SUBSURFACE EXPLORATION

AND

GEOTECHNICAL ENGINEERING REPORT

DOUGLAS STATION APARTMENTS

SOUTH OF NW SLOAN AND NE SYCAMORE

LEE'S SUMMIT, MO

ANDY MACKEY LLC

8305 NE 89th STREET

KANSAS CITY, MO 64157

KCTE JOB NO. G20-23-092

DATE: 8/4/2023

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KCTE NO. G20-23-092

Submitted to: Andy Mackey LLC
8305 NE 89th Street
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STATE OF MISSOURI
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08-07-2023
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Appendices

1.0 INTRODUCTION

Kansas City Testing & Engineering, LLC (KCTE) has completed subsurface exploration for the proposed new Douglas Station Apartments, located at NW Sloan and NE Sycamore St. The exploration was performed at the request of Andy Mackey, LLC in accordance with our proposal No. GP20-23-139 and letter of acceptance dated 6/29/2023.

The purpose of this geotechnical exploration is to identify the soil strata, on-site soil physical properties for the client to plan and design the new facilities. This geotechnical report is limited to general on-site soil characterization, depth to bedrock if encountered, and groundwater where encountered, including sections on foundation recommendations, slabs-on-grade, site preparation, controlled fill, and pavement subgrades.

2.0 PROJECT AND SITE DESCRIPTION

KCTE understands the construction will consist of 5 new apartments and parking. The apartments range in size from approximately 9,000 SF to 13,000 SF. Currently the land is vacant and is located as depicted below and in Appendix A, Site and Boring Locations. A brief historical review over the last 30 years did not indicate the presence of previous structures. Previous earthwork was identified.

Site Plan

The site gently slopes down to the center where a small creek flows from south to north. The above image depicts the presence of a pond (Circa 1990) located beween two planned apartments. The creek flows to the northwest and exits the site after flowing beneath the planned north apartment.

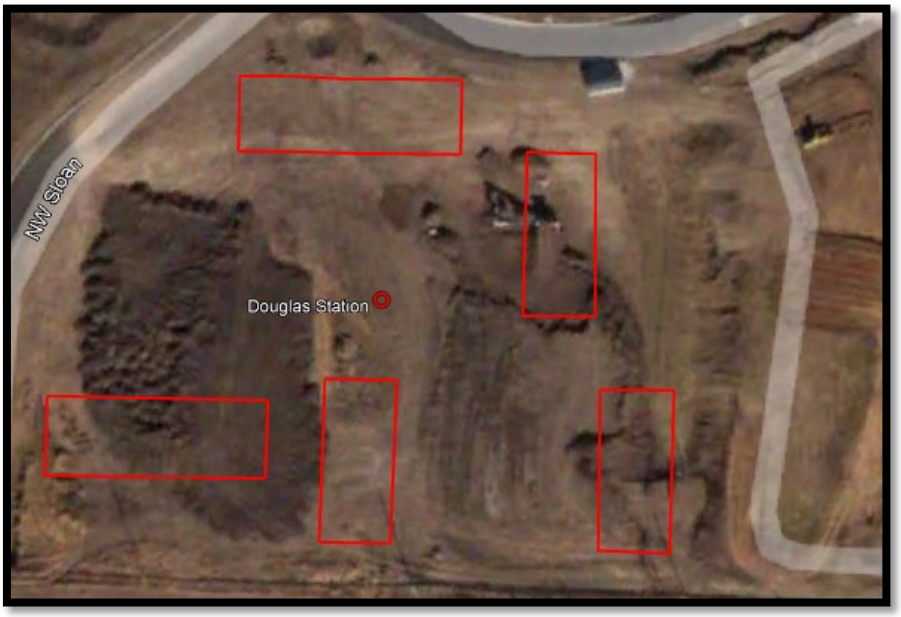
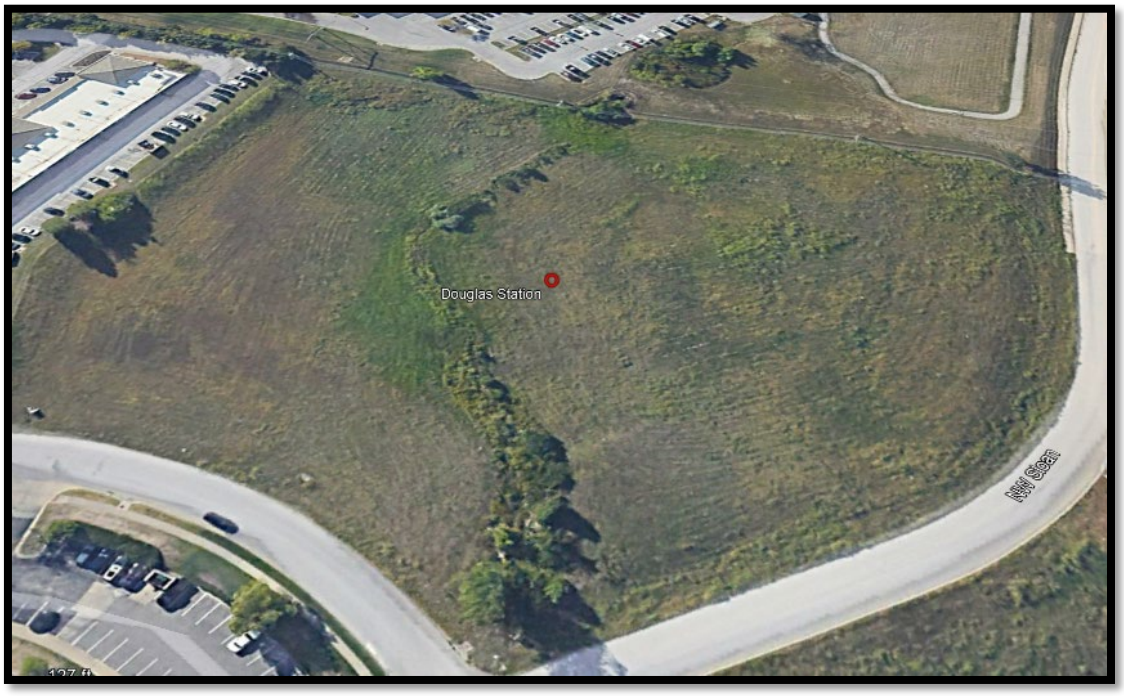


Image of Earthwork Circa 2003

The image above indicates earthwork previously occurred on the site.



Recent Image from North looking South.

Item	Description
Site Layout	• Undeveloped, grass covered, sloping to the center of the site to a creek that flows south to north. Previous earthwork was identified.
Utilities	• Underground sewer is present on the site. The location should be identified prior to construction. Other utilities may be present.
New Construction	Assumptions include: • New apartments and parking
Anticipated Foundation & Floor Slab Loadings	Assumptions include: (Not to Exceed) • Wall = 2,500 plf • Concentrated = 10,000 lb
Provided Anticipated Finish Floor Elevations (FFE)	• Not Available
Grading	Assumptions include: • Could not be determined

3.0 FIELD EXPLORATION PROGRAM

KCTE performed sampling at 15 locations for structures and 5 locations for streets as approved by the client. The borings were drilled to the plan depth of 15 feet for the structures and 5 feet for the parking and drives. The borings were drilled to plan depth. KCTE obtained standard penetration sampling or thin-walled tube samples of soils encountered as conditions warrant. KCTE backfilled holes with drill spoils or bentonite chips upon completion.

The boring locations were marked in the field by KCTE using non-precision geospatial references (cell Phone), in conjunction with measurements from curbs or other landmarks.

Borings were performed using a CME 55 drill rig. Soil samples were obtained from the borings during the drilling process using thin-walled tube sampling techniques (ASTM D 1587) and Standard Penetration sampling techniques (ASTM D 1586). Sample depths are indicated on the attached boring logs in Appendix B.

The field crew prepared logs of the materials encountered during drilling. The field logs represent the conditions observed at the time of the exploration. The field logs have been edited to incorporate the results of laboratory test data.

Field samples obtained from the borings were returned to our laboratory where they were visually classified and logged. The laboratory tests consisted of moisture and Atterberg limits, and unconfined compressive strength testing, in substantial compliance with ASTM Procedures. The test results were utilized in the development of the geotechnical recommendations.

3.1 LABORATORY TESTING PROGRAM

Visual classification Laboratory testing was performed on the soil samples to estimate pertinent engineering and index properties of the materials. Results of the laboratory tests are presented in Appendix B in the boring logs. The laboratory testing program consisted of the following:

- *(ASTM D 2488, Standard Practice for Description and Identification of Soils Visual-Manual Procedure)*

- Moisture content tests (ASTM D 2216, *Standard Test Method for Laboratory Determination of Water Moisture Content of Soil and Rock by Mass*)

- Atterberg limits tests (ASTM D 4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils)*

- Unconfined compression tests on soil (ASTM Designation D 2166, *Standard Test Method for Unconfined Compressive Strength of Cohesive Soil)*

- Pocket Penetrometer

4.0 SUBSURFACE CONDITIONS

KCTE has explored the subsurface conditions of the project site at selected boring locations that represents future construction. The following sections describe the findings of our field exploration, laboratory testing and visual classification of the field samples.

This section presents a general summary of the materials encountered in the borings. Specific subsurface conditions encountered at the boring locations are presented on the respective boring logs in Appendix B. The stratification lines shown on the logs represent the approximate boundaries between material types; in many cases the transitions have been estimated.

4.1 SOIL STRATA

The soils encountered in the borings are described below and in Appendix B. The borings typically encountered up to 5 feet of topsoil, fat brown to grey clay that transitioned to shale. Shale bedrock and sampler refusal occurred in two of the borings.

Stratum	Depth	Description	Comment
Stratum 1	0 - 5 ft	TOPSOIL	Present in all borings
Stratum 3	0.25 -15 ft	FAT CLAY (CH) Medium to Hard	Present in borings

4.2 BEDROCK OBSERVATIONS

Shale bedrock when encountered, typically occurred between sampling depths. The transition was gradual, and the depths are approximate. Bedrock was observed in the following borings:

Boring No.	Depth	Description	Comment
B-13	13.5-15 ft	SHALE	SAMPLER REFUSAL
B-15	13.5-15 ft	SHALE	SAMPLER REFUSAL

4.3 GROUNDWATER OBSERVATIONS

The drill crew observed the borings for evidence of groundwater at each location at the time of drilling. Groundwater was not observed during or immediately following the completion of the borings.

Our observations are based on the conditions encountered only at the actual boring locations at the time of drilling. Due to the low permeability of the soils encountered in the borings, a relatively long period of time may be required for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells may be required to define groundwater levels in these materials or at this site.

Also, it should be understood that the level of groundwater might fluctuate at other times of the year depending upon climatic and rainfall conditions. Groundwater levels may be different during construction or at other times during the life of the project.

5.0 RECOMMENDATIONS

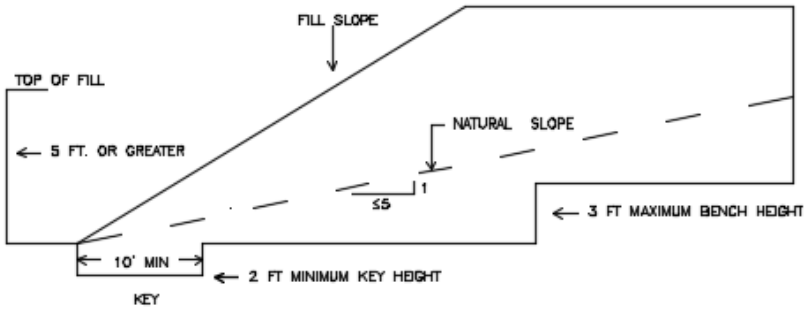
KCTE is providing recommendations in the following sections based on our laboratory/field testing during this exploration, observation in the field by the geotechnical professional and experience with local materials.

5.1 SITE PREPARATION

KCTE recommends complete removal Topsoil, soft soils, or unsuitable material in building pad and pavement locations prior to controlled fill placement.

- Stratum 1 Topsoil should be removed and disposed of off-site or used in green spaces**.**
- Stratum 2 soils do not meet the requirements of Low Volume Change (LVC) layers as stated in Section 5.3 and should not be used in LVC layers beneath slabs-on-grade.
- Stratum 2 soils may be used in controlled fills.

All natural slopes in soil steeper than 5 horizontal to 1 vertical (5H:1V) in areas to receive fill greater than 5 ft., should be benched prior to placement of fill. The benching of slopes allows interlocking of the fill and the natural soils, and in addition provides a level platform for the compaction of the fill. Benches should be cut as the fill progresses, and bench heights should be restricted to a maximum of 3 ft. with a minimum 2 ft. cut for keying of fill into the natural slope. The benches should have a minimum width of 4.5 ft. and the key should be a minimum of 10ft wide. KCTE recommends fill slopes constructed no steeper than a 3H:1V for maintenance and promoting the growth of vegetation.



Recommended Benching Procedures

Special consideration should be given to areas if bedrock is exposed in the bench cuts. Drainage measures may be required to collect and divert groundwater from the exposed bedrock prior to placing the new fill.

After the existing soil subgrade is excavated to the proposed subgrade level, the exposed material should be observed by a representative of the geotechnical engineer. The subgrade should be proof-rolled with a loaded tandem-axle dump truck, typically with an axle load of a minimum of 9 tons.

Soft zones that are observed to rut or deflect excessively (typically greater than 1 inch) under the moving load during a proof-roll test should be undercut and replaced with properly compacted fill or stabilized in place. In place stabilization could be performed by moisture conditioning and recompaction. Alternately, soft soil could be removed and replaced with suitable on-site or off-site soil. The proof-rolling and undercutting activities should be observed by a representative of the geotechnical engineer and should be performed during a period of dry weather.

Subgrade soils should be dried, or moisture conditioned as necessary to achieve a moisture content in the range of -2 to 3% of the optimum moisture and compacted to at least 95% of the maximum dry density determined in accordance with the standard Proctor test (ASTM D698).

The upper fine-grained soils encountered at this site may 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 significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and subgrade preparation activities during dry weather.

5.2 CONTROLLED FILL

After subgrade preparation has been completed, fill placement may begin to establish construction grade. The first layer of fill material should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils. Fill materials should be free of organic or other deleterious material and have a maximum particle size less than 3 inches in any direction. The on-site soils may be suitable for reuse as engineered fill provided deleterious materials are removed prior to its use as engineered fill. A densely graded, crushed stone, equivalent to KDOT AB-3 aggregate or MoDOT Type 5 aggregate, is also acceptable as engineered fill material. All fill material should be unfrozen and be approved by the geotechnical engineer.

The geotechnical engineer should be notified at least 72 hours before fill is placed, to sample and test the material. No imported material should be delivered to the site without proper sampling and testing. The fill material should be unfrozen and be approved by the geotechnical engineer prior to placement.

The fill material should be placed in loose lifts having a maximum thickness of 8 inches and compacted to at least 95% of the maximum dry density in accordance with ASTM D 698 at moisture contents between -2% and +3% of the optimum moisture content.

Backfill material over unsuitable soils (i.e., soft, wet, frozen, thawing, or spongy surface) or during unfavorable weather conditions should be prohibited. Where soil has been loosened or eroded by flooding or placement during rain, the damaged area should be removed and recompacted to the required density.

Backfilling of curbs and other structures whose foundation is unprotected from water should be accomplished as soon as the concrete has met the designs strength and forms are removed to eliminate possibility of a loosened subbase below the structure.

Placement of soils may be difficult during wet weather conditions. If the native soils and imported soils are too wet and cannot be dried to near-optimum moisture within the construction schedule, they can be stabilized with the addition of lime or Portland cement to provide a stable subgrade material. As an alternate to stabilized subgrade, granular material may be placed at the site surface to provide a working platform. Stabilized soils may also be used for road embankment fill. Backfilling of curbs and other structures whose foundation is unprotected from water should be accomplished as soon as the concrete has met the designs strength and forms are removed to eliminate possibility of a loosened subbase below the structure.

We recommend observation and periodic testing of materials by the geotechnical engineer of record or their designated representative during the placement of fill and backfill material.

5.3 SLABS-ON -GRADE

KCTE recommends the upper 24 inches of the subgrade below slabs-on-grade should consist of a low volume change (LVC) material with a liquid limit (LL) less than 45 and a plasticity index (PI) below 23. **The on-site materials will not meet this requirement**. To minimize the potential for future damage relating to movement of slabs, KCTE recommends options 2a, 2b, 2c. or 2d.

SLABS-ON-GRADE
1. DRAINAGE LAYER – 6" THICK
2. LVC LAYER – 18" THICK a. MODOT TYPE 5 OR KDOT AB-3 b. CEMENT STABILIZED SUBBASE c. DRAINAGE LAYER (3/4" CLEAN STONE) d. OFF-SITE SOIL MEETING THE REQUIREMENT OF LVC

(1) Drainage Layer - KCTE recommends that a minimum 6-inch-thick mat of open-graded (clean) stone, with a maximum particle size of ¾-inch and less than 5 percent passing the No. 4 sieve (ASTM D448, No. 467, No. 57, No. 67, or similar material) be placed beneath the floor slab to enhance drainage. The granular layer will ease construction, provide a capillary break, and aid in drainage. The 6-inch-thick drainage aggregate below the slab should be

considered as part of the 24 inches of LVC below the slabs.

(2) LVC Layer - Any soils or crushed stone used for the LVC layer in building pads should be tested prior to placement of the drainage layer. Soil, if used should meet the requirements of (LVC) material with a liquid limit (LL) less than 45 and a plasticity index (PI) below 23. Crushed stone should be a well-graded stone similar in gradation to a KDOT AB-3 or MODOT Type 5 aggregate. Compaction of low swell potential soil or crushed stone under the slab should be to a minimum of 95 percent of the material's maximum dry density as determined by ASTM D 698 at a moisture content between 0 and +4 percent of the optimum.

It is very important that the subgrade soils be maintained at or above standard Proctor optimum moisture content until concrete is placed. Any rutted subgrade should be repaired prior to placement of base rock to avoid a potential water trap and subsequent sub grade movement. To remove any potential water collected under the slab, KCTE recommends a temporary dewatering system (i.e., sump pump) be installed during the installation of the crushed stone base course. To reduce the effects of differential movement, slabs-on-grade should not be rigidly connected to columns, walls, or foundations unless it is designed to withstand the additional resultant forces. Floor slabs should not extend beneath exterior doors or over foundation grade beams, unless saw cut at the beam after construction. Expansion joints may be used to allow unrestrained vertical movement of the slabs. The floor slabs should be designed to have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage. We suggest joints be provided on a minimum spacing of 15 feet on center.

5.4 FOUNDATION RECOMMENDATIONS

Based on the subsurface conditions encountered and following the recommended site preparation procedures outlined in the previous sections, the proposed structures may be supported on shallow foundations bearing in native clay or controlled fill. It is considered essential that a representative of KCTE observe footing bottoms prior to placement of reinforcing steel. Recommendations for shallow foundation design and construction are provided in the following table.

5.4.1 ALLOWABLE BEARING PRESSURE – SPREAD FOOTINGS

Footings founded in the recommended materials may be proportioned for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) bearing in native clay or controlled fill as long as the recommendations below are followed. The allowable bearing pressure is based on a factor of safety of approximately three (3) with respect to shear failure of the foundation bearing materials.

Continuous wall footings should have a minimum width of 16 inches, and isolated spread footings should have a minimum width of 30 inches. Trench footings should have a minimum width of 12 inches to facilitate cleaning and evaluation of the bearing surface. All exterior footings and footings founded in unheated portions of the structures should be supported a minimum of 36 inches below final exterior grade to provide protection against frost penetration. All footings should be earth-formed, poured in neat excavations.

Description	Mat (Spread Footing)	Continuous Footing
Net allowable bearing pressure (Controlled fill or competent natural foundation soils)[1]	2,000 psf	
Minimum dimensions	30”	16”
Maximum footing width	10 ft.	
Recommended bearing level[1]	Native Clay or Controlled fill	
Minimum embedment below finished grade for frost protection and variation in soil moisture (footings on soil)[2]	3.0 ft.	
Minimum footing bearing depth below compacted fill surface	1 ft.	
Allowable passive pressure[3]	600 psf	
Coefficient of sliding friction[4]	0.33 (controlled fill or clay)	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The recommended pressure considers all unsuitable and/or soft or loose soils, if encountered, are undercut and replaced with tested and approved new engineered fill. Footing excavations should be free of loose and disturbed material, debris, and water when concrete is placed.
2. For perimeter footings and footings beneath unheated areas.
3. Allowable passive pressure value considers a Factor of Safety of about 2. Passive pressure value applies to undisturbed native clay or properly compacted fill. If formed footings are constructed, the space between the formed side of a footing and excavation sidewall should be cleaned of all loose material, debris, and water and backfilled with tested approved fill compacted to at least 95% of the material’s Standard Proctor dry density. Passive resistance should be neglected for the upper 2.5 ft. of the soil below the final adjacent grade due to strength loss from freeze/thaw and shrink/swell.
4. Coefficient of friction value is an ultimate value and does not contain a Factor of Safety.

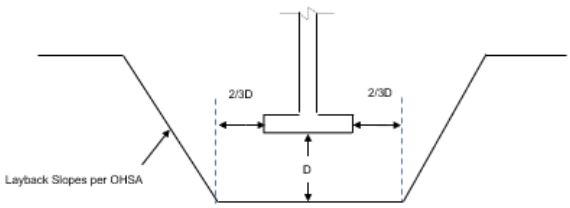
5.4.2 ESTIMATED SETTLEMENTS

Long-term structural settlement for spread footings designed and constructed as outlined above should be minor, 1-inch or less for structures with the bearing elevation throughout the structure. If there are multiple bearing elevations for a given structure, additional evaluation is recommended to further evaluate potential settlements. Differential settlements should occur gradually across the proposed structures and be on the order of 3/4-inch or less over 40 to 60 feet.

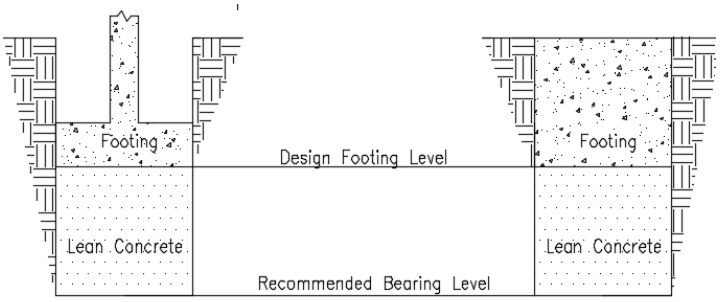
5.4.3 UNDERCUTTING - SPREAD FOOTINGS

When soft or unsuitable soil is encountered at bearing level during foundation excavation, KCTE recommends over-excavation a minimum of 2 feet beneath planned bearing level and backfilling with compacted crushed stone to planned level. The crushed stone should meet the requirements

of MoDOT Type 5 (or similar) type backfill material. See Section 5.2 for compaction requirements. Over-excavation should extend outside of the footing 2/3D, where D is the depth of the over-excavation as depicted below.



At the contractor's option the footings may also be over-excavated with replaced with lean concrete to plan bottom of footing level as depicted below.



Lean Concrete Backfill

5.4.4 SEISMIC DESIGN CONSIDERATIONS

The 2018 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e., depth of soil and strata types). Based on the subsurface conditions of the site and the estimated shear strength properties of the materials in the upper 100 feet, Site Class "D" (i.e., Stiff Soil) is recommended for this project.

5.5.4 PAVEMENTS

Pavement subgrades should be prepared in accordance with the recommendations presented in the 5.1 Site Preparation and 5.2 Controlled Fill sections.

Construction scheduling, involving paving and grading by separate contractors, typically results in a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation, and/or wetting of the subgrade between grading and paving can result

in deterioration of the previously completed subgrade. A non-uniform subgrade can result in poor pavement performance and local failures relatively soon after pavements are constructed.

We recommend that the pavement subgrades be proof-rolled and the moisture content and density of the top 12 inches of subgrade be checked within two days prior to commencement of actual paving operations. If any significant event, such as precipitation, occurs after proof-rolling, the subgrade should be reviewed by qualified personnel immediately prior to placing the pavement. The subgrade should be in its finished form at the time of the final review.

5.5.2 TYPICAL SECTIONS – ASPHALT CEMENT CONCRETE (ACC)

Asphaltic concrete pavements should have a minimum thickness of 5-inches for light duty and 8-inches for heavy duty. Asphalt pavement should be supported by 6-inches of compacted crushed stone (MoDOT Type 5 or KDOT AB-3). Compaction of crushed stone under the pavement should be to 95 percent of the material's maximum dry density as determined by ASTM D 698 at a moisture content between -2 to +3 percent of the optimum.

All asphaltic concrete pavements should be constructed with a minimum surface course thickness of 2 inches. The above sections represent minimum design thicknesses and, as such, periodic maintenance should be anticipated.

ACC
5" Light Duty and 8" Heavy Duty
6" Compacted Crushed Stone

5.5.3 TYPICAL SECTIONS – PORTLAND CEMENT CONCRETE (PCC)

Portland cement concrete pavements should have a minimum thickness of 5-inches for light duty and 7-inches for heavy duty. We also recommend that a 6-inch leveling and drainage course of clean ¾" crushed stone be placed below all concrete pavements. The pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub drainage or connection to a suitable gravity outfall should be provided to remove water from the granular base.

PCC
5" Light Duty and 7" Heavy Duty
6" ¾ Inch Clean Crushed Stone

5.6 PAVEMENT SUBGRADE STABILIZATION - PORTLAND CEMENT

As an option to crushed stone beneath asphaltic pavement, the soil subgrade may be stabilized using Type 1 Portland Cement material. Type 1 Portland cement should be incorporated in a 9-inch compacted lift of soil (compacted thickness) at a rate of 5% as calculated by dry unit weight of the soil.

After the soil subgrades have been prepared in accordance with the Site Preparation and Controlled Fill sections in this report, Portland cement stabilized materials should be incorporated into the subgrade in the following manner.

Portland cement should be spread uniformly across the prepared soil surface at the full application rate by using an agricultural seed or spreader or other equipment acceptable to the geotechnical engineer's designated representative. Portland cement should be distributed at a uniform rate and in such a manner to prevent the scattering of the material by wind.

Mixing should begin within 2 hours of distribution of Portland cement. The soil, Portland cement material, and required water should be thoroughly mixed, blended, and pulverized by approved road mixers or by a depth-controlled rotary tiller. Scarifying and mixing should be controlled to provide uniform depth within 0.1 ft of the depth specified.

Compaction should begin within 2 hours of the start of mixing. Portland cement stabilized subgrade should be compacted in accordance with the requirements for controlled fill. The compaction should be a minimum of 95% of the maximum density in accordance with ASTM D698 and within –3% to +2% of the optimum moisture content of Portland cement stabilized soil.

In addition, the following recommendations should be followed:

- Portland cement should not be added when wind or weather conditions are not favorable in the opinion of the geotechnical engineer's designated representative.
- Portland Cement should be kept free from moisture prior to use.
- Portland cement stored on the project should be placed in weatherproof bins or buildings with adequate protection from ground dampness.
- Portland cement should be spread only on those areas where mixing operations can be completed during the same working day.
- Mixing and spreading should not be performed during freezing temperatures. When the temperature is below 40 degrees F, the completed base course should be protected against freezing by a sufficient covering of straw, or by other approved methods, until the course has dried out. Any areas of completed base course that are damaged by freezing, rainfall, or other weather conditions should be repaired by the contractor.
- Portland cement should not be applied when the atmospheric temperature is less than 40 degrees F.

Portland cement should be applied to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F, Portland cement treated areas should be protected against any detrimental effects of freezing.

5.6 DRAINAGE AND MAINTENANCE OF PAVEMENTS

KCTE recommends the installation of perimeter foundation drains along the outside of pavement curbs and gutters. The drains should consist of at least 6" thick, clean aggregate columns with a 4" inch minimum perforated pipes at the bottom. The pipes should be connected and allowed to daylight or connected to a drop inlet.

5.7 DRAINAGE AND MAINTENANCE AROUND STRUCTURES

KCTE recommends the installation of perimeter drains along the outside of structures. The drains should consist of at least 6" thick, clean aggregate column with a 4" inch minimum perforated pipe at the bottom. The pipes should be connected and allowed to daylight or connected to a sump system.

5.8 EXCAVATION AND TRENCHES

All temporary slopes and excavations should conform to Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry (29CFR Part 1026, Subpart P).

All excavations should be kept dry during subgrade preparation. Storm water runoff should be controlled and removed to prevent severe erosion of the subgrade and eliminate free standing water. Subgrade that has been rendered unsuitable from erosion or excessive wetting should be removed and replaced with controlled fill.

Trenches should be excavated so that pipes and culverts can be laid straight at uniform grade between the terminal elevations. Trench width should provide adequate working space and sidewall clearances. Trench subgrade should be removed and replaced with engineered fill if found to be wet, soft, loose, or frozen. Trench backfills under roads should consist of crushed limestone with fines (MoDOT Type 5 or KDOT AB-3) or as specified by the City's Design and Construction Manual. Trench subgrade should be compacted to a minimum of 95% of the maximum dry density in accordance with ASTM D 698 at moisture contents between -2% to +3% of the optimum moisture content. A representative of the geotechnical engineer should be on-site full-time during trench backfill operations to test each lift of fill material.

Granular bedding materials for pipes should conform to the pipe manufacturers recommendation. Typically, well-graded sand or gravel may be used provided that the bottom of the trench is graded so that water flows away from structures. Open-graded granular bedding may be used provided that a separation geotextile is used at the subgrade interface. Bedding material should be graded to provide a continuous support beneath all points of the pipe and joints. Embedment material should be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Compacted engineered fill material will be required for the full depth of the trench above the embedment material. No backfill should be placed or compacted in standing water.

6.0 GENERAL COMMENTS

This report is presented in broad terms to provide an assessment of the subsurface conditions and their potential effect on the adequate design and economical construction of the proposed development. Any changes in the design or location of the proposed streets or utilities should be assumed to invalidate the conclusions and recommendations given in this report until we have had the opportunity to review the changes and, if necessary, modify our conclusions and recommendations accordingly. It is recommended that the geotechnical engineer be afforded the opportunity of a general review of the final design plans and specifications prior to construction in order to determine if they are consistent with the conclusions and recommendations given in this report. For this project, these geotechnical document review services will be provided as part of the geotechnical report cost. Particular details of foundation design, construction specifications or quality control may develop, and we would be pleased to respond to any questions that you may have regarding these details.

The scope of our services did not include any environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater, or air below or around this site.

APPENDIX A

Site and Boring Locations Maps

Figure 1 Site Location Map

Figure 2 Boring Location Map (approximate)

APPENDIX B

Boring Logs and Laboratory Data

Kansas City Testing and Engineering, LLC
1141 Southwest Blvd.
Kansas City, KS 66103
Tel: 913-321-8100
Fax: 913-321-8181

BORING NUMBER B-1

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 3"**										
		FAT CLAY (CH), Red Brown to Grey Brown, Medium to Stiff										
		Red to Brown Silty Clay, Stiff	SPT 1	4-5-5 (10)	67			16.9				
2.5												
		Red to Brown Silty Clay, Trace Gravel Medium	SPT 2	4-4-4 (8)	67			20.1				
5.0												
		Brown to Drk Brown Clay, Stiff	SPT 3	3-6-9 (15)	100			28.8				
7.5												
		Dark Grey Mottled Red-Brown Clay, Stiff	SPT 4	3-4-8 (12)	100			25.9				
10.0												
12.5												
		Grey Mottled Red-Brown Clay, Stiff	SPT 5	3-4-7 (11)	100			25.2				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-2

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 14"**										
		Red to Brown Clay, Stiff **FAT CLAY (CH), Dark Brown to Grey Brown, Medium to Stiff**	SPT 1	3-4-5 (9)	67			20.7				
2.5		Red to Brown Clay, Medium	SH 2		100	14707	104	19.3				4.5
5.0		Brown to Drk Brown Clay, Stiff	SPT 3	4-6-8 (14)	100			27.5				
7.5		Dark Grey Mottled Red-Brown Clay, Stiff	SPT 4	3-3-5 (8)	100			26.0				
10.0												
12.5		Grey Mottled Red-Brown Clay, Stiff	SPT 5	3-4-6 (10)	100			23.2				
15.0		Bottom of borehole at 15.0 feet.										

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BORING NUMBER B-3

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/14/23 **COMPLETED** 7/14/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		Grey Brown Silty Clay, Stiff **FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 1	3-3-5 (8)	78			18.7				
2.5												
		Red to Brown Clay, Trace Gravel Medium	SPT 2	3-3-6 (9)	100			24.6				
5.0												
		Red Brown Clay Clay, Stiff	SPT 3	3-5-7 (12)	100			25.7				
7.5												
		Red-Brown Clay Mottled Dark Grey, Stiff	SPT 4	2-4-6 (10)	100			24.5				
10.0												
12.5												
		Red-Brown Clay to Olive Grey Clay, Very Stiff	SPT 5	5-7-10 (17)	100			20.7				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-4

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/14/23 **COMPLETED** 7/14/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 6"**										
		FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff										
		Grey Brown Silty Clay, Stiff	SPT 1	2-2-4 (6)	89			22.9				
2.5												
		Red Brown Clay, Stiff	SPT 2	3-3-6 (9)	100			26.4				
5.0												
		Red Brown Mottled Grey Clay Clay, Stiff	SPT 3	3-5-7 (12)	100			23.2				
7.5												
		Olive Grey Clay, Very Stiff	SPT 4	6-12-18 (30)	100			17.7				
10.0												
12.5												
		Red-Brown Clay to Olive Grey Clay, Very Stiff	SPT 5	14-24-30 (54)	100			16.8				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-5

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		Dark Grey Brown Silty Clay, Stiff **FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 1	2-3-4 (7)	67			18.7				
2.5												
		Red Brown Clay, Medium	SPT 2	3-4-5 (9)	100			25.6				
5.0												
		Red Brown Clay Clay, Stiff	SPT 3	3-6-4 (10)	100			24.9				
7.5												
		Red Brown Clay Mottled Dark Grey, Stiff	SPT 4	6-10-15 (25)	100			19.9				
10.0												
12.5												
		Orangish Tan Clay , Very Stiff	SPT 5	14-22-31 (53)	100			20.0				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-6

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		Dark Grey Brown Silty Clay, Medium **FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 1	3-3-3 (6)	67			18.4				
2.5												
		Red Brown Clay, Stiff	SPT 2	2-3-6 (9)	100			22.3				
5.0												
		Red Brown Clay Clay, Stiff	SPT 3	2-7-8 (15)	100			23.9				
7.5												
		Red Brown Clay Mottled Grey, Stiff	SPT 4	3-4-5 (9)	100			24.0				
10.0												
12.5												
		Orangish Tan Clay , Very Stiff	SPT 5	6-8-8 (16)	100			22.7				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-7

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/14/23 **COMPLETED** 7/14/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 6"**										
		FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff										
		Red Brown Clay, Stiff	SPT 1	3-4-8 (12)	56			20.6				
2.5												
		Grey Brown Clay, Medium	SPT 2	3-4-7 (11)	100			21.7				
5.0												
		Orangish Brown to Olive Grey Clay, Very Stiff	SPT 3	8-18-30 (48)	100			18.5				
7.5												
		Olive Grey to Grey Brown Clay, Very Stiff	SPT 4	17-26-38 (64)	100			15.2				
10.0												
12.5												
		Olive Grey to Grey Brown Clay, Very Stiff	SPT 5	18-30-45 (75)	100			15.1				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-8

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/14/23 **COMPLETED** 7/14/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 5'**										
			SPT 1	2-2-3 (5)	44			17.1				
2.5			SH 2		78	3702	90	27.0	63	28	35	
5.0		Dark Grey Clay, Medium **FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 3	3-3-5 (8)	100			27.8				
7.5												
		Red Brown Mottled Dark Grey Clay, Stiff	SPT 4	2-4-6 (10)	100			25.4				
10.0												
12.5												
		Orangish Brown to Olive Grey Clay , Very Stiff	SPT 5	9-18-32 (50)	100			19.7				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-9

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/14/23 **COMPLETED** 7/14/03 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 18"**										
		Black Topsoil to Dark Brown Grey Clay, Stiff	SPT 1	4-5-6 (11)	67			19.7				
2.5		**FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**										
		Brown Grey Clay, Medium	SPT 2	2-3-5 (8)	100			25.5				
5.0												
		Red Brown Clay, Stiff	SPT 3	3-5-7 (12)	100			23.7				
7.5												
		Orangish Brown to Olive Grey Clay, Very Stiff	SPT 4	16-25-36 (61)	100			18.2				
10.0												
12.5												
		Orangish Brown to Olive Grey Clay, Very Stiff	SPT 5	17-28-36 (64)	100			16.6				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-10

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		Red Brown Clay, Stiff **FAT CLAY (CH), Red Brown, Very Dark Brown to Olive Grey Clay, Stiff to Very Stiff**	SPT 1	3-4-6 (10)	44			18.8				
2.5												
		Very Dark Brown Clay, Stiff	SPT 2	3-5-6 (11)	100			30.6				
5.0												
		Very Dark Brown Clay, Stiff	SPT 3	3-4-5 (9)	100			26.3				
7.5												
		Orangish Brown Clay, Stiff	SPT 4	3-5-7 (12)	100			20.3				
10.0												
12.5												
		Olive Grey Clay, Very Stiff	SPT 5	13-22-31 (53)	100			17.4				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-11

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		Red Brown Clay, Stiff **FAT CLAY (CH), Red Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 1	4-4-9 (13)	78			18.4				
2.5		Very Dark Brown Clay, Medium	SPT 2	3-3-4 (7)	100			30.3				
5.0		Dark Grey Brown Clay, Stiff	SPT 3	3-4-5 (9)	100			30.5				
7.5		Orangish Brown Clay, Stiff	SPT 4	3-4-7 (11)	100			23.0				
10.0												
12.5		Olive Grey Clay, Very Stiff	SPT 5	12-23-37 (60)	100			17.1				
15.0		Bottom of borehole at 15.0 feet.										

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BORING NUMBER B-12

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 18"**										
		Very Dark Brown Clay, Medium	SPT 1	2-3-5 (8)	100			19.0				
2.5		**FAT CLAY (CH), Very Dark Brown, Red Brown to Olive Grey Clay, Medium to Very Stiff**										
		Very Dark Brown Clay, Medium	SPT 2	3-3-6 (9)	100			32.6				
5.0												
		Red Brown Clay, Stiff	SPT 3	3-4-6 (10)	100			28.2				
7.5												
		Orangish Brown Clay, Stiff	SPT 4	10-17-28 (45)	100			18.3				
10.0												
12.5												
		Olive Grey Clay, Trace Blue Grey Shale @ 14.0', Very Stiff	SPT 5	25-50-50 (100)	67			14.7				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-13

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		FAT CLAY (CH), Grey Brown, Medium to Stiff	SPT 1	3-3-5 (8)	100			17.8				
2.5		Dark Brown to Red Brown Clay, Stiff	SPT 2	3-4-6 (10)	100			22.3				
5.0		Brown to Red Brown Clay, Stiff	SPT 3	3-5-6 (11)	100			25.6				
7.5		Tan Brown Clay, Very Stiff	SPT 4	4-6-13 (19)	100			21.5				
10.0												
12.5		**SHALE, Dark Blue Grey Moderately Hard** Weathered to Fresh Shale	SPT 5	23-39-50 (89)	100			11.9				
15.0		Bottom of borehole at 15.0 feet.										

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BORING NUMBER B-14

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 18"**										
		Brown Clay, Medium	SPT 1	2-3-4 (7)	100			18.0				
2.5		**FAT CLAY (CH), Dark Brown, Orangish Brown to Olive Grey Clay, Medium to Very Stiff**	SPT 2		61	15460	105	20.9	54	26	28	
5.0		Brown Grey Clay, Medium	SPT 3	3-5-8 (13)	100			21.5				
7.5												
10.0		Orangish Brown Clay, Stiff	SPT 4	9-17-25 (42)	100			19.9				
12.5												
15.0		Olive Grey Clay, Very Stiff	SPT 5	12-17-26 (43)	100			17.4				

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-15

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 6"**										
		FAT CLAY (CH), Olive to Grey Brown, Medium to Stiff										
		Red Brown Clay, Stiff	SPT 1	4-6-6 (12)	67			16.7				
2.5												
		Dark Brown to Red Brown Clay, Stiff	SPT 2	2-4-5 (9)	100			20.4				
5.0												
		Dark Brown to Red Brown Clay, Stiff	SPT 3	3-4-5 (9)	100			18.8				
7.5												
		Olive Grey Clay, Medium	SPT 4	2-3-5 (8)	100			23.6				
10.0												
12.5												
		SHALE, Dark Blue Grey, Moderately Hard										
		Dark Blue Grey Shale, Moderately Hard	SPT 5	25-50-50 (100)	61			13.2				
15.0												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-16

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 3"**										
		FAT CLAY (CH), Brown to Very Dark Brown Clay, Stiff										
		Brown Clay, Trace Gravel, Stiff	SPT 1	5-4-5 (9)	67			20.3				
2.5												
		Very Dark Brown Clay, Stiff	SPT 2	3-5-8 (13)	100			27.8				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER B-17

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 3"**										
		FAT CLAY (CH), Brown to Very Dark Brown Clay, Stiff										
		Brown Grey Silty Clay, Stiff	SPT 1	4-4-6 (10)	78			16.6				
2.5												
		Very Dark Brown Clay, Stiff	SPT 2	2-3-6 (9)	100			27.1				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER B-18

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 12"**										
		FAT CLAY (CH), Brown to Very Dark Brown Clay, Medium to Stiff Brown to Black Clay, Medium	SPT 1	3-3-5 (8)	67			26.3				
2.5												
		Dark Brown Grey Clay, Stiff	SPT 2	3-4-6 (10)	100			24.3				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER B-19

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 3"**										
		FAT CLAY (CH), Brown to Very Dark Brown Clay, Stiff										
		Dark Grey mottled Red Brown Clay, Stiff	SPT 1	2-4-5 (9)	78			22.5				
2.5												
		Red Brown Clay, Stiff	SPT 2	3-5-7 (12)	100			18.3				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER B-20

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri

DATE STARTED 7/17/23 **COMPLETED** 7/17/23 **GROUND ELEVATION** _____ **HOLE SIZE** 4 inches

DRILLING CONTRACTOR _____ **GROUND WATER LEVELS:**

DRILLING METHOD 4 SS **AT TIME OF DRILLING** ---

LOGGED BY JS **CHECKED BY** SC **AT END OF DRILLING** ---

NOTES _____ **AFTER DRILLING** ---

Depth	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOWS (N COUNT)	RECOVERY % (RQD)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0.0		**TOPSOIL 3"**										
		FAT CLAY (CH), Brown to Very Dark Brown Clay, Medium										
		Brown to Black Clay, Medium	SPT 1	3-3-5 (8)	78			23.7				
2.5												
		Dark Brown to Orangish Brown Clay, Medium	SPT 2	2-3-5 (8)	100			27.1				
5.0												

Bottom of borehole at 5.0 feet.

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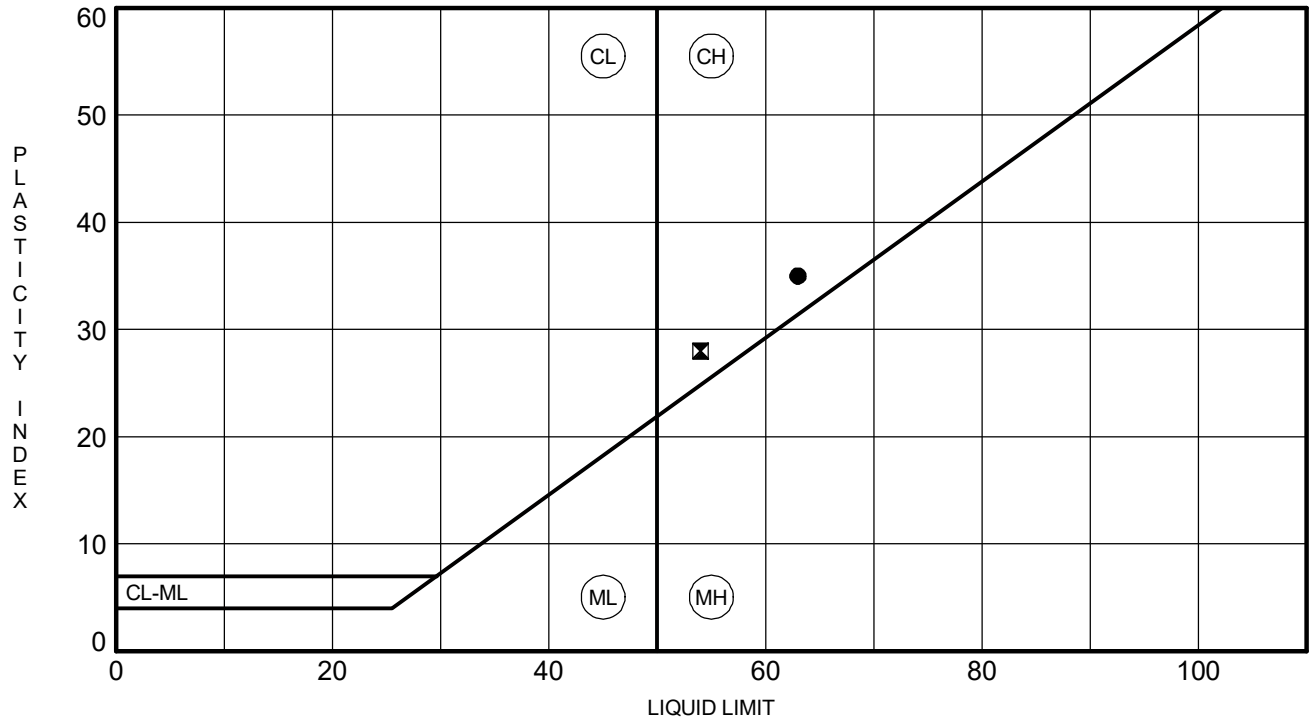
ATTERBERG LIMITS' RESULTS

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-8**	**3.0**	**63**	**28**	**35**		FAT CLAY (CH)
⊠	**B-14**	**3.0**	**54**	**26**	**28**		FAT CLAY (CH)

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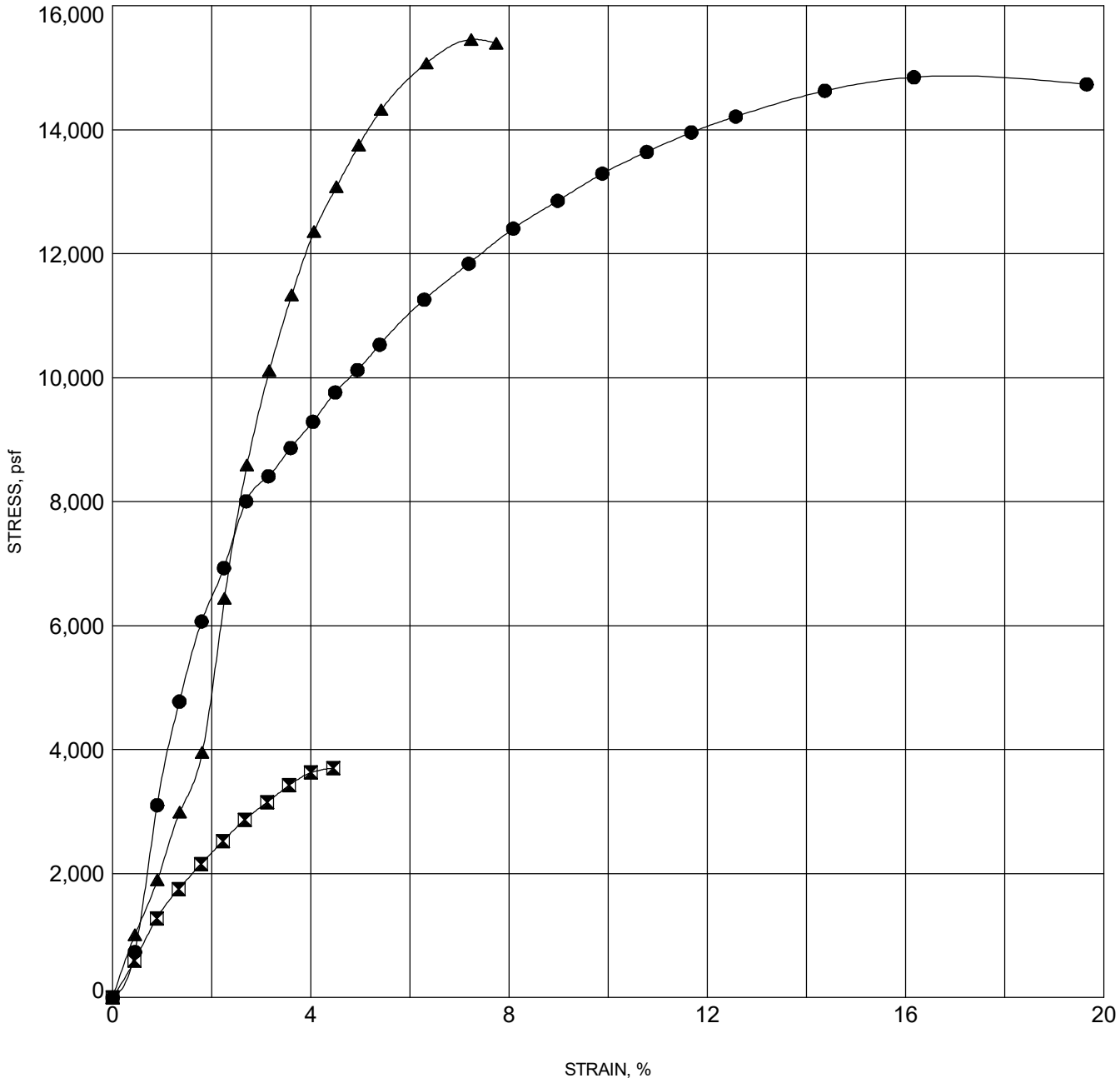
UNCONFINED COMPRESSION TEST

CLIENT _____ **PROJECT NAME** Douglas Station Apartments

PROJECT NUMBER G20-23-092 **PROJECT LOCATION** Lee's Summit, Missouri



BOREHOLE		DEPTH	Classification	γ_d	MC%
●	B-2	3.0		104	19
⊠	B-8	3.0		90	27
▲	B-14	3.0		105	21

APPENDIX C

General Comments and Soil Classifications

General Notes

KANSAS CITY TESTING & ENGINEERING, LLC

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

AS	Auger Sample
CS	Continuous Sampler
HA	Hand Auger
HS	Hollow Stem Auger
PA	Power Auger
CF	Continuous Flight Auger
WB	Wash Bore
RB	Rock Bit
SS*	Split Spoon
ST	Shelby Tube

* The Standard Penetration Test (SPT) is conducted in conjunction with the split-spoon sampling procedure. The "N" value corresponds to the number of blows required to drive the the last 1 foot of an 18-inch-long, 2-inch O.D. split-spoon sampler with a 140-lb hammer falling a distance of 30 inches. The Standard Penetration Test is carried out according to ASTM D 1586.

WATER LEVEL MEASUREMENTS

ATD	At Time of Drilling
EOD	End of Drilling
AD	After Drilling

SOIL PROPERTIES & DESCRIPTIONS

TEXTURE

PARTICLE	*SIZE*
Clay	<0.002 mm
Silt	<#200 Sieve
Sand	#4 to #200 Sieve
Gravel	3 inch to #4 Sieve
Cobbles	12 inch to 3 inch
Boulders	> 12 inch

COMPOSITION

SAND & GRAVEL	
trace	< 15%
with	15% - 29%
some	> 30%
FINES (clay & silt)	
trace	< 5%
with	5% - 12%
some	> 12%

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM D 2487 and D 2488. The USCS group symbol on the boring logs corresponds to the group names listed below. The descriptions include soil constituents, consistency or relative density, color and other appropriate descriptive terms. Geologic description of bedrock, when encountered, also is shown in the description column.

COHESIVE SOILS

CONSISTENCY	*UNCONFINED COMPRESSIVE STRENGTH* (psf)	(kPa)
Very Soft	< 500	< 24
Soft	500-1000	24-48
Medium Stiff	1001-2000	49-96
Stiff	2001-4000	97-192
Very Stiff	4001-8000	193-383
Hard	> 8001	> 384

PLASTICITY	Liquid Limit, %
Lean	< 45
Lean to Fat	45 - 49
Fat	> 50

COHESIONLESS SOILS

RELATIVE DENSITY	*N VALUE*
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	> 49

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD**)

QUALITY	*RQD, %*
Very Poor	0-25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	90-100

**RQD is defined as the total length of sound core pieces, 4 inches (102 mm) or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

DEGREE OF WEATHERING

Slightly Weathered	Slight decomposition of parent material.
Weathered	Well developed and decomposed.
Highly Weathered	Highly decomposed, may be extremely broken.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy	Containing small cavities < 1/2 " (13mm)
Porous	Containing numerous voids, may be interconnected.
Cavernous	Containing cavities, sometime large.

When classification of bedrock materials has been estimated from disturbed samples, core samples and petrographic analysis may reveal other rock types.

HARDNESS & DEGREE OF CEMENTATION

LIMESTONE	
Hard	Difficult to scratch with knife.
Moderately Hard	Scratch with knife but not fingernail.
Soft	Can be scratched with fingernail.
SHALE	
Hard	Scratch with knife but not fingernail.
Moderately hard	Can be scratched with fingernail.
Soft	Can be molded easily with fingers.
SANDSTONE	
Well Cemented	Capable of scratching with a knife.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken easily with fingers.

BEDDING CHARACTERISTICS

TERM	*THICKNESS, INCHES (MM)*
Very Thick Bedded	> 36 (915)
Thick Bedded	12-36 (305-915)
Medium Bedded	4-12 (102-305)
Thin Bedded	1-4 (25-102)
Very Thin Bedded	0.4-1 (10-25)
Laminated	0.1-0.4 (2.5-10)
Thinly Laminated	< 0.1 (<2.5)

Bedding Planes - Planes dividing layers, beds or strata of rocks.
Joint - Fracture in rock, usually vertical or transverse to bedding.
Seam - Applies to bedding plane with unspecified weathering.

KANSAS CITY TESTING & ENGINEERING, LLC

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 11

(Based on Unified Soil Classification System)

MAJOR DIVISIONS				GROUP SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel [F]
		Gravels with Fines More than 12% fines	Fines classify as ML or MH	GM	Silty gravel [F G H]
			Fines classify as CL or CH	GC	Clayey gravel [F G H]
	Sands 50% or more of coarse faction passes No. 4 sieve	Clean Sands Less than 5% fines	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand [I]
		Sands with Fines More than 12% fines	Fines classify as ML or MH	SM	Silty Sand [G H I]
			Fines classify as CL or CH	SC	Clayey sand [G H I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line	CL	Lean clay [K L M]
			PI < 4 or plots below "A" line	ML	Silt [K L M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay [K L M N] Organic silt [K L M O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [K L M]
			PI plots below "A" line	MH	Elastic silt [K L M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay [K L M O] Organic silt [K L M O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

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

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

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

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

[E] $Cu = D_{60}/D_{10}$ $Cc=(D_{30})^2 / (D_{10} \times D_{90})$

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

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

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

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

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

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

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

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

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

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

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

[Q] PI plots below "A: line.