GEOTECHNICAL EXPLORATION
NKU SOFTBALL FIELD RENOVATIONS
HIGHLAND HEIGHTS, KENTUCKY

Prepared for:

NORTHERN KENTUCKY UNIVERSITY
HIGHLAND HEIGHTS, KENTUCKY

Prepared by:

GEOTECHNOLOGY, INC.
ERLANGER, KENTUCKY

Date:

DECEMBER 9, 2019

Geotechnology Project No.:

J035590.01

SAFETY
QUALITY
INTEGRITY
PARTNERSHIP
OPPORTUNITY
RESPONSIVENESS

GEOTECHNOLOGY INC
FROM THE GROUND UP

December 9, 2019

Ms. Elizabeth Birkenhauer
Northern Kentucky University
729 Lucas Administrative Center
Highland Heights, Kentucky 41099

Re: Geotechnical Exploration
NKU Softball Field Renovations
Highland Heights, Kentucky
Geotechnology Project No. J035590.01

Dear Ms. Birkenhauer:

Presented in this report are the results of our geotechnical exploration completed for the softball field renovations on the campus of Northern Kentucky University (NKU) in Highland Heights, Kentucky. Our services were performed in general accordance with our Proposal P035590.01, which was dated October 21, 2019, which was authorized by NKU Purchase Order No. 4700002521, dated October 30, 2019.

We appreciate the opportunity to provide the geotechnical services for this project. If you have any questions regarding this report, or if we may be of any additional service to you, please do not hesitate to contact us.

Respectfully submitted,
GEOTECHNOLOGY, INC.

Michelle E. Casto, PE
Senior Engineer

STATE OF KENTUCKY
MICHELLE E. CASTO 24688
LICENSED PROFESSIONAL ENGINEER

Daniel A. Furgason, PE
Geotechnical Manager

MEC/DAF:mec/tmk

Copies submitted: Client (email/2 mail)

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1.0 INTRODUCTION

Geotechnology, Inc. (Geotechnology) prepared this geotechnical exploration report for Northern Kentucky University (NKU) for the softball field renovations on the campus of Northern Kentucky University (NKU) in Highland Heights, Kentucky. Our services documented in this report were provided in general accordance with the terms and scope of services described in our Proposal P035590.01, which was dated October 21, 2019, which was authorized by NKU Purchase Order No. 4700002521, dated October 30, 2019.

The purposes of our services were to explore the subsurface conditions and to provide geotechnical recommendations for the design and construction of the project with respect to grading and drainage. Our scope of services included a site reconnaissance, geotechnical borings, laboratory testing, engineering analyses, and preparation of this report.

2.0 PROJECT INFORMATION

The following project information was derived from:

- The Topographic Survey and the Grading Plan Option 1, which were prepared by the Kleingers Group, dated September 19, 2019;
- The original Grading Plan for the softball field, which was prepared by the Commonwealth of Kentucky, Division of Engineering, dated August 11, 1998;
- The 1963 GIS mapping in the vicinity of the project site; and
- Correspondence with Ms. Birkenhauer.

We understand that the existing softball field was constructed in 1999. Since then, areas of potential settlement have occurred in the form of “bird baths” in four locations within the field. Also, the area in the immediate vicinity of the first base dugout is low-lying and holds water. In addition, there has been erosion of the rip-rap from the warning track in the area of the storm sewer headwall. It is our understanding the NKU is planning to renovate the field, including re-grading the existing ground surface of the field and possibly installing a turf field. Site grading is anticipated to be minimal on the order of plus or minus 1 foot.

3.0 SITE CONDITIONS

The project site consists of the existing softball field located northwest of the intersection with Johns Hill Road and Kenton Drive on the campus of Northern Kentucky University in Highland Heights, Kentucky. The softball field is grass covered with the exceptions of the gravel covered warning track and the soil exposed for the dirt infield and dugout areas. The ground surface surrounding the softball field is also grass-covered with the exception of the rip rap along the northern boundary of the field. The ground surface is relatively flat within the playing field area, with an overall topographic relief of about 3 feet. The high point is in the infield and drainage is northwardly toward the outfield. The ground surface slopes downward to the north, west and south around the perimeter of the field, with a parking lot located along the east boundary of the field. The southern/western embankment is about 16 feet tall at the highest and the northern embankment is about 4 to 5 feet tall. The gradient of the embankments in on the order of 4 Horizontal to 1 Vertical (4H:1V) or flatter. According to the 1963 GIS mapping, a drainage valley existed across the southern half of the softball field, which has since been filled to current grades.

Small low lying areas, or “bird baths”, were observed as evidenced by distressed vegetation or “bald spots” in the grass and depressions in the ground surface. The soil in the vicinity of the first base dugout area appeared to be moist and softer than the rest of the infield area. Erosion of the rip rap and warning track gravel was observed in the vicinity of the drainage pipe near the central portion of the warning track by the scaffolding platform.

4.0 SUBSURFACE EXPLORATION

The subsurface exploration consisted of six borings, numbered B-1 through B-6. The boring locations were selected and staked in the field by us utilizing hand held GPS equipment. The locations of the borings are shown on our Boring Plan, which is included in Appendix B.

The borings were drilled between November 8 and 11, 2019, with a track-mounted drill rig advancing hollow-stem augers, as indicated on the boring logs presented in Appendix C. Sampling of the overburden soils and bedrock was accomplished ahead of the augers at the depths indicated on the boring logs, with either 2-inch-outside-diameter (O.D.) split-spoons or 3-inch-O.D., thin-walled Shelby tube samplers in general accordance with the procedures outlined by ASTM D1586 and ASTM D1587, respectively. Standard Penetration Tests (SPTs) were performed with the split-spoon sampler to obtain the standard penetration resistance or N-value[1] of the sampled material.

As each boring was advanced, the Drilling Foreman kept a field log of the subsurface profile noting the soil and bedrock types and stratifications, groundwater, SPT results, and other pertinent data.

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[1] The standard penetration resistance, or N-value, is defined as the number of blows required to drive the split-spoon sampler 12 inches with a 140-pound hammer falling 30 inches. Since the split spoon sampler is driven 18 inches or until refusal, the blows for the first 6 inches are for seating the sampler, and the number of blows for the final 12 inches is the N-value. Additionally, “refusal” of the split-spoon sampler occurs when the sampler is driven less than 6 inches with 50 blows of the hammer.

Observations for groundwater were made in the borings during drilling and at the completion of drilling. The holes were backfilled immediately, such that long-term water readings were not taken.

Representative portions of the split-spoon samples were placed in glass jars with lids to preserve the in-situ moisture contents of the samples. The Shelby tubes were capped and taped at their ends to preserve the in-situ moisture contents and densities of the samples, and the tubes were transported and stored in an upright position. The glass jars and Shelby tubes were marked and labeled in the field for identification when returned to our laboratory.

5.0 LABORATORY REVIEW AND TESTING

Upon completion of the fieldwork, the samples recovered from the borings were transported to our Soil Mechanics Laboratory, where they were visually reviewed and classified by the Project Geotechnical Engineer.

Laboratory testing was performed on selected soil samples to estimate engineering and index properties. Laboratory testing of the selected soil samples included various combinations of the following tests: moisture content, Atterberg limits, and unconfined compression. The results of these tests are summarized in the Tabulation of Laboratory Tests in Appendix D, along with the corresponding laboratory test forms.

The boring logs, which are included in Appendix C, were prepared by the Project Geotechnical Engineer on the basis of the field logs, the visual classification of the soil and bedrock samples in the laboratory, and the laboratory test results. Soil and Rock Classification Sheets are also included in Appendix C, which describe the terms and symbols used on the boring logs. The dashed lines on the boring logs indicate an approximate change in strata as estimated between samples, whereas a solid line indicates that the change in strata occurred within a sample where a more precise measurement could be made. Furthermore, the transition between strata can be abrupt or gradual.

6.0 SUBSURFACE CONDITIONS

6.1 Stratification

Generally, the existing ground surface was underlain by 4 to 6 inches of topsoil, where encountered, followed by 1.5 to 17.2 feet of existing lean clay or shale fill, then by 2.5 to at least 6.0 feet of native fat or lean clay soils, where encountered, underlain by interbedded shale and limestone bedrock. The depth to the surface of the bedrock ranged from 2.0 to 14.5 feet below the ground surface, where encountered in Borings B-2 through B-6. More specific descriptions of the subsurface strata are provided below, and the boring logs containing detailed material descriptions are located in Appendix C.

6.1.1 Topsoil

Topsoil was encountered at the ground surface in Borings B-1 through B-5. The thickness of the topsoil in these borings varied from 4 to 6 inches thick.

6.1.2 Existing Fill

Existing fill was encountered beneath the ground surface or the topsoil in Borings B-1 through B-6. The existing fill in these borings varied from 1.5 to 17.2 feet thick and typically consisted of lean clay and/or shale sometimes containing topsoil, organics, roots, oxide stains, oxide concretions, cinders, metal pieces, limestone fragments, limestone floaters and shale fragments. An exception is that the surficial 1.2-foot-thick layer of fill in Boring B-6 consisted of loose sand and/or gravel. The fill was described as mixed brown, dark brown, gray, greenish gray and/or dark green in color and had variable consistencies ranging from soft to stiff. The N-values of the existing fill ranged from 5 to 13 bpf with no particular pattern regarding soil type or consistency.

Several moisture contents of the fill ranged from 20.1 to 28.3 percent. Two samples of the lean clay fill were classified as CL soils according to the Unified Soil Classification System (USCS) with liquid limits, plastic limits, and plasticity indices of 47, 23 and 24 percent and 45, 24, and 21 percent, respectively. One sample of the lean clay fill had an unconfined compressive strength of 4,790 pounds per square foot (psf) with a corresponding natural dry density of 106.5 pounds per cubic foot (pcf).

6.1.3 Native Overburden Soils

Native fat and lean clay soils were encountered beneath the fill at depths of 4.5 to 18.0 feet in Borings B-1, B-3, and B-6. The thickness of the native overburden soils, where penetrated in Borings B-3 and B-6 ranged from 2.5 to 4.8 feet. Boring B-1 was terminated in the native soil at a depth of 24.0 feet. The native overburden soils were described as brown, trace gray, moist, stiff to very stiff fat or lean clay with and without gravel, oxide stains, limestone fragments and traces of bedding planes. The N-values of the native soils ranged from 14 to 27 bpf.

The majority of the native overburden soils consisted of highly plastic fat clay soils with moisture contents ranging from 26.0 to 29.8 percent. One sample of the fat clay was classified as a CH soil according to the USCS with a liquid limit, plastic limit and plasticity index of 69, 28 and 41 percent. One sample of the lean clay had a moisture content of 18.6 percent.

6.1.4 Bedrock

The topsoil, existing fill, and native overburden soils at the site are underlain by bedrock consisting of interbedded shale and limestone layers. Bedrock was encountered at depths of 2.0 to 14.5 feet below the ground surface in all but Boring B-1.

According to the 1973 United States Geological Survey (USGS) Geologic Map of the Newport and Withamsville Quadrangle, Campbell and Kenton Counties, Kentucky, the bedrock underlying the overburden soils transitions between the Bull Fork Formation and the Grant Lake Limestone Formation.

The referenced USGS map describes the bedrock formations as follows:

- The Grant Lake Limestone Formation consists of rubbly weathering, mottled medium-light-gray and light-olive-gray, irregularly bedded to nodular limestone with irregular partings and beds of shale. The limestone predominantly consists of whole and coarsely broken fossils in a fine-grained argillaceous limestone matrix. A portion of this formation consists of interbedded limestone and shale, where the limestone comprises 65 to 85 percent of the formation, and shale comprises the balance. In this portion, the limestone is medium-light-gray to medium-bluish-gray, fine- to coarse-grained, fossil fragmental, evenly thin- to medium-bedded, and medium to well sorted with minor thin, irregularly bedded argillaceous limestone. The shale is medium-gray, fissile, and calcareous in this portion of the formation.

- The Bull Fork Formation consists of interbedded limestone and shale. The limestone is more than 50 percent of formation and is described as medium-gray, irregularly to evenly bedded in mostly thin beds, but with beds locally more than 6 inches thick. The limestone contains abundant whole or broken fossils. The shale is mostly medium gray, calcareous, and less fossiliferous than the limestone.

Bedrock in the Northern Kentucky Area is typically categorized as highly weathered, weathered, or unweathered, based on the degree of weathering of the shale component. The highly weathered zone is typically the uppermost zone, wherein the shale is brown to olive brown in color and has almost weathered to a clay. In the intermediate weathered zone, the shale is typically olive brown with occasional gray and is stronger than the shale in the highly weathered zone. In the unweathered parent zone, the shale is gray and is stronger than the shale in the weathered zones. Each zone is interbedded with limestone. It is common for one or both of the weathered bedrock zones to be absent due to differential weathering, erosion, or prior excavation. The Rock Classification Sheet, which is included in Appendix C, describes the varying degrees of weathering along with the rock strength descriptions that are used on the appended boring logs.

Regarding the limestone, these layers are predominantly unweathered, and their strengths are estimated to range from medium strong to very strong (i.e., uniaxial compressive strengths ranging from 4,000 psi to upwards of 30,000 psi). Occasionally, layers are encountered within the bedrock profile where groundwater seepage is concentrated and weathering of the limestone layers is more advanced.

Interbedded highly weathered shale and limestone bedrock was encountered in all but Boring B-1. The depth to the top of the highly weathered bedrock, where encountered, ranged from 2.0 to 14.5 feet from the ground surface, and the thickness, where penetrated, varied from 2.5 to 5.2 feet. Borings B-2 and B-6 were terminated in this zone at depths of 19.0 and 12.8 feet, respectively. The strength of the highly weathered shale was described as extremely weak.

Interbedded weathered shale and limestone bedrock was encountered in Borings B-3 and B-5. The depth to the top of the weathered bedrock, where encountered, ranged from 4.5 to 14.5 feet from the ground surface. Borings B-3 and B-5 were terminated in the weathered bedrock at depths of 21.5 and 5.5 feet, respectively. The strength of the weathered shale was described as extremely weak.

Interbedded unweathered shale and limestone bedrock was encountered in Boring B-4 at a depth of 7.0 feet. The strength of the unweathered shale was described as very weak. Boring B-4 was terminated in the unweathered zone of bedrock at a depth of 7.8 feet.

6.2 Groundwater Conditions

The majority of the borings were noted to be dry during drilling, with the exception of Boring B-1, which encountered groundwater at a depth of 5.0 feet within the fill. Borings B-1 and B-2 were noted to cave to depths of 6.0 and 12.0 feet, respectively upon completion of drilling. Borings B-3 through B-6 were noted to be dry upon completion of drilling.

Based on the groundwater observations and our local experience, groundwater seepage is anticipated, along the fill/native soil interface, along the overburden soil/bedrock interface, along limestone layers within the bedrock, and in the saturated zones of fill or native soils that are within the perched groundwater zones, or that are below the groundwater table. Locally concentrated flow may occur due to saturated layers of fill or native soils or along fractures in the bedrock. Additionally, groundwater levels and seepage amounts are expected to vary with time, location, season of the year, and amounts of precipitation.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our engineering reconnaissance of the site, the borings, the visual examination of the recovered samples, the laboratory test results, our understanding of the proposed project, our engineering analyses, and our experience as Consulting Soil and Foundation Engineers in the Northern Kentucky Area, we have reached the following conclusions and make the following recommendations of this report.

7.1 Subsurface Conditions

As discussed in Section 3.0, the project site is an existing softball field that is relatively flat with periodic low-lying “bird bath” areas observed in the grass-covered outfield area and in the dirt infield near the first base dugout area. Generally, the existing ground surface was underlain by 4 to 6 inches of topsoil, where encountered, followed by 1.5 to 17.2 feet of existing lean clay or shale fill, then 2.5 to 4.8 feet of native fat or lean clay soils, underlain by interbedded shale and limestone bedrock. As discussed in Section 6.2, groundwater was only encountered in Boring B-1 at a depth of 5.0 feet within the fill. Refer to Section 6.1 and the boring logs in Appendix C for additional information on the subsurface strata.

7.2 General Discussion

The borings results indicate that 4.5 to 17.5 feet of fill was placed in the valley across the southern portion of the site in Borings B-1, B-2, B-3 and B-6. The overall consistency of the fill was variable with softer layers intermixed with stiffer layers. Borings B-3 and B-4 were drilled within “bird bath” areas and encountered 2.0 to 4.5 feet of fill, which contained limestone floaters. Boring B-5 was drilled in an area of the softball that was not low-lying and had a similar soil profile to that of Boring B-4, which was in a “bird bath”. Deeper fill of 9.5 feet was encountered in Boring B-6, which was drilled near the first base dugout in the low lying area.

In general, it is our opinion that the low-lying areas are occurring due to one or a combination of the following:

1) Minor settlement amounts of the existing fill material have likely occurred over the last 21 years since the field was constructed, which is typical for deeper valley fills.

2) Limestone floaters could be “nested” together below the surface, with voids resulting. Over time finer grained soil tends to migrate to the voids, resulting in surface depressions.

3) In areas where a crust of 2.0 to 4.5-feet of fill was encountered over the native soils or bedrock, low spots may have occurred due to limestone floaters within the fill that are close to subgrade level, which have been pushed up when the ground freezes and thaws, displacing the soil around the floaters.

In areas where relatively flat grades are developed, small amounts of settlement over the years can cause low spots to form, which will hold water and gradually worsen over repeated freeze/thaw cycles throughout the years. It is noted that highly plastic clay soils were not an issue within the top few feet of subgrade.

7.3 Site Preparation and Earthwork

As stated in Section 2.0, site grading is anticipated to be minimal on the order of plus or minus 1 foot. It is our opinion that the subsurface profile is suitable to support an artificial turf softball field provided that the following recommendations are implemented.

The initial preparation of the site for grading should include the removal of vegetation, heavy root systems, and topsoil from the proposed cut and fill areas. The topsoil may be stockpiled for future use in landscaped areas, if permitted by specification, whereas the vegetation, including the heavy root systems, should be disposed of off site in accordance with applicable regulations.

Following clearing the site of the existing vegetation and topsoil and after making the required excavations in the cut areas, the exposed subgrade should be thoroughly proofrolled using a heavily loaded piece of equipment under the review of the Project Geotechnical Engineer, or a representative thereof. Soft or yielding soils observed during the proofrolling should be undercut to stiff non-yielding cohesive soils or medium dense to dense well-graded cohesionless soils; the depth of undercut below proposed subgrade may be limited to 2 feet.

Where undercuts are performed, the excavations should be backfilled with new compacted fill satisfying the material and compaction requirements presented in this section. The undercut soils may be reused provided that they conform to the recommendations contained in this report regarding acceptable fill materials. We recommend that the Contract Documents include a bid item for the recommended undercutting, as deemed necessary, and their replacement with new compacted and tested fill on a “per cubic yard of in-place compacted fill” basis.

If soft or yielding soils are encountered at the maximum undercut depth specified above and the compaction requirements of the undercut backfill cannot be achieved at the bottom of the undercut, the subgrade may be stabilized at those depths using an approved biaxial or triaxial geogrid (e.g., Tensar BX-1200 or TriAx TX160) and an 8-inch lift of compacted crushed stone. The remainder of the undercut should be backfilled with clayey soils satisfying the material and compaction requirements presented in this section. An approved separation geotextile fabric should be provided at the interface between the crushed stone and the clayey soils.

Fill materials should consist of approved on-site, non-organic, clayey soils, bedrock, or approved borrow material that are relatively free of topsoil, vegetation, trash, construction or demolition debris, frozen materials, particles over 6 inches in maximum dimension, or other deleterious materials. Additionally, limestone floaters should be restricted from the fill within the top 2-feet of the subgrade.

The fill should be placed in shallow level lifts (or layers), 6 to 8 inches in loose thickness. Each lift should be moisture-conditioned to within the acceptable moisture content range provided in Table 1, and compacted with a sheepsfoot roller or self-propelled compactor to at least the minimum percent compaction indicated in the same table. Moisture-conditioning may include: aeration and drying of wetter soils; wetting drier soils; and/or thoroughly mixing wetter and drier soils into a uniform mixture.

Table 1. Percent compaction and moisture-conditioning requirements for fill.

Area	Minimum Percent Compaction[a,b]	Acceptable Moisture Content Range[b]
Softball field subgrade	98% of SPMDD	-2% to +3% of OMC

[a] SPMDD = standard Proctor maximum dry density determined from ASTM D698.
[b] OMC = optimum moisture content determined from ASTM D698 or ASTM D1557.

Groundwater is not expected to have a significant adverse effect on the proposed earthwork construction; however, the Contractor must be prepared to remove seepage that accumulates in excavations, on fill surfaces, or at subgrade levels.

Maintaining the moisture content of bearing and subgrade soils within the acceptable range provided in Table 1 is important during and after construction for the proposed softball field. The clayey subgrade soils should not be allowed to become excessively wet or dried during or after construction, and measures should be taken to prevent water from ponding on these soils and to prevent these soils from desiccating during dry weather.

Positive drainage should be established across and around the proposed softball field to promote the rapid drainage of surface water away from the field in order to prevent the ponding of water. Finish grading in the field areas should be sloped at a gradient of at least 2 percent. The final grades should direct the surface water to storm water collection systems.

We recommend that the earthwork operations be carried out during the drier season of the year and that a sufficient gradient be maintained at the ground surface to prevent ponding of surface water. In our experience, the weather conditions are historically more favorable for earthwork during the months of May through October in the Northern Kentucky Area. Regardless of the time of year, fill should not be placed over frozen or saturated soils, and frozen or saturated soils should not be used as compacted fill.

Best management practices (BMPs) should be implemented to reduce the effects of erosion and the siltation of adjacent properties. Upon completion of earthwork, disturbed areas should be stabilized. It is also recommended that riprap and/or suitable armoring be used at the outlets of storm sewers and headwalls to reduce flow velocities and protect against erosion. Excavation Support

Excavation support should be the responsibility of the Contractor. Excavation support should be designed and implemented such that excavations are adequately ventilated and braced, shored, and/or sloped in order to protect and ensure the safety of workers within and near the excavations and to protect adjacent ground, slopes, structures, and infrastructure. Federal, state, and local safety regulations should be satisfied. The analyses, discussions, conclusions, and recommendations throughout this report are not to be interpreted as pre-engineering compliance with any safety regulation.

8.0 RECOMMENDED ADDITIONAL SERVICES

The conclusions and recommendations given in this report are based on: Geotechnology's understanding of the proposed design and construction, as outlined in this report; site observations; interpretation of the exploration data; and our experience. Since the intent of the design recommendations is best understood by Geotechnology, we recommend that Geotechnology be included in the final design and construction process, and be retained to review the project plans and specifications to confirm that the recommendations given in this report have been correctly implemented. We recommend that Geotechnology be retained to participate in prebid and preconstruction conferences to reduce the risk of misinterpretation of the conclusions and recommendations in this report relative to the proposed construction of the subject project.

Since actual subsurface conditions between boring locations may vary from those encountered in the borings, our design recommendations are subject to adjustment in the field based on the subsurface conditions encountered during construction. Therefore, we recommend that Geotechnology be retained to provide construction observation services as a continuation of the design process to confirm the recommendations in this report and to revise them accordingly to accommodate differing subsurface conditions. Construction observation is intended to enhance compliance with project plans and specifications. It is not insurance, nor does it constitute a warranty or guarantee of any type. Regardless of construction observation, contractors, suppliers, and others are solely responsible for the quality of their work and for adhering to plans and specifications.

9.0 LIMITATIONS

This report has been prepared on behalf of, and for the exclusive use of, the client for specific application to the named project as described herein. If this report is provided to other parties, it should be provided in its entirety with all supplementary information. In addition, the client should make it clear that the information is provided for factual data only, and not as a warranty of subsurface conditions presented in this report.

Geotechnology has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. The recommendations and conclusions contained in this report are professional opinions. The report is not a bidding document and should not be used for that purpose.

Our scope for this phase of the project did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

Our scope did not include: any services to investigate or detect the presence of mold or any other biological contaminants (such as spores, fungus, bacteria, viruses, and the by-products of such organisms) on and around the site; or any services, designed or intended, to prevent or lower the risk of the occurrence of an infestation of mold or other biological contaminants.

The analyses, conclusions, and recommendations contained in this report are based on the data obtained from the subsurface exploration. The field exploration methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Consequently, subsurface conditions may vary gradually, abruptly, and/or nonlinearly between sample locations and/or intervals.

The conclusions or recommendations presented in this report should not be used without Geotechnology's review and assessment if the nature, design, or location of the facilities is changed, if there is a substantial lapse in time between the submittal of this report and the start of work at the site, or if there is a substantial interruption or delay during work at the site. If changes are contemplated or delays occur, Geotechnology must be allowed to review them to assess their impact on the findings, conclusions, and/or design recommendations given in this report. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party's interpretations of the subsurface data or with reuse of the subsurface data or engineering analyses in this report.

The recommendations included in this report have been based in part on assumptions about variations in site stratigraphy that may be evaluated further during earthwork and foundation construction. Geotechnology should be retained to perform construction observation and continue its geotechnical engineering service using observational methods. Geotechnology cannot assume liability for the adequacy of its recommendations when they are used in the field without Geotechnology being retained to observe construction.

A copy of "Important Information about This Geotechnical-Engineering Report" that is published by the Geotechnical Business Council (GBC) of the Geoprofessional Business Association (GBA) is included in Appendix A for your review. The publication discusses some other limitations, as well as ways to manage risk associated with subsurface conditions.

APPENDIX A – IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

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

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

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

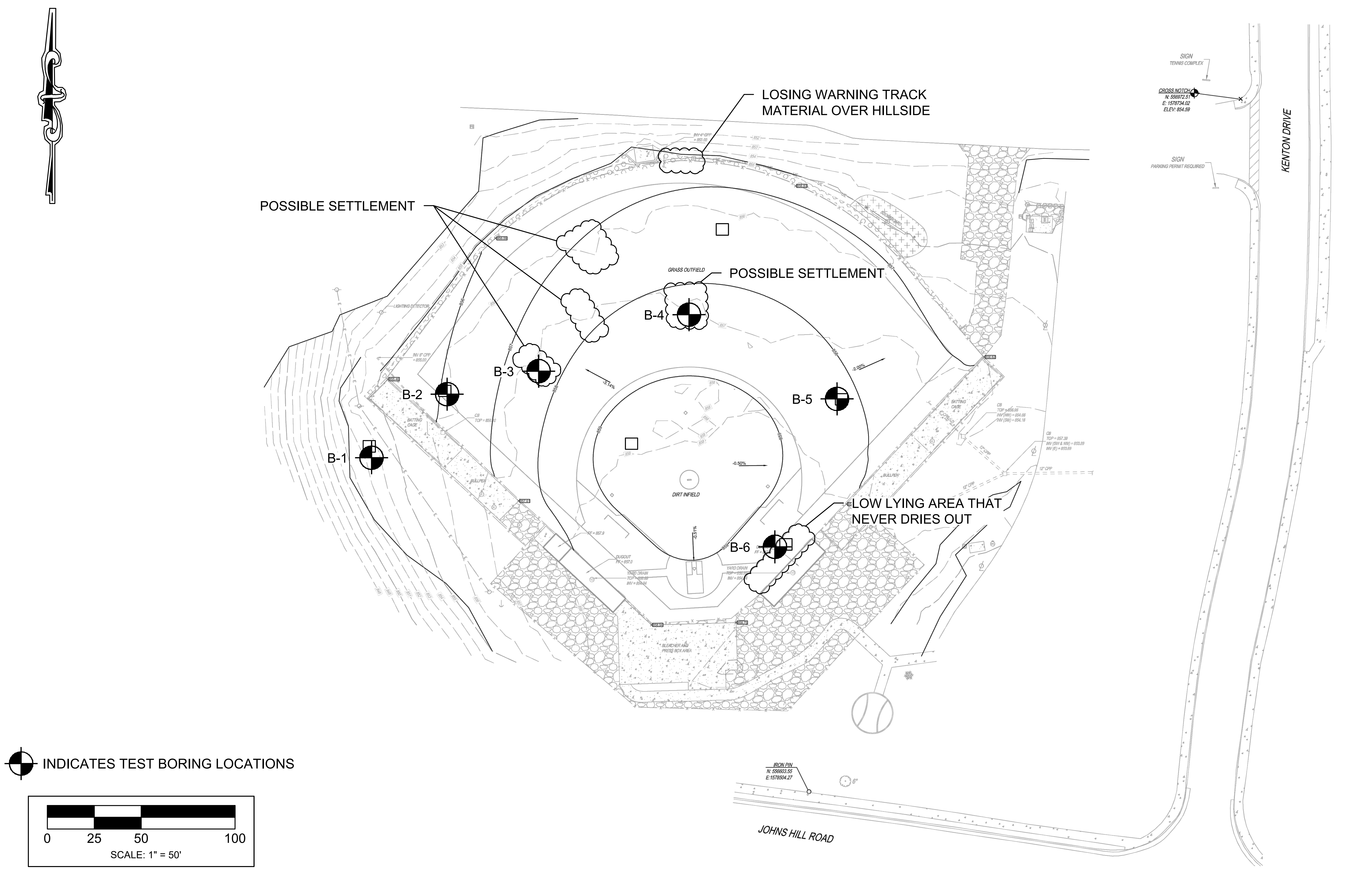
Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX B – PLANS

Boring Plan, Sheet No. 1



NOTE: BASE MAP FROM GRADING PLAN (OPTION 1) BY KLEINGERS, DATED SEPTEMBER 2019.

GEOTECHNOLOGY INC
FROM THE GROUND UP

Project: Northern Kentucky University
Geotechnical Exploration
NKU Softball Field

Location: Highland Heights, Kentucky

Title: BORING PLAN

Client: Northern Kentucky University

Date: 12/9/2019
Project No.: J035590.01
Sheet No.: 1

APPENDIX C – BORING INFORMATION

Boring Logs

Soil Classification Sheet

Rock Classification Sheet

GEOTECHNOLOGY INC
FROM THE GROUND UP

LOG OF TEST BORING

CLIENT: Northern Kentucky University
PROJECT: NKU Softball Field Renovations
Highland Heights, Kentucky
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

BORING #: B-1
PROJECT #: J035590.01
PAGE #: 1 of 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
853.7	Ground Surface	0.0	0						
853.4	TOPSOIL	0.3							
851.7	Mixed brown, trace gray moist medium stiff to stiff FILL, lean clay, trace clay with roots, oxide stains and concretions, limestone fragments and shale fragments.	2.0		I	1A 1B	DS	6-5-8	14	78
848.9	Mixed brown, trace gray moist stiff FILL, lean clay, trace roots with shale and limestone fragments and limestone floaters.	4.8		I	2	DS	4-2-4	16	89
846.2	Mixed brown, trace gray very moist soft FILL, lean clay, trace roots with oxide concretions and shale and limestone fragments.	7.5	5	I	3	DS	7-6-5	14	78
843.9	Mixed brown, trace gray moist stiff FILL, lean clay and shale with limestone fragments and floaters.	9.8		I	4	DS	11-4-8	14	78
841.7	Mixed brown, trace gray moist medium stiff FILL, lean clay, trace clay with shale fragments, limestone fragments and limestone floaters.	12.0	10	I	5	DS	2-2-4	16	89
839.2	Mixed brown, trace dark brown and greenish gray very moist medium stiff to stiff FILL, fat clay, trace topsoil and organics with shale and limestone fragments.	14.5		I	6	DS	8-4-3	14	78
836.2	Mixed brown, black and greenish gray, very moist medium stiff FILL, lean clay, some organics with limestone fragments.	17.5	15	I	7	DS	6-3-5	14	78
835.7	TOPSOIL	18.0							
834.2	Brown, trace gray moist stiff FAT CLAY with oxide stains.	19.5		I	8A 8B	DS	8-8-9	18	100
831.7	Brown, trace gray moist very stiff LEAN CLAY with limestone fragments, trace bedding planes (residual).	22.0	20	I	9	DS	8-12-15	18	100
829.7	Brown, trace gray moist very stiff FAT CLAY with oxide stains and limestone fragments, trace bedding planes (residual).	24.0		I	10	DS	9-9-11	16	89
	Bottom of test boring at 24.0 feet.		25						
			30						

Datum: NAVD 88	Hammer Weight: 140 lb.	Hole Diameter: 8 in.	Drill Rig: CME 550 BD-1
Surface Elevation: 853.7 ft.	Hammer Drop: 30 in.	Rock Core Diameter: --	Foreman: P. Pattison
Date Started: 11/8/2019	Pipe Size: 2 in. O.D.	Boring Method: HSA-3.25	Engineer: Michelle E. Casto
Date Completed: 11/8/2019			

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: 5.0 ft.
At Completion: Caved in to 6.0 ft.
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

GEOTECHNOLOGY INC
FROM THE GROUND UP

LOG OF TEST BORING

CLIENT: Northern Kentucky University
PROJECT: NKU Softball Field Renovations
Highland Heights, Kentucky
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

BORING #: B-2
PROJECT #: J035590.01
PAGE #: 1 of 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
856.3	Ground Surface	0.0						
855.8	TOPSOIL with roots, trace gravel.	0.5						
851.8	Mixed brown, trace gray moist stiff FILL, lean clay with shale and limestone fragments, trace roots.	4.5	I	1A 1B	DS	3-4-3	14	78
			I	2	DS	2-3-2	16	89
849.3	Mixed brown, trace gray moist very stiff FILL, lean clay with shale and limestone fragments (CL).	7.0	U	3	PT		17	71
847.0	Mixed brown, trace gray and dark brown moist medium stiff FILL, lean clay, trace topsoil and organics with shale and limestone fragments.	9.3	I	4	DS	3-2-9	14	78
844.3	Mixed brown, trace gray moist stiff FILL, lean clay with shale and limestone fragments.	12.0	I	5	DS	6-5-3	16	89
842.8	Mixed brown, dark brown and gray moist very stiff FILL, fat clay, trace organics with oxide stains, shale fragments and limestone floaters, trace metal pieces.	13.5						
841.8	Mixed dark brown and dark greenish gray moist soft FILL, lean clay with limestone fragments.	14.5	I	6A 6B	DS	5-4-7	18	100
837.3	Interbedded brown moist extremely weak highly weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).	19.0	I	7	DS	10-12-21	18	100
			L	8	DS	50/2"	0	0
	Bottom of test boring at 19.0 feet.							

Datum: NAVD 88
Surface Elevation: 856.3 ft.
Date Started: 11/8/2019
Date Completed: 11/8/2019
Hammer Weight: 140 lb.
Hammer Drop: 30 in.
Pipe Size: 2 in. O.D.
Hole Diameter: 8 in.
Rock Core Diameter: --
Boring Method: HSA-3.25
Drill Rig: CME 550 BD-1
Foreman: P. Pattison
Engineer: Michelle E. Casto

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Caved in to 12.0 ft.
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

GEOTECHNOLOGY INC
FROM THE GROUND UP

LOG OF TEST BORING

CLIENT: Northern Kentucky University
BORING #: B-3
PROJECT: NKU Softball Field Renovations
PROJECT #: J035590.01
Highland Heights, Kentucky
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
857.2	Ground Surface	0.0	0						
856.7	TOPSOIL with roots.	0.5							
	Mixed brown moist stiff FILL, lean clay with oxide stains and limestone fragments and floaters.			I	1	DS	4-4-3	16	89
				I	2	DS	4-4-9	18	100
852.7		4.5	5						
	Brown, trace gray moist stiff FAT CLAY, trace gravel with oxide stains (CH).			U	3	PT		10	42
850.2		7.0							
	Brown, trace gray moist very stiff FAT CLAY with oxide stains.			I	4	DS	6-6-8	18	100
847.9		9.3	10						
	Interbedded brown moist extremely weak highly weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).			I	5	DS	10-13-22	18	100
				I	6	DS	22-50/5"	6	55
842.7		14.5	15						
	Interbedded olive brown and gray moist very weak weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).			I	7	DS	49-29-50/1"	10	77
				I	8	DS	50/3"	3	100
			20	I	9	DS	50/5"	5	100
835.7		21.5							
	Bottom of test boring at 21.5 feet.		25						
			30						

Datum: NAVD 88	Hammer Weight: 140 lb.	Hole Diameter: 8 in.	Drill Rig: CME 550 BD-1
Surface Elevation: 857.2 ft.	Hammer Drop: 30 in.	Rock Core Diameter: --	Foreman: P. Pattison
Date Started: 11/8/2019	Pipe Size: 2 in. O.D.	Boring Method: HSA-3.25	Engineer: Michelle E. Casto
Date Completed: 11/8/2019			

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Dry
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

GEOTECHNOLOGY INC
FROM THE GROUND UP

LOG OF TEST BORING

CLIENT: Northern Kentucky University
BORING #: B-4
PROJECT: NKU Softball Field Renovations
Highland Heights, Kentucky
PROJECT #: J035590.01
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
856.9	Ground Surface	0.0						
856.4	TOPSOIL with roots.	0.5						
854.9	Mixed brown, trace gray moist stiff FILL, lean clay, trace gravel with shale fragments (CL).	2.0	I	1A 1B	DS	3-3-2	16	89
849.9	Interbedded brown moist extremely weak highly weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).	7.0	I	2	DS	4-30-21	18	100
			I	3	DS	32-50/2"	4	50
849.1	Interbedded gray moist very weak unweathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).	7.8	I	4	DS	60/4"	4	100
	Bottom of test boring at 7.8 feet.							

Depth Scale (feet): 0, 5, 10, 15, 20, 25, 30

Datum: NAVD 88
Surface Elevation: 856.9 ft.
Date Started: 11/8/2019
Date Completed: 11/8/2019
Hammer Weight: 140 lb.
Hammer Drop: 30 in.
Pipe Size: 2 in. O.D.
Hole Diameter: 8 in.
Rock Core Diameter: --
Boring Method: HSA-3.25
Drill Rig: CME 550 BD-1
Foreman: P. Pattison
Engineer: Michelle E. Casto

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Dry
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

GEOTECHNOLOGY INC
FROM THE GROUND UP

LOG OF TEST BORING

CLIENT: Northern Kentucky University
BORING #: B-5
PROJECT: NKU Softball Field Renovations
Highland Heights, Kentucky
PROJECT #: J035590.01
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
857.7	Ground Surface	0.0	0						
857.3	TOPSOIL with roots, trace brick fragments.	0.4							
855.7	Mixed brown moist stiff FILL, lean clay, trace gravel with shale fragments.	2.0		I	1A 1B	DS	2-3-4	18	100
853.2	Interbedded brown moist extremely weak highly weathered SHALE and gray medium strong to very strong unweathered LIMESTONE with fat clay seams (bedrock).	4.5		I	2	DS	16-15-21	18	100
852.2	Interbedded olive brown moist very weak weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).	5.5	5	I	3	DS	66/6"	6	100
	Bottom of test boring at 5.5 feet.								
			10						
			15						
			20						
			25						
			30						

Datum: NAVD 88
Hammer Weight: 140 lb.
Hole Diameter: 8 in.
Drill Rig: CME 550 BD-1
Surface Elevation: 857.7 ft.
Hammer Drop: 30 in.
Rock Core Diameter: --
Foreman: P. Pattison
Date Started: 11/8/2019
Pipe Size: 2 in. O.D.
Boring Method: HSA-3.25
Engineer: Michelle E. Casto
Date Completed: 11/8/2019

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Dry
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

LOG OF TEST BORING

CLIENT: Northern Kentucky University
PROJECT: NKU Softball Field Renovations
Highland Heights, Kentucky
LOCATION OF BORING: As shown on Boring Plan, Sheet No. 1

BORING #: B-6
PROJECT #: J035590.01
PAGE #: 1 of 1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
859.2	Ground Surface	0.0						
858.2	Mixed red and brown moist loose FILL, fine sand, trace silt.	1.0	I	1A	DS	5-3-3	18	100
858.0	Mixed brown moist loose FILL, fine to coarse sand and gravel with piece of filter fabric.	1.2		1B				
857.2	Mixed brown, trace gray very moist soft FILL, lean clay with shale fragments.	2.0		1C				
			I	2	DS	5-4-7	18	100
854.7	Mixed brown, trace gray moist medium stiff to stiff FILL, lean and fat clay with shale fragments, trace roots.	4.5						
			I	3	DS	6-3-3	18	100
852.2	Mixed dark green, trace black very moist soft FILL, lean clay, little topsoil, trace cinders.	7.0						
			I	4	DS	3-3-5	15	83
849.7	Mixed dark grayish brown moist medium stiff to stiff FILL, lean clay, little topsoil.	9.5						
			I	5	DS	4-6-12	18	100
847.2	Brown moist stiff FAT CLAY with oxide stains and limestone floaters.	12.0						
846.4	Interbedded brown moist extremely weak highly weathered SHALE and gray medium strong to very strong unweathered LIMESTONE (bedrock).	12.8	I	6	DS	50/4"	4	100
	Bottom of test boring at 12.8 feet.							

Depth Scale (feet): 0, 5, 10, 15, 20, 25, 30

Datum: NAVD 88
Surface Elevation: 859.2 ft.
Date Started: 11/11/2019
Date Completed: 11/11/2019
Hammer Weight: 140 lb.
Hammer Drop: 30 in.
Pipe Size: 2 in. O.D.
Hole Diameter: 8 in.
Rock Core Diameter: --
Boring Method: HSA-3.25
Drill Rig: CME 550 BD-1
Foreman: P. Pattison
Engineer: Michelle E. Casto

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Dry
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

GEOTECHNOLOGY INC
FROM THE GROUND UP

SOIL CLASSIFICATION SHEET

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

Relative Properties

Descriptive Term	Percent
Trace	1 – 10
Little	11 – 20
Some	21 – 35
And	36 – 50

Particle Size Identification

Boulders	- 8 inch diameter or more	
Cobbles	- 3 to 8 inch diameter	
Gravel	- Coarse	- 3/4 to 3 inches
	- Fine	- 3/16 to 3/4 inches
Sand	- Coarse	- 2mm to 5mm (dia. of pencil lead)
	- Medium	- 0.45mm to 2mm (dia. of broom straw)
	- Fine	- 0.075mm to 0.45mm (dia. of human hair)
Silt		- 0.005mm to 0.075mm (Cannot see particles)

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency	Field Identification	Unconfined Compressive Strength (tons/sq. ft.)
Very Soft	Easily penetrated several inches by fist	Less than 0.25
Soft	Easily penetrated several inches by thumb	0.25 – 0.5
Medium Stiff	Can be penetrated several inches by thumb with moderate effort	0.5 – 1.0
Stiff	Readily indented by thumb but penetrated only with great effort	1.0 – 2.0
Very Stiff	Readily indented by thumbnail	2.0 – 4.0
Hard	Indented with difficulty by thumbnail	Over 4.0

Classification on logs are made by visual inspection.

Standard Penetration Test – Driving a 2.0" O.D., 1 3/8" I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the drill log (Example – 6/8/9). The standard penetration test results can be obtained by adding the last two figures (i.e. 8+9=17 blows/ft.). Refusal is defined as greater than 50 blows for 6 inches or less penetration.

Strata Changes – In the column "Soil Descriptions" on the drill log, the horizontal lines represent strata changes. A solid line (————) represents an actually observed change; a dashed line (— — — —) represents an estimated change.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

ROCK CLASSIFICATION SHEET

ROCK WEATHERING

Descriptions	Field Identification
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than it its fresh condition.
Highly Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Residual Soil	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact with bedding planes visible, and the soil has not been significantly transported.

ROCK STRENGTH

Descriptions	Field Identification	Uniaxial Compressive Strength (psi)
Extremely Weak	Indented by thumbnail	40-150
Very Weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	150-700
Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	700-4,000
Medium Strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow of a geological hammer.	4,000-7,000
Strong	Specimen requires more than one blow of a geological hammer to fracture.	7,000-15,000
Very Strong	Specimen requires many blows with a geological hammer to fracture.	15,000-36,000
Extremely Strong	Specimen can only be chipped with geological hammer.	>36,000

BEDDING

Descriptive Term	Bed Thickness
Massive	> 4 ft.
Thick	2 to 4 ft.
Medium	2 in. to 2 ft.
Thin	< 2 in.

APPENDIX D – LABORATORY TEST DATA

Tabulation of Laboratory Tests

Soil Unconfined Compressive Strength Test Forms

TABULATION OF LABORATORY TESTS

Boring No.	Sample No.	Depth (ft.)		Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits (%)			USCS Classification	Unconfined Compressive Strength (psf)
		From	To			LL	PL	PI		
B-1	2	2.5	4.0	20.1						
B-1	3	5.5	7.0	26.7						
B-1	8B	18.0	19.0	26.2						
B-1	9	20.0	21.5	18.6						
B-1	10	22.5	24.0	26.3						
B-2	1B	0.5	1.5	21.6						
B-2	2	2.5	4.0	23.3						
B-2	PT-3	5.9	6.4	22.6	106.5	47	23	24	CL	4,790
B-3	1B	0.5	1.5	24.7						
B-3	2	2.5	4.0	22.0						
B-3	PT-3	5.3	5.8	28.4	96.7	69	28	41	CH	3,960
B-4	1B	0.5	1.5	25.5		45	24	21	CL	
B-5	1B	0.4	1.5	24.5						
B-6	1C	1.2	1.5	22.8						
B-6	2	2.5	4.0	25.5						
B-6	3	5.0	6.5	28.3						
B-6	5	10.0	11.5	29.8						

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
ASTM D2166

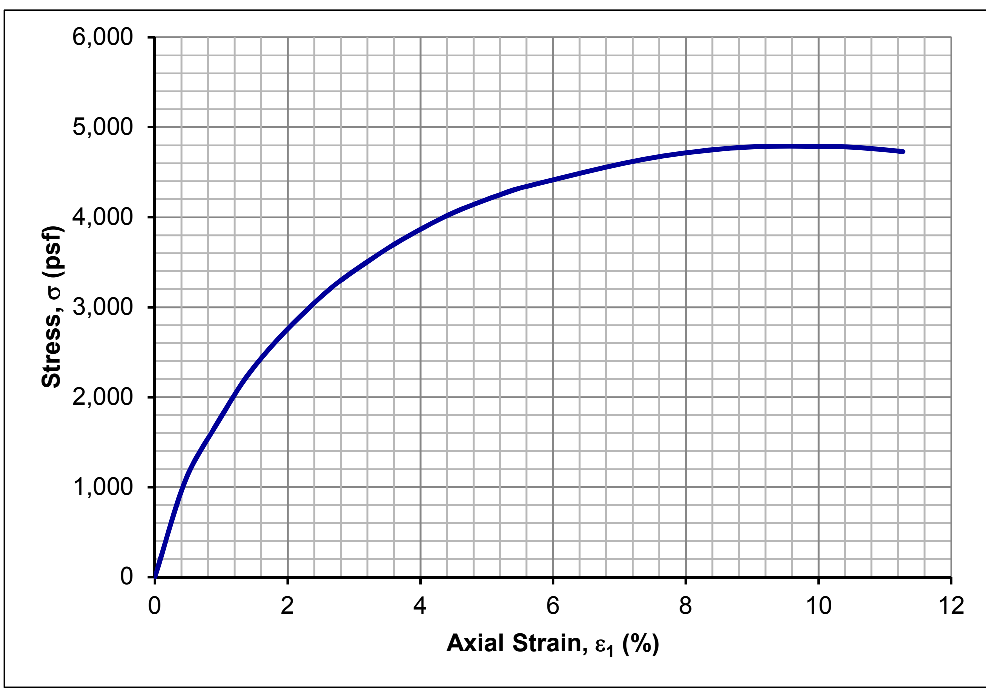
CLIENT : Northern Kentucky University — DATE: 11/27/2019
PROJECT NO.: J035590.01
PROJECT: NKU Softball Field
LOCATION: Highland Heights, KY

BORING NO.: B-2 — SAMPLE NO.: PT-3 — DEPTH (ft.): 5.9-6.4
SAMPLE OBTAINED BY: Shelby Tube — CONDITION: Undisturbed
SAMPLE DESCRIPTION: Mixed brown, trace gray moist very stiff FILL, lean clay with shale and limestone fragments.

LIQUID LIMIT (%): 47 — PLASTIC LIMIT (%): 23 — PLASTICITY INDEX (%): 24 — USCS: CL
GRAVEL (%): — SAND (%): — SILT (%): — CLAY (%):
SPECIFIC GRAVITY OF SOLIDS: 2.75 (Assumed) — LOAD CELL NO.: 1059

SAMPLE DATA	
DIAMETER (in.):	2.84
HEIGHT (in.):	5.55
HEIGHT TO DIAMETER RATIO:	1.96
WET UNIT WEIGHT (pcf):	130.6
DRY UNIT WEIGHT (pcf):	106.5
VOID RATIO:	0.61
MOISTURE CONTENT (%)*:	22.6
DEGREE OF SATURATION (%):	100

FAILURE DATA	
AVERAGE RATE OF AXIAL STRAIN TO FAILURE (%/min.):	**1.0**
AXIAL STRAIN AT FAILURE (%):	**9.5**
TIME TO FAILURE (min.):	**9.4**
UNCONFINED COMPRESSIVE STRENGTH, q_u (psf):	**4,790**
UNDRAINED SHEAR STRENGTH, s_u (psf):	**2,395**
SENSITIVITY, S_t:	**-**



FAILURE SHAPES

FRONT VIEW

SIDE VIEW

REMARKS :

*Moisture content determined after shear from entire sample.

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
ASTM D2166

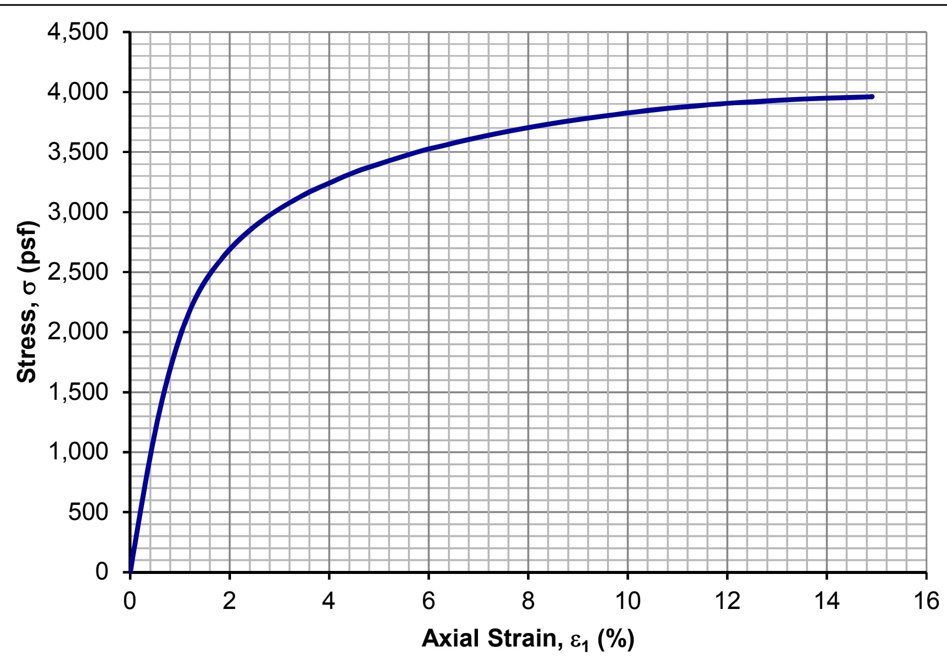
CLIENT : Northern Kentucky University — DATE: 11/26/2019
PROJECT NO.: J035590.01
PROJECT: NKU Softball Field
LOCATION: Highland Heights, KY

BORING NO.: B-3 — SAMPLE NO.: PT-3 — DEPTH (ft.): 5.3-5.8
SAMPLE OBTAINED BY: Shelby Tube — CONDITION: Undisturbed
SAMPLE DESCRIPTION: Brown, trace gray moist stiff FAT CLAY, trace gravel with oxide stains.

LIQUID LIMIT (%): 69 — PLASTIC LIMIT (%): 28 — PLASTICITY INDEX (%): 41 — USCS: CH
GRAVEL (%): — SAND (%): — SILT (%): — CLAY (%):
SPECIFIC GRAVITY OF SOLIDS: 2.75 (Assumed) — LOAD CELL NO.: 1059

SAMPLE DATA	
DIAMETER (in.):	2.84
HEIGHT (in.):	5.53
HEIGHT TO DIAMETER RATIO:	1.95
WET UNIT WEIGHT (pcf):	124.1
DRY UNIT WEIGHT (pcf):	96.7
VOID RATIO:	0.78
MOISTURE CONTENT (%)*:	28.4
DEGREE OF SATURATION (%):	100

FAILURE DATA	
AVERAGE RATE OF AXIAL STRAIN TO FAILURE (%/min.):	**1.0**
AXIAL STRAIN AT FAILURE (%):	**14.9**
TIME TO FAILURE (min.):	**14.7**
UNCONFINED COMPRESSIVE STRENGTH, q_u (psf):	**3,960**
UNDRAINED SHEAR STRENGTH, s_u (psf):	**1,980**
SENSITIVITY, S_t:	**-**



FAILURE SHAPES

FRONT VIEW

SIDE VIEW

REMARKS :

*Moisture content determined after shear from entire sample.