING METHOD**  Mobile B-59  
**ON-SITE REP.**  ---

**GROUND ELEVATION**  845 ft  
**LATITUDE / LONGITUDE**  ---

**PROPOSED FFE**  ---  
**NORTHING / EASTING**  ---

**REFUSAL**  Depth 7.7 ft / Elev 837.3 ft  
**GROUND WATER LEVELS:**

- **AT END OF DRILLING** --- Dry
- **AFTER 1 HOUR** --- Backfilled
- **AFTER 24 HOURS** --- Backfilled

**PROJECT LOCATION**  1411 TN-158, Knoxville, TN 37916

**BEGAN CORING**  ---  
**AT END OF DRILLING** --- Dry

**FOOTAGE CORED (LF)**  ---  
**AFTER 1 HOUR** --- Backfilled

**BOTTOM OF HOLE**  Depth 7.7 ft / Elev 837.3 ft  
**AFTER 24 HOURS** --- Backfilled

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY % (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTICITY INDEX</th>
<th>ATTERBERG LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>845.0</td>
<td></td>
<td>(CH) Fat CLAY - with gravel and trace cinders - black, dark brown and gray - moist (FILL)</td>
<td>SS 1</td>
<td></td>
<td>2-3-5 (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>840.0</td>
<td></td>
<td>GRAVEL - gray - dry (FILL)</td>
<td>SS 2</td>
<td></td>
<td>11-50/5&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NR 3</td>
<td></td>
<td>50/5&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:** Auger refusal at 7.7 feet. Boring was offset 5.0 feet east and refused at 6.4 feet.

Refusal at 7.7 feet. Bottom of borehole at 7.7 feet.
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
<th>DRILLING METHOD</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTICITY INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>839.0</td>
<td>(CH) Lean CLAY - with gravel - reddish brown, orangish brown, dark brown and tan - moist (FILL)</td>
<td>Mobile B-59 &amp; NQ Rock Coring</td>
<td>4-4-4 (8)</td>
<td>5-5-11 (16)</td>
<td>6-6-5 (11)</td>
</tr>
<tr>
<td>5</td>
<td>834.0</td>
<td>GRAVEL - gray - dry (FILL)</td>
<td>Mobile B-59 &amp; NQ Rock Coring</td>
<td>4-4-4 (8)</td>
<td>5-5-11 (16)</td>
<td>6-6-5 (11)</td>
</tr>
<tr>
<td>10</td>
<td>829.0</td>
<td>DOLOMITE - fine-grained with limestone, shale seams, partially healed calcium seams and trace quartz seams - light gray and dark gray - slightly to moderately weathered and high to moderately fractured - no discernible degree dip angle - hard - moderate HCL reaction</td>
<td>Mobile B-59 &amp; NQ Rock Coring</td>
<td>4-4-4 (8)</td>
<td>5-5-11 (16)</td>
<td>6-6-5 (11)</td>
</tr>
<tr>
<td>15</td>
<td>824.0</td>
<td></td>
<td>Mobile B-59 &amp; NQ Rock Coring</td>
<td>4-4-4 (8)</td>
<td>5-5-11 (16)</td>
<td>6-6-5 (11)</td>
</tr>
<tr>
<td>20</td>
<td>819.0</td>
<td>Auger Refusal at 17.4 Feet (Began Coring)</td>
<td>Mobile B-59 &amp; NQ Rock Coring</td>
<td>4-4-4 (8)</td>
<td>5-5-11 (16)</td>
<td>6-6-5 (11)</td>
</tr>
</tbody>
</table>

**NOTES:**

(Continued Next Page)
# Boring Number B-8

**Project Name:** G10 Parking Garage Addition - University of Tennessee  
**GEOservices Project #:** 21-23360  
**Date:** 4/13/23  
**Drilling Contractor:** Tri-State Drilling  
**Drilling Method:** Mobile B-59 & NQ Rock Coring  
**Ground Elevation:** 839 ft  
**Proposed FFE:** ---  
**Refusal:** Depth 17.1 ft / Elev 821.9 ft  
**Top of Rock:** Depth 17.1 ft / Elev 821.9 ft  
**Began Coring:** Depth 17.1 ft / Elev 821.9 ft  
**Footage Cored (LF):** 11.1 ft  
**Bottom of Hole:** Depth 28.2 ft / Elev 810.8 ft  

## Material Description

<table>
<thead>
<tr>
<th>Depth  (ft)</th>
<th>Elevation (ft)</th>
<th>Graph Log</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>819.0</td>
<td></td>
<td>Clay Filled Void</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>From 21.5 Feet to 22.1 Feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>DOLOMITE (continued)</strong></td>
</tr>
<tr>
<td>25</td>
<td>814.0</td>
<td></td>
<td>DOLOMITE - fine-grained with limestone, sandstone seams, quartz seams and trace shale seams - light gray, white, gray and bluish gray - slightly weathered and slightly fractured - 10.0 to 40.0 degree dip angle - hard - moderate HCl reaction</td>
</tr>
</tbody>
</table>

Refusal at 17.1 feet.  
Bottom of borehole at 28.2 feet.

## Ground Water Levels:

- **At End of Drilling:** --- Dry  
- **After 1 Hour:** --- Backfilled  
- **After 24 Hours:** --- Backfilled  

## Project Location:

---  
**1411 TN-158, Knoxville, TN 37916**

---  
**Ground Elevation:** 839 ft  
**Proposed FFE:** ---  
**On-Site Rep.:** ---  

---  
**Sample Type/Number:** RC  
**Recovery % (RQD):** 84 (80)  
**Blow Counts (N value):**  
**Moisture Content (%):**  
**Liquid Limit:**  
**Plasticity Index:**  
**Atterberg Limits:**

---  
**Notes:**
**BORING NUMBER B-9**

**PROJECT NAME**  G10 Parking Garage Addition - University of Tennessee  
**GEOservices PROJECT#**  21-23360

**DATE**  4/12/23  
**DRILLING CONTRACTOR**  Tri-State Drilling  
**DRILLING METHOD**  Mobile B-59 & NQ Rock Coring  
**GROUND ELEVATION**  836 ft  
**PROPOSED FFE**  ---

**REFUSAL**  Depth 22.6 ft / Elev 813.4 ft

**TOP OF ROCK**  Depth 22.6 ft / Elev 813.4 ft

**BEGAN CORING**  Depth 22.6 ft / Elev 813.4 ft

**FOOTAGE CORED (LF)**  10.0 ft

**BOTTOM OF HOLE**  Depth 32.6 ft / Elev 803.4 ft

**GROUND WATER LEVELS:**
- AT END OF DRILLING: --- Dry
- AFTER 1 HOUR: --- Backfilled
- AFTER 24 HOURS: --- Backfilled

**GROUND ELEVATION**  836 ft

**REFUSAL**  Depth 22.6 ft / Elev 813.4 ft

**GROUND WATER LEVELS:**
- AT END OF DRILLING: --- Dry
- AFTER 1 HOUR: --- Backfilled
- AFTER 24 HOURS: --- Backfilled

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>836.0</td>
<td>(CH) Fat CLAY - reddish brown and orangish brown - very moist (FILL)</td>
</tr>
<tr>
<td>5</td>
<td>831.0</td>
<td>(CL) Gravelly Lean CLAY - with brick fragments and trace cinders - reddish brown, gray and black - dry (FILL)</td>
</tr>
</tbody>
</table>
| 10         | 826.0          | No Sample Recovery  
  Driller Notes: Gravel fill with clay and brick |
| 15         | 821.0          | (CL) Lean CLAY - with topsoil, trace gravel and strong organic odor - dark brown and black - moist (FILL) |
| 20         | 816.0          | BRICK - with metal fragments - reddish brown and gray - dry (FILL) |

<table>
<thead>
<tr>
<th>SAMPLE TYPE NUMBER</th>
<th>RECOVERY % (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTICITY INDEX</th>
</tr>
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<tbody>
<tr>
<td>SS 1</td>
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</tr>
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<td>SS 2</td>
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</tr>
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</tr>
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<td>SS 6</td>
<td></td>
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</tr>
</tbody>
</table>

**NOTES:**

---

**GROUND WATER LEVELS:**
- AT END OF DRILLING: --- Dry
- AFTER 1 HOUR: --- Backfilled
- AFTER 24 HOURS: --- Backfilled

**GROUND ELEVATION**  836 ft

**REFUSAL**  Depth 22.6 ft / Elev 813.4 ft

**GROUND WATER LEVELS:**
- AT END OF DRILLING: --- Dry
- AFTER 1 HOUR: --- Backfilled
- AFTER 24 HOURS: --- Backfilled
**Lean CLAY** - with topsoil, trace gravel and strong organic odor - dark brown and black - moist (FILL)  

Auger Refusal at 22.6 Feet (Began Coring)

DOLOMITE - fine-grained with limestone, quartz seams, iron stained joints, trace shale seams and trace vugs - dark gray, black, maroon, bluish gray and light gray - slightly weathered and slightly fractured - 0.0 to 25.0 degree dip angle - hard - moderate HCl reaction

Refusal at 22.6 feet.
Bottom of borehole at 32.6 feet.
**MATERIAL DESCRIPTION**

- **GRAVEL** - gray - dry (FILL)
- **(CH) Gravelly Fat CLAY** - with sand - reddish brown, gray and black - dry (FILL)
- **(CH) Fat CLAY** - with trace gravel and organic odor - reddish brown and gray - moist (FILL)
- **(CL) Sandy Lean CLAY** - with significant brick fragments and trace concrete fragments - black - dry (FILL)
- **(CL) Lean CLAY** - with topsoil, sand, root structure and strong organic odor - dark brown and gray - moist (FILL)
Lean CLAY - with topsoil, sand, root structure and strong organic odor - dark brown and gray - moist (FILL)

(CL) Lean CLAY - with silt and trace sand - tan and brown - moist - hard (RESIDUUM)

Refusal at 24.8 feet.
Bottom of borehole at 24.8 feet.
**GRAVEL - gray - dry (FILL)**

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>836.0</td>
<td>GRAVEL - gray - dry (FILL)</td>
</tr>
<tr>
<td>5</td>
<td>831.0</td>
<td>(CL) Lean CLAY - with sand, trace gravel and organic odor - dark brown, black, orangish brown and gray - moist to very moist (FILL)</td>
</tr>
<tr>
<td>10</td>
<td>826.0</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>821.0</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>816.0</td>
<td>Auger Refusal at 20.2 Feet (Began Coring)</td>
</tr>
</tbody>
</table>

**NOTES:**

(Continued Next Page)
DOLOMITE - fine-grained with limestone, trace partially healed calcium seams and trace shale seams - gray and light gray - slightly weathered and slightly fractured - 0.0 to 30.0 degree dip angle - hard - moderate HCl reaction

Open Void
From 23.1 Feet to 25.3 Feet

DOLOMITE - fine-grained with limestone, trace partially healed calcium seams and trace shale seams - gray and light gray - slightly weathered and slightly fractured - 0.0 to 30.0 degree dip angle - hard - moderate HCl reaction

Refusal at 20.2 feet.
Bottom of borehole at 30.2 feet.
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION (ft)</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY % (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>MOISTURE CONTENT (%)</th>
<th>ATTERBERG LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>836.0</td>
<td></td>
<td>(CH) Gravelly Fat CLAY - dark brown, gray and reddish brown - moist (FILL)</td>
<td>SS 1</td>
<td>4-3-2</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>3-2-2</td>
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<td></td>
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</tr>
<tr>
<td>5</td>
<td>831.0</td>
<td></td>
<td>(CL) Lean CLAY - with trace gravel - gray, orangish brown and reddish brown - moist (FILL)</td>
<td>SS 2</td>
<td>3-3-10</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50/5&quot;</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Refusal at 11.1 feet.
Bottom of borehole at 11.1 feet.
APPENDIX B
Rock Core Photographs
<table>
<thead>
<tr>
<th>Remarks</th>
<th>B-1 – From 65.6 Feet to 80.6 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remarks</td>
<td>B-1 – From 80.6 Feet to 85.1 Feet</td>
</tr>
</tbody>
</table>
Remarks | B-5 – From 5.2 Feet to 23.1 Feet
---|---
Remarks | B-5 – From 23.1 Feet to 33.1 Feet
G10 Parking Garage Addition
Coring Photographs

5
Remarks
B-8 – From 17.1 Feet to 21.0 Feet

6
Remarks
B-9 – From 22.6 Feet to 32.6 Feet
G10 Parking Garage Addition
Coring Photographs

| Remarks         | B-11 – From 20.2 Feet to 30.2 Feet |

21-23360