ALPHA-OMEGA
GEOTECH

1701 State Avenue
Kansas City, KS 66102

t 913-371-0000
f 913-371-6710

AOGeotech.com

GEOTECHNICAL ENGINEERING REPORT

<u>LEE'S SUMMIT SURGICAL</u>

SEC OF NE INDEPENDENCE AVE & NE JONES INDUSTRIAL DR
LEE'S SUMMIT, MISSOURI
(AOG 17-407E)

Date: October 26, 2017

Submitted to: Mr. Tim Breece
TD Capital Investments
11715 Administration Drive
Maryland Heights, MO 63146

Submitted by: ALPHA-OMEGA GEOTECH, INC.

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Dear Mr. Breece,

Alpha Omega Geotech, Inc. (AOG) has completed its geotechnical engineering investigation for the above-referenced project.

Attached are the following items that were utilized in the analysis and evaluation of the subsurface conditions at this site: a sketch giving the approximate location of the nine (9) auger borings completed during this investigation with reference to the existing site features; detailed laboratory results of four (4) moisture contents (ASTM D2216), four (4) dry densities (ASTM D7263), two (2) sets of Atterberg limits (ASTM D4318), and four (4) unconfined compression (ASTM D2166) tests; eight (8) calibrated pocket penetrometer readings; and nine (9) auger boring (ASTM D1452) logs that describe the materials encountered, their approximate thicknesses, and the sampling depths where Shelby tube, thin-walled steel, samplers (ASTM D1587) and Standard Penetration (ASTM D1586) tests were performed.

Representatives of AOG located each of the selected borings by measuring from the existing site features, and these measurements should be considered accurate only to the extent implied by the method of measurement. Elevations were not determined in the field at the time of drilling. Each of the borings was completed by AOG using a CME 55 high-torque drill rig.

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1.0 PROJECT AND SITE DESCRIPTION

Based on the information provided in the proposal, AOG understands the project consists of constructing a new 42,300 square-foot, multi-story medical office building. It is anticipated that the medical office building will be a two-story, steel-framed structure. Although no loading information was provided at the time of this report, AOG anticipates the planned building to be, relatively, lightly loaded. There will also be paved parking lots and access roads associated with the building.

Currently, the proposed project site is an empty, grass covered lot. The proposed site generally grades downward from the north to the south, and subtly from the east to the west. Based on the grading plan and building elevations that were available at the time of this report, and, as such, AOG has anticipated minimal amounts of cut and fill, 2 to 3 feet, +/-, will be necessary to achieve the desired construction grade.

2.0 SUBSURFACE INVESTIGATION

This subsurface exploration and the services documented, herein, were provided in accordance with the scope of work described in Alpha Omega Geotech's proposal number PW-5912 dated September 6, 2017 and authorized by TD Capital Investments.

Based on the information provided at the time of this exploration, AOG drilled nine (9) auger borings at the proposed site. Four (4) borings with planned depths of twenty (20) feet were drilled within the footprint of the proposed structures and five (5) borings with planned depths of five (5) feet were drilled in paved areas. The borings were advanced to their planned depths, or auger refusal, whichever occurred first.

It should be understood that the depth of boring, split-spoon refusal or auger refusal reported, herein, applies to the type of drilling equipment used. As such, it might be possible to extend some of these borings deeper using different drilling equipment and/or techniques. Conversely, residual sandstone, shale and limestone materials through which AOG's drill rig penetrated, without achieving refusal, may be difficult to excavate depending upon the equipment being used. As such, Alpha-Omega Geotech, Inc. shall not be responsible, for the determination of Others, regarding the rippability, or ease of excavation, of the in-situ subgrade, bedrock and/or geo-intermediate materials.

Above the depth at which auger refusal or boring termination occurred, predominantly fat clay soils were encountered in the borings. Thin-walled, steel, Shelby tube samplers (ASTM D1587) were used to collect relatively undisturbed samples from these borings for laboratory analysis. Standard Penetration tests (SPT) (ASTM D1586) were also used to sample and evaluate the consistency of the in-situ subgrade materials encountered in these test borings. Standard Penetration Tests are conducted by advancing a hollow, split spoon sampler into the base of the auger hole by means of dropping a 140-pound hammer a distance of 30 inches onto the drill rods. Each drop of the hammer is one blow, and these blow counts are recorded for each of three, 6-inch advances of the sampler. The first 6-inch advance is the seating drive, and the summation of the blow counts of the final two, 6-inch advances is taken as the standard penetration resistance. The standard penetration resistance, or N-value, as it is known, along with the soil classification, can be used to estimate the density, shear strength and other engineering properties of the materials encountered.

The N-values obtained from each of the SPT's completed in these borings using a CME automatic hammer are included on the boring logs and summarized in the Summary of Laboratory Testing sheet found in Appendix B. Samples retrieved during drilling efforts were returned to AOG's laboratory for testing and evaluation.

3.0 LABORATORY TESTING PROGRAM

Laboratory testing on materials collected during drilling was performed on samples selected by AOG. Results from these tests can be found in Appendix B and on the boring logs in Appendix C. The following laboratory tests were performed by qualified AOG personnel in accordance with ASTM specifications to determine pertinent engineering properties of the soils:

- Visual classification (ASTM D2488)
- Moisture content tests (ASTM D2216)
- Atterberg limits tests (ASTM D4318)
- Dry Unit Weight (ASTM D7263)
- Unconfined compression tests on soil (ASTM D2166)

The dry unit weights of specimens cut from the Shelby tube samples were found to be moderate, ranging from 97.0 pounds per cubic foot (pcf) to 103.8 pcf. Depending upon the material composition and depth below existing grade, the moisture content of the specimens cut from these tube samples ranged from 20.5 to 26.9 percent. The unconfined compressive strength of the specimens cut from the Shelby tube samples ranged from 2812 to 8236 pounds per square foot (psf). It should be noted that several of the maximum unconfined compressive strength values were obtained at high strain rates exceeding 10 percent. As a result, given the onsite soil types, these high strain rates typically indicate that larger settlements could occur unless a lower allowable bearing capacity value is used than otherwise indicated by the unconfined compressive strength test results. Calibrated pocket penetrometer readings ranging from 1.5 tons per square foot (tsf) (3000 psf) to 4.5 tsf (9000 psf) were obtained on the recovered Shelby tube samples. However, it should be noted that the pocket penetrometer values tend to over-estimate the strength of in-situ subgrade materials relative to the actual unconfined compressive strength test.

The Atterberg consistency limits were determined for two, generally, representative samples taken at relatively shallow depth from within the proposed buildings' footprints. Based on the Atterberg limits, the samples were classified in accordance with the Unified Soil Classification System (USCS) as fat clay, i.e. CH classification materials. The results of these laboratory analyses are presented in the following table:

Table #1: Atterberg Limits Results

ATTERBERG LIMITS TESTS					
Sample	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification
B1 ST-2	4-6	58	22	36	FAT CLAY (CH)
B4 ST-2	4-6	64	23	41	FAT CLAY (CH)

Based on the Atterberg limits, it is anticipated the majority of the onsite soil materials generally possess a high swelling potential. The swelling potential of a clay soil is an indication of the volume changes that may take place with variations in the soil moisture content.

Except for the samples for which the Atterberg limits were determined, all of the other soil classifications given throughout the laboratory test data, as well as, the boring logs, were made using the visual and tactile techniques described in ASTM D2488. As a result, additional analyses could reveal other soil types of different classification and potentially higher plasticity and swelling potential both onsite and within the nearby vicinity.

4.0 GROUNDWATER

Groundwater was observed at 17 fbeg in boring B-3 while drilling. No water was observed in any of the remaining borings during drilling. However, a twenty-four-hour water level was not established in these borings due to time restrictions, as well as, potential safety hazards associated with open bore holes.

Although the ground water levels given on the boring logs reflect the conditions observed at the time the borings were made, they should not be construed to represent an accurate or permanent condition. There is uncertainty involved with short-term water level observations in bore holes especially in clay soils of relatively low permeability. The groundwater level should be expected to fluctuate with variations in precipitation, site grading and drainage conditions. In addition, it is also possible that seasonal perched ground water may be encountered within these soil deposits and bedrock formations at different depths during other times of the year based on drainage conditions, seasonal snowmelt and rainwater infiltration.

5.0 GEOTECHNICAL CONSIDERATIONS

The following considerations are given based on observations made by AOG at the time of drilling, during reconnaissance trips, and based on the project requirements and description as stated above:

- *Expansive Materials:* Expansive clays were encountered during this exploration. Expansive clays are known to experience significant volume changes with changes in moisture. Expansive clays located beneath any slabs on grade should be removed in accordance with Section 8.0, SLABS ON GRADE of this report.

6.0 SITE DEVELOPMENT

6.1 Site Preparation

Based on the information provided, AOG anticipates minimal amounts of cut and fill, less than about 2 to 3 feet (+/-) from the current elevation, within the proposed structure footprint, will be required to achieve finish floor elevations. It is possible that additional cuts and fills may be required to obtain improved surface drainage.

Appropriate erosion control measures, such as proper site contouring during grading activities, as well as, silt fences, should be maintained to help keep any eroded materials onsite.

Within the footprint of the proposed new structure and associated paving, it is recommended that any topsoil, vegetation, utility backfill, and other deleterious material (i.e. concrete slabs, relic foundations, utilities, etc.) or pavements should be stripped and removed prior to the placement of any fill required to achieve the finished floor elevation. In accordance with the local building code, this should be verified by a representative of Alpha-Omega Geotech, Inc. prior to the placement of fill.

Once initial site stripping operations have been completed and prior to the placement of any engineered fill in this area, it is recommended that the exposed subgrade be moisture conditioned and recompacted, as needed, and be thoroughly evaluated by means of a proof-roll with a fully loaded, tandem-axle dump truck to locate any soft, compressible areas within the proposed project site. Any soft, compressible areas identified on the proposed project site must be corrected by over-excavation to a suitable subgrade and replaced with an acceptable material. Although it is not anticipated that any extensive removal and replacement would be necessary, it is possible that some effort may be required to develop a stable platform on which to place the necessary fill material and address any other existing site conditions that become known during construction. It is generally anticipated that the extent of these efforts would strongly depend upon the ground moisture conditions at the time the site work begins. In the event that the ground is generally dry, it is possible that only a minimal amount of stabilization would be required, which may be possible to accomplish by simple moisture conditioning and recompaction efforts. *Nevertheless, it is recommended that a representative of Alpha-Omega Geotech, Inc. should be onsite to witness this proof-rolling and offer recommendations, as needed, to correct any problem areas identified.*

6.2 Undocumented Fill

Undocumented fill is a foreign material, of which no records of testing or evaluation by a qualified professional during the time of placement exist. The risks associated with supporting foundations and floor slabs on undocumented fill include total and differential settlements in excess of tolerable limits. Undocumented fill was not encountered during this exploration. If undocumented fill is encountered during construction, it should be addressed in accordance with this report.

Undocumented fill is, generally, unsuitable beneath structures and pavements, and, if encountered during development, should be completely removed and replaced with engineered fill.

Partial fill remediation in pavement areas can be considered with an increased risk, which is accepted by the owner, for pavement distress. If partial fill remediation is desirable, AOG can provide additional recommendations based on observations at the time of construction.

6.3 Engineered Fill Placement

It is assumed that any fill material needed will come from cut areas and, if necessary, on-site or nearby borrow sources of similar material. It is recommended that unweathered shales should NOT be used to construct any of the necessary fill within either the new building or paved portions of the site. Assuming they are properly moisture conditioned and compacted, it generally appears that the clean clay soils encountered in the borings that are free of rubble, trash, concrete, asphalt, and other debris would be acceptable for use as controlled fill. However, due to their very high swelling potential, detailed recommendations for the placement of a non-expansive subbase are provided in Section 8.0, SLABS ON GRADE of this report.

Any imported fill materials for use as structural fill should be tested by Alpha-Omega Geotech, Inc. to determine if they are acceptable for the intended use. Any ground water seeps that are encountered must be diverted prior to placing fill.

In addition, no compaction of soil fill material should be performed during freezing weather. Nevertheless, as weather conditions dictate, it may be possible to substitute crusher-run limestone in lieu of soil fill to allow placement of engineered controlled fill material to continue during the cold fall and winter months. However, any frozen fill material must be stripped prior to placing subsequent lifts.

All general fill within the area of the new building (except for the upper 28-inches, as discussed in Section 8.0, SLABS ON GRADE of this report, should be placed in lifts not exceeding 6 inches in thickness, and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content.

As required by the local building code, the compaction of any structural fill beneath the new buildings, pavements, and any other areas where settlement control is necessary, as well as, any slopes that are steeper than 4:1 (H:V) should be tested lift-by-lift by a representative of Alpha-Omega Geotech, Inc.

6.4 Drainage Considerations

Fluctuations of the ground water level can occur due to seasonal variations in the amount of rainfall and other climatic factors that were not evident at the time the borings were made. The possibility of ground water level fluctuations should be considered when developing the design and construction plans for the project. In spring and late fall, soil moisture contents may be abnormally high and drying of the soils that are exposed and/or undercutting may be required to develop a suitable base for the placement and compaction of engineered fill. Disking and aeration of the exposed soils may be sufficient to develop a stable base. However, if site grading begins during the summer or early fall, moisture contents may be abnormally low and the plastic clay soils encountered during this exploration may undergo significant volume changes with subsequent increases in their moisture content. Therefore, when these conditions exist, disking and moisture conditioning of the exposed subgrade soils may be required.

It is important to consider drainage and construction elements that will help to inhibit future slab on grade problems, foundation cracks, as well as, intolerable settlements due to volume changes of the onsite soils. The surface drainage must be designed to prevent ponding and effectively move water away from both the new and existing buildings, pavements and other structures. It is also very important to place all materials under carefully controlled conditions of moisture and density to inhibit significant soil volume changes. Shrubs and trees with deep root systems and requiring large quantities of water should not be planted within 20 feet of the building lines. Any planters located near the building should have impermeable bases with weep holes to discharge water away from the wall lines. Down spouts should be connected to subsurface drains to carry the water to safe exits beyond the building lines, retaining walls, pavements, slopes and other site features or structures that could be adversely affected by water seepage.

In addition to controlling surface drainage, it is recommended that a gravity drainage system, such as a French drain or similar, designed to intercept free water prior to contact with foundations be installed in areas where the topography will direct water toward the proposed structure. foundation drainage systems should, also, be considered to prevent any free water accumulation and/or ingress at the foundations where shallow groundwater was encountered. Any basement or below grade slabs should have a permanent dewatering system, such as a sump pump or similar type system, installed to alleviate and water accumulation.

6.5 General

Permanent slopes should not be steeper than 3:1 (H:V) to help ensure their future stability and accommodate normal mowing equipment. The responsibility for excavation safety and stability of temporary construction slopes should lie solely with the contractor and should follow the OSHA regulations given in 29 CFR Part 1926.650 - .652, Subpart P. The stability of open excavations is dependent upon a number of factors including but not limited to the presence of gravel, sand and/or silt seams, ground water seepage, strength characteristics of the soil layers, slickensides and other unique geological features, the slope and height of the cut, surcharge loading and vibrations during construction, weather conditions, as well as, the length of time the excavation is left open. Alpha-Omega Geotech, Inc. does not assume any responsibility for construction site safety or the contractor's or other parties' compliance with all local, state and federal safety or other regulations including imprudent excavating practices that results in any damage to nearby structures, roadways, utilities, as well as, onsite or offsite improvements.

7.0 FOUNDATIONS

7.1 Foundation Recommendations

Based on the finding during this geotechnical exploration and AOG's understanding the proposed project, it is AOG's opinion that a shallow foundation system consisting of either earth-formed trench or spread footings may be used as economical foundation elements for both structures (hotel and storage facility) as well as the three future building pads.

Based on the subsurface conditions that have been identified, Site Class C conditions (IBC 2012) may be assumed for seismic consideration.

Perimeter footings, and any footings in unheated areas, should be placed at least 3 feet below final exterior grade to provide adequate frost protection and place them in a more stable moisture environment. Under heated areas, the interior footings can be founded at shallower depths of at least 18 inches below the finished floor elevation. The footing excavations should be carried to undisturbed, inorganic soil or engineered fill.

7.2 Allowable Bearing Pressure

Provided all design and inspection recommendations as given in this report are closely followed and good construction practices are exercised, it is recommended an allowable bearing value of 2,500 psf may be used for design purposes to proportion the spread/wall footings. A twenty-percent increase, i.e. 3,000 psf, may be used for individual column footings. These allowable bearing capacity values, which are based on shear strength alone and not on settlement, incorporate a factor of safety of 3.0. *The actual bearing capacity of all subgrade supporting the foundation elements must be confirmed by a representative of Alpha-Omega Geotech, Inc. as the excavations for the load-bearing wall and column footings are completed and prior to* *placement of reinforcing steel and concrete.* For transient loading conditions, such as unsustained wind and earthquake, a 33 percent increase may be applied to the above-referenced allowable bearing capacity values.

7.3 Anticipated Settlement

Uniform bearing conditions should be provided beneath the footings to minimize differential settlements. If any soft or otherwise unsuitable material is encountered in the footing excavations, it will have to be removed and replaced with engineered controlled fill. Recommendations for the over-excavation and replacement with engineered controlled fill can be made when the footing excavations are inspected during construction, if needed. *A representative of Alpha-Omega Geotech, Inc. should inspect all of the footing excavations to verify that uniform and competent bearing material is present beneath all of the foundation elements prior to the placement of any reinforcing steel and concrete.*

For spread footings designed and constructed in accordance with this report, it is anticipated that settlements will be limited to 0.5 inches of differential and .75 inches in total.

7.4 General

If possible, the over-dug footing excavations should not be left open for more than 24 hours to help reduce excessive sloughing, softening or drying of the exposed subgrade material. The base of the footing excavations should be free of water and loose soil prior to placing reinforcing steel and concrete. No groundwater is expected in the footing excavations since groundwater was not encountered in any of the borings that were made at the time of drilling. However, if groundwater is encountered within the expected depth of excavation for the footings, it is anticipated that it can be removed by the use of sumps and pumps. Based on the subsurface conditions that have been identified, it is anticipated that earth-formed trench footing excavations may be used effectively on this project. A minimum width of 12 inches should be used for trenched wall footings to allow for steel placement and inspection. Minimum widths of 16 and 24 inches should be used for formed wall and column footings, respectively.

8.0 SLABS ON GRADE

8.1 Slab Thicknesses

Slabs on grade that will be subjected to repeated wheel loads, such as passenger vehicles, should be at least 6 inches in thickness. Slabs that are **not** exposed to repeated wheel loads, should be at least 4 inches in thickness. Slabs in storage areas may need to be thicker due to shelving post and other concentrated floor loads.

8.2 Low Volume Change (LVC)

The following recommendations provided to help protect the slabs from damage caused by volume changes within the underlying subgrade, and should be implemented in conjunction with Section 7.0, FOUNDATIONS of this report:

1) Cut the subgrade a minimum of 28-inches beneath the base of slab elevation to allow placement of a 24-inch subbase and a 4-inch base course beneath the slab-on-grade.
2) Scarify and recompact the upper 9 inches of exposed subgrade to within 95 to 100 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content wet of the optimum moisture content 0 to 3 percent.
3) For the 24-inch granular subbase, place crusher-run limestone or rock dust in three (3), 8-inch lifts and compact to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density. The moisture content of this material at the time of placement must be sufficient to achieve the specified level of compaction.
4) Place a 4-inch base course of clean, open-graded crushed limestone. This granular base course should be compacted with a suitable vibratory steel wheel roller.

Alternatively, it would be possible to consider constructing the 24-inch subbase by stabilizing the onsite fat clay soil material with Type C flyash, blended at 15 percent by weight using a large Bomag Tiller. However, due to the amount of dust that is generated, the use of flyash stabilization may not be a viable alternative for this project site. In addition, it should also be noted that flyash stabilization is, generally, only effective when the ground temperature is a minimum of 50° to 60°F. Nevertheless, if this alternative is utilized, the flyash stabilized subbase should be placed in three (3), 8-inch lifts and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content. Compaction of the flyash-supplemented soil should be completed within one hour after incorporation. Additional compaction after two hours could cause degradation of the soil strength. Please note, when constructing in areas where fat clays are present, the owner should recognize there is an inherent risk of distress associated with volume changes of the soil, even with subgrade removal and/or treatment.

8.3 General

It is recommended that under-slab utility trenches should be backfilled with impermeable clay soil (*), flowable fill or lean concrete to help reduce the potential of these trenches acting as aqueducts transmitting groundwater beneath the new building, pavements, retaining walls and other structures.

(*) If impermeable clay soil is used as backfill, it should be placed in lifts not exceeding 6 inches in thickness and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content, which should be verified lift-by-lift during placement by a representative of Alpha-Omega Geotech, Inc. Although clay soil may be less costly than flowable fill or lean concrete, the OSHA excavation safety regulations given in 29 CFR Part 1926.650 - .652, Subpart P must be followed in the event that clay soil is used to backfill any utility trenches.

Finally, it should be noted that the recommendations given, herein, regarding placement of low-volume change fill to help protect the slabs on grade from volume changes associated with fluctuations within the moisture content of the underlying subgrade materials, would still apply.

Plumbing lines and other water leaks occurring beneath the structure's slab-on-grade floor can induce volume changes within the underlying subgrade materials. Therefore, it is recommended that all water supply and waste water lines should be tested for leaks prior to backfilling the utility trenches. In addition, it is also recommended that every effort should be made to maintain the plumbing in good working order and prevent or minimize water leaks and discharges.

It is assumed the concrete will be reinforced with properly placed steel reinforcement, such as #4 bars, and control joints will be cut during or shortly after finishing (to be designed by the project structural engineer). Properly placed wire mesh may be used as secondary reinforcement. Fiber reinforcement may also be considered to help control shrinkage cracking and the use of other admixtures may be considered to enhance the workability and performance of the concrete. Suitable construction and sawed joints should be used to control cracking of the slab. In addition, it is recommended that the slump and temperature of the concrete at the time of placement should be limited to standard American Concrete Institute (ACI) guidelines. Furthermore, it is also recommended that proper concrete curing techniques should be utilized and the addition of jobsite water to the concrete be avoided or very closely controlled to within acceptable parameters. Nevertheless, it should be noted that cracking of concrete used for slabs on grade is a normal occurrence and should be expected.

If an 24-inch thick subbase layer of crusher-run limestone (AB-3) or rock dust is used, as recommended, a modulus of subgrade reaction of 150 pci may be assumed for reinforcement and thickness design to support surface loads. If a higher modulus of subgrade reaction were desired, we would be pleased to work with the project's structural engineer to develop recommendations for alternate bases and/or subbases to achieve a higher modulus of subgrade reaction.

9.0 EARTH PRESSURE COEFICIENTS

A coefficient of sliding friction over the in-situ clay soils at this site may be taken as 0.32. A minimum factor of safety of 1.5 should be used when considering sliding resistance.

Active, passive and at-rest earth pressure coefficients of 0.25, 4.2 and 0.4 may be assumed for backfills of clean, open-graded crushed limestone.

Active, passive and at-rest earth pressure coefficients of 0.5, 1.9 and 1.0 may be assumed for the in-situ clay soils at this site.

However, the in-situ soils encountered during this exploration are classified as a Fat Clay and possess a high swelling potential, and, as such, should not be used as backfill since considerable lateral loads may develop with the addition of water.

If deflection of extended foundation walls or retaining walls is not tolerable, as rest earth pressures should be assumed.

These earth pressure coefficients do not include the effect of surcharge loads, hydrostatic loading or a sloping backfill nor do they incorporate a factor of safety. Also, these earth pressure coefficients do not account for high lateral pressures that may result from volume changes when expansive clay soils are used as backfill behind walls with unbalanced fill depths. In addition, any disturbed soils that are relied upon to provide some level of passive resistance should be placed in lifts not exceeding 6 inches in thickness and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content. It is recommended that a representative of Alpha-Omega Geotech, Inc. should verify the compaction of any such materials relied upon to provide passive pressure lift-by-lift during placement.

10.0 PAVEMENTS

10.1 Subgrade Preparation

Please note, a formal pavement design is beyond AOG's scope of service. Standard asphaltic concrete and concrete pavement designs for a given service life requires evaluation of the soil by means of a California Bearing Ratio (CBR) test or other methods, estimates of traffic volumes and axle weights, drainage requirements, and the desired level of maintenance. As such, some standard pavement design options based on assumptions made for materials of this nature are included in this section.

Without stabilization or treatment, the subgrade soils at this site are considered to be poor subgrade materials for the support of pavements. California Bearing Ratio (CBR) values we have obtained rarely exceed 5, soaked, for these materials. Pavements, either total strength flexible or rigid, do not usually perform well when they are placed directly on highly expansive, poor soil subgrades. Soft areas can develop during wet periods and differential shrinkage can occur during dry periods. As a result, no pavement can avoid damage from wheel loads under these circumstances.

Unless the subgrade is stabilized with Class C flyash, the subgrade for all pavements should consist of at least 9 inches of properly compacted soil, which will require tilling and recompacting in cut sections. It is recommended that any untreated aggregate base or flyash stabilized subgrade layers should extend at least 2 feet beyond the pavement and curb lines. The subgrade should be compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content. Any additional fill that is required to develop the paved areas should also be placed in loose lifts not exceeding 8 inches in thickness and compacted in accordance with these recommendations. The subgrade should be proof-rolled with a loaded tandem-axle dump truck after the final subgrade elevation has been established throughout the paved area. A representative of Alpha-Omega Geotech, Inc. should witness this proof-rolling.

Please note, if asphaltic pavements are used, annual maintenance including, but not limited to, crack sealing, fog sealing, and possible patch with overlay should be anticipated. In addition, the quality of the aggregates and overall composition of the asphalt or concrete mix, as well as, drainage conditions can have a profound effect upon the durability of the pavement section.

10.2 Pavement Sections

Table 2: Recompacted Subgrade Section

RECOMPACTED SUBGRADE SECTIONS (INCHES)			
PAVEMENT MATERIALS	CAR PARKING	DRIVE LANES	HEAVY DUTY AREAS (i.e. Dumpster pads, approach lanes, etc.)
Asphaltic Surface Course	2	2	NA
Asphaltic Base Course	3	5.5	NA
Portland Cement Concrete	5	7	8
Crushed Stone (3/4-inch minus)	4	4	4

*Reference Section 10.3, "Recompacted Subgrade Sections"

Table 3: Recommended Thicknesses with Flyash Subgrade Stabilization

FLYASH SUBGRADE STABILIZATION SECTIONS (INCHES)			
PAVEMENT MATERIALS	CAR PARKING	DRIVE LANES	HEAVY DUTY AREAS (i.e. Dumpster pads, approach lanes, etc.)
Asphaltic Surface Course	2	2	NA
Asphaltic Base Course	2	4	NA
Flyash Stabilization	12	12	NA
Portland Cement Concrete	4	6	7
Crushed Stone (3/4-inch minus)	4	4	4
Flyash Stabilization	12	12	12

*Reference Section 10.4, "Subgrade Stabilization Sections"

Table 4: Recommended Thicknesses with Geogrid Reinforcement & Baserock

GEOGRID REINFORCEMENT AND BASEROCK SUBGRADE STABILIZATION SECTIONS (INCHES)			
PAVEMENT MATERIALS	CAR PARKING	DRIVE LANES	HEAVY DUTY AREAS (i.e. Dumpster pads, approach lanes, etc.)
Asphaltic Surface Course	2	2	NA
Asphaltic Base Course	2	4	NA
Crushed Stone (3/4-inch minus)	6	6	NA
Portland Cement Concrete	4	6	7
Crushed Stone (3/4-inch minus)	6	6	6

*Reference Section 10.4, "Subgrade Stabilization Sections"

10.3 Recompacted Subgrade Sections

10.3.1 Flexible Pavements Sections

From an initial cost perspective, flexible asphaltic concrete pavement is the most economical pavement section. However, treating the subgrade with Class C flyash or using a geogrid reinforced base course can provide a higher quality pavement section, having a much longer service life. Nevertheless, if the subgrade is untreated and asphaltic pavement is used, areas used exclusively for automobile parking should consist of at least 5.0 inches of asphaltic concrete (2.0 inches of surface mix and 3.0 inches of base mix). *Drives should be constructed of at least 7.5 inches of asphaltic concrete (2.0 inches of surface and 5.5 inches of base mix).* The above-referenced pavement section represents minimum design thicknesses and, as such, periodic maintenance should be anticipated. If an increased pavement performance is desired, as described in Section 10.4, "Subgrade Stabilization," flyash stabilization or the use of a layer of base rock and geogrid reinforcement may be considered. Asphaltic cement concrete should NOT be used in areas where heavy truck loads/concentrations are expected.

It is also recommended that an asphalt binder grade of PG 64-28 should be considered to help reduce the potential of thermal cracking based on the climatic conditions of this region. However, for base mix asphalt placed at least 4 inches below the surface, an asphalt binder grade of PG 64-22 should be sufficient.

10.3.2 Rigid Pavement Sections

As an alternative, rigid Portland Cement concrete with a 4-inch thick base course of crushed limestone may also be used with minimum thicknesses of 5.0 and 7.0 inches for automobile parking areas and drive lanes, respectively. The above-referenced pavement section represents minimum design thicknesses and, as such, periodic maintenance should be anticipated. If a better pavement is desired, as described in Section 10.4, "Subgrade Stabilization," flyash stabilization or the use of a layer of base rock and geogrid reinforcement may be considered.

The crusher-run limestone base course should be compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content sufficient to achieve the specified level of compaction.

For areas where heavy truck loads/concentrations are anticipated, Portland Cement concrete is recommended. Portland cement concrete slabs having a thickness of 8 inches over a 4-inch, minimum, compacted, crusher-run limestone base should be used for dumpster stations, parking lot entrances, areas where a high concentration of heavily loaded trucks are anticipated, as well as, any areas where trucks accelerate/decelerate and execute sharp turning maneuvers.

10.4 Subgrade Stabilization Sections

Alternate pavement sections utilizing flyash, geogrids, granular base and/or subbase courses should be considered. Treating the subgrade with Class C flyash or using a geogrid reinforced base course can provide a pavement section having a much longer service life.

If specific pavement performance standards are to be met, AOG would be pleased to be of further assistance once the actual design loading conditions, service-life and maintenance expectations have been defined.

10.4.1 Flyash

The use of flyash is usually not effective during cold winter months. Notwithstanding this weather limitation, assuming the flyash is thoroughly and uniformly mixed with the subgrade, flyash stabilization can greatly reduce the swelling potential and improve the strength of the subgrade soil.

If the subgrade is stabilized with Class C flyash to a depth of 12 inches, full depth asphalt pavements with thicknesses of 4.0 and 6.0 inches for parking and drive lanes, respectively, can be used. Likewise, if the subgrade is stabilized with flyash, the Portland cement concrete pavement sections over a 4-inch thick base course of crushed limestone may also be reduced to 4.0 and 6.0 inches, respectively. The crushed limestone base course should be compacted to the specifications given in Section 10.3, "Rigid Pavement Sections," of this report.

Based on experience with similar projects, adding more flyash does not always increase the stiffness of the subgrade. In fact, too much flyash in the subgrade may cause excessive brittleness, which may result in reflective cracking problems to develop. It is usually cost effective to determine the optimum amount of flyash necessary by laboratory testing; however, it usually ranges from about 12 to 15 percent by weight. The Class C flyash should be thoroughly mixed with the subgrade soil by means of a Bomag tiller or other similar equipment specifically designed for such procedures and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content.

10.4.2 Geogrid Reinforcement & Base Rock

Soft areas can develop even when the subgrade is stabilized with Class C flyash. An even better pavement section can be developed by the use of a tri-axial geogrid over a properly compacted subgrade, as discussed in this report, and a layer of untreated crushed limestone base rock under either flexible or rigid pavements. The purpose of the geogrid is to help span soft spots that will inevitably develop in the subgrade. The geogrid helps to confine the base rock and acts as a "snowshoe," distributing the loads over the subgrade in a tri-axial direction. The layer of base rock, which is placed over the geogrid, must be thick enough to support construction traffic and paving equipment so the geogrid does not become exposed. In general, the crushed limestone base rock should not be less than approximately 6 inches in thickness. If this option is chosen, it is recommended that Tensar TX-140, which is a tri-axial polypropylene geogrid, be used. The geogrid reinforcement should be placed and overlapped as needed in accordance with the manufacturer's recommendations, which should be verified by a representative of Alpha-Omega Geotech, Inc.

Asphaltic concrete thicknesses of 4.0 and 6.0 inches for parking areas and drive lanes, respectively, can be used if geogrid and base rock stabilization are used. Similarly, the Portland cement concrete sections can be reduced to 4.0 and 6.0 inches for the respective areas. Although these thicknesses are the same as given if the subgrade is treated with Class C flyash, the use of a tri-axial geogrid and base rock usually represents the most effective, reasonable pavement section.

10.5 General

If asphaltic pavements are used, periodic maintenance including, but not limited to, crack sealing, fog sealing, and possible patch with overlay should be anticipated. In addition, the quality of the aggregates and overall composition of the asphalt or concrete mix, as well as, drainage conditions can have a profound effect upon the durability of the pavement section.

Where engineered controlled fill is placed beneath paved areas, it is recommended the compacted fill should extend a minimum distance of two (2) feet beyond the pavement edge or curb line, or a distance equal to the depth of the fill, whichever is greater.

Asphalt mixes meeting KDOT BM-2 and BM-2B specifications may be used for surface and base mixes, respectively. Compaction testing of each pavement layer is recommended to help ensure compliance with the mix design specifications.

For areas where heavy truck loads/concentrations are anticipated, Portland Cement concrete is should be used. It is recommended that load-transfer devices should be installed where construction joints are required. For dumpster stations, the concrete slabs should be large enough to accommodate the dumpster and at least the rear wheels of the disposal vehicle. Rigid pavements should have No. 4 bars on at least 2-foot centers and positioned in the upper third of the slab. Joints should be tooled or cut within 4 hours of hardening to a depth of at least one fourth of the thickness.

The subgrade should be moistened prior to placement of concrete. Fresh concrete should be properly cured as recommended by the American Concrete Institute (ACI). To help provide resistance to damage caused by alternating cycles of freezing and thawing, it is recommended that any exposed concrete should be properly air entrained; typically at 5 to 7 percent. In addition, it is also recommended the outer edges of pavement slabs should be thickened to help resist cracking associated with heavy wheel loads near these unrestrained areas.

If full-depth pavement is used, it is important the moisture content of the subgrade should be kept as constant as possible from the time of recompacting until the pavement is laid. However, if the subgrade becomes dry, it should be moistened for at least 72 hours prior to paving, but it should not be saturated. In all cases, pavements should be sloped to inhibit ponding and provide rapid surface drainage. If water is allowed to pond on or adjacent to the pavement, the subgrade could become saturated and lose its bearing capacity which would contribute to premature pavement deterioration under a single cycle of heavy wheel loads or a number of cycles of lighter wheel loads.

11.0 TESTING AND INSPECTION RECOMMENDATIONS

Unless Alpha-Omega Geotech, Inc. is retained to provide the construction observation, monitoring and testing services for this project, we cannot accept any responsibility for any conditions that deviate from those identified in this subsurface investigation nor for the performance of the foundations, pavements and other structures including any retaining walls that are a part of this project. Alpha-Omega Geotech, Inc. is accredited by AASHTO and we are experienced in construction quality control and have a fully-equipped soil, concrete, aggregate, rock and asphalt testing laboratory, as well as, qualified field technicians to provide these field services.

It is not economically practical to perform enough exploratory borings on any site to identify all subsurface conditions. Some conditions affecting the design and/or construction may not become known until the project is underway. The boring logs, field SPT and laboratory test results depict subsurface conditions only at the specified locations and depths at the site. The boundaries between soil and rock layers indicated on the boring logs are based on observations made during drilling and an interpretation of the laboratory testing results. The exact depths of these boundaries are approximate and the transitions between soil and rock types may be gradual rather than being clearly defined. Also, due to the prior development at this site, as well as, the natural conditions of the formation of soils and rock, it is possible that unanticipated subsurface conditions may be encountered during construction. Monitoring of the subsurface conditions that are revealed during construction is needed to verify that subsurface conditions are consistent with those conditions identified in this preliminary geotechnical investigation. If variations in subsurface conditions are encountered, it will be necessary for Alpha-Omega Geotech, Inc. to re-evaluate the recommendations that have been made in this report.

Special Inspections should be performed in accordance with the local building code under which the project is designed, as adopted by Lee's Summit, Missouri.

Prior to filling, it is recommended that a representative of Alpha-Omega Geotech, Inc. should verify that the site has been properly stripped of all topsoil and other deleterious material, benched as needed and prepared for the placement of fill. The compaction of any structural fill beneath the new building, pavements, and any other areas where settlement control is necessary should be tested lift-by-lift by a representative of Alpha-Omega Geotech, Inc. as it is being placed. This should include the prepared subgrade layers beneath the building's slab-on-grade, as well as, any other fill material relied upon to provide passive resistance. Also, in accordance with the local building code, any fill that is used to construct slopes steeper than 4:1 (H:V) must be placed as engineered controlled fill and the compaction tested lift-by-lift during placement.

Assuming that uniform fill material is used, nuclear density gauges (ASTM D2922/D3017) should be used to test compaction wherever necessary. However, if fill material of non-uniform consistency is used, other evaluation methods may be required. Such methods may include, but not be limited to, the use of a GeoGauge Stiffness meter, Dynamic Cone Penetrometer (DCP), proof-rolling or other visual inspection techniques.

Any geotextile fabric and geogrid reinforcement that is utilized should be placed and overlapped as needed in accordance with the manufacturer's recommendations, which should be verified by a representative of Alpha-Omega Geotech, Inc. Proper placement of the reinforcing steel for drilled piers, grade beams, pier caps, foundation walls and other structural elements including any necessary wing walls and retaining walls should be verified prior to the placement of concrete. The subgrade under the slabs on grade and pavements should be checked to verify they are in compliance with the density and moisture requirements. Wherever possible, in addition to compaction testing, cut and fill areas should be proof-rolled with a loaded tandem-axle dump truck to identify soft areas that will need to be corrected. A representative of Alpha-Omega Geotech, Inc. should observe this proof-rolling. Checks should also be made of the subbases, concrete and any pavement materials.

Finally, the inspection and testing services listed herein are given as a minimum and it should be understood that additional inspection and testing services might also be required or otherwise beneficial.

12.0 LIMITATIONS

This report is presented in broad terms to provide a comprehensive assessment of the interpreted subsurface conditions and their potential effect on the adequate design and economical construction of the proposed Lee's Summit Surgical project located in Lee's Summit, MO, as discussed herein. This report has been prepared for the exclusive use of our client for specific application to the project discussed herein and has been prepared within our client's directive and budgetary constraints and in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

It should be noted that the concept of risk is an important aspect of the geotechnical engineering evaluation and report since the recommendations given in this report are not based on exact science but rather analytical tools and empirical methods in conjunction with engineering judgment and experience. Therefore, the recommendations given herein should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soil materials and the proposed structures will perform as planned. Nevertheless, the geotechnical engineering recommendations presented herein are Alpha-Omega Geotech, Inc.'s professional opinion of those measures that are necessary for the proposed structures to perform according to the proposed design based on the information provided to Alpha-Omega Geotech, Inc., the referenced information gathered during the course of this investigation and our experience with these conditions.

Any significant structural changes to the proposed new structure or its location on this site relative to where these test borings were completed shall be assumed to invalidate the conclusions and recommendations given in this report until we have had the opportunity to review these changes and, if necessary, modify our conclusions and recommendations accordingly. It is also strongly suggested that Alpha-Omega Geotech, Inc. should review your plans and specifications dealing with the earthwork, foundations, as well as, any pavements prior to construction to confirm compliance with the recommendations given herein. Particular details of foundation design, construction specifications or quality control may develop, and we would be pleased to respond to any questions regarding these details.

If Alpha-Omega Geotech, Inc. is not retained to review the project plans and specifications, address to the proposed building and parking structure or their location on the site relative to where these test borings were completed, provide the recommended construction phase observation, monitoring and testing services and respond to any subsurface conditions that are identified during construction to evaluate whether or not changes in the recommendations given in this report are needed, we cannot be held responsible for the impact of those conditions on the project or the future performance of the buildings, pavements and/or structures that may be involved.

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, ground water or air, either on, below or adjacent to this site. In addition, no determination regarding the presence or absence of wetlands was made. Furthermore, it should be understood that the scope of geotechnical services for this project does not include either specifically or by implication any biological (i.e. mold, fungi or bacteria) assessment of the site or the proposed construction. Any statements in this report or included on the boring logs regarding odors, colors and unusual or suspicious items or conditions are strictly for informational purposes only.

We appreciate the opportunity to be of service to TD Capital Investments, as well as, the project developers and look forward to working with you throughout the construction process. We are prepared to provide the Special Inspection services that will be required by the local building code under which this project is designed, as adopted by the City of Lee's Summit, MO, as well as, the other necessary construction observation, monitoring and testing services discussed in this report. If you have any questions concerning this report, or if we may be of further assistance, please call us at (913) 371-0000.

Sincerely,
ALPHA-OMEGA GEOTECH, INC.

Garic Abendroth, P.E.
Engineering Department Manager

Enclosures

Appendix Section A

SITE SKETCH

Site and Boring Location Plans

Site Location Plan	Date: Oct 26, 2017	Project Name: Lee's Summit Surgical Site	Project Number: 17-407E
ALPHA-OMEGA GEOTECH 1701 State Ave. Kansas City, KS 66102 913-371-0000	Notes: Images adopted from Google Earth		

Appendix Section B

LABORATORY TEST RESULTS

Summary of Laboratory Testing

SLT 22205

Alpha-Omega Geotech, Inc.
1701 State Avenue
Kansas City, KS 66102
Office: (913) 371-0000 Fax: (913) 371-6710
Website: www.aogeotech.com

PROJECT NAME:	Lee's Summit Surgical	PROJECT NUMBER:	17-407E
PROJECT LOCATION:	Lee's Summit, MO	DATE:	10/11/2017

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B-1	ST-1	2'-4'	Brown LEAN CLAY with trace of organics (finger roots)						CL					PP = 1.5 tsf
B-1	ST-2	4'-6'	Brown, mottled reddish brown, spotted dark brown FAT CLAY	24.3	103.1	58	22	36	CH		8236	8.6		PP = 3.5 tsf
B-1	SS-1	8.5'-10'	Light brown, mottled gray FAT CLAY						CH					N = 15
B-1	SS-2	13.5'-15'	Light brown, mottled gray FAT CLAY with trace of gravel						CH					N = 38/10"
B-2	ST-1	2'-4'	Brown, spotted dark brown FAT CLAY						CH					PP = 4.5 tsf
B-2	ST-2	4'-6'	Light brown, mottled reddish brown, spotted brown FAT CLAY	20.5	103.8				CH		2812	7.0		PP = 2.75 tsf
B-2	SS-1	8.5'-10'	Brown FAT CLAY						CH					N = 9
B-2	SS-2	13.5'-15'	Brown FAT CLAY						CH					N = 9
B-3	ST-1	2'-4'	Brown, mottled dark brown FAT CLAY						CH					PP = 3.0 tsf
B-3	ST-2	4'-6'	Brown, spotted dark brown and light reddish brown LEAN/FAT CLAY	26.9	98.8				CL/CH		4536	9.4		PP = 2.5 tsf

SLT 22205

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ALPHA-OMEGA GEOTECH

PROJECT NAME: Lee's Summit Surgical
PROJECT LOCATION: Lee's Summit, MO
PROJECT NUMBER: 17-407E
DATE: 10/11/2017

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B-3	SS-1	8.5'-10'	Brown, mottled dark brown LEAN/FAT CLAY						CL/CH					N = 14
B-3	SS-2	13.5'-15'	Brown, mottled gray FAT CLAY						CH					N = 10
B-3	SS-3	18.5'-20'	Brown, mottled gray LEAN CLAY (shale)						CL/CH					N = 45
B-4	ST-1	2'-4'	Light brown, mottled dark brown FAT CLAY						CH					PP = 2.25 tsf
B-4	ST-2	4'-6'	Brown, mottled reddish brown and gray FAT CLAY	25.6	97.0	64	23	41	CH		3811	5.9		PP = 2.75 tsf
B-4	SS-1	8.5'-10'	Brown, mottled light brown and gray FAT CLAY						CH					N = 7
B-4	SS-2	13.5'-15'	Brown FAT CLAY						CH					N = 10
B-4	SS-3	18.5'-20'	Light brown, mottled gray FAT CLAY						CH					N = 14
B-5	SS-1	.5'-2'	Brown FAT CLAY with trace of organics						CH					N = 13
B-5	SS-2	2'-3.5'	Brown, mottled dark brown FAT CLAY						CH					N = 13

Alpha-Omega Geotech, Inc.
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PROJECT NAME: Lee's Summit Surgical
PROJECT LOCATION: Lee's Summit, MO
PROJECT NUMBER: 17-407E
DATE: 10/11/2017

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B-5	SS-3	3.5'-5'	Brown FAT CLAY with trace of organics (finger roots)						CH					N = 10
B-5	SS-4	8.5'-10'	Brown FAT CLAY						CH					N = 14
B-6	SS-1	.5'-2'	Brown, mottled reddish brown FAT CLAY						CH					N = 14
B-6	SS-2	2'-3.5'	Brown FAT CLAY						CH					N = 16
B-6	SS-3	3.5'-5'	Brown FAT CLAY						CH					N = 11
B-6	SS-4	8.5'-10'	Light bronwn, mottled light gray LEAN/FAT CLAY (weathered shale)						CL/CH					N = 62
B-7	SS-1	.5'-2'	Brown, mottled reddish brown FAT CLAY						CH					N = 9
B-7	SS-2	2'-3.5'	Brown, mottled light reddish brown FAT CLAY						CH					N = 15
B-7	SS-3	3.5'-5'	Olive brown, mottled reddish brown, speckled dark brown FAT CLAY						CH					N = 13
B-7	SS-4	8.5'-10'	Brown, mottled gray LEAN CLAY (shale)						CL/CH					N = 52

Summary of Laboratory Testing

SLT 22205

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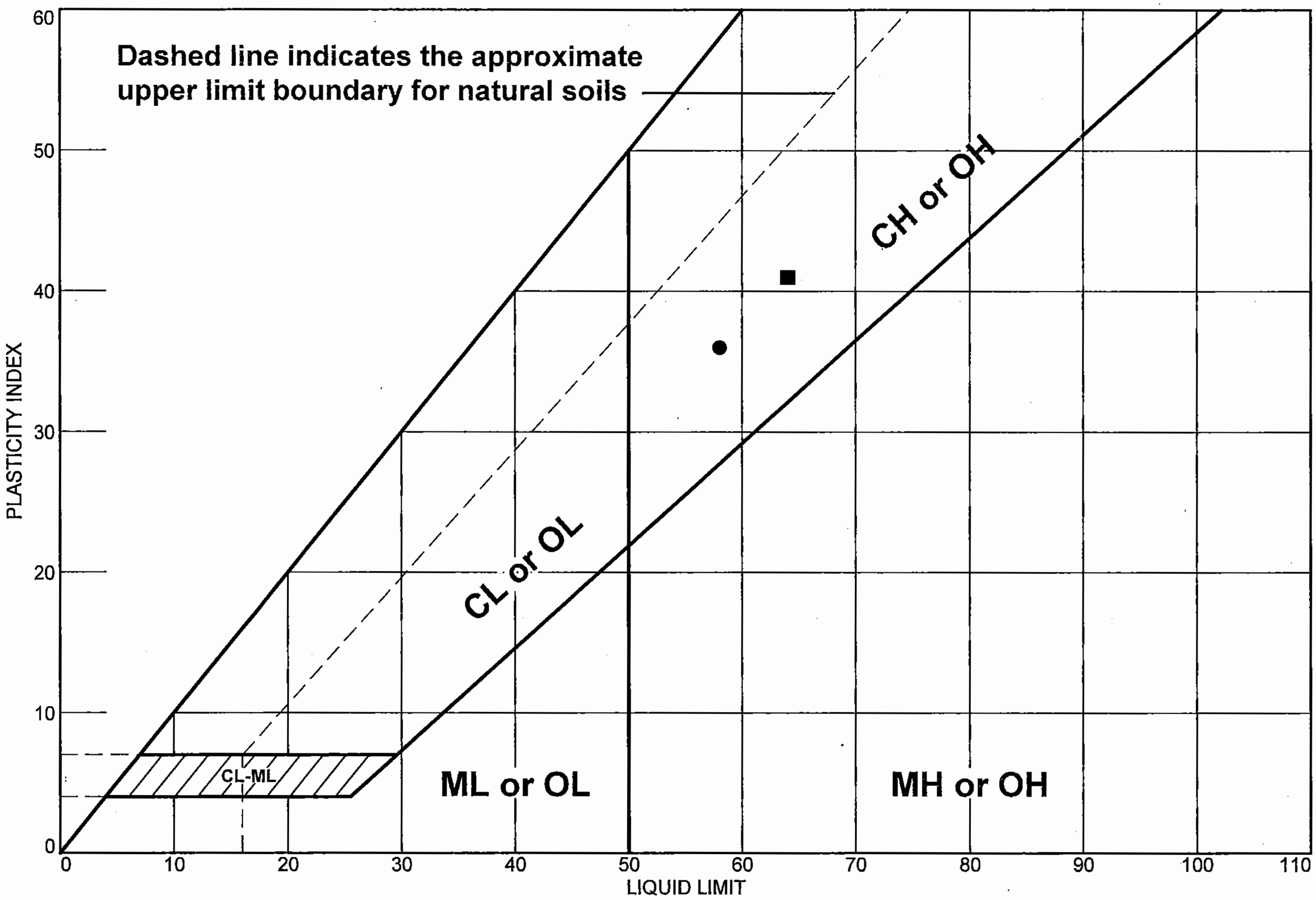
ALPHA-OMEGA GEOTECH

PROJECT NAME: Lee's Summit Surgical
PROJECT LOCATION: Lee's Summit, MO
PROJECT NUMBER: 17-407E
DATE: 10/11/2017

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B-8	SS-1	.5'-2'	Brown FAT CLAY						CH					N = 12
B-8	SS-2	2'-3.5'	Brown FAT CLAY						CH					N = 14
B-8	SS-3	3.5'-5'	Brown, mottled gray FAT CLAY						CH					N = 12
B-8	SS-4	8.5'-10'	Brown FAT CLAY						CH					N = 14
B-9	SS-1	.5'-2'	Brown FAT CLAY						CH					N = 16
B-9	SS-2	2'-3.5'	Brown FAT CLAY						CH					N = 13
B-9	SS-3	3.5'-5'	Light brown FAT CLAY						CH					N = 9
B-9	SS-4	8.5'-10'	Brown, mottled gray FAT CLAY						CH					N = 15

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown, mottled reddish brown, spotted dark brown FAT CLAY	58	22	36			
■	Brown, mottled reddish brown and gray FAT CLAY	64	23	41			

Project No. 17-407E **Client:** TD Capital Investments

Project: Lee's Summit Surgical

● **Source of Sample:** B-1 **Depth:** 4 **Sample Number:** ST-2

■ **Source of Sample:** B-4 **Depth:** 4 **Sample Number:** ST-2

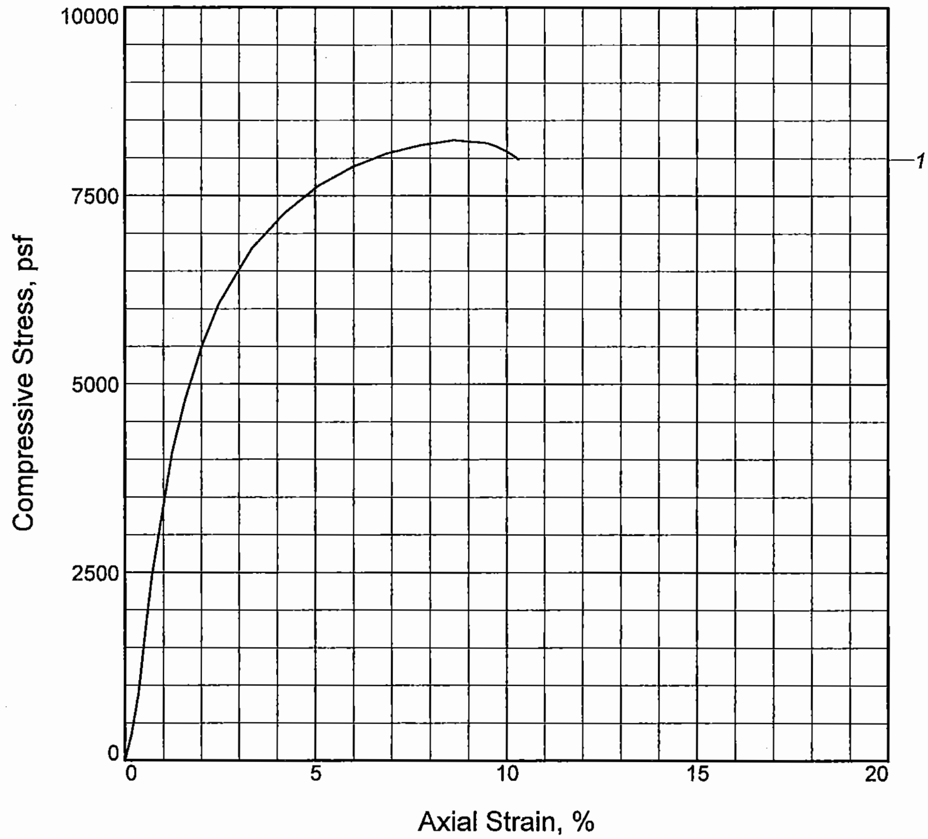
Remarks:

ALPHA-OMEGA GEOTECH

Figure 1 of 1

Tested By: TB **Checked By:** GA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	8236			
Undrained shear strength, psf	4118			
Failure strain, %	8.6			
Strain rate, in./min.	0.075			
Water content, %	24.3			
Wet density, pcf	128.2			
Dry density, pcf	103.1			
Saturation, %	103.4			
Void ratio	0.6348			
Specimen diameter, in.	2.860			
Specimen height, in.	5.700			
Height/diameter ratio	1.99			

Description: Brown, mottled reddish brown, spotted dark brown FAT CLAY

LL = 58	PL = 22	PI = 36	Assumed GS= 2.70	Type: Undisturbed

Project No.: 17-407E
Date Sampled: 10/13/2017
Remarks:

Client: TD Capital Investments

Project: Lee's Summit Surgical

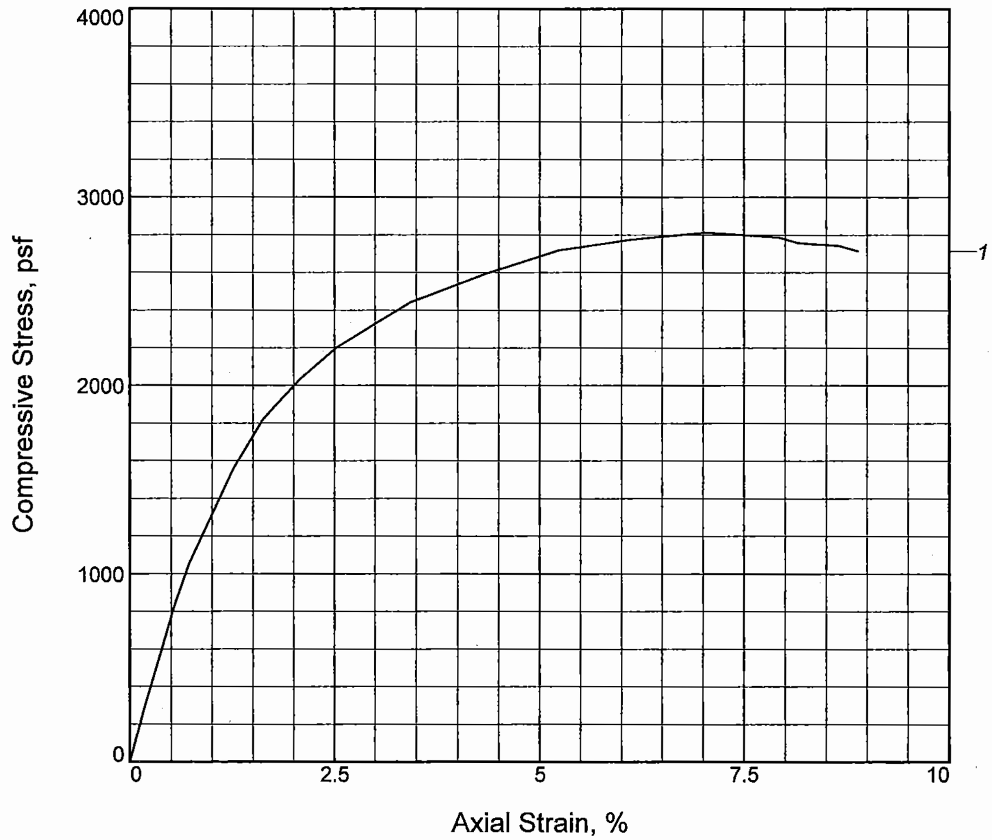
Source of Sample: B-1 **Depth:** 4
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Figure 1 of 1

Tested By: TB **Checked By:** GA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2812			
Undrained shear strength, psf	1406			
Failure strain, %	7.0			
Strain rate, in./min.	0.075			
Water content, %	20.5			
Wet density, pcf	125.1			
Dry density, pcf	103.8			
Saturation, %	88.7			
Void ratio	0.6231			
Specimen diameter, in.	2.850			
Specimen height, in.	5.550			
Height/diameter ratio	1.95			

Description: Light brown, mottled reddish brown, spotted dark brown FAT CLAY

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 17-407E
Date Sampled: 10/13/2017
Remarks:

Figure 1 of 1

Client: TD Capital Investments

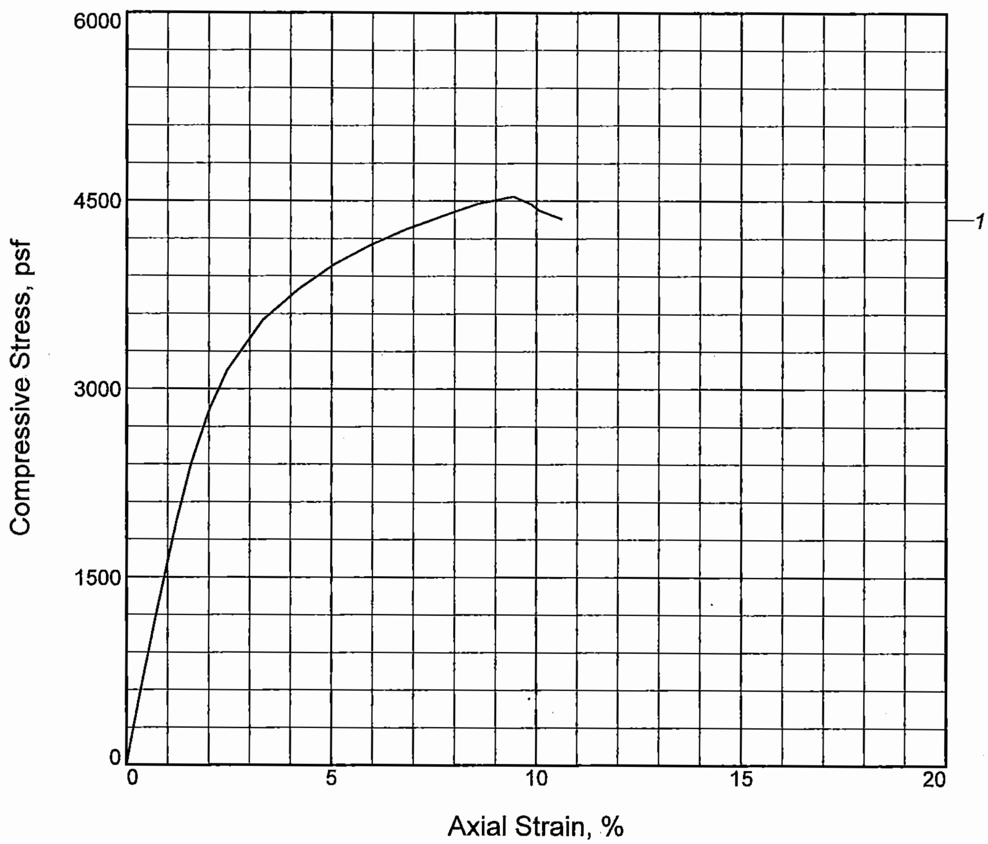
Project: Lee's Summit Surgical

Source of Sample: B-2 **Depth:** 4
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: TB **Checked By:** GA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4536			
Undrained shear strength, psf	2268			
Failure strain, %	9.4			
Strain rate, in./min.	0.075			
Water content, %	26.9			
Wet density, pcf	125.3			
Dry density, pcf	98.8			
Saturation, %	102.7			
Void ratio	0.7060			
Specimen diameter, in.	2.870			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, spotted dark brown and light reddish brown LEAN/FAT CLAY

LL =	PL =	PI =	Assumed GS= 2.70	Type: Undisturbed

Project No.: 17-407E
Date Sampled: 10/13/2017
Remarks:

Client: TD Capital Investments

Project: Lee's Summit Surgical

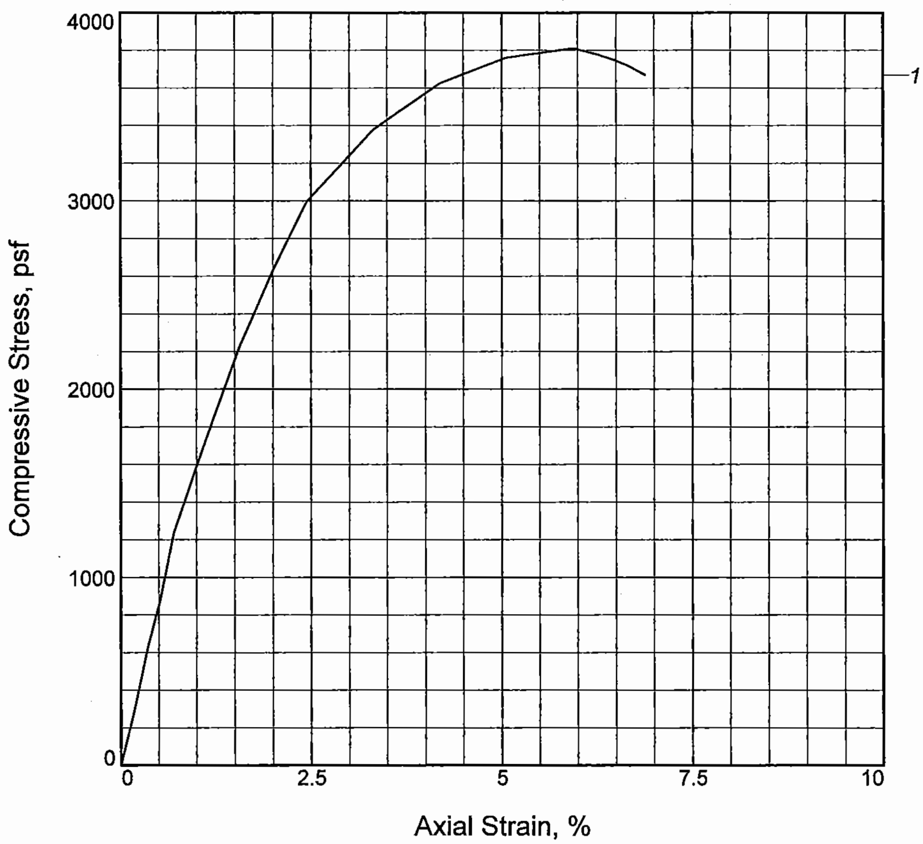
Source of Sample: B-3 **Depth:** 4
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Figure 1 of 1

Tested By: TB **Checked By:** GA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3811			
Undrained shear strength, psf	1905			
Failure strain, %	5.9			
Strain rate, in./min.	0.075			
Water content, %	25.6			
Wet density, pcf	121.9			
Dry density, pcf	97.0			
Saturation, %	93.8			
Void ratio	0.7375			
Specimen diameter, in.	2.870			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, mottled reddish brown and gray FAT CLAY

LL = 64	**PL =** 23	**PI =** 41	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 17-407E

Date Sampled: 10/13/2017

Remarks:

Figure 1 of 1

Client: TD Capital Investments

Project: Lee's Summit Surgical

Source of Sample: B-4 **Depth:** 4

Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: TB **Checked By:** GA

Appendix Section C

BORING LOGS

Note: The logs of subsurface conditions shown in this section apply only at the specific boring location and depths at the date indicated and might not be indicative of all subsurface conditions that may be encountered. This information is not warranted to be representative of subsurface conditions at other locations, depths and times. The passage of time or construction operations at or adjacent to this site may result in changes to the soil conditions at these boring locations and depths. As a result, the character of subsurface materials shall be each bidder's responsibility.

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-1

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E

CLIENT: TD Capital Investments

PROJECT LOCATION: Lee's Summit, MO

LOCATION: NE Building **ELEVATION:** ND

DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs

DRILLING METHOD: AO/ST/SS **DATE:** 10/10/2017

DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** C nONE

Elevation / Depth (ft.)	Soil Symbols, Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0		Dark brown LEAN/FAT CLAY								CL-CH
2		Brown LEAN CLAY with trace of organics (finger roots)							1.5	CL
4		Brown, mottled reddish brown, spotted dark brown FAT CLAY	24.3	103.1	58	36		8236	3.5	CH
6		Brown, mottled reddish brown, spotted dark brown FAT CLAY								CH
8.5	5 6 9	Light brown, mottled gray FAT CLAY								CH
10		Light brown, mottled gray FAT CLAY								CH
13.5	5 8 30/4"	Light brown, mottled gray FAT CLAY with trace of gravel								CH
14.83		Weathered limestone (very hard, slow drilling)								LS
18.5		Auger refusal at about 18.5' End of boring at about 18.5'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-2

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E
CLIENT: TD Capital Investments
PROJECT LOCATION: Lee's Summit, MO
LOCATION: SE Building **ELEVATION:** ND
DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs
DRILLING METHOD: AO/ST/SS **DATE:** 10/10/2017
DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** None

Depth (ft.)	Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0–2		Dark brown LEAN/FAT CLAY								CL-CH
2–4		Brown, spotted dark brown FAT CLAY							4.5	CH
4–6		Light brown, mottled reddish brown, spotted dark brown FAT CLAY	20.5	103.8				2812	2.75	CH
6–8.5		Light brown, mottled reddish brown, spotted dark brown FAT CLAY								CH
8.5–10	4 4 5	Brown FAT CLAY								CH
10–13.5		Brown FAT CLAY								CH
13.5–15	3 4 5	Brown FAT CLAY								CH
15–17		Brown FAT CLAY								CH
17		Auger refusal at about 17' on limestone End of boring at about 17'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-3

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E
CLIENT: TD Capital Investments
PROJECT LOCATION: Lee's Summit, MO
LOCATION: NW Building **ELEVATION:** ND
DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs
DRILLING METHOD: AO/ST/SS **DATE:** 10/10/2017
DEPTH TO - WATER> INITIAL: 17' **AFTER 24 HOURS:** NA **CAVING>** C nONE

Depth (ft.)	Soil Symbols, Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0–2		Brown LEAN/FAT CLAY								CL-CH
2–4		Brown, mottled dark brown FAT CLAY							3.0	CH
4–6		Brown, spotted dark brown and light reddish brown LEAN/FAT CLAY	26.9	98.8				4536	2.5	CL-CH
6–8.5		Brown, spotted dark brown and light reddish brown LEAN/FAT CLAY								CL-CH
8.5–10	5 6 8	Brown, mottled dark brown LEAN/FAT CLAY								CL-CH
10–13.5		Brown, mottled dark brown LEAN/FAT CLAY								CL-CH
13.5–15	4 4 6	Brown, mottled gray FAT CLAY								CH
15–18.5	(water level 17')	Brown, mottled gray FAT CLAY								CH
18.5–20	7 15 30	Brown, mottled gray LEAN CLAY (shale)(very hard, slow drilling)								CL
20		End of boring at about 20'								

Elevation / Depth (ft.): 0, 5, 10, 15, 20, 25, 30, 35

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-4

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E

CLIENT: TD Capital Investments

PROJECT LOCATION: Lee's Summit, MO

LOCATION: SW Building **ELEVATION:** ND

DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs

DRILLING METHOD: AO/ST/SS **DATE:** 10/10/2017

DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** C nONE

Depth (ft.)	Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0–2		Brown silty LEAN/FAT CLAY								CL-CH
2–4		Light brown, mottled dark brown FAT CLAY							2.25	CH
4–6		Brown, mottled reddish brown and gray FAT CLAY	25.6	97.0	64	41		3811	2.75	CH
6–8.5		Brown, mottled reddish brown and gray FAT CLAY								CH
8.5–10	3, 3, 4	Brown, mottled light brown and gray FAT CLAY								CH
10–13.5		Brown, mottled light brown and gray FAT CLAY								CH
13.5–15	4, 4, 6	Brown FAT CLAY								CH
15–18.5		Brown FAT CLAY								CH
18.5–20	5, 6, 8	Light brown, mottled gray FAT CLAY								CH
20		End of boring at about 20'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-5

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E

CLIENT: TD Capital Investments

PROJECT LOCATION: Lee's Summit, MO

LOCATION: NE Paving **ELEVATION:** ND

DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs

DRILLING METHOD: AO/SS **DATE:** 10/10/2017

DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** C nONE

Elevation / Depth (ft.)	Soil Symbols, Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0 – .5	6 7 6	Dark brown LEAN CLAY								CL
.5 – 2	5 6 7	Brown FAT CLAY with trace of organics (finger roots)								CH
2 – 3.5		Brown, mottled dark brown FAT CLAY								CH
3.5 – 5	3 3 7	Brown FAT CLAY with trace of organics (finger roots)								CH
5 – 8.5		Brown FAT CLAY with trace of organics (finger roots)								CH
8.5 – 10	6 6 8	Brown FAT CLAY								CH
10		End of boring at about 10'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-6

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E

CLIENT: TD Capital Investments

PROJECT LOCATION: Lee's Summit, MO

LOCATION: SE Paving **ELEVATION:** ND

DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs

DRILLING METHOD: AO/SS **DATE:** 10/10/2017

DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** C nONE

Elevation / Depth (ft.)	Soil Symbols Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0	4 6 8	Brown LEAN CLAY								CL
.5		Brown, mottled reddish brown FAT CLAY								CH
2	7 7 9	Brown FAT CLAY								CH
3.5	4 5 6	Brown FAT CLAY								CH
5		Brown FAT CLAY								CH
8.5	15 30 32	Light brown, mottled light gray LEAN/ FAT CLAY (weathered shale)(very hard, slow drilling)								CL-CH
10		End of boring at about 10'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-7

PROJECT: Lee's Summit Surgical PROJECT NO.: 17-407E
CLIENT: TD Capital Investments
PROJECT LOCATION: Lee's Summit, MO
LOCATION: Mid Paving ELEVATION: ND
DRILLER: Mike Burdick, Sr. LOGGED BY: Chuck Jacobs
DRILLING METHOD: AO/SS DATE: 10/10/2017
DEPTH TO - WATER> INITIAL: None AFTER 24 HOURS: NA CAVING> C nONE

Depth (ft.)	Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0–.5	4 4 5	Brown LEAN CLAY								CL
.5–2		Brown, mottled reddish brown FAT CLAY								CH
2–3.5	5 6 9	Brown, mottled light reddish brown FAT CLAY								CH
3.5–5	5 6 7	Olive brown, mottled reddish brown, speckled dark brown FAT CLAY								CH
5–8.5		Olive brown, mottled reddish brown, speckled dark brown FAT CLAY								CH
8.5–10	11 22 30	Brown, mottled gray LEAN CLAY (shale)(very hard, slow drilling)								CL
10		End of boring at about 10'								

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-8

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E
CLIENT: TD Capital Investments
PROJECT LOCATION: Lee's Summit, MO
LOCATION: NW Paving **ELEVATION:** ND
DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs
DRILLING METHOD: AO/SS **DATE:** 10/10/2017
DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** nONE

Elevation / Depth (ft.)	Soil Symbols, Sampler Symbols and Field Test Data	Description	Bottom Depth	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0	4 6 6	Brown LEAN CLAY	.5								CL
		Brown FAT CLAY	2								CH
	5 7 7	Brown FAT CLAY	3.5								CH
	4 5 7	Brown, mottled gray FAT CLAY	5								CH
5		Brown, mottled gray FAT CLAY	8.5								CH
	5 6 7	Brown FAT CLAY	10								CH
10		End of boring at about 10'									

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B-9

PROJECT: Lee's Summit Surgical **PROJECT NO.:** 17-407E

CLIENT: TD Capital Investments

PROJECT LOCATION: Lee's Summit, MO

LOCATION: SW Paving **ELEVATION:** ND

DRILLER: Mike Burdick, Sr. **LOGGED BY:** Chuck Jacobs

DRILLING METHOD: AO/SS **DATE:** 10/10/2017

DEPTH TO - WATER> INITIAL: None **AFTER 24 HOURS:** NA **CAVING>** C nONE

Depth (ft.)	Field Test Data	Description	Bottom depth	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0	7 8 8	Brown LEAN CLAY	.5								CL
		Brown FAT CLAY	2								CH
	7 6 7	Brown FAT CLAY	3.5								CH
	3 4 5	Light brown FAT CLAY	5								CH
5		Light brown FAT CLAY	8.5								CH
	5 7 9	Brown, mottled gray FAT CLAY	10								CH
10		End of boring at about 10'									

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	LEAN/FAT CLAY
	LEAN CLAY
	FAT CLAY
	Weathered LIMESTONE
Misc. Symbols	
	Drill rejection
	Water table during drilling
Soil Samplers	
	Undisturbed thin wall Shelby tube
	Standard penetration test

Notes:

1. Borings were drilled on October 10, 2017 using auger only, shelby tube and split spoon techiniques.

2. Ground water was encountered while in the drilling process.

3. Borings were staked by Alpha-Omega Geotech, Inc.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs. Abbreviations are:

DDen =	natural dry density (pcf)	LL =	Liquid limit
w% =	natural moisture content (%)	PI =	Plasticity index
UComp =	Unconfined compression (psf)	PPen =	Pocket Penetrometer
-200 =	percent passing #200 sieve (%)	RQD =	Rock Quality
DCP =	Dynamic Cone Penetrometer		