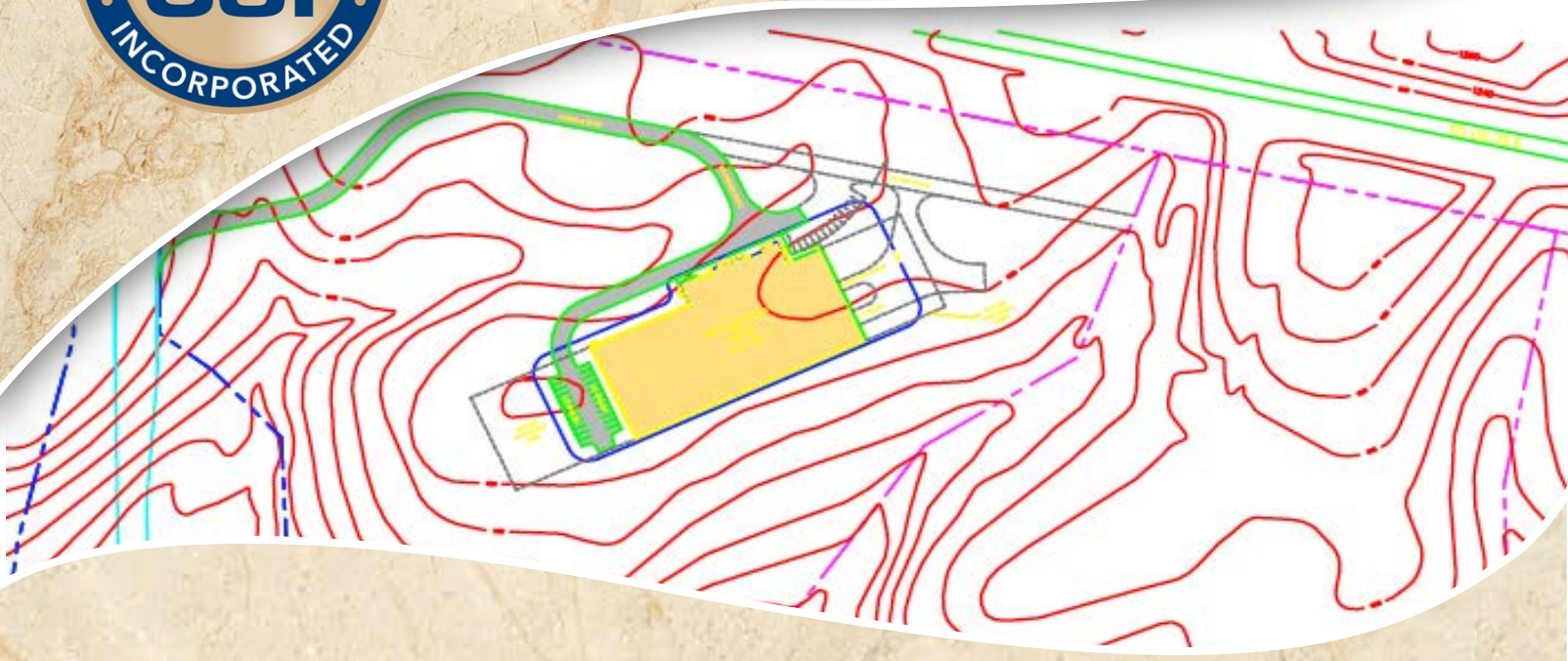

Geotechnical Report

for

Project Comet

Site 10

Corbin, Kentucky

February 27, 2015

Prepared for

Southeast Kentucky Regional Industrial Authority

c/o MSE of Kentucky, Inc.

Lexington, Kentucky

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February 27, 2015

Southeast Kentucky Regional Industrial Authority
c/o MSE of Kentucky, Inc.
624 Wellington Way
Lexington, KY 40503

ATTN: Mr. Glen Ross, PE

Subject: **Report of Geotechnical Exploration**
Project Comet (Site 10)
Corbin, Kentucky
CSI Project No. LX150023

Dear Mr. Ross:

Consulting Services Incorporated of Kentucky (CSI) is pleased to present our Report of Geotechnical Exploration for proposed Project Comet (Site 10) in Corbin, Kentucky. We provided our services in general accordance with CSI Proposal Number 3575, dated January 14, 2015.

Our report represents information provided to us, readily available published data relevant to the site and site area, our observations and subsurface conditions encountered, and our opinion of primary geotechnical conditions (discussion and recommendations) affecting design, construction and performance of the proposed soil supported portions of the project.

We appreciate the opportunity to provide our geotechnical services to you and the design team. Please do not hesitate to contact us for questions or comments about the information contained herein.

Sincerely,

Travis Greenwell, EIT, SI
Staff Professional

Bruce L. Hatcher, PE, SI
Chief Engineer
Licensed KY 14,527

STATE OF KENTUCKY
BRUCE L. HATCHER
14,527
LICENSED
PROFESSIONAL ENGINEER

2-27-15

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INTRODUCTION

1 SCOPE OF THE GEOTECHNICAL EXPLORATION

As we proposed, we conducted geotechnical services which are summarized in the following report. Our services included a review of the project information provided, conducting a subsurface exploration that utilized soil borings to obtain samples for modeling the soil/rock conditions at the subject site, an analysis of the data and information obtained, and providing recommendations for the earth-supported portions of the site as listed in our proposal.

2 PROVIDED INFORMATION

Project information was provided to us via e-mail and telephone correspondence with Mr. Glen Ross, PE of MSE of Kentucky Inc. We were provided the following documents:

- A .pdf file entitled "C-1 Grading Plan" topography map depicting the site location and proposed building locations
- Corbin_Aerial Map combined depicting approximate lot boundaries
- Corbin_topographic map combined depicting approximate lot boundaries and contours
- Project Aurora layout map depicting lots 7-10 with the proposed building layouts
- SEKBPSiteMap depicting site contours and boundary of lots within regional park

We understand that the proposed Project Comet (Site 10) project is currently in the design phase. Specifically, the project site is located east of the Woodbine Connector, south of KY-3041 (Corbin Bypass), and north of Southeast Kentucky Business Drive in Corbin, Kentucky. The project site is a 40.5 acre property in this area. Please reference the Site Location Plan in the Appendix for details.

We understand that the project may consist of the construction of a speculative building at Site 10 with a warehouse area of approximately 52,500 square feet. A 5,000 square feet office area will also be included along the northwest side of the building. Additionally, we understand that the current location of the proposed speculative building may be changed. Thus, there may be a need for future geotechnical work, depending on the final location selected for this building. We have not been provided with specific structural information for this report preparation. However, we assume that the construction will consist of a pre-engineered structural steel building with metal siding.

We also assume that the foundations will consist of shallow spread foundations (on soil) and that concrete slab-on-grade floors will be used for the building. We have not been provided with structural loading information. However, we expect that the maximum anticipated foundation loads will not exceed 6 kips per linear foot (for continuous footings) and 100 kips (for isolated footings). Also, we have not been provided expected floor slab live loads. Thus, we have assumed that the floor slab live loads will not exceed 100 pounds per square foot.

At this time, we understand that the final building location (and thus the final grades) has not yet been set. Based on the provided topographic information, we anticipate moderate grading (cuts/fills less than 10 feet) may be required to achieve a relatively level area for the building footprint. However, we do not anticipate the need for steep cut/fill slopes or retaining walls for the project. Also, we have assumed that no basements, partial basements, or pits will be included in the proposed construction.

Additionally, we understand that new pavement areas are included for this project. We expect that both light and heavy duty asphalt pavements will be utilized for parking areas and drive lanes, respectively. We assume that rigid (concrete) pavement may be utilized for any proposed dumpster pads, etc. Thus, we have provided recommendations for light and heavy duty asphalt pavements as well as concrete pavements later in this report.

If any of the aforementioned information is in error or if the information changes during the course of the project, please contact our office so that we can re-evaluate the new information with respect to our findings and recommendations.

3 AREA/SITE INFORMATION

3A AREA TOPOGRAPHY/PHYSIOGRAPHY

The site is located near the western edge of the Eastern Kentucky Coal Fields Physiographic Region of Kentucky. This area consists of forested hills and V-shaped valleys. Published topographic mapping by the USGS (United States Geologic Survey) indicates the elevations in the project site vicinity range from approximately 1080 feet to 1500 feet.

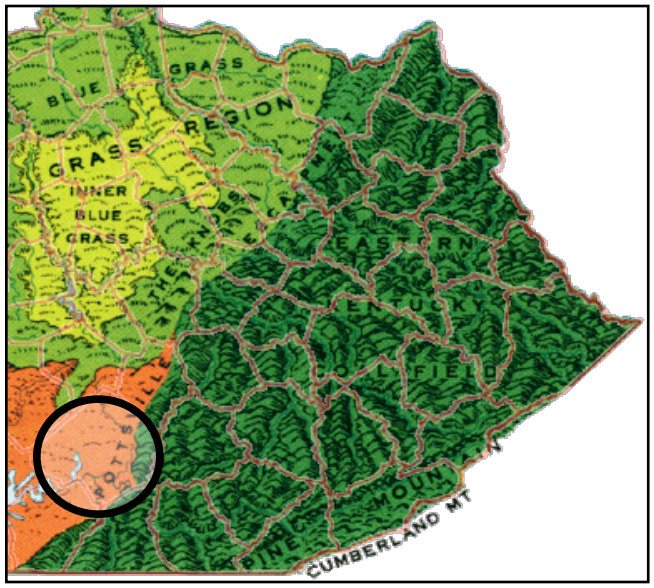


Figure 1. Kentucky Physiographic Map (site vicinity shown in the circle)

3B SITE GEOLOGY

A review of the *USGS Geologic Map of the Corbin Quadrangle, Kentucky* (dated 1963) indicates the majority of the project site is located in an area underlain by the Breathitt Formation. The project site (along Southeast Kentucky Business Drive) is mapped as being underlain by alluvium (water-transported) soils.

As mapped, the alluvium consists of silt and sandy silt with minor clay with thicknesses of up to 10 feet. The Breathitt Formation in this area consists of shale, siltstone, sandstone, and clay. The shale and siltstone are described as gray to dark gray, weathers yellowish brown to buff, and can be carbonaceous. The sandstone is described as yellowish gray to buff, fine to medium grained, and is generally friable. The clay is described as gray, weathers very light gray to white and interbedded with shale. The Blue Gem coal bed is mapped in the project vicinity at elevations above the project site.

Faults, Karst activity (i.e. – sinkholes, caves, underground streams, etc.), or other geologic hazards are not commonly associated with the Breathitt Formation. The geologic dip in this area is less than 1 percent to the southeast. No faults were mapped within 1 mile of the project site. The figure below indicates the site geologic mapping. Below is a figure of the location of the site with respect to the area geology.

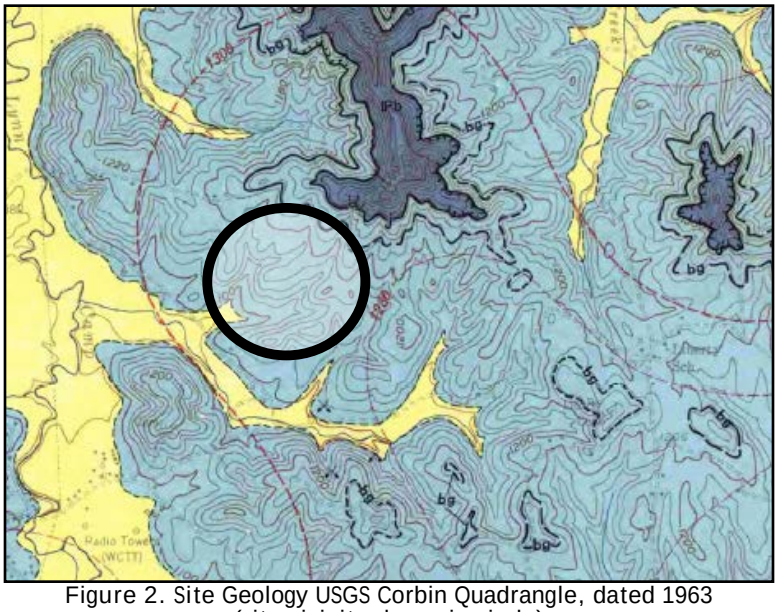


Figure 2. Site Geology USGS Corbin Quadrangle, dated 1963
(site vicinity shown in circle)

The following coal seam outcrops are mapped in the project vicinity:

- Blue Gem coal bed - outcrop mapped at elevations ranging from 1220 feet to 1240 feet.
- Jellico coal bed - outcrop mapped at elevations ranging from 1300 to 1320

These coal beds are mapped at elevations above the project site. No other coal seam outcrops are mapped in the immediate vicinity of the project site.

Review of Mining Activities Noted on USGS Maps

Our review of the USGS topographic and geologic maps for the Corbin Quadrangle revealed the following information:

- Previous deep mining activities (i.e. - adits) and strip mining activities are noted on the Quadrangle
- Strip, auger, and deep mining are mapped to the north, south, east, and west of the project site.
- No mining activities are mapped at the project site.

Review of Department of Mines and Minerals

We reviewed publicly available underground mine maps from the Kentucky Mine Mapping Information System through their web site www.minemaps.ky.gov. It should be noted that stored underground mining maps were destroyed in a fire at the Department of Mines and Minerals map room in 1948. Although most of the maps were able to be retrieved, not all maps were recovered.

Based on our review of the publically available mine maps, mining of the following coal seams has occurred near the site vicinity:

- Seam 215 - The Jellico coal bed - contour strip mining
- Seam 225 - The Blue Gem coal bed - contour strip mining

Based on our mine map review, mining has occurred near the project vicinity. However, none of the reviewed mapping shows mining activities at the project site. The following is the mine works map for the site vicinity.

Figure 3. *Knox County Mined Areas* Map, KGS
(site vicinity shown in circle)

3C PUBLISHED SITE SOIL CONDITIONS

According to the USDA Soil Survey of Knox County (NRCS website), the soils underlying the site vicinity consist of the following series:

- Cotaco loam (Co), rarely flooded
- Latham silt loam (LaC), 6 to 12 percent slopes
- Latham silt loam (LaD), 12 to 20 percent slopes
- Morehead silt loam (Mo), rarely flooded
- Shelocta gravelly silt loam (ShC), 6 to 12 percent slopes
- Shelocta gravelly silt loam (ShD), 12 to 20 percent slopes
- Shelocta-Latham silt loams (SLE), 20 to 30 percent slopes
- Shelocta-Latham silt loams (SLF), 30 to 60 percent slopes
- Stendal silt loam (St), frequently flooded
- Wernock silt loam (WnB), 2 to 6 percent slopes
- Depth to restrictive feature (i.e. – lithic bedrock) for these soil series is generally listed as ranging from 20 inches to more than 80 inches.
- Depth to the water table for these soil series is generally listed generally listed from 18 inches to more than 80 inches.
- These soil series are generally listed as being somewhat to very limited for site development. Particular issues affecting construction include slope, shrink-swell potential, low strength, depth to saturated zone, depth to soft bedrock, unstable excavation sidewalls, and too clayey.

The following figure shows the site's web soil survey mapping.

Figure 4. USDA Soil Survey Map of Project Site

3D OTHER PUBLISHED SITE INFORMATION

We have reviewed several available aerial photographs, dated as far back as March, 1997. In the March 1997 aerial photograph, the site was mostly a wooded hillside with possible pastureland on top of the hillside. In the time between the March, 1997 aerial and the November, 2004 aerial, the hillside was deforested and a small access road was built to the site. The site remained relatively unchanged through the October, 2008 aerial. In the time between the October, 2008 aerial and the August, 2010 aerial, the Woodbine Connector was constructed to the west of the site. Since the August, 2010 aerial, the site has remained relatively unchanged.

FINDINGS

4 SITE SURFACE OBSERVATIONS

A site visit was performed by Mr. Travis Greenwell, EIT of CSI on February 10, 2015. The CSI representative observed and documented site surface conditions that could have an impact on the proposed construction.

The project site and surrounding areas were sloping hillsides, covered in moderately sized trees and scrub bushes. The site appeared to have been cleared for pastureland on the top of the hills. According to the provided topographic information, there appears to be roughly 20 to 30 feet of vertical relief across the site. However, the proposed building location was more gently sloping with approximately 10 feet of vertical relief with ankle to knee high grasses.

No underground utilities were marked in the vicinity of our soil borings, although various underground utilities are located along the western perimeter of the site off of the hill. Overhead utility lines run along the Corbin Bypass (KY-3041) to the north. The following show some photos of the site at the time of drilling.

Photo 1. View from B-101 looking south

Photo 2. View from B-204 looking west

Photo 3. View from B-105 looking north

Photo 4. View from B-109 looking west

5 SUBSURFACE CONDITIONS

The subsurface conditions encountered at each of our soil boring locations are shown on the Test Boring Logs in the Appendix. It should be noted that our soil borings were sampled according to the procedures presented in the Appendix. The Boring Logs represent our interpretations of the subsurface conditions based on field logs, visual examination of field samples by an engineer, and tests of the samples collected. The letters in parentheses following the soil descriptions are the soil classifications in accordance with the Unified Soil Classification System. It should be noted that the stratification lines shown on the soil boring logs represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths. Water levels shown on the Test Boring Logs represent the conditions only at the time of our exploration.

5A SOIL CONDITIONS

We utilized 13 soil test borings (labeled B-101 through B-109 and B-201 through B-204) with an additional offset sounding (boring without sampling) labeled B-202A, to explore the subsurface conditions at the site. Please reference the Boring Location Plan in the Appendix for the approximate boring and sounding locations.

In general, we encountered a thin topsoil layer, overlying possible previously placed fill (where applicable), overlying residual soils, overlying weathered rock, overlying bedrock.

In all thirteen of our borings, we encountered a thin topsoil layer. The topsoil layer varied in thickness from 2 inches to 8 inches.

Possible previously placed fill was encountered below the topsoil layer at six of our thirteen soil boring locations. The possible previously placed fill generally consisted of a brown clay with trace rock fragments, sand, and root hairs. This material appeared disturbed. However, we did not encounter any construction debris or deleterious material in these samples. Additionally, this material appeared similar to the natural soils on-site. Thus, it was difficult to ascertain definitively that this was indeed old fill. The possible previously placed fill had thicknesses

ranging from 1.0 feet (boring B-109) to 1.8 feet (boring B-203). The possible previously placed fill was generally sampled as soft to firm.

Residual soils were encountered below the topsoil and/or possible previously placed fill at all of our soil boring locations. The residual soil generally consisted of three soil types. The first soil type was a brown sandy lean clay (CL) with trace root hairs and rock fragments. The second soil type consisted of a orangish-brown clayey sand (SC) with gray silt. The third soil type consisted of an orange to orangish-brown mottled gray fat clay (CH) with sand. The thickness of the residual soil ranged from 2.7 feet (at boring B-203) to 19.5 feet (at boring B-102). The residual soil was generally sampled as stiff to hard.

Weathered rock was encountered at 11 of our 13 boring locations and at our offset sounding location B-202A. Auger refusal is typically interpreted as top of hard bedrock. Auger refusal was encountered at depths ranging from 3.3 feet (boring B-203) to 20.7 feet (boring B-102). The thickness of the weathered rock ranged from approximately 0.4 feet (boring B-101) to 1.5 feet (boring B-104).

5B GROUNDWATER CONDITIONS

Free water was not observed in any of our soil boring locations upon completion of soil augering. Water conditions that usually affect construction and performance of projects consist of trapped/perched water zones which occur in variable areas in the soil mass, at or near the bedrock bedding planes, or at or near the soil/rock interface. Perched water sources are often not linked to the more continuous relatively stable ground water table that typically occurs at greater depths. Site excavation activities or ground disturbance can expose these features and the resulting seepage can vary greatly. Finally, water issues are also dependent upon recent rainfall activity and surface and subsurface drainage patterns in the area.

6 LABORATORY TESTING

During the course of our work, we selected representative soil samples for laboratory testing. Detailed descriptions of these tests and the results of our testing are included in the Appendix. Tests performed included:

- Natural moisture content
- Atterberg limits
- Percent fines analyses
- Standard Proctor test

GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

7 DISCUSSION-GEOTECHNICAL ISSUES

Based on our experience with similar projects and the conditions observed during our subsurface exploration, we believe the site can be adapted for the proposed development. The primary geotechnical concerns are:

- Possible Previously Placed Fill
- High Plasticity (Fat) Clay Soils
- Site Clearing
- Shallow and Varying Depths to Bedrock
- Site Grading
- Differing Bearing Conditions
- Additional Considerations

The following sections of this report discuss each issue. However, recommendations to address the issues are contained in later sections of the report.

7A POSSIBLE PREVIOUSLY PLACED FILL

As mentioned, possible previously placed fill was encountered within six of our thirteen soil boring locations. The possible previously placed fill had thicknesses ranging from 1.0 feet (boring B-109) to 1.8 feet (boring B-203). The possible previously placed fill generally consisted of a brown clay (CL) with trace rock fragments, sand, and root hairs. This material appeared disturbed. However, we did not encounter any construction debris or deleterious material in these samples. Additionally, this material appeared similar to the natural soils on-site. Thus, it was difficult to ascertain definitively that this was indeed old fill.

Old fill materials are often improperly compacted, commonly contain organics and debris, and can be poor bearing materials. Fills placed in an uncontrolled manner have proven to be problematic. The problems generally arise not from general settlement, but from erratic differential settling of the fill. The settlement of old fill masses is dependent upon several factors such as fill thickness, degree of compaction, fill contents, and age of the fill mass.

We recommend complete removal of any encountered previously placed fill within the proposed building and/or pavement areas. If any old fill is left in-place beneath the proposed site improvements, you must be aware of the risk of construction over old fill material and hold CSI harmless for poor performance of the site improvements due to construction over the old fill. We can provide recommendations to reduce (but not eliminate) the risk if you chose to leave the existing fill in-place.

7B HIGH PLASTICITY (FAT) CLAY SOILS

Based on our knowledge of the geology in the area and the soil samples collected at our boring locations, high plasticity (fat) clay soils are likely present on-site. Laboratory testing on representative samples from nearby Sites 7 and 8 confirmed the presence of fat clay (CH) soils on-site. The Atterberg limits testing on the representative samples (from Sites 7 and 8) indicated a maximum Plasticity Index (PI) of 39 percent. Soils with a PI at or above 30 percent can have a tendency to shrink/swell with changes in moisture content. Soils with a PI greater than 50 are generally highly susceptible to volume change. Some of the deeper samples obtained on-site were visually classified as fat clay (CH) soils based on the lab testing performed on similar soils from the adjacent site (Sites 7 and 8).

Soils with a PI between these limits have low to moderate volume change potential. The laboratory test results for soil samples from this site vicinity fall in the low to moderate susceptibility range with a maximum PI of 39 percent. Although the obtained bulk sample tested indicated a low PI, low PI soils can still be susceptible to shrink/swell potential.

Shrinking and swelling of foundation and bearing soils are generally not as severe in the central Kentucky area as in other areas because long periods of excessively wet or dry weather do not normally occur. However, if site grading takes place during the dry summer or fall months, significant drying of the exposed subgrade soils may occur. If these soils re-saturate after completion of construction, structural distress may be experienced. Also, moisture content loss typically results in settlement of soil supported building components. Where the soil moisture fluctuates, movement may be ongoing throughout the building's life, resulting in deterioration and building distress. Strength loss may also affect building components, but is more likely to adversely affect parking lots - especially flexible asphalt pavements. Accumulation of water beneath pavement followed by repeated traffic loads, may result in the failure of both pavement and the subgrade materials. Therefore, the volume change potential of the soils should be considered for this project.

Based on our experience with similar fat clay (CH) soils, we do not recommend that these soils be used as structural fill. Additionally, these soils are not desirable bearing soils. Thus, we do not recommend that these soils be left in-place at the design bottom-of-footing elevation. Also, we do not recommend that the project floor slabs bear on these fat clay (CH) soils. As such, we recommend that additional laboratory testing (including a swell test) be performed on the existing soils in the area based on the final building location (once this location has been determined) and the selected grades.

7C SITE CLEARING

The site is located in a partially wooded area with pastureland along the ridgelines. The portions of the site that are wooded have numerous moderate to large diameter trees. Expect that removal of large root masses will be required during site clearing. In some instances, these root masses could extend into the shallow bedrock. The voids left when the root masses are removed will need to be filled.

7D SHALLOW AND VARYING DEPTHS TO BEDROCK

Our 13 boring locations encountered bedrock at depths ranging from 3.3 feet to 20.7 feet. As such, selection of final grades will have a significant impact on the construction budget since rock removal is expensive. Mass earthwork cuts, foundation excavations and deep excavations (such as sanitary sewer, storm sewer, water lines, etc.) could intersect the soil/rock interface. Additionally, in select areas, rock excavation may be required for plumbing, electrical, and other utility installation.

The underlying bedrock for this area typically consists of friable sandstone and/or shale. Typically, this type of bedrock is rippable with a D8 (or larger) dozer with a rip blade. Isolated areas may require the use of a hoe ram to remove. Deeper beds may be problematic to cut, and removal methods might require blasting or hoe-ram efforts.

If the site bedrock is found to be interbedded and/or nondurable in nature, ripped bedrock can create an issue of "mixing" soil, non-durable shale/siltstone and sandstone during blasting or rock removal. To lessen problems with fill, regardless of rock percentage in on-site fill, any rock on-site materials should be placed in accordance with soil guidelines, unless the geotechnical engineer can determine that clean shot rock is being obtained. Water should be tilled in to break any soft rock into soil-like material.

7E SITE GRADING

We understand that the final building location (and thus the final grades) is not yet finalized. Additionally, we understand that a bearing capacity of about 6,500 pounds per square foot could be required for the building. As such, rock bearing foundations would be required to achieve this bearing capacity. If rock bearing foundations are required for the building, the final grades should be selected as low as practical to reduce the amount of undercut required in the proposed foundation excavations to encounter bedrock. Thus, grade selection will be extremely important for this project.

7F DIFFERING BEARING CONDITIONS

Depending upon the selected final grades and building location, we expect that there will be the likelihood of foundations bearing either on soil while others may bear on bedrock. Bearing project foundations on any combination of both soil and rock will likely result in unwanted differential settlement. Therefore, the building foundations should either be entirely rock bearing -OR- entirely soil bearing, not a combination of both. Due to the potential for the building location to be altered, the remainder of this report has been written for both soil or rock bearing foundation options.

7G ADDITIONAL CONSIDERATIONS

As mentioned, we understand the location and final grades for the Project Comet (Site 10) are not finalized. Thus, depending on selected location, additional work could be needed including additional borings and laboratory testing (Atterberg limits, swell tests, California Bearing Ratio (CBR) tests, etc.) of the on-site soils. This testing is especially important due to the likely presence of fat clay (CH) soils on-site.

8 EARTHWORK

Historically, more change orders (in orders and costs) occur during the earthwork portion of construction than in almost any other part of the project. Further, the site preparation phase of construction always affects the future performance of project structures and pavements. Add into this, the fact that earthwork is the portion of work most influenced by wet weather and unknown conditions and time-wise, this section of the report could be the most important to prevent and minimize delays and costs during construction and for the life of the project.

Please review the concerns listed in section 7 prior to reading the following recommendations. If problems occur that the recommendations do not address or do not adequately remedy, please contact CSI as soon as possible.

8A SITE PREPARATION (WORK PRIOR TO FILLING)

- Remove trees (as necessary) and organic materials from the construction area. These materials should be wasted off-site.

- When ready to commence construction, all topsoil should be removed (stripped) from the construction area and all structural fill areas. These areas should be proofrolled with a heavily loaded dump truck or similar equipment judged acceptable by a CSI geotechnical engineer. These materials should be stockpiled for use as topsoil in landscape areas.

- Remove any encountered old fill (if any).

- Areas ready to receive new fill should be proofolled with a heavily loaded dump truck (i.e. - gross vehicle weight of 80,000 pounds) or similar equipment judged acceptable by a CSI geotechnical engineer.

- The level of proofroll should be determined by a CSI geotechnical engineer on a case-by-case basis.

- Perform the proofrolling after a suitable period of dry weather to avoid degrading the subgrade.

- Areas which pump, rut, or wave during proofrolling may require undercutting, so a CSI geotechnical engineer should be contacted for guidance. We expect that the existing fill soils will fail proofroll. Thus, the upper portion of the existing fill will require re-compaction (during a dry weather period) to prepare the subgrade for new construction.

- Backfill of undercut areas should be done in accordance with sections 8B and 8C of this report.

- Retain CSI to observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered. This can save time on the construction schedule and save unnecessary undercutting.

We recommend that site grading should take place between about late April to early November. Earthwork taking place outside this time period will likely encounter wet conditions and weather conditions that will provide little to no assistance with drying the soils.

8B NEW FILL OPERATIONS (MASS EARTHWORK)

Our laboratory tests performed for this site indicate that the on-site soils may be suitable for use as structural fill material provided the material is placed and compacted in accordance with the following guidelines and specifications. However, fat clay (CH) soils were visually classified on this site based on the lab testing performed on similar soils from the adjacent site (Sites 7 and 8). These fat clay (CH) soils may not be suitable for use as structural fill. Once the final building location and final grades have been selected, a representative soil sample should be obtained for additional lab testing, including a swell test.

If any off-site soil fill material is imported to the project site, representative samples should be obtained of the proposed fill material to determine the moisture-density relationship and overall classification of the material. The tests also would assist in determining if the material is suitable for use as structural fill.

After the subgrade has been approved to receive new fill, the fill may commence with the following procedures and guidelines recommended:

- On-site soils may be used as fill material provided they are not fat clay (CH) soils. If fat clay soils are encountered, a swell test should be performed on these soils to determine their suitability for use as structural fill.
- We recommend the use of off-site soils with a PI of 30 percent or less for use as structural fill material for this project.
- Place fill in maximum 8-inch thick loose lifts.
- Fill lifts should be compacted to at least 98 percent of the soil's maximum dry density (ASTM D 698).
- Maintain the moisture content of compacted fill within 2 percent of optimum moisture.
- Fill compaction requirements should extend to at least 5 feet outside the structure and pavement perimeter.
- Maximum particle size of the soil should be limited to 4 inches in any one dimension. Additionally, no concentration of large fragments should be permitted.
- Density testing should be performed as a means to verify percent compaction and moisture content of the material as it is being placed and compacted.

- Soils should not be “overcompacted” and construction traffic should be kept to minimum to assure compaction is achieved and that the soil is not allowed to “break down”.

- Retain a representative of CSI to observe and document fill placement and compaction operations.

8C BACKFILL OPERATIONS (FOUNDATION WALLS, UTILITIES, ETC.)

These materials are placed in more confined areas than mass earthwork materials or pavement materials and therefore cannot be placed in full compliance with sections 8A or 8B. The following are general recommendations for backfill areas:

- Fill lift thicknesses will vary dependent on compaction equipment available and material types, but in no case should exceed 8 inches.

- For crushed stone/aggregate backfills in trenches or wall backfill and when using smaller compaction equipment (such as a plate compactor or trench compactor or similar) the lift thickness should not exceed 4 inches.

- Compaction/moisture percentages and density testing frequency should be the same as in section 8B.

- CSI should be retained to provide addition recommendations for backfill.

8D GENERAL NOTES

- For all earthwork operations, positive surface drainage is prudent to keep water from ponding on the surface and to assist in maintaining surface stability.

- The surface should be sealed prior to expected wet weather. This can usually be accomplished with rubber-tired construction equipment or a steel-drum roller.

If any soil placement problems occur, CSI should be retained to provide additional recommendations, as needed.

9 SITE DRAINAGE

During construction, water should not be allowed to pond in excavations or undercutting will likely be required. During the life of the project, slope the subgrade and other site features so that surface water flows away from the site structures. Structure roof drains should be piped away to proper storm drainage systems. Diversion ditches should be used at the toe of all slopes to keep surface water from accumulating at or near site structures.

For excavations during construction, most free water from the subsurface conditions could likely be removed via sump pumps and open channel flow (ditches) at or near the source of seepage. Water could be encountered during foundation excavations. However, if normal dewatering measures prove insufficient, CSI should be retained to provide recommendations on the issue.

Daylighting wet zones for drainage or the use of french/rock drains may be prudent or cost effective methods of de-watering wet areas of the site. Pumping with long-flexible hoses day-lighted hundreds of feet away or other types of sumping could also be utilized if necessary. CSI should be retained to observe all excavations in locations of springs or other water-bearing features.

10 FOUNDATIONS

Based on the information provided and the conditions encountered, we believe that shallow spread foundations (continuous, isolated, or combinations thereof) bearing on soil OR rock may be used for this project. As discussed previously, we understand that the final building location and thus, the final grades are not yet set. Thus, the expected bearing conditions for the building are not yet known. As such, we have provided recommendations for both soil and rock bearing foundations in the following section of this report.

Please note that consistent bearing conditions will be required for the project foundations. Thus, the project foundations should either bear entirely on soil - OR - entirely on rock, not a combination of both. Constructing project foundations on inconsistent bearing conditions will likely result in unwanted differential settlement.

If there are any changes in the project criteria or building location, CSI should be allowed to review the recommendations to determine if any modifications are required.

10A SHALLOW FOUNDATIONS ON SOIL

In the event that soil bearing foundations are utilized for this project, we have provided the following soil bearing foundation recommendations. Shallow spread footings (on soil) may be sized using a maximum allowable bearing pressure of 2,500 pounds per square foot (psf). Foundations should bear on stiff or better existing soils or newly and properly compacted fill. If rock is encountered within the foundation excavation, remove an additional 2 feet of rock and replace with compacted soil to provide a soil cushion.

A detailed settlement analysis was beyond the scope of this exploration. However, based on the estimated structure loads, the anticipated behavior of soil types encountered during field activities, and our experience with similar projects, we expect that total settlements will not exceed 1 inch, and that differential settlements will not exceed 1/2 inch between columns or along continuous footing distances of 30 feet or less. We recommend the structure be designed to accommodate this magnitude of total and differential settlement.

Settlement estimates are based, in part, upon the assumption that site preparation is performed in accordance with our recommendations and with good quality control of the earthworks. Proper placement and compaction of new fill is particularly important in keeping settlements within tolerable limits.

Additional design considerations for project foundations are outlined as follows:

- Design all footings with a minimum 18 inches width.

- All exterior footing bottoms should bear at least 27 inches below finished exterior grading (Kentucky Building Code, Table 1805.2.1 for Knox County).

- Interior footings (those not exposed to freezing) may be placed at nominal depths or 18 inches deep, whichever is deeper.

- Include control joints at suitable intervals in the walls of structures and in areas where changes in support from native soil to fill are anticipated, to help accommodate differential foundation movements.

10B SHALLOW FOUNDATIONS - CONSTRUCTION NOTES

Any soils can lose strength if they become wet, so we recommend the foundation subgrades be protected from exposure to water. For foundations construction, we also recommend the following procedures:

- For soils that will remain exposed overnight or for an extended period of time, place a "lean" concrete mudmat over the bearing areas. The concrete should be at least 4 inches thick. Flowable fill concrete or low-strength concrete is suitable for this cover, as conditions allow.

- Disturbed soil should be removed prior to foundation concrete placement.

- Foundation bearing conditions should be benched level.

- Areas loosened by excavation operations should be recompacted prior to reinforcing steel placement.

- Loose soil, debris, and excess surface water should be removed from the bearing surface prior to concrete placement.

- The bearing conditions of foundation soils should be checked by means of portable dynamic cone penetration (DCP) testing at the direction of a CSI geotechnical engineer.

- Retain a CSI geotechnical engineer to observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered.

10C SHALLOW FOUNDATIONS ON ROCK

For foundations bearing completely on bedrock, foundations may be sized using a maximum allowable bearing pressure of 8,000 pounds per square foot (8 ksf). Any existing soil or weathered rock should be excavated until competent rock is exposed in the bottom of the foundation excavation. We interpret competent by observing the teeth of the backhoe or trackhoe being dragged vertically across the top of exposed rock. Upon approval by a CSI geotechnical engineer, the excavation can be backfilled to the design bottom of footing elevation with lean concrete (2,000 psi minimum) or flowable fill (500 psi minimum).

A detailed settlement analysis was beyond the scope of this exploration. However, based on the supplied structural loads and foundations bearing on competent bedrock, we expect both total settlements and differential settlements will not exceed ¼ inch between columns or along continuous footing distances of 30 feet or less.

Additional design considerations for spread foundations bearing on bedrock are outlined as follows:

- Design all footings with a minimum 18 inches width;
- Spread foundations bearing on bedrock are not subject to a minimum frost embedment depth.

10D SHALLOW FOUNDATIONS ON ROCK - CONSTRUCTION NOTES

For spread foundations constructed on top of competent bedrock, we also recommend the following procedures.

- Loose soil, mud, debris, and excess water should be removed from the bearing surface immediately prior to concrete placement.
- Foundation bearing surfaces should be benched to provide nearly-level bearing surfaces.
- A CSI geotechnical engineer should observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered.

11 SEISMIC SITE CLASSIFICATION

The Kentucky Building Code (KBC), as updated was reviewed to determine the Site Seismic Classification. Based on our review of geologic data, our experience, and subsurface conditions encountered, we recommend a Seismic SITE CLASS "C" for the site if soil bearing foundations are used. However, if rock bearing foundation are used, then we recommend a Seismic SITE CLASS "B" for the site.

A detailed geotechnical earthquake engineering analysis was not performed since it was beyond the scope of our authorized work. However, based on a review of published literature and our experience with similar subsurface conditions, we believe the potential for slope instability, liquefaction, and surface rupture due to faulting or lateral spreading resulting from earthquake motions is low. However, this potential could be elevated during wet periods of the year unless adequate drainage is provided.

12 CONCRETE SLABS-ON-GRADE

A grade supported floor slab may be suitable for the proposed structure, provided the subgrade is prepared according to the recommendations contained within this report. As discussed, depending on the final building location and the final grades, the project floor

slabs could bear on soil -OR- on rock. Based on our visual classifications and/or lab testing on soils obtained from the adjacent site, we believe that the site may be underlain by fat clay (CH) soils. These soils may have an increased potential of shrink/swell with moisture fluctuations. Please note that a swell test was not included in our proposed scope of work.

If project floor slabs are to bear on soil, then we recommend that a representative soil sample be obtained to perform additional lab testing (including a swell test) to determine the soil's swell potential. At that time, additional recommendations can be provided to remedy the soil's swell potential, if needed.

If project floor slabs are rock bearing, then a relatively smooth surface (free of loose or pinnacled rock) should be provided to construct the project floor slabs.

The following features are recommended as part of the floor slab construction:

- Provide isolation joints between the slab and columns and along footing supported walls.
- Adequate joint patterns (ACI and ICC guidelines) should be used to permit slab movement due to normal soil settlement, normal subgrade disturbance and material expansion/contraction.
- Place a minimum of 4 inches of clean, compacted gravel or crushed stone beneath the slab to provide a working base. The actual thickness of the gravel layer should be based on design requirements.
- Keep the crushed stone or gravel moist, but not wet, immediately prior to slab concrete placement to minimize curling of the slab due to differential curing conditions between the top and bottom of the slab.
- Retain CSI to review the actual subgrade conditions prior to slab construction and make recommendations for any unsuitable conditions encountered.

Note: Slab subgrade conditions are also considered earthwork areas and the recommendations contained in the Earthwork section of the report.

13 PAVEMENT RECOMMENDATIONS

Since the proposed pavement will be for an office and warehouse, we expect that the traffic will be limited primarily to automobiles, delivery trucks, and garbage trucks. Thus, we expect that heavy duty and light duty asphalt will be used for the drive lanes and parking stalls, respectively.

Adequate soil/subgrade support is critical for any pavement area. Please refer to the Earthwork section of this report for subgrade preparation recommendations. Prior to base stone placement for the pavement areas, we recommend an additional heavy proofroll (i.e. – GVW of 80,000 pounds) of the subgrade be performed to verify subgrade conditions. Recommendations for undercutting/repair of the subgrade can be made at that time by a CSI geotechnical engineer.

Adequate drainage and slope of the pavement subgrade and pavement section should be provided to promote adequate drainage. Edges of the pavement should be provided a means of water outlet by extending the aggregate base course through to side ditches or providing drain pipes and weep holes at catch basin walls.

The following pavement recommendations are based on our experience with similar materials and loading conditions.

13A ASPHALT PAVEMENT

Typically, pavement design is based on supplied traffic loads and CBR values. However, no traffic loads were provided to us for this project and a CBR test was not included in our scope for this project. Thus, generalized pavement designs for light duty and heavy duty pavements are given below based on our experience on similar projects.

Table 1. Light Duty Asphalt Pavement Section	
Pavement Section Component	Thickness (in)
Bituminous Surface Course	1.5
Bituminous Binder Course	1.5
Dense Graded Aggregate (DGA)*	8.0

*DGA to be placed in 6 inch thick maximum, compacted lifts

Table 2. Heavy Duty Asphalt Pavement Section	
Pavement Section Component	Thickness (in)
Bituminous Surface Course	1.5
Bituminous Binder Course	2.5
Dense Graded Aggregate (DGA)*	10.0

*DGA to be placed in 6 inch thick maximum, compacted lifts

The dense graded aggregate (DGA) should be placed and compacted in accordance with Kentucky Department of Highways Standard Specifications, latest edition. The asphalt should be mixed, placed, and compacted in accordance with Kentucky Department of Highways Standard Specifications, latest edition. It is common practice to place the base stone and binder course prior to completion of construction without placing the surface course. It should be noted that repeated passes of heavily loaded construction traffic on the binder course will likely decrease the service life of your pavement.

13B CONCRETE PAVEMENT

Typically, concrete pavement is used when heavy, repeated loads are expected in a specific area. Concrete pavement is commonly used for dumpster pads, entrance and exit areas, loading docks, etc.

We recommend a minimum DGA thickness of 8 inches beneath new concrete pavement and a minimum concrete thickness of 6 inches for new concrete pavement areas. Obviously, thicker pavement concrete sections can be used in select areas where heavy wheel loads are expected. We also recommend that the concrete pavement be reinforced with heavy welded

wire fabric or reinforcing steel. For dumpster pads and refuse container pads, the concrete pads should be large enough to accommodate both the refuse container and all axles of the truck.

14 NOTES ON THE REPORT AND RECOMMENDATIONS

We recommend that this report be provided to the various design team members, the contractors and the project Owner. Potential contractors should be informed of this report in the "Instructions to Bidders" section of the bid documents. A geotechnical exploration, such as the one we performed, uses widely spaced borings to attempt to model the subsurface conditions at the site. Because no exploration contains complete data or a complete model, there is always a possibility that conditions between borings will be different from those at specific boring locations and that conditions will not be as anticipated by the project team. Thus, it is possible that some subsurface conditions will not be anticipated by the project team or contractor. If this report is included or referenced in the actual contract documents, it shall be explicitly understood that this report is for informational purposes only. CSI shall not be responsible for the opinions of, or conclusions drawn by, others.

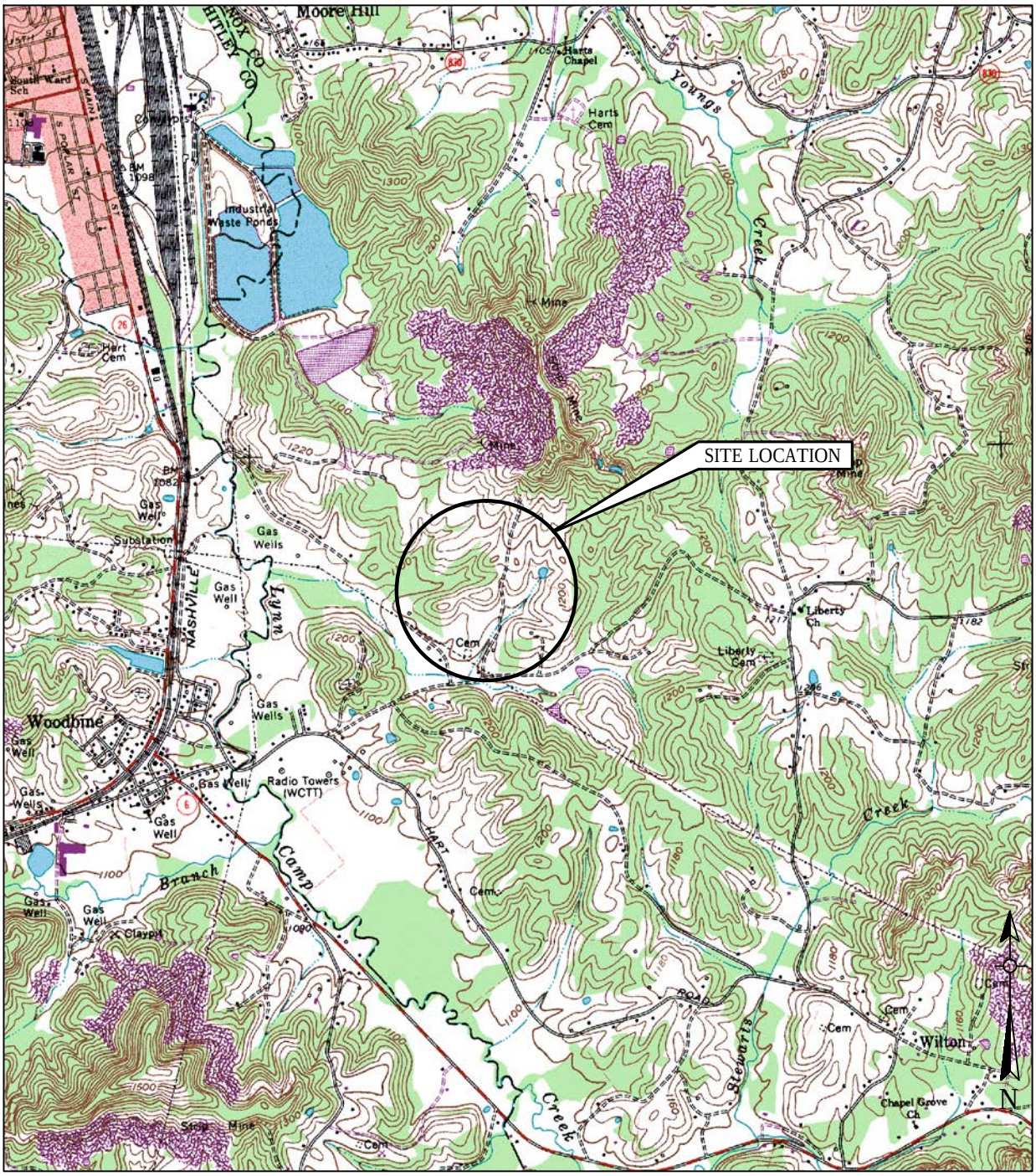
It has been our experience that the construction process often disturbs soil conditions and this process, no matter how much experience we use to anticipate construction methodology, is not completely predictable. Therefore, changes or modifications to our recommendations are likely needed due to these possible variances. Experienced CSI geotechnical personnel should be used to observe and document the construction procedures and the conditions encountered. Unanticipated conditions and inadequate procedures should be reported to the design team along with timely recommendations to solve the problems created. We recommend that the owner retain CSI to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of the recommendations.

This report is based on the provided project information, the subsurface conditions observed at the time of the report, and our experience with similar conditions. As such, it cannot be applied to other project sites, types, or combinations thereof. If the Project Information section in this report contains incorrect information or if additional information is available, you should convey the correct or additional information to us and retain us to review our recommendations. Our recommendations may then require modification.

No section or portion of this report (including Appendix information) can be used as a stand alone article to make distinct changes or assumptions. The entire report and Appendix should be used together as one resource. We wish to remind you that our exploration services include storing the soil samples collected and making them available for inspection for 30 days. The samples are then discarded unless you request otherwise. Please inform us if you wish to keep any of the obtained samples.

APPENDIX

Site Location Plan
Boring Location Plan
Key to Symbols and Descriptions
Soil Boring Logs
Field Testing Procedures
Summary of Lab Testing Table(s) and Lab Testing Sheets
Laboratory Testing Procedures



Site Location Plan adapted from USGS Corbin Topographic Quadrangle map dated 1970 (photorevised 1978), with further adaptation by CSI personnel.

FOR ILLUSTRATION PURPOSES ONLY

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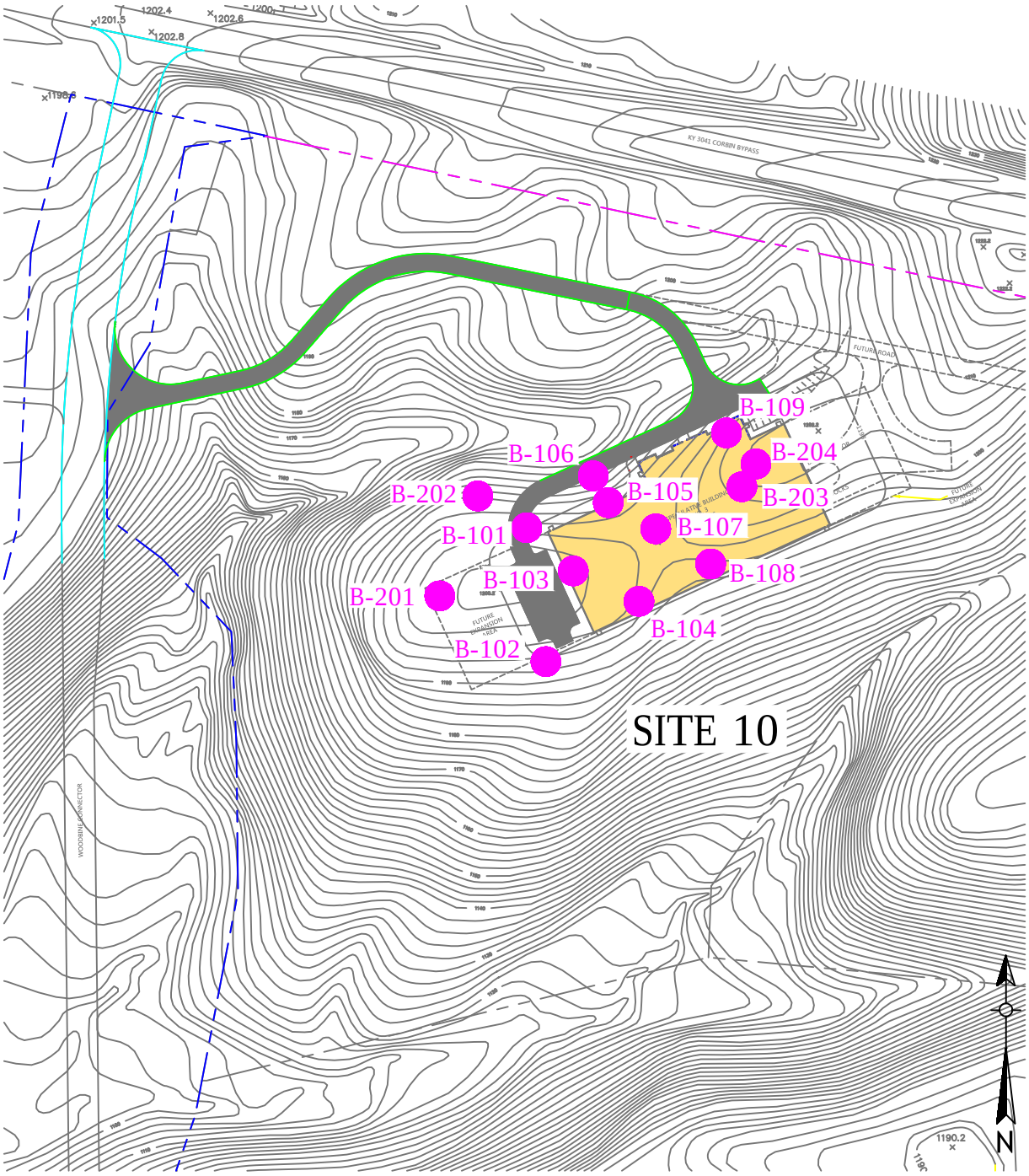
Lexington, Kentucky 40505
859.309.6021 Office | 888.792.3121 Fax
www.csikentucky.com

TITLE: SITE LOCATION PLAN		Project No: LX150023	Drawn By: JAC
PROJECT: PROJECT COMET SITE 10 CORBIN, KENTUCKY		Date: February 27, 2015	Checked By: TG
		Scale: Not To Scale	Drawing No: 1 of 1



Boring Location Plan adapted from provided Site Grading Plan, with further adaptation by CSI personnel.

Elevations were estimated using provided topographic information.

LEGEND

B-XXX BORING LOCATIONS

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TITLE: BORING LOCATION PLAN	Project No: LX150023	Drawn By: JAC
PROJECT: PROJECT COMET SITE 10 CORBIN, KENTUCKY	Date: February 27, 2015	Checked By: TG
	Scale: Not To Scale	Drawing No: 1 of 2

Consulting Services Incorporated
LEXINGTON | LOUISVILLE | CINCINNATI

Geotechnical Boring Information Sheet

Sample Type Symbols	
Splitspoon (SPT)	
Dynamic Cone Penetrometer (DCP)	
Shelby Tube	
Grab	
Bulk	
Rock Core	

Surface Symbols	
Topsoil	
Asphalt	
Concrete	
Lean Clay	
Fat Clay	
Sandy Clay	
Silt	
Elastic Silt	
Lean Clay to Fat Clay	
Gravelly Clay	
Sandy Silt	
Gravelly Silt	
Sand	
Gravel	
Fill	
Void	
Limestone	
Sandstone	
Shale/Siltstone	
Weathered Rock	

Samples Strength Descriptors	
Cohesive Soils:	N
Very Soft	0-1
Soft	2-4
Firm	5-8
Stiff	9-15
Very Stiff	16-30
Hard	31+
Non-cohesive Soils:	
Very Loose	0-4
Loose	5-10
Firm	11-20
Very Firm	21-30
Dense	30-50
Very Dense	51+

Definitions

SPT-"Splitspoon" or standard penetration test. Blow counts are number of drops required for a 140 lb hammer dropping 30 inches to drive the sampler 6 inches.

N-value is the addition of the last two intervals of the 18-inch sample.

Shelby tubes are often called "undisturbed samples". They are directly pushed into the ground, twisted, allowed to rest for a small period of time and then pulled out of the ground. Tops and bottoms are cleaned and then sealed.

Sample classification is done in general accordance with ASTM D2487 and 2488 using the Unified Soil Classification System (USCS) as a general guide.

Soil moisture descriptions are based on the recovered sample observations. The descriptors are dry, slightly moist, moist, very moist and wet. These are typically based on relative estimates of the moisture condition of a visual estimation of the soils optimum moisture content (EOMC). Dry is almost in a "dusty" condition usually 6 or more percent below EOMC. Slightly moist is from about 6 to 2 percent below EOMC at a point at which the soil color does not readily change with the addition of water. Moist is usually 2 percent below to 2 percent above EOMC and the point at which the soil will tend to begin forming "balls" under some pressure in the hand. Very moist is usually from about 2 percent to 6 percent above EOMC and also the point at which it's often considered "muddy". Wet soil is usually 6 or more percent above EOMC and often contains free water or the soil is in a saturated state.

Silt or Clay is defined at material finer than a standard #200 US sieve (<0.075mm) Sand is defined as material between the size of #200 sieve up to #4 sieve. Gravel is from #4 size sieve material to 3". Cobbles are from 3" to 12". Boulders are over 12".

Rock hardness is classified as follows:

Very Soft:	Easily broken by hand pressure
Soft:	Ends can be broken by hand pressure; easily broken with hammer
Medium:	Ends easily broken with hammer; middle requires moderate blow
Hard:	Ends require moderate hammer blow; middle requires several blows
Very Hard:	Many blows with a hammer required to break core

Rock Quality Designation (RQD) is defined as total combined length of 4" or longer pieces of core divided by the total core run length; defined in percentage.

Water or cave-in observed in borings is at completion of drilling each boring unless otherwise noted.

Strata lengths shown on borings represents a rough estimate. Transition may be more abrupt or gradual. Soil borings are representative of that estimated location at that time and are based on recovered samples. Conditions may be different between borings and between sample intervals. Boring information is not to be considered stand alone but should be taken in context with comments and information in the geotechnical report and the means by which the borings are logged, sampled and drilled.

Consulting Services Inc. of Kentucky — Boring Log

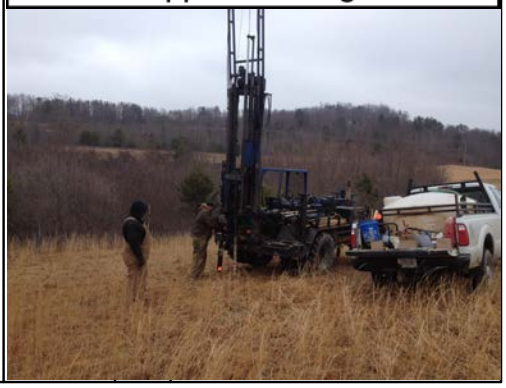
858 Contract Street | Lexington, Kentucky 40505 | 859.309.6021 tel | 888.792.3121 fax

PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-101
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1195

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1195	0		TOPSOIL - 6 inches			1-2-3	18		Dry upon completion of soil augering
			SANDY LEAN CLAY (CL) - FIRM to VERY STIFF, brown, with trace roots hairs, with sandstone fragments, moist			5-5-13	16		
1192	3		CLAYEY SAND (SC) - FIRM to DENSE, orangish brown, with gray silt, moist			11-50/0.3	6		
			Weathered Rock						
1189	6		Auger Refusal at 4.9 feet						
1186	9								
1183	12								
1180	15								
1177	18								
1174	21								

Photo of Approx. Boring Location



Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-102
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1193

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1193	0		TOPSOIL - 3 inches			2-2-2	17		Dry upon completion of soil augering
			CLAYEY SAND (SC) - LOOSE to FIRM, brown to orange, with trace root hairs, moist			4-8-11	14		
1190	3					6-9-11	17		
1187	6					9-11-16	15		
			Encountered sandstone fragments at 7.5 feet						
1184	9		FAT CLAY (CH) - VERY STIFF to HARD, orange, mottled, gray, with sand, moist			8-10-13	18		
1181	12								
1178	15					8-19-25	18		
			SHALE - heavily weathered, HARD, dark gray						
1175	18					22-50/0.1	6		
			Weathered Rock						
1172	21		Auger Refusal at 20.7 feet						

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-103
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1198

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1198	0		TOPSOIL - 4 inches			1-2-3	18		Dry upon completion of soil augering
			SANDY LEAN CLAY (CL) - FIRM to VERY STIFF, brown to orangish brown, with pinkish gray sandstone below 2.5 feet, moist to wet			3-5-30	18		
1195	3		FAT CLAY (CH) - HARD, gray to orangish brown, with sand, moist			8-16-50/0.3	15		
1192	6		Auger Refusal at 5.6 feet						
1189	9								
1186	12								
1183	15								
1180	18								
1177	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-104
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1195

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1195	0		TOPSOIL - 3 inches			2-2-2	18		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as SOFT, brown clay, with trace root hairs, with rock fragments, moist			5-10-50/0.1	11		
1192	3		SANDY LEAN CLAY (CL) - VERY STIFF, orangish brown to gray, with weathered sandstone fragments (from 4.3 to 4.6 feet), moist			23-14-17	12		
1189	6		FAT CLAY (CH) - VERY STIFF to HARD, gray to brown, with black oxide staining at 7.7 feet, with sand, moist			14-14-18	17		
1186	9		Weathered Rock			50/0.4	0		
			Auger Refusal at 10.7 feet						
1183	12								
1180	15								
1177	18								
1174	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-105
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1192

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1192	0		TOPSOIL - 5 inches			2-1-2	17		Dry upon completion of soil augering
			LEAN CLAY (CL) - SOFT, brown, with trace rock fragments, with trace sand, with root hairs, moist			9-12-50/0.4	11		
1189	3		SANDY LEAN CLAY (CL) - HARD, orangish brown, moist						
			SANDSTONE - weathered to heavily weathered, HARD			37-50/0.4	9		
1186	6		Auger Refusal at 5.4 feet						
1183	9								
1180	12								
1177	15								
1174	18								
1171	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-106
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1184

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1184	0		TOPSOIL - 4 inches			2-2-3	16		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as FIRM to STIFF, brown clay, with trace root hairs, with rock fragments, moist			5-5-7	12		
1181	3		Encountered sandstone fragments from 1.5 to 1.8 feet						
			SANDY LEAN CLAY (CL) - STIFF to HARD, orangish brown to gray brown, moist			14-23-27	16		
			SANDSTONE - heavily weathered, HARD						
1178	6		Weathered Rock						
			Auger Refusal at 5.8 feet						
1175	9								
1172	12								
1169	15								
1166	18								
1163	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-107
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1195

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1195	0		TOPSOIL - 4 inches			2-2-3	18		Dry upon completion of soil augering
			LEAN CLAY (CL) - FIRM, brown, with trace root hairs, with rock fragments, moist			6-10-30	17		
1192	3		SANDY LEAN CLAY (CL) - HARD, orangish brown, with black oxide staining, with red sandstone fragments, moist						
			SANDSTONE - highly weathered, HARD			50/0.3	0		
1189	6		Weathered Rock						
			Auger Refusal at 5.8 feet						
1186	9								
1183	12								
1180	15								
1177	18								
1174	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

858 Contract Street | Lexington, Kentucky 40505 | 859.309.6021 tel | 888.792.3121 fax

PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-108
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1194

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1194	0		TOPSOIL - 8 inches			2-2-4	14		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as FIRM, brown clay, with trace rock fragments, with trace root hairs, moist to damp			4-5-5	2		
1191	3		Encountered sandstone fragments from 1.4 to 1.8 feet						
			FAT CLAY (CH) - STIFF to HARD, orangish brown to reddish gray, with trace rock fragments, with black oxide staining, with sand, moist			9-15-50/0.1	11		
1188	6		SANDSTONE - weathered, HARD						
			Auger Refusal at 5.7 feet						
1185	9								
1182	12								
1179	15								
1176	18								
1173	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-109
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1198

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1198	0		TOPSOIL - 2 inches			2-3-5	16		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as FIRM, light brown clay, with trace root hairs, with trace rock fragments, moist			10-12-12	17		
1195	3		Encountered weathered sandstone seams at 1.4 feet and 2 feet FAT CLAY (CH) - VERY STIFF to HARD, orangish brown, with sand, damp			12-17-18	18		
1192	6		SANDSTONE - heavily weathered, HARD			50/0.2	0		
			Weathered Rock						
			Auger Refusal at 7.7 feet						
1189	9								
1186	12								
1183	15								
1180	18								
1177	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-201
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1199

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1199	0		TOPSOIL - 3 inches			3-3-4	15		Dry upon completion of soil augering
			CLAYEY SAND (SC) - LOOSE to FIRM, brown to orange, with trace root hairs, moist			3-7-13	16		
1196	3		SANDSTONE - weathered, orange to white, HARD			26-50/0.2	6		
1193	6		Boring Terminated at 5.5 feet						
1190	9								
1187	12								
1184	15								
1181	18								
1178	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-202
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1190

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1190	0		TOPSOIL - 2 inches			2-14-5	13		Dry upon completion of soil augering
			CLAYEY SAND (SC) - FIRM, orangish brown with black streaks, with trace root hairs, with sandstone fragments, moist			4-5-8	14		
1187	3								
			Weathered Rock			50/0.2	0		
			Auger Refusal at 4.3 feet						
1184	6								
1181	9								
1178	12								
1175	15								
1172	18								
1169	21								

Photo of Approx. Boring Location

No Photo Available

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-202A
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1190

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1190	0		Sounding - no samples taken Offset 5 feet east from boring B-202 to verify shallow depth to rock						Dry upon completion of soil augering
1187	3								
			Auger Refusal at 4.3 feet						
1184	6								
1181	9								
1178	12								
1175	15								
1172	18								
1169	21								

Photo of Approx. Boring Location

No Photo Available

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

Consulting Services Inc. of Kentucky — Boring Log

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-203
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1200

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1200	0		TOPSOIL - 5 inches			1-2-3	18		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as FIRM to HARD, brown clay, with root hairs, with trace rock fragments, moist			2-28-50/0.3	15		
1197	3		SANDSTONE - highly weathered, HARD						
			Weathered Rock						
			Auger Refusal at 3.3 feet						
1194	6								
1191	9								
1188	12								
1185	15								
1182	18								
1179	21								

Photo of Approx. Boring Location

No Photo Available

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

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PROJECT: Project Comet
PROJECT NUMBER: LX150023
BORING NUMBER: B-204
LOCATION: Corbin, Kentucky
WEATHER: Cloudy, 30's
DRILL RIG TYPE: CME-550 ATV
DRILLER: Geo-Drill
DATE DRILLED: 02-10-2015
DRILLING METHOD: 4" OD SFA
CSI FIELD REP: T. Greenwell
CLIENT: MSE of Kentucky, Inc.

TOP OF GROUND ELEVATION: 1202

ELEV. (feet)	DEPTH (feet)	Water Level	Strata Description	SOIL TYPE	SAMPLES	SPT Blow Counts	Recovery (in)	RQD (%)	Notes
1202	0		TOPSOIL - 5 inches			2-4-5	13		Dry upon completion of soil augering
			POSSIBLE FILL - sampled as STIFF, brown clay, with root hairs, with trace rock fragments, with sandstone fragments (from 1 to 1.6 feet), moist			6-9-12	13		
1199	3		SANDY LEAN CLAY (CL) - VERY STIFF to HARD, orangish brown, with trace sandstone fragments, moist			8-12-50/0.3	16		
			Weathered Rock						
1196	6		Boring Terminated at 5.3 feet						
1193	9								
1190	12								
1187	15								
1184	18								
1181	21								

Photo of Approx. Boring Location

Please note: Boring log is for information only. Soil borings only show conditions observed in specific recovered samples at that particular location. Elevations were estimated using topographic information.

FIELD TESTING PROCEDURES

Field Operations: The general field procedures employed by CSI are summarized in ASTM D 420 which is entitled "Investigating and Sampling Soils and Rocks for Engineering Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the subsurface conditions. These techniques are:

a. Continuous 2-1/2 or 3-1/4 inch I.D. hollow stem augers;

b. Wash borings using roller cone or drag bits (mud or water);

c. Continuous flight augers (ASTM D 1425).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field test boring record by the chief driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soils in general accordance with the procedures outlined in ASTM D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

The detailed data collection methods using during this study are discussed on the following pages.

Soil Test Borings: Soil test borings were made at the site at locations shown on the attached Boring Plan. Soil sampling and penetration testing were performed in accordance with ASTM D 1586.

The borings were made by mechanically twisting a hollow stem steel auger into the soil. At regular intervals, the drilling tools were removed and soil samples obtained with a standard 1.4 inch I.D., 2 inch O.D., split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. Test Boring Records are attached which graphically show the soil descriptions and penetration resistances.

Core Drilling: Refusal materials are materials that cannot be penetrated with the soil drilling methods employed. Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Prior to coring, casing is set in the drilled hole through the overburden soils, if necessary, to keep the hole from caving. Refusal materials are then cored according to ASTM D 2113 using a diamond-studded bit fastened to the

end of a hollow double tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovered is measured, the samples are removed and the core is placed in boxes for storage.

The core samples are returned to our laboratory where the refusal material is identified and the percent core recovery and rock quality designation is determined by a soils engineer or geologist. The percent core recovery is the ratio of the sample length obtained to the depth drilled, expressed as a percent. The rock quality designation (RQD) is obtained by summing up the length of core recovered, including only the pieces of core which are four inches or longer, and dividing by the total length drilled. The percent core recovery and RQD are related to soundness and continuity of the refusal material. Refusal material descriptions, recoveries, and RQDs are shown on the "Test Boring Records".

Hand Auger Borings and Dynamic Cone Penetration Testing: Hand auger borings are performed manually by CSI field personnel. This consists of manually twisting hand auger tools into the subsurface and extracting “grab” or baggie samples at intervals determined by the project engineer. At the sample intervals, dynamic cone penetration (DCP) testing is performed. This testing involves the manual raising and dropping of a 20 pound hammer, 18 inches. This “driver” head drives a solid-1¾ inch diameter cone into the ground. DCP “counts” are the number of drops it takes for the hammer to drive three 1¾ inch increments, recorded as X-Y-Z values.

Test Pits: Test pits are excavated by the equipment available, often a backhoe or trackhoe. The dimensions of the test pits are based on the equipment used and the power capacity of the equipment. Samples are taken from the spoils of typical buckets of the excavator and sealed in jars or “Ziplock” baggies. Dynamic Cone Penetration or hand probe testing is often performed in the upper few feet as OSHA standards allow. Refusal is deemed as the lack of advancement of the equipment with reasonable to full machine effort.

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Test Boring Records". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of the hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The time of boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

LABORATORY TESTING SUMMARY SHEET

Project Comet Site 10 - Corbin, Kentucky
CSI PROJECT NUMBER - LX150023

Boring No.	Depth (feet)	Sample Type*	USCS Classification	Natural Moisture Content %	% Finer No. 200	Atterberg Limits Information			CBR (Percent at 0.1")	Max. DD (pcf)	OMC (%)	Qu (psf)	Swell Pressure (psf)
						LL	PL	PI					
B-101	0.0-1.5	SS		24.9									
	1.5-3.0	SS		21.9									
B-102	0.0-1.5	SS		8.1									
	1.5-3.0	SS		18.9									
	4.0-5.5	SS		18.3									
	6.5-8.0	SS		19.6									
	9.0-10.5	SS		20.5									
B-103	0.0-1.5	SS		21.0									
	1.5-3.0	SS		32.2									
B-104	0.0-1.5	SS		24.3									
	1.5-2.6	SS		21.1									
	4.0-5.5	SS		17.3									
B-105	0.0-1.5	SS		20.0									
	1.5-2.9	SS		20.1									
B-106	0.0-1.5	SS		19.5									
	1.5-3.0	SS		21.2									
B-107	0.0-1.5	SS		20.0									
	1.5-3.0	SS		24.2									
B-108	0.0-1.5	SS		17.9									
	1.5-3.0	SS		6.7									
B-109	0.0-1.5	SS		26.1									
	1.5-3.0	SS		11.4									

* SS = splitspoon sample, UD = undisturbed (Shelby tube) sample, BULK = bulk sample, GRAB = grab sample, CORE = rock core sample

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LABORATORY TESTING SUMMARY SHEET

Project Comet Site 10 - Corbin, Kentucky
CSI PROJECT NUMBER - LX150023

Boring No.	Depth (feet)	Sample Type*	USCS Classification	Natural Moisture Content %	% Finer No. 200	Atterberg Limits Information			CBR (Percent at 0.1")	Max. DD (pcf)	OMC (%)	Qu (psf)	Swell Pressure (psf)
						LL	PL	PI					
B-201	0.0-1.5	SS		20.8									
	1.5-3.0	SS		18.7									
B-202	0.0-1.5	SS		15.4									
	1.5-3.0	SS		18.6									
B-203	0.0-1.5	SS		18.4									
B-204	0.0-1.5	SS		21.3									
	1.5-3.0	SS		16.9									
Bulk 1	1.0-3.0	BULK	CL	17.3	56.6	29	19	10		103.4	20.7		

* SS = splitspoon sample, UD = undisturbed (Shelby tube) sample, BULK = bulk sample, GRAB = grab sample, CORE = rock core sample

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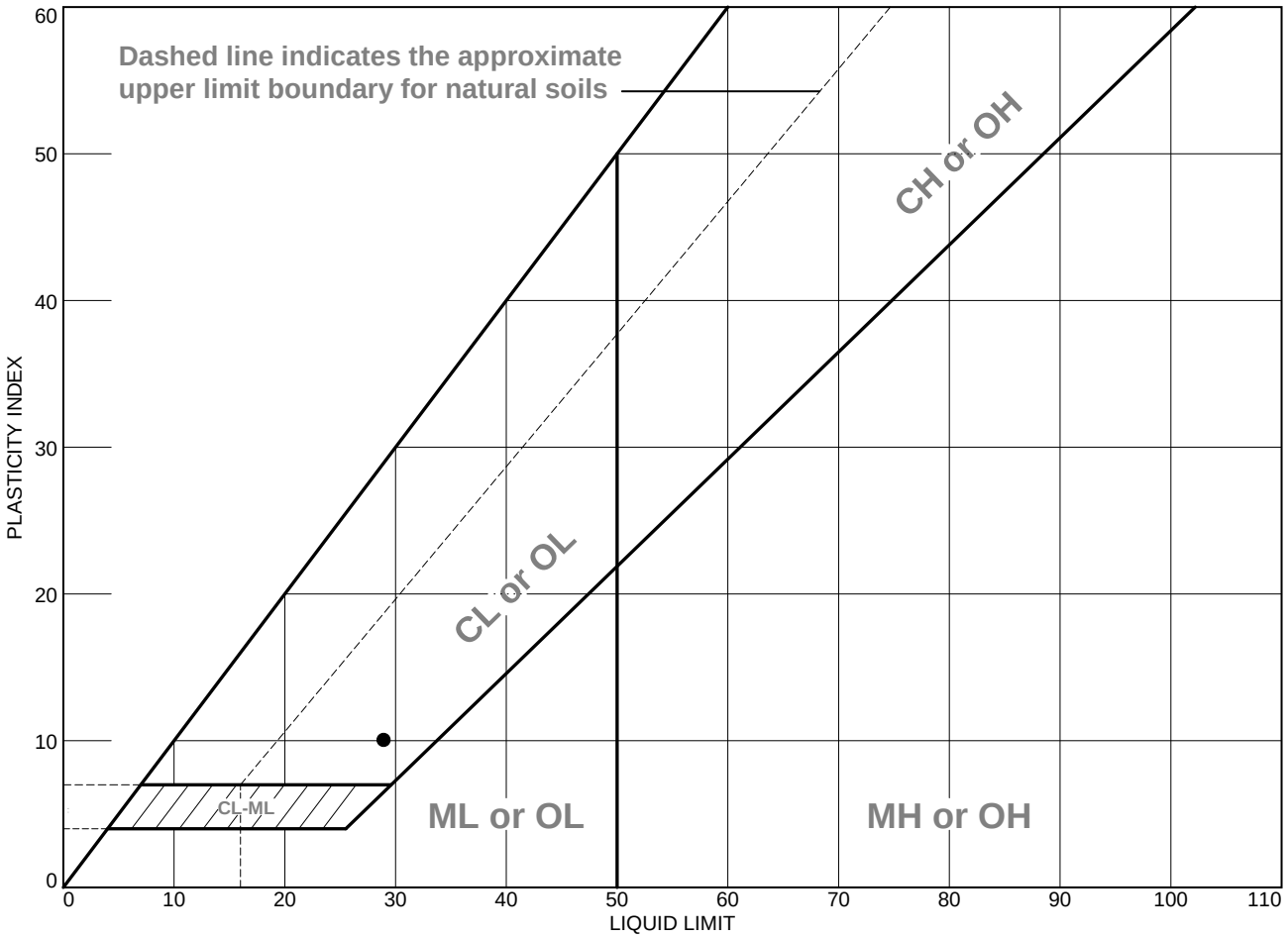
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	orangish brown SANDY LEAN CLAY	29	19	10		56.6	CL

Project No. LX150023 **Client:** MSE of Kentucky, Inc.

Project: Project Comet Site 10 - Corbin, Kentucky

●**Source of Sample:** Borings **Depth:** 1.0-3.0 **Sample Number:** Bulk 1

Remarks:

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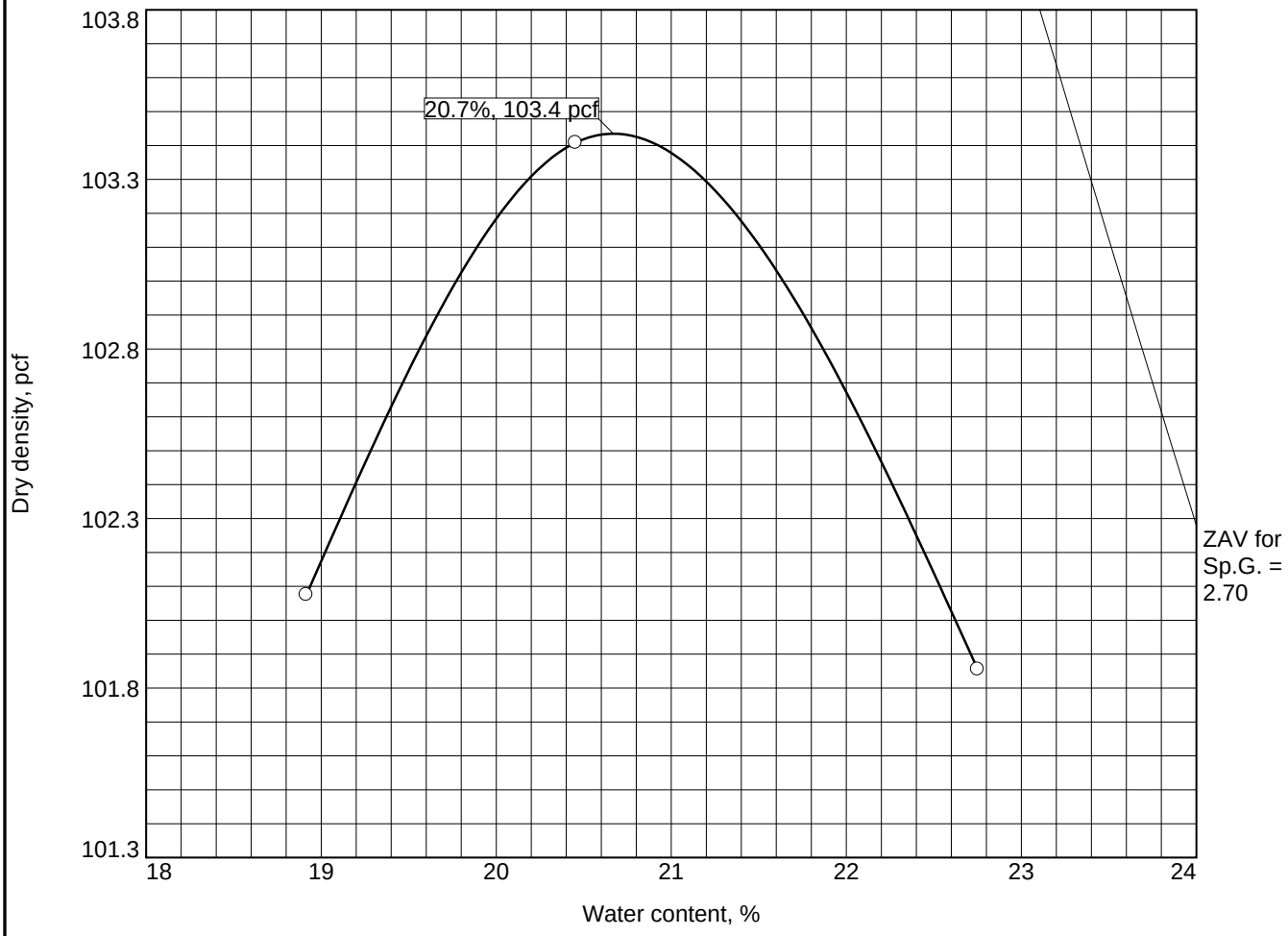
Figure

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1.0-3.0	CL		17.3		29	10		56.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.4 pcf Optimum moisture = 20.7 %	orangish brown SANDY LEAN CLAY

Project No. LX150023 **Client:** MSE of Kentucky, Inc.
Project: Project Comet Site 10 - Corbin, Kentucky

○**Source of Sample:** Borings **Sample Number:** Bulk 1

Remarks:

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Figure

LABORATORY TESTING PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our "Test Boring Records."

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D 2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

Rock Classification: Rock classifications provide a general guide to the engineering properties of various rock types and enable the engineer to apply past experience to current situations. In our explorations, rock core samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The rock cores are classified according to relative hardness and RQD (see Guide to Rock Classification Terminology), color, and texture. These classification descriptions are included on our Test Boring Records.

Atterberg Limits: Portions of the samples are taken for Atterberg Limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D 4318.

Moisture Content: The Moisture Content is determined according to ASTM D 2216.

Percent Finer Than 200 Sieve: Selected samples of soils are washed through a number 200 sieve to determine the percentage of material less than 0.074 mm in diameter.

Rock Strength Tests: To obtain strength data for rock materials encountered, unconfined compression tests are performed on selected samples. In the unconfined compression test, a cylindrical portion of the rock core is subjected to increasing axial load until it fails. The pressure required to produce failure is recorded, corrected for the length to diameter ratio of the core and reported.

Compaction Tests: Compaction tests are run on representative soil samples to determine the dry density obtained by a uniform compactive effort at varying moisture contents. The results of the test are used to determine the moisture content and unit weight desired in the field for similar soils. Proper field compaction is necessary to decrease future settlements, increase the shear strength of the soil and decrease the permeability of the soil.

The two most commonly used compaction tests are the Standard Proctor test and the Modified Proctor test. They are performed in accordance with ASTM D 698 and D 1557, respectively. Generally, the Standard Proctor compaction test is run on samples from building or parking areas where small compaction equipment is anticipated. The Modified compaction test is generally performed for heavy structures, highways, and other areas where large compaction equipment is expected. In both tests a representative soil sample is placed in a mold and compacted with a compaction hammer. Both tests have three alternate methods.

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/ Layer
Standard	A	5.5 lb./12"	4"	No. 4 sieve	3	25
D 698	B	5.5 lb./12"	4"	3/8" sieve	3	25
	C	5.5 lb./12"	6"	3/4" sieve	3	56

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/ Layer
Modified	A	10 lb./18"	4"	No. 4 sieve	5	25
D 1557	B	10 lb./18"	4"	3/8" sieve	5	25
	C	10 lb./18"	6"	3/4" sieve	5	56

The moisture content and unit weight of each compacted sample is determined. Usually 4 to 5 such tests are run at different moisture contents. Test results are presented in the form of a dry unit weight versus moisture content curve. The compaction method used and any deviations from the recommended procedures are noted in this report.

Laboratory California Bearing Ratio Tests: The California Bearing Ratio, generally abbreviated to CBR, is a punching shear test and is a comparative measure of the shearing resistance of a soil. It provides data that is a semi-empirical index of the strength and deflection characteristics of a soil. The CBR is used with empirical curves to design pavement structures.

A laboratory CBR test is performed according to ASTM D 1883. The results of the compaction tests are utilized in compacting the test sample to the desired density and moisture content for the laboratory California Bearing Ratio test. A representative sample is compacted to a specified density at a specified moisture content. The test is performed on a 6-inch diameter, 4.58-inch-thick disc of compacted soil that is confined in a cylindrical steel mold. The sample is compacted in accordance with Method C of ASTM D 698 or D 1557.

CBR tests may be run on the compacted samples in either soaked or unsoaked conditions. During testing, a piston approximately 2 inches in diameter is forced into the soil sample at the rate of 0.05 inch per minute to a depth of 0.5 inch to determine the resistance to penetration. The CBR is the percentage of the load it takes to penetrate the soil to a 0.1 inch depth compared to the load it takes to penetrate a standard crushed stone to the same depth. Test results are typically shown graphically.