January 17, 2025

SITE WORK GEOTECHNICAL REPORT

ESTILL COUNTY MIDDLE SCHOOL

IRVINE, KY

CETCO

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January 17, 2025

Estill County Schools
c/o DECO Architects and Sams and DeGough Engineering
Sent via email: s.toby@decoarchitects.com and logan@sd-eng.org

Subject: **Site Work Geotechnical Report**
New Estill County Middle School
Irvine, Kentucky
CETCO Project No. 1606-24-0102

Dear Sirs:

CETCO appreciates the opportunity to provide our services to you and the design team leaders. As follows, we are providing our "site work" geotechnical report. Our services were provided in general accordance with our proposal number CET 2709-24-0321, dated, December 17, 2024. Also, please note the report appendix which contains many detailed findings as well as our standard of care for providing our services. As stated, this report contains details for the "site work" (mass earthwork, "mountain top removal" and building/site pad design and construction. The report address initial recommendations for floor slabs and building foundations, but the final recommendations will be provided in a 2nd phase of drilling and reporting after earthwork is complete.

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

Cordially,
CETCO

Hunter Hawkins, SI
Staff Geologist

Joseph S. Cooke, P.E.
Principal
Licensed KY 21244

Attachments: Geotechnical Report and Appendix

Cooke Engineering and Testing Company

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NEW ESTILL COUNTY MIDDLE SCHOOL, IRVINE, KENTUCKY

SITE WORK GEOTECHNICAL SERVICES

REPORT SUMMARY

We provided our services in general accordance with our previous discussions and our proposal number 2709-24-0321, dated December 12, 2024. CETCO has consulted with your office and discussed the geotechnical services including a "phased approach" for sampling and exploration with soil test borings, site field services by our office, lab testing and analysis and providing a geotechnical report.

These services included providing our opinion of the conditions encountered for the purpose of design and development of a vacant site into a potential new middle school campus project. The project plans are in the initial stage, and may change. CETCO should be advised on any changes from the information presented in our report.

The site is a ridge line area about 1000 feet southwest of the existing Estill County Middle School in Irvine, Kentucky. Potential concept plans indicate a "X-Shaped" winged building approximately of at least 100,000 square feet in size. The site grading will require a large amount of cut (removal of much of the ridge line). Initial planned finished sub grade elevations range from about 780 to 785 feet at or near the building, which indicates cuts as deep as 60 to 80 feet.

This introductory section, which has previously been discussed with your office, provides a brief summary for quick reference. The report that follows provides much greater details for planning, design and construction of the overall site work and building pads. General foundation planning recommendations are also provided in this initial phase report. A second phase of services will be required by CETCO (per our contract) at completion of mass grading to provide greater detailed recommendations for project foundations and floor slabs.

In general, we encountered "thin" (less than 2 to 3 feet) overburden of mostly brown silty clay. However, much of this material is likely mixed with tree roots and topsoil (i.e., little to no clean soil). Shale bedrock (with some thin seams of dolomite and also some isolated pyrite lenses) was encountered in all borings ranging as shallow as 1.5 feet at the site. Bedrock coring confirmed that the shale material is present down to below initial planned cut elevations.

The site is suitable for the development. Once the pad is leveled and filled properly, we believe shallow spread footings can be used for the proposed building. Conventional slab-on-grade floors would also be suitable for the building.

The primary geotechnical concern at the site is potential "heaving" due to the weathering of pyritic sulfur (naturally occurring within the shale bedrock). The mass ridgeline cut will expose the bedrock over the entire building footprint. We are recommending to cap the entire building footprint with 4 feet of compacted clay (sealing the shale from future weathering).

Other issues such as swelling clay soils (elastic silt), shallow bedrock and slope construction are present at the site. All of these risks are common for the area.

Details for these issues and recommendations for design and construction as well as our other recommendations are discussed in the report.

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1 PROJECT BACKGROUND

1.1 CETCO SCOPE OF SERVICES

Our overall geotechnical scope is being provided in “phases”. This report discusses the initial phase of exploration primarily for the purpose of site work: mass earthwork (overall site cut and fill) and construction of the main building pad. We anticipate the other site work features such as main road construction, slopes, drainage and athletic fields will require additional recommendations once the main building area pad is set. Also, the planning and concepts of the project foundations and floor slabs will be addressed in this initial phase, but actual design recommendations will be addressed in the second phase of exploration and reporting after completion of the site mass cut and fill. For this initial phase, the exploration was limited to borings along a former cemetery road along the ridge top. This included 6 soil test borings (borings B-1 through B-6) and 19 auger rock soundings (S-1 through S-19). We are issuing this initial phase geotechnical report as follows.

1.2 PROVIDED INFORMATION

We were provided information for the project as follows:

Provided Document	Source
Site drawings are in the “concept” stage. The provided sketch shows the potential footprint/building pad layout on the site.	Deco Architects
Site/property topographic information and lot layout.	Midwest Engineering

The following information summarizes our understanding of the project conditions

Condition	Specifics
Building/ Structure Information	One main “X-shaped” winged, single story building with a footprint several hundred feet across at each wing and a new gymnasium at the westernmost wing. The building structure will likely include conventional shallow spread footings, masonry load-bearing walls, possible ICF concrete construction, pre-engineered metal framing and some structural steel framing. The maximum foundation loading were not been provided. We have assumed loads of less than 150 kips for isolated columns and less than 6 to 8 kips per linear foot for any continuous footings.
Site Grading	A preliminary finished grading elevation is at around 780 to 785 feet. Site mapping would indicate cuts of 50 to 80 feet, and fills in adjacent valleys of at least 20 to 40 feet. Final slope heights (cut and/or fill) are not known. Cut and fill slopes of 20 or more feet would be likely.
Pavement areas	Typical educational project pavement areas: passenger car parking areas, small area loading docks, bus “loop” and parking, event parking and a main 2-lane campus road.

If any of the aforementioned information is incorrect or requires modification, please let CETCO know. Changes to our reporting, recommendations and opinions may be required.

1.3 PUBLISHED SITE AND AREA INFORMATION

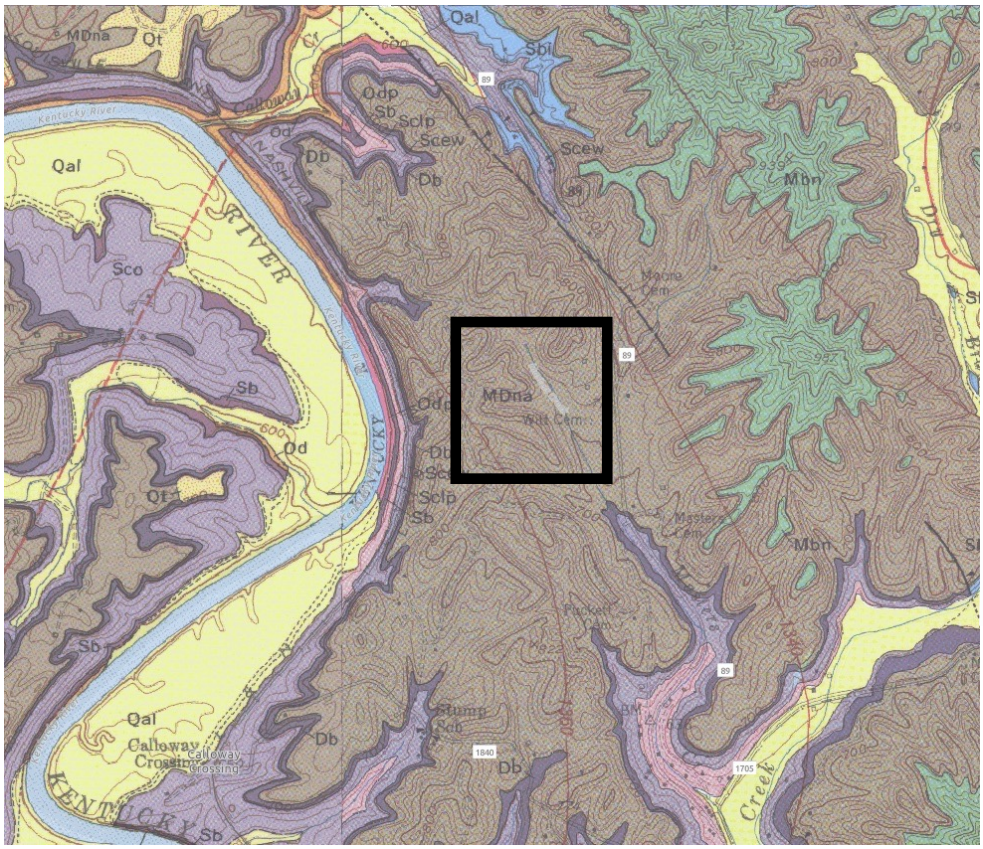
We have reviewed the following published/public domain site information.

AREA TOPOGRAPHY AND PHYSIOGRAPHY

The site is located at or near the boundary of the Outer Bluegrass and Eastern Kentucky Coal Field regions of Kentucky in the area called “The Knobs”. The terrain is hilly, with rugged uplands and narrow ridges being the highest elevated areas. The meandering Kentucky river runs through Estill County creating deeply entrenched valleys and is the lowest elevations in the area. The Pottsville Escarpment separates the Outer Bluegrass Region and the Eastern Kentucky Coal Field region, where the bedrock changes from more limestone type materials to combinations of shale and siltstone materials. Elevations in the site vicinity range from 600 to 970 feet, with elevations at the site around 700 to 850 feet according to published topography, our site GPS measurements.

SITE GEOLOGY

The Kentucky Geologic Survey public information was reviewed including the USGS mapped geologic information for the site (the Irvine Geological Quadrangle, 1976). Available geologic mapping indicates the site vicinity is underlain by the New Albany Shale and Dolomite of Devonian age. New Albany Shale is grayish-black, organic, and commonly contains iron sulfide minerals such as Pyrite. These iron sulfide minerals can cause oxidation when exposed to moisture, and cause rapid weathering. These sulfates develop through crystal growth and undergo volume changes, which can lead to the expansion and lifting of the soil (heaving). The shale weathered gray to dark yellowish brown due to limonite staining. A study done by Warren Anderson with Kentucky Geological Survey analyzed the shale conditions using X-ray diffraction and fluorescence at the existing middle school. The shale was 60% clay, 30% quartz silt, 5% pyrite nodules and less than 5% calcite. Pyritic shale heave has been known to cause structural damage to buildings in Estill County. An unnamed northwest-trending fault is mapped about 1000 feet north of the site along the main main Irvine-Paint Creek Fault System. The images below show the mapped geology.



MINE and OIL/GAS MAPPING

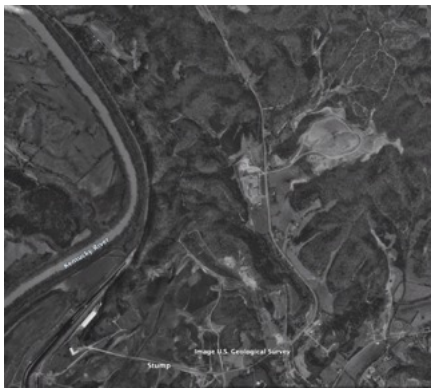
Kentucky mine mapping information systems was reviewed for the site and site area. No coal seams are mapped at or near the site. However, mine permits for the site area (immediately to the south and west of the site) appear to be coal “refuse recovery” including gob (garbage of bituminous) and coal slurry. There is a coal refuse plant in the near vicinity, however there are no indications that any mining occurred below the site according to available permits and maps reviewed. Based on our observations and information reviewed, it is our opinion that the mining risk associated with former mines (subsidence, mine run-offs, waste fills present, etc.) is low compared to areas one or more miles away from the site. It should always be noted that “illegal”, “non-permit” or “un-mapped” mines are always possible in any area. We cannot ascertain such unknown risks.

Oil/Gas Wells: The area of Estill County/ has a history of oil and gas production (Irvine furnace field). These wells are usually 1500 or more feet below the ground surface and pose little to no

threat to top of ground stability. The majority risk is due to the presence of any actual well on a property. No such wells are mapped at the site or within the close vicinity.

AERIAL MAPPING AND SITE HISTORICAL DEVELOPMENT

Aerial information back as far as 1997 was readily available for the site. Images showing site progression. Photo on the left is the aerial from 1997, showing undeveloped wooded land within the site vicinity. The Estill County school system east of the site was built prior to 1997. The site vicinity has had minimal changes and appears that the site conditions are as they appear in the most recent aerial from 2024. The small gravel/dirt road at the site ridge line is obvious in some aerial photos. However, no structures such as houses or barns were observed in the photos or while on site.



1997 : Aerial from Google Earth

2006 : Aerial from Google Earth

2024 : Aerial from Google Earth

SITE SOIL SURVEY MAPPING

The Soil Survey of the site area was also reviewed. Issues affecting the site development included: slope construction, depth to soft/hard bedrock, and shrink swell clay soils. Some of the overburden is classified as acidic due to the underlying pyritic New Albany shale. We are providing recommendations to address these issues.

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2 CETCO FINDINGS

We provided a site and area reconnaissance, logged soil test borings and explored the site using those borings. The following sections discuss our findings. Mr. Hunter Hawkins, staff geologist and Mr. Joe Cooke, PE our Principal Engineer provided our field services including site reconnaissance and logging of the borings in the field, during the exploration on December 19th, 30th and 31st, 2024.

2.1 CURRENT SITE SURFACE CONDITIONS AND OBSERVATIONS

The site is located off of Witt Ridge Road in Irvine, Kentucky. The new main building and campus will be located on the hilltop overlooking the high school and technical school campus, about 1,000 feet southwest of the existing middle school. The current hilltop is mostly undeveloped and densely wooded with a trail (dirt/gravel road) on top of the narrow ridge. The ridge generally runs east-west on the western portion, transitioning to northwest-southeast on the eastern portions. Moderately steep valleys are located downward to the north and south. Near the southeastern most portion of accessible trail, there were multiple small poles including a wooden wall. The drilling was limited to the trail/dirt road and slightly off the edges of the road due to dense tree cover.

The ground surface appeared to be “firm” and did not appreciably rut under the weight of the drill rig during our drilling operations. The site appears to drain well along the road, as the weather conditions prior to drilling drilling included rainy days, but no large-scale ponding of water due to the rain was observed. However, the site easily became “muddy” and “soft” when wet.

Some small amount of shale rock outcropping was observed along the dirt road. Other ground cover included dense trees and some brush cover.

The following page shows photos of the area at the time of our field work.

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Project Site Photos (cont.)-1

Description	Photo
Photo example showing grayish black shale fragments on the top of ground near S-18. Facing south.	
Photo example showing B-3 and S-1 locations which was the furthest east we drilled along the trail. Facing east.	

Project Photos

Description	Photo
Photo example showing the trail on the ridge top. Facing east.	
Photo example showing the elevation increasing near the middle of the trail. Facing northeast.	

Project Site Photos (cont.)

Description	Photo
Photo example showing the highest elevated point along the trail, and where B-1 and core was taken. Most of the water shown was due to core water from drilling. Facing east.	
Photo example showing the drill rig taking soundings just off of the trail. Facing west.	

2.2 SUBSURFACE INFORMATION SUMMARY

A total of 6 soil test borings (B-1 to B-6), 19 auger rock soundings (S-1 to S-19) were utilized to explore the subsurface conditions at the site. The borings were drilled along the old dirt/ gravel road to provide an indication of the site subsurface conditions with proximity to the proposed building location. The boring location plan in the appendix shows the approximate drilling locations.

SUBSURFACE CONDITIONS: At our sampling locations, we encountered a thin layer of native soils. The native soils were generally brown to dark brown in coloring and were classified as a silty lean clay transitioning to an elastic silt with depth. The soils overlie a weathered clayey shale zone (mostly elastic silt), overlying shale bedrock. Below is a table summarizing the soil conditions at the site. Detailed findings are in the Appendix boring logs and laboratory testing pages.

Strata	Thickness	Notes
Topsoil	0-1 inch	Most borings were drilled in the dirt/gravel road, which was stripped of topsoil.
Wooded Areas: likely at least 6 to 8 inches of topsoil or highly organic clays	6-8 inches	Based on visual surface observations.
Native soils: mostly “silty lean clay”, brown to dark brown in coloring with few organics, and generally “slightly moist” and “stiff”.	3-10 inches	All borings showed this strata
Soil-Rock mixed layer: Native soils and weathered shale bedrock zone. The soils were mostly dark brown ***“ELASTIC SILT”*** with some shale fragments. ***SHALE*** was grayish black to dark brown in coloring and generally “slightly moist” and “very stiff”.	1-2 feet	Slightly layered toward bottom of strata
Soft bedrock layer: ***SHALE*** was grayish black to dark brown in coloring and sampled as soft weathered bedrock.	6 inches to 2 feet	Some yellow/orange staining observed in this strata
Competent bedrock: Black to grayish black ***NEW ALBANY SHALE*** with few clay and pyrite seams, fine grained, generally moderately hard.	N/A	Cores taken at B-1, B-4, B-5, and B-6.

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Sampler or auger refusal was encountered in all borings and soundings. However, we were able to penetrate the upper 1 to 5 feet of the black shale in almost every boring. The table below shows our interpretation of the depth to competent (hard) shale bedrock at each boring location. At this depth, rock-excavating equipment (hoe-ram or blasting) is likely required to remove/excavate the material.

BEDROCK and GROUNDWATER CONDITIONS: One 5' core was taken at B-1. The core showed grayish black shale, fine grained, soft to moderately hard. Three "deep" cores were taken at B-4 (70 feet deep), B-5 (40 feet deep), and B-6 (30 feet deep) that showed grayish black shale, with some clay and pyrite seams, fine grained, and soft to moderately hard.

Free water or "wet" conditions were not encountered in any borings or soundings.

Boring Number	Depth to hard shale (feet)
B-1	5.0
B-2	3.8
B-3	1.5
S-1	1.7
S-2	3.5
S-3	3.0
S-4	3.5
S-5	2.9
S-6	2.7
S-7	3.2
S-8	3.0

Boring Number	Depth to hard shale (feet)
S-9	2.4
S-10	3.5
S-11	2.7
S-12	2.5
S-13	3.6
S-14	4.0
S-15	2.7
S-16	2.0
S-17	2.4
S-18	1.5
S-19	4.0

Boring Number	Depth to hard shale (feet)
B-4	5.5
B-5	5.5
B-6	5.5

3 OPINIONS AND DISCUSSION

SUMMARY: In general, the project site is suitable for the proposed new middle school building pad and entrance road. This includes the use of shallow spread footings and conventional building slab-on-grade floors for most typical building types.

3.1 PRIMARY GEOTECHNICAL ISSUES

The following issues are our opinion of the primary geotechnical-related issues at the site. Other issues are likely present, but we believe the following represent the greatest impact to the project budget, schedule, design and construction. Our recommendations address these issues.

- Pyritic Shale - Shrink Swell
- Shrink/Swell Potential of On-Site Clay
- Mass Cut (Rock Excavation and Rock Fill Placement)

Pyritic Shale

The New Albany Shale (aka Chattanooga or Ohio Shale) is mostly dark gray to black, mostly hard to very hard shale with lenses and some layering of pyrite materials (often in sulfur or similar mineral combinations). This is common throughout Estill County, and has led to foundation and structural issues on several projects. This is due to the clay and iron sulfide minerals known as pyrite, that react with water (and air) and to form a sulfuric acid. Due to the reaction, it causes the shale to “split”, crystals form/grow and expand the bedrock materials, typically along bedding plane lines. The heave amounts are often several inches up to over one foot and can have heave uplift pressures of several thousand pounds per square feet (up to 12,000 psf has been measured). This has been observed in the existing middle school, the nearby Carhart facility, the local hospital and other commercial buildings throughout the county. The heaving from the New Albany Shale has occurred in Berea, Stanton, Bardstown, Lebanon Junction, Lebanon, Shepherdsville and and Mt. Washington, Kentucky (and likely other areas too).

The amount and location of heaving on a project area is highly variable, even when similar amounts of expandable material is present. This is due to variable overburden/building “down”

pressures, amounts of exposed moisture/air, some variability in “available” pyrite (organic sulfur pyrite) and different amounts of bonding of the crystals that form. Also, due to this variability and unpredictable risk, areas of non-pyrite containing New Albany Shale will require equal risk treatment despite no measured pyrite content.

Research and experience has indicated that a key to minimize the heaving potential is to avoid exposure of freshly cut bedrock to air/moisture combined conditions over the life of the building. Several means to avoid exposure have proven effective, but most methods require a great deal of experience in the implementation of the method. One such somewhat complex method is the use of bitumen (tars, sprays, pastes, grout or similar bituminous sealant mixtures) cover application. Resisting heave such as the use of rock-anchors can also be effective for foundations, but the anchoring system themselves have been shown to be problematic when anchoring into the additional pyrite containing materials (i.e., New Albany Shale) and the anchors would need to penetrate into non-pyrite materials. The “resisting heave” methods are also not usually cost-effective for slab areas. Lastly, means of altering or lowering acidic levels in soil overburden and upper portions of the New Albany Shale (such as lime treatment) can serve to limit the potential of the water/air and pyrite reaction, but these again require experienced contractors not just with lime treatment, but with lime treatment of pyrite containing materials.

The most cost-effective method for risk reduction to limit the heave potential is a clay soil cap over any exposed shale bedrock. This requires no specialized contractor and the soil is placed as normal compacted structural soil fill. This is the method of heave potential reduction that should be used for this site. At least 4 feet of cover is needed for the building pad. The clay cap should extend at least 10 feet outside the building limits. At least 2 feet of cover if needed for foundations (i.e., 2 feet of clay between the foundation bottom and shale bedrock). The site contains minimal soil cover, so this will likely require a large amount of haul-in from nearby borrow sites. The material should be low to moderate plastic clayey soils (Liquid Limit of less than 50). This cap recommendation applies to any structure deemed to be a building.

Grassy slope or non-structural areas require no cap cover over shale materials (i.e., swelling should not affect their performance). Sidewalk areas outside the 10 feet horizontal limit do not have clay cap requirements, since these areas can facilitate expansion of the ground by means of closely spaced joints (no further than 4 feet apart for conventional sidewalk widths). Pavement areas and athletic fields should have a 12 inch clay cap, which could likely come from on-site soils.

Shrink/Swell Potential of On-Site Clay

The soils on-site are mostly silty lean clay, but they transition to “Elastic Silt” with depth and have Plasticity Indices of around 26 (two samples tested). These materials can have a “moderate” potential for swelling/shrinking when exposed to large fluctuations in moisture over-time. ***The materials should not be used within 5 feet horizontally of any new building areas.***

Mass Cut (Rock Excavation)

The mass excavation at the site will encounter moderately to very hard shale bedrock. Some hard lenses of dolomite are also present. ***The upper 1 to 3 feet of bedrock could likely be removed with a rip-bladed D-8/D-9 or larger dozer. Below this depth, rock-removal equipment such as a hoe-ram or blasting will be required for excavation.***

The upper few feet of shale rock materials will likely deteriorate over-time (slaking process of “turning into clay”). These materials will require “wetting” and “mixing” and “compacting similar to soil” methods of placement. Our earthwork recommendations contain these guidelines. Our earthwork recommendations also discuss “competent rock” fill materials.

Rock cut slope design recommendations for the road can be provided at a later date, once the final roadway elevations for the design are established. In general, the upper 5 to 10 feet of shale bedrock in cut slopes would be classified as non-durable shale (1:1 slopes or flatter for rock cuts), with materials below this depth being classified as durable rock, with near vertical cut slopes possible.

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4 RECOMMENDATIONS

The following recommendations are provided to assist in the planning, design and construction of the project.

4.1 SITE PREPARATION

Timing of Mass Earthwork

Most of the site work will be a mass cut of the ridge line, producing several hundred thousand yards of rock fill. Our borings encountered minimal soil overburden. This would indicate that weather delays associated with “wet soil” or “cold weather” may not be applicable for much of the rock fill. ***The durable shale materials (likely the lower 80% of the rock cut) can be placed during wetter/colder periods of weather.***

However, some of the ***upper rock material is “soft shale”*** which will deteriorate and be similar to “wet soil” and ***would be unsuitable to use during wet and/or freezing weather*** and may require setting aside for later placement. ***The limited soil overburden too cannot be placed properly during wet and/or freezing weather.*** Site grading using this upper rock and/or soil should take place between about late April to early November or consider stockpiling the material for placement during drier/warmer time periods. Moving this material outside this time period will likely encounter wet conditions and weather conditions that will provide little to no assistance with drying the soils. Again, they would require stockpiling or avoidance during these wetter/colder seasons.

General Site Preparation Notes

The following bulleted items are critical to prepare the site for earthwork and additional construction.

- Topsoil and organic materials should be removed (stripped) from the construction area and all structural fill areas. These materials should be wasted from the site or used as topsoil in landscape areas;
- As normal, the ridgeline, hillsides and valley bottoms have dense tree growth. Much of the available soil will be mixed with the tree roots and likely be un-usable for structural fill.
- **The adjacent valleys to the ridge line areas and any swale area will likely have thicker than normal organic materials and also have soft and wet soils at the swale bottom;**

- Areas ready to receive new fill should be proofolled with a loaded dump truck or similar equipment judged acceptable by CETCO;
- Proofrolling should not be performed on wet subgrade. If possible, perform proof rolls after suitable dry weather periods of time;
- **The elastic silt soils on site often do not "pass" a proof roll, even when at or near optimum moisture conditions. CETCO should be on-site to observe and evaluate soil stability;**
- CETCO should determine amounts of undercutting (if any) for any area which pumps or ruts. CETCO should also determine acceptable backfill materials and backfill methods. In general any backfill should be accomplished in general accordance with section 4.2;
- Remove deleterious materials or materials that are unsuitable for use in supporting the overlying new fill. The backfill should be consistent with the requirements listed in section 4.2;
- **The borings did not encountered wet soils. However, the soil mapping and our experience indicate that wet zones, especially at or near hillside bottoms, any swale areas and all low-lying areas, are likely. CETCO should be retained to provide guidance on undercutting and other means of addressing wet zones;**
- CETCO should observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered.
- ***As stated previously, once the main building pad area bedrock is cut to grade, at least 4 feet of newly placed clay should be placed to "seal" the New Albany Shale. The clay cap should extend at least 10 feet outside any building limit.***

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4.2 EARTHWORK

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

Three types of material will likely be derived from mass mountain top excavation:

- Type 1-very limited amount of clean soil
- Type 2-some amount of clayey shale/soft shalt/soil mixed with shale zone
- Type 3-a large amount of more durable, hard shale

Type 1 Material: mostly clean soil (likely silty lean clay or some elastic silt)

Soil fill placement guidelines (includes clay cap for pyritic shale sealing):

- Structural fill should be placed in maximum 8-inch thick loose lifts;
- Maximum particle size of the soil should be limited to 8 inches in any dimension;
- Materials should have a plasticity index (PI) of less than 30.
- The soil on site is silty. Construction traffic beyond the required amount to enable adequate compaction and stability should be avoided.
- Compact with a sheepsfoot until the roller “walks out” and lift is deemed stable by the CETCO representative.
- See quality assurance guidelines (page 21) for compaction and moisture requirements.
- **Again, the 4-feet clay cap for sealing the pyritic shale should follow these guidelines.**
- **Borrow material for the 4-feet clay cap should follow this requirement, as well as the aforementioned maximum Liquid Limit of 50.**

Type 2 Material: clayey shale/soft shale/soil mixed with shale

Despite the appearance of "dry" or "rock-like" zones, any material that can be removed with a large trackhoe or that can be ripped with a dozer rip-blade or that does not meet durable rock definitions, should be considered a soil-like material (will turn to clay/soil over time by slaking). The Kentucky Transportation Cabinet has guidance placement of such material and is summarized and adapted by CETCO as follows:

- Maximum lift thickness of 12 inches
- Apply a sufficient amount of water, at the direction of CETCO, to induce slaking. Do not dump the mixture into final position. Distribute the mixture in a manner that minimizes voids, pockets, and bridging.
- Apply compactive effort using a sheepsfoot to kneed the lifts of material while compacting.
- Maximum particle size of materials is 12 inches

Type 3 Material: durable, hard shale

The mass removal of this harder shale will likely require blasting methods. This material is likely to be similar to limestone shot-rock material, however, ***the New Albany Shale is prone to have "weaker" or "softer" zones, which can deter or limit explosive potential (regardless of the rock core RQD or descriptors we have used). Only contractors experienced in blasting these types of shale materials should be selected.***

The following are shot-rock placement (durable bedrock material) guidelines. ***These likely will require modification once the actual rock removal begins. This would specifically be the case if the blasting produces very large amounts of fines or sand with only small amounts of larger rocks.*** CETCO shall determine any changes to be made to placement guidelines.

- For this type of material placement criteria, the rock should meet durable material guidelines (hard rock, will not degrade when wetted and cannot be "scratched" easily).

- Maximum size of 18 inches in any dimension. Most New Albany Shale tends to blast in thin “plates” or “chips”. Longer plate pieces should be broken to meet this requirement. Our experience suggest normal dozer traffic can usually break these long/wide pieces.

- Materials should have sufficient fines (rock powder, sand and gravel) to choke void spaces.

- Material should be placed in maximum 18 inch loose lifts and compactive effort should be applied with a sheepsfoot roller (compactive effort for the finer portions of fill) and dozer. The dozer should also “back-blade” the material while leveling to further fill void spaces.

- The loaded haul trucks should show minimal to no movement while traversing each completed lift of shot-rock.

- Minimal soil (less than 5% or so) should be present in the shot-rock. If more than this amount is present, the material would be considered “soil” and would require the use of soil placement guidelines (Type 1 material).

Quality control testing guidelines:

- For all three types of fill material:
    - Lift thickness is critical (see each section)
    - Use of a sheepsfoot roller for each lift until the roller “walks out” is required.
    - Use haul trucks to seal off surfaces for protection against rain/water infiltration.
    - Observation of haul trucks and frequent proofrolling is key: minimal to no movement should be observed under loaded truck traffic.
- Clean soil: Density testing of newly placed clay soils should be performed. The rate of testing should be at least 3 per lift and at least one per 10,000 square feet of soil placement. Soil should be compacted to at least 95 percent of standard Proctor (ASTM D698) maximum dry density. **Do not over compact the soils. Moisture content should be from minus 3 to plus 1 percent of optimum moisture content (range is such due to the silty nature of the on-site materials)**;

    - Soil or non-durable shale portions should never be placed “dry” (dusty). CETCO should observe fill placement to determine acceptable moisture;

- Observation of fill “stability” is critical. The roller and earthwork equipment traversing over the new fill should be observed to document minimal movement occurs. This includes sheepsfoot roller action observed to ensure the compactor is “walking out” of each lift;

- CETCO should observe and document fill placement and compaction operations.

Backfill Construction

These materials are placed in more confined areas than mass earthwork materials and therefore cannot be placed in full compliance with the previous recommendations. The following are general recommendations for backfill areas:

- Gravel/granular materials are recommended for confined fill 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, the lift thickness should not exceed 4 inches;

- Observation of stability and moisture should be similar to those mentioned previously;

- CETCO should provide addition recommendations for backfill.

Slope Considerations

We were not provided a finalized grading plan, but large fill slopes are likely based on the site topography. An in-depth slope analysis was beyond our scope of services, but we are providing the following general considerations for the slope design and construction:

- Fill slopes should be designed with maximum final slopes of 3H:1V or flatter;

- When filling into existing embankments, the existing area should be “keyed” into place prior to fill placement;

- Slope surfaces should be thoroughly compacted with the sheepsfoot roller upon completion of each lift.

- Diversion ditches should be placed above all slopes (at least 10 feet from the slope crest) to prevent water from flowing directly over the slope.
- Cut slope for bedrock for roadway: when final road elevations are determined, a cut-slope of the bedrock slopes can be determined. In general, KyTC guidance for slopes, benches and drainage of cut slope areas should apply.
- The site civil engineer and CETCO should review final grading together to arrive at additional slope guidelines and requirements.

Site Drainage

Site drainage (water flow into, along and from the site) is key to minimize damaging effects of water flow. Excess water ponding can destabilize soils. Excessive water flow can erode soils and destabilize soils, especially at or near slopes.

The site is positioned on a ridge top with steep valleys on either side. The ridge top will be removed, and the material excavated will be used as fill material in the valleys. Springs are possible, especially along hillsides and near the swale bottom areas.

For shallow groundwater seepage (less than 5 feet deep or so), the water encroaching upon construction excavations can be removed by placing a sump near the source of seepage and then pumping from the sump. Should heavy seepage occur, or should there be evidence of soil particle migration such as silting of the sump, then the geotechnical engineer should be contacted.

The following are general guidelines for site drainage.

- **French drains (rock-lined ditches with filter fabric cover or similar) may be needed for some of the wet conditions encountered.**
- **We are recommending 18 to 36 inch diameter french drain systems (sized dependent of the swale size and drainage area) along the bottom of any large swale. CETCO should work with civil engineer to determine these areas. The drain should daylight at least 25 feet outside the overlying fill and fill slopes.**
- 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;

- 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;
- 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. However, if normal dewatering measures prove insufficient, CETCO should be retained to provide recommendations on the issue;

4.3 SITE SEISMIC DESIGN

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, recommended “4 feet of soil cover” and proposed mass excavation of the ridge line (i.e., building footprint overlying bedrock) we recommend a Seismic SITE CLASS "B" for the site.

A detailed geotechnical earthquake engineering analysis was not performed. 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.

4.4 FOUNDATION PLANNING

The following recommendations are also based on the previously described project information, the listed provided building type information, the subsurface conditions encountered in the borings, the results of laboratory testing, empirical correlations for the soil types encountered, and CETCO’s analyses and experience.

We have also assumed that the main building pad will be constructed according to our recommendations. This includes the 4 feet thick clay cap.

Once earthwork is complete, additional borings must be drilled by CETCO to verify conditions at that time and a foundation design geotechnical report issued for that specific building type and the soil/site conditions at that time.

Shallow Spread Footings

The site conditions encountered and/or newly/properly compacted engineered fill can support the proposed single story industrial type buildings with shallow spread footings. ***A maximum allowable net bearing pressure of 3,000 pounds per square foot (psf) is recommended for footings bearing on firm or better compacted engineered fill (i.e., the clay cap).***

Additional design considerations for project foundations are outlined as follows:

- Design footings with a minimum dimension of 24 inches wide;
- Place all exterior footing bottoms to at least 24 inches below finished exterior grade;

Shallow Foundation Construction Considerations

The soils encountered in this exploration may lose strength if they become wet during construction. Therefore, we recommend the foundation subgrades be protected from exposure to water. The following guides address protection of footing subgrades and our recommended remediation for any soft soils encountered.

- Bearing condition evaluations must be conducted using dynamic cone penetration (DCP) and hand auger borings at all footing locations. ***The hand auger should also verify that at least 2 feet of clay cap is present between footing excavation bottom and the top of shale bedrock.*** These holes should be backfilled tightly with soil.
- To protect against “moisture loss” or “soil drying” during warmer months, foundation concrete should be placed the same day as excavation.
- Remove any soils disturbed by exposure prior to foundation concrete placement.
- Level or suitably bench the foundation bearing area.
- Remove loose soil, debris, and excess surface water from the bearing surface prior to concrete placement.
- CETCO must observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered.
- CETCO should be retained to evaluate actual conditions.

4.5 FLOOR SLAB PLANNING

Normal conventional type slabs can be supported by engineered fill soils (i.e., the clay cap) if our recommendations are followed for the pad construction. Again, the areas should be proof rolled at the direction of CETCO prior to slab gravel base placement. Further, the subgrade

should be prepared according to the recommendations contained within this report. The following features are recommended as part of the floor slab construction:

- If possible, avoid construction of slabs during the hottest/driest months (typically July, August or September) due to potential “dry soil” conditions.
- 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 CETCO to review the actual subgrade conditions prior to slab construction and make recommendations for any unsuitable conditions encountered.

4.6 ROAD AND PAVEMENT CONSTRUCTION PLANNING

We understand a long, main road with possible large bedrock cut slopes as well as bus loop and parking are planned for the campus. Our recommendations address the construction of the earthwork (mass cut and fill) for such features, but do not address final pavement design thickness. Those can be determined once the final grading is known and final sub grade materials can be ascertained. However, for planning and initial budgeting a pavement section of 6 inches of asphalt overlying 8 inches of compacted DGA can be used. This section will be verified in the second phase of geotechnical services once the site grading plan is finalized and most of the grading is finished.

In general, please refer the Earthwork section of this report for mass cut-fill and final subgrade preparation. Prior to stone base placement we recommend an additional proofroll of the subgrade should be performed to verify subgrade conditions. Recommendations for undercutting/repair of the subgrade can be made at that time by CETCO.

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

Since the roadway will be used for construction access and is not likely to be paved in the near future, we recommend an initial layer of #3 stone, or similar sized large stone, be placed at the bottom of the stone base. This material should be tracked into place with on-site dozer or other tracked equipment. The remaining stone can be DGA to fill the large air gaps in this large stone and to provide a smoother surface. At least 8 inches total of stone should be used.

4.7 POST-REPORT GEOTECHNICAL CONSULTING

CETCO services as “geotechnical engineer of record” include answering questions pertaining to the materials presented in this report and the appendix. However, if conditions arise during construction that are different than those encountered during our exploration or if additional recommendations are needed, CETCO should be retained to provide that guidance. Construction observation and testing are beyond the typical scope of the geotechnical engineer, but are essential to completing the geotechnical engineer’s anticipated completion of their recommendations. CETCO should always be contracted as the testing/inspection firm for any project that applies their geotechnical report information. This always saves time, risk and project costs.

5 NOTES ON THE REPORT

The report is being issued for the planning, design and construction of the earthwork and site work for the proposed school camplus. After completing of the main building pad construction, additional geotechnical exploration and reporting for the main building will be required at that time.

The assessment of site environmental conditions or the presence of contaminants in the soil, rock, surface water or groundwater of the site was beyond the scope of this exploration.

The recommendations provided are based in part on project information provided to us and they only apply to the specific project and site discussed in this report. 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. We can then modify our recommendations if they are inappropriate for the proposed project.

Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings/test pits will be different from those at specific boring/test pit locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process may itself alter soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures used 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 CETCO to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of the recommendations.

We recommend that this complete 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. The report should not be included or referenced in the actual contract documents.

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. Rock cores will be saved for 4 months.

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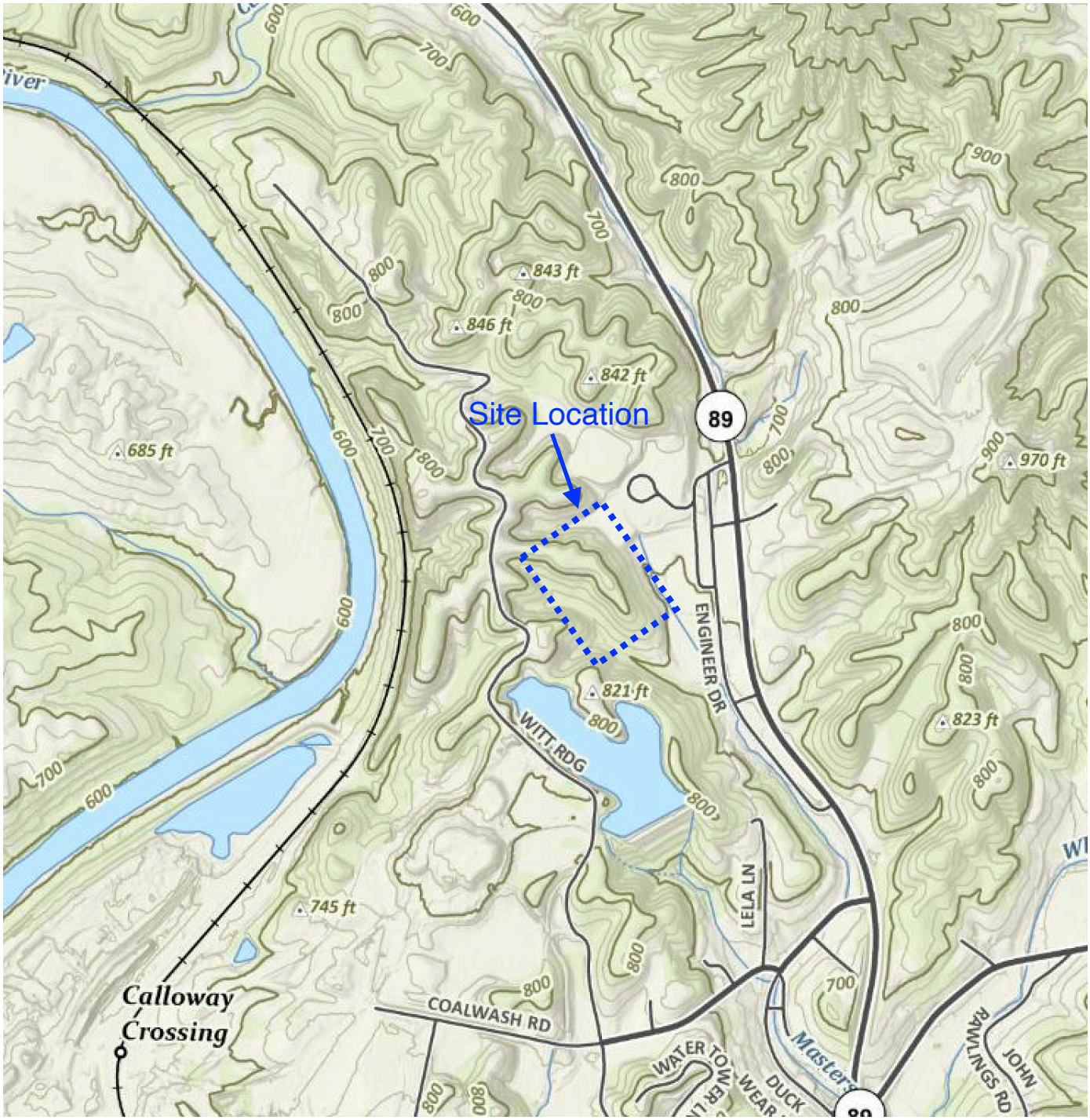
APPENDIX

SITE LOCATION PLAN
BORING LOCATION PLAN
TEST BORING LOGS
FIELD STANDARDS
LABORATORY TESTING
LABORATORY STANDARDS



Site location plan adapted from Kentucky Geological Survey, with further adaptations from CETCO professionals.

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Lexington, KY 40515
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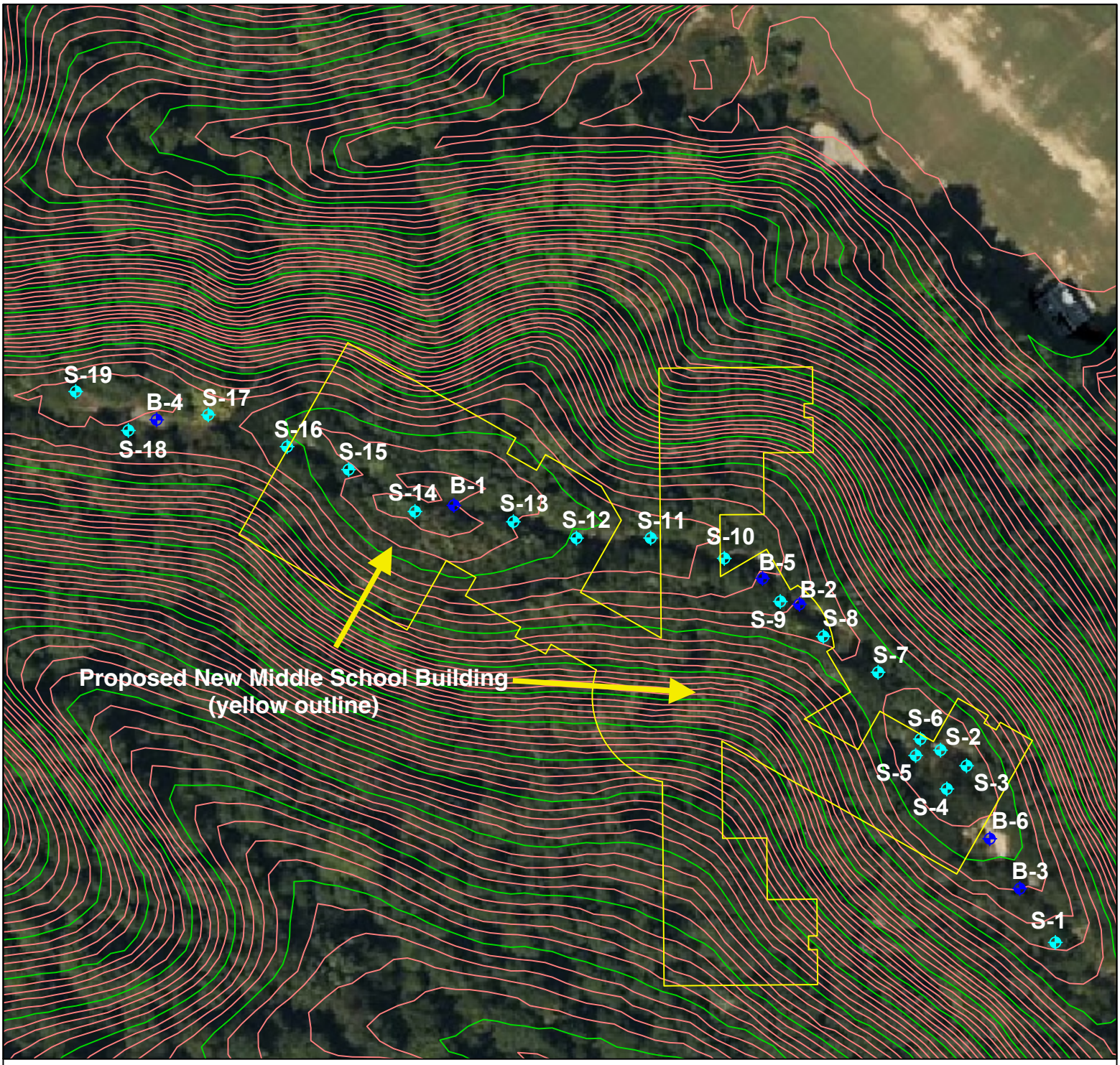
SITE LOCATION PLAN
for Estill Co. Middle School

Irvine, Kentucky

CETCO Project: 1606-24-0102
Date: January 9, 2025
Drawn by: Mason Ross
Checked by: Joe Cooke, PE
Drawing: 1 of 1



Legend

- Boring B-X
- Sounding S-X
- 10' Contour
- 2' Contour

Boring location plan adapted from Google Earth and GeoSync, with further adaptations from CETCO professionals. Building footprint adapted from provided ACAD drawing from Midwest Engineering Inc. Drilling locations were collected on-site using GPS equipment

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BORING LOCATION PLAN

For Estill Co. Middle School

Estill County, KY

CETCO Project #: 1606-24-0102
Date: January 10, 2025
Drawn by: Mason Ross
Checked by: Joe Cooke, PE
Drawing: 1 of 1
Scale: NTS

CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-1

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 834 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0	TOPSOIL - (1 inch)					
	Brown LEAN CLAY (CL), with few black oxides, slightly moist, STIFF	SPT S-1	100	5-5-10 (15)		
	Light brown and gray LEAN CLAY (CL), slightly moist, STIFF					
	Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE, slightly moist, VERY STIFF to HARD	SPT S-2	100	10-16-50/2"		
2.5	Grayish black weathered SHALE					
		SPT S-3	100	50/5"		
5.0	Black to grayish black SHALE					
		SPT S-4	100	50/4"		
7.5						
	Black Chattanooga SHALE, moderately HARD	RC C-1	97 (30)			
10.0						
12.5						

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

>>

>>

>>

Refusal at 2.7 feet.
Bottom of borehole at 14.0 feet.

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BORING NUMBER B-2

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 825 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Brown LEAN CLAY (CL), with few black oxides, slightly moist, STIFF	SPT S-1	100	4-6-8 (14)			
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE, slightly moist, VERY STIFF TO HARD	SPT S-2	100	50/5"			>>
2.5		Grayish black weathered SHALE						
		Black to grayish black SHALE	SPT S-3	100	50/4"			>>
5.0								

Refusal at 1.9 feet.
Bottom of borehole at 6.4 feet.

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BORING NUMBER B-3

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 818 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0	Brown LEAN CLAY (CL), with few black oxides, slightly moist, STIFF	SPT S-1	100	6-9-18 (27)		
	Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE, slightly moist, VERY STIFF to HARD					
	Grayish black weathered SHALE					
	Black to grayish black SHALE	SPT S-2	100	50		
2.5		SPT S-3	100	50/2"		

Refusal at 2.0 feet.
Bottom of borehole at 4.1 feet.

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

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BORING NUMBER B-4

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/30/24 **COMPLETED** 12/30/24
GROUND ELEVATION 824 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING --- Dry prior to coring
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Cloudy, 40's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		TOPSOIL						
		SOUNDING ONLY: Appeared to be gray weathered SHALE and CLAY mix (GC), slightly moist						
		SOUNDING ONLY: TOP OF SOFT ROCK						
		SOUNDING ONLY: Appeared to be weathered gray SHALE						
2.5								
5.0		Dark gray SHALE, MODERATELY HARD						
7.5			RC 1	100 (11)				
		Dark gray SHALE, with 45 degree joint, MODERATELY HARD						
10.0		Dark gray SHALE, MODERATELY HARD						
12.5								
15.0			RC	100				

(Continued Next Page)

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BORING NUMBER B-4

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
15.0		Dark gray SHALE, MODERATELY HARD *(continued)*	2	(76)				
17.5		Medium gray sandy SHALE seam Dark gray SHALE, MODERATELY HARD Dark gray SHALE, with 45 degree joint, MODERATELY HARD Dark gray SHALE, MODERATELY HARD						
20.0								
22.5								
25.0		Dark gray SHALE, with verticle joint, MODERATELY HARD	RC 3	100 (75)				
27.5		Dark gray SHALE, MODERATELY HARD						
30.0								

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BORING NUMBER B-4

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
32.5		Dark gray SHALE, MODERATELY HARD *(continued)*						
35.0			RC 4	98 (93)				
37.5		Dark gray SHALE, with 70 degree joint, MODERATELY HARD Dark gray SHALE, MODERATELY HARD						
40.0		Light gray SHALE seam, MEDIUM HARD Dark gray SHALE, MEDIUM HARD						
42.5								
45.0		Light gray SHALE seam, MEDIUM HARD Dark gray SHALE, MEDIUM HARD	RC 5	100 (100)				
47.5								

(Continued Next Page)

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BORING NUMBER B-4

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
50.0		Dark gray SHALE, MEDIUM HARD *(continued)*						
		Dark gray SHALE, MODERATELY HARD						
52.5								
55.0			RC 6	100 (100)				
57.5								
60.0		Dark gray SHALE, VERY HARD						
62.5								
65.0			RC 7	98 (95)				

(Continued Next Page)

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BORING NUMBER B-4

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
		Dark gray SHALE, VERY HARD *(continued)*						
67.5								
70.0								

Bottom of borehole at 70.0 feet.

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BORING NUMBER B-5

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/30/24 **COMPLETED** 12/30/24
GROUND ELEVATION 823 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING --- Dry prior to coring
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Cloudy, 40's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		SOUNDING ONLY: Appeared to be Brown LEAN CLAY (CL), silty, very moist						
		SOUNDING ONLY: Appeared to be Black weathered SHALE and CLAY mix (GC), moist						
2.5		SOUNDING ONLY: TOP OF SOFT ROCK						
		SOUNDING ONLY: Appeared to be weathered black SHALE						
5.0		Dark gray SHALE, MODERATELY HARD						
7.5			RC 1	100 (0)				
		Brown DOLOMITE, with a verticle joint						
		Dark gray SHALE, MODERATELY HARD						
10.0								
12.5		Dark gray SHALE, fractured zone, MODERATELY HARD						
		Dark gray SHALE, MODERATELY HARD						
15.0			RC	100				

(Continued Next Page)

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BORING NUMBER B-5

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
15.0		Dark gray SHALE, MODERATELY HARD *(continued)*	2	(31)				
17.5		Dark gray SHALE, with 60 degree joint, MODERATELY HARD						
		Dark gray SHALE, MODERATELY HARD						
		PYRITE SEAM						
20.0		Dark gray SHALE, MODERATELY HARD						
22.5								
25.0			RC 3	100 (41)				
27.5								
30.0								

(Continued Next Page)

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624 Wellington Way
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BORING NUMBER B-5

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
32.5		Dark gray SHALE, MODERATELY HARD *(continued)*						
			RC 4	100 (84)				
35.0								
37.5		Light gray SHALE seam, SOFT						
		Dark gray SHALE, MODERATELY HARD						
40.0								

Bottom of borehole at 40.0 feet.

CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-6

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/30/24 **COMPLETED** 12/31/24
GROUND ELEVATION 828 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING --- Dry prior to coring
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Cloudy, Rainy, 40's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		SOUNDING ONLY: Appeared to be Brown LEAN CLAY (CL), silty, very moist						
2.5		SOUNDING ONLY: Appeared to be Black weathered SHALE and CLAY mix (GC), moist						
		SOUNDING ONLY: TOP OF SOFT ROCK						
5.0		SOUNDING ONLY: Appeared to be weathered black SHALE						
7.5		Dark gray SHALE, HARD	RC 1	100 (15)				
10.0		Dark gray SHALE, MODERATELY HARD						
12.5		Dark gray SHALE, with few 20-30 degree joints, MODERATELY HARD						
		Dark gray SHALE, MODERATELY HARD						
15.0		Brown DOLOMITE, with a near verticle joint	RC	100				

(Continued Next Page)

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BORING NUMBER B-6

CLIENT Deco Architects **PROJECT NAME** Estill County Middle School

PROJECT NUMBER 1606-24-0102 **PROJECT LOCATION** Irvine, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
15.0		Dark gray SHALE, MODERATELY HARD *(continued)*	2	(34)				
17.5								
20.0		Dark gray SHALE, MEDIUM HARD						
22.5								
25.0			RC 3	100 (58)				
27.5								
30.0		Bottom of borehole at 30.0 feet.						

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BORING NUMBER S-1

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 815 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 1.7 feet.
Bottom of borehole at 1.7 feet.

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BORING NUMBER S-2

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 823 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.5 feet.
Bottom of borehole at 3.5 feet.

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BORING NUMBER S-3

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 824 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.0 feet.
Bottom of borehole at 3.0 feet.

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BORING NUMBER S-4

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 824 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.5 feet.
Bottom of borehole at 3.5 feet.

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BORING NUMBER S-5

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 824 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 2.9 feet.
Bottom of borehole at 2.9 feet.

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BORING NUMBER S-6

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 824 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						
		Refusal at 2.7 feet.						
		Bottom of borehole at 2.7 feet.						

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BORING NUMBER S-7

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 823 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.2 feet.
Bottom of borehole at 3.2 feet.

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BORING NUMBER S-8

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 823 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.0 feet.
Bottom of borehole at 3.0 feet.

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BORING NUMBER S-9

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 825 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 2.4 feet.
Bottom of borehole at 2.4 feet.

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BORING NUMBER S-10

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 828 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Brown LEAN CLAY (CL)						
2.5		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 3.5 feet.
Bottom of borehole at 3.5 feet.

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BORING NUMBER S-11

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 829 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						
2.5								

Refusal at 2.7 feet.
Bottom of borehole at 2.7 feet.

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BORING NUMBER S-12

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 830 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						
		Refusal at 2.5 feet.						
		Bottom of borehole at 2.5 feet.						

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BORING NUMBER S-13

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 832 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 3.6 feet.
Bottom of borehole at 3.6 feet.

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BORING NUMBER S-14

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 835 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Topsoil ~ 2"						
		Dark brown LEAN CLAY (CL)						
2.5		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 4.0 feet.
Bottom of borehole at 4.0 feet.

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BORING NUMBER S-15

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 832 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Dark brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

Refusal at 2.7 feet.
Bottom of borehole at 2.7 feet.

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BORING NUMBER S-16

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 829 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Dark brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 2.0 feet.
Bottom of borehole at 2.0 feet.

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BORING NUMBER S-17

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 828 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Dark brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 2.4 feet.
Bottom of borehole at 2.4 feet.

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BORING NUMBER S-18

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 828 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
		Gray to grayish black WEATHERED SHALE						

Refusal at 1.5 feet.
Bottom of borehole at 1.5 feet.

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BORING NUMBER S-19

CLIENT Deco Architects
PROJECT NAME Estill County Middle School
PROJECT NUMBER 1606-24-0102
PROJECT LOCATION Irvine, Kentucky
DATE STARTED 12/19/24 **COMPLETED** 12/19/24
GROUND ELEVATION 829 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 30's
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0.0		Light brown LEAN CLAY (CL)						
		Dark brown LEAN CLAY (CL) to ELASTIC SILT (MH) and SHALE						
2.5		Gray to grayish black WEATHERED SHALE						

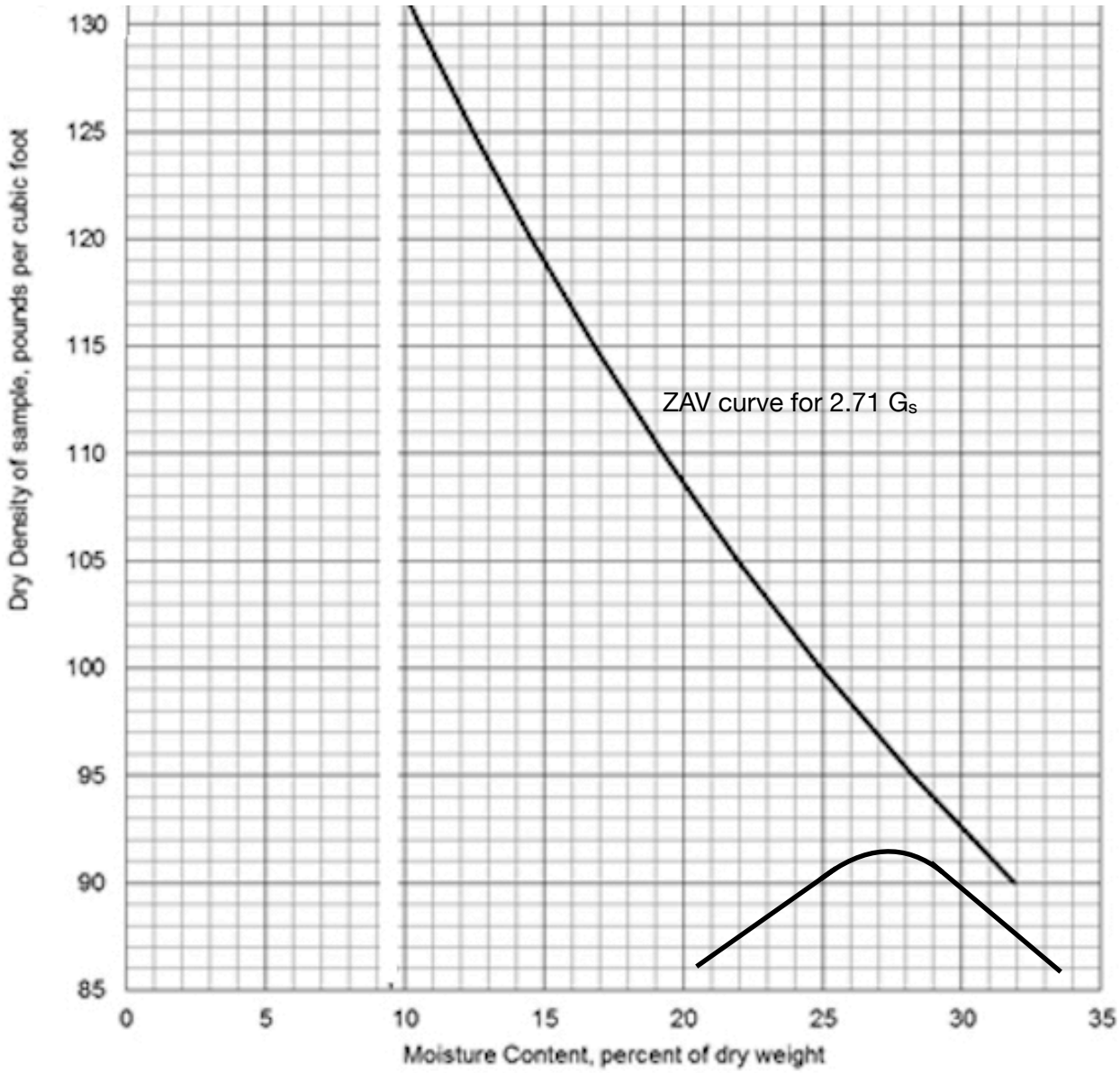
Refusal at 4.0 feet.
Bottom of borehole at 4.0 feet.

Cooke Engineering and Testing Company

Moisture-Density ("Proctor") Sheet

Project Name:	Estill Co. Middle School	Date:	January 2, 2025
Project Location:	Irvine, KY	Reviewed by:	Joe Cooke, PE
Client:	Deco Architects	CETCO Project Number:	1606-24-0102
Brown Gravelly Elastic Silt (MH)		"Proctor", ASTM D698-A	

Sample ID	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	% Finer than #200 Sieve
P-1, 0'-1'	25.6	60	26	91.5	27.4	56.8

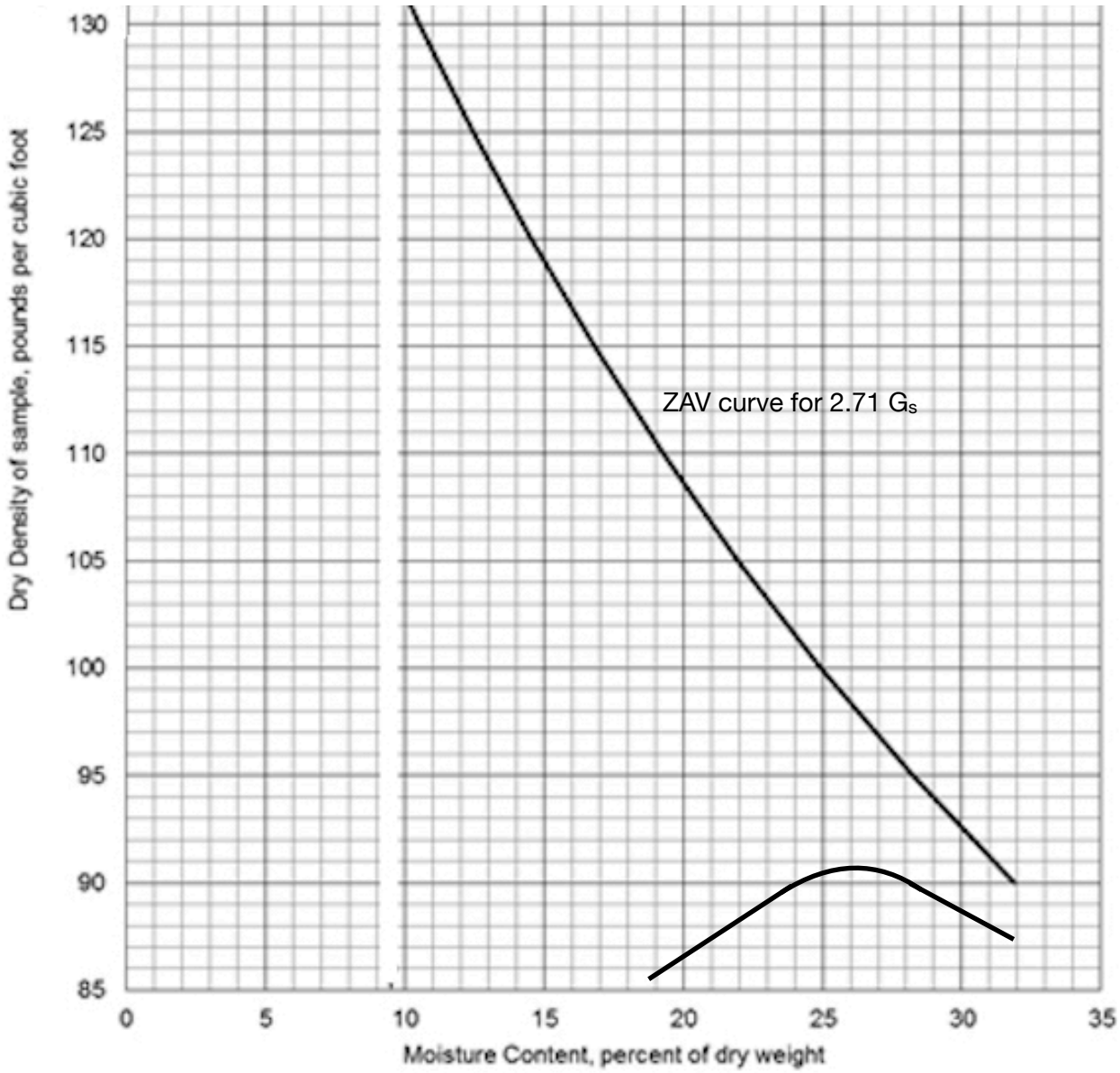


Cooke Engineering and Testing Company

Moisture-Density (“Proctor”) Sheet

Project Name:	Estill Co. Middle School	Date:	January 2, 2025
Project Location:	Irvine, KY	Reviewed by:	Joe Cooke, PE
Client:	Deco Architects	CETCO Project Number:	1606-24-0102
Dark Brown Elastic Silt (MH)		“Proctor”, ASTM D698-A	

Sample ID	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	% Finer than #200 Sieve
P-2, 0’-4’	28.2	58	26	90.8	26.2	82.0



Cooke Engineering and Testing Company

Atterberg Limits Chart

Project Name:	Estill Co. Middle School	Date:	January 2, 2025
Project Location:	Irvine, KY	Reviewed by:	Joe Cooke, PE
Client:	Deco Architects	CETCO Project Number:	1606-24-0102
		“Atterberg Limits”, ASTM D4318	

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve
P-1, 0’-1’ ▲	0-1	25.6	60	34	26	56.8
P-2, 0’-4’ ★	0-4	28.2	58	32	26	82.0

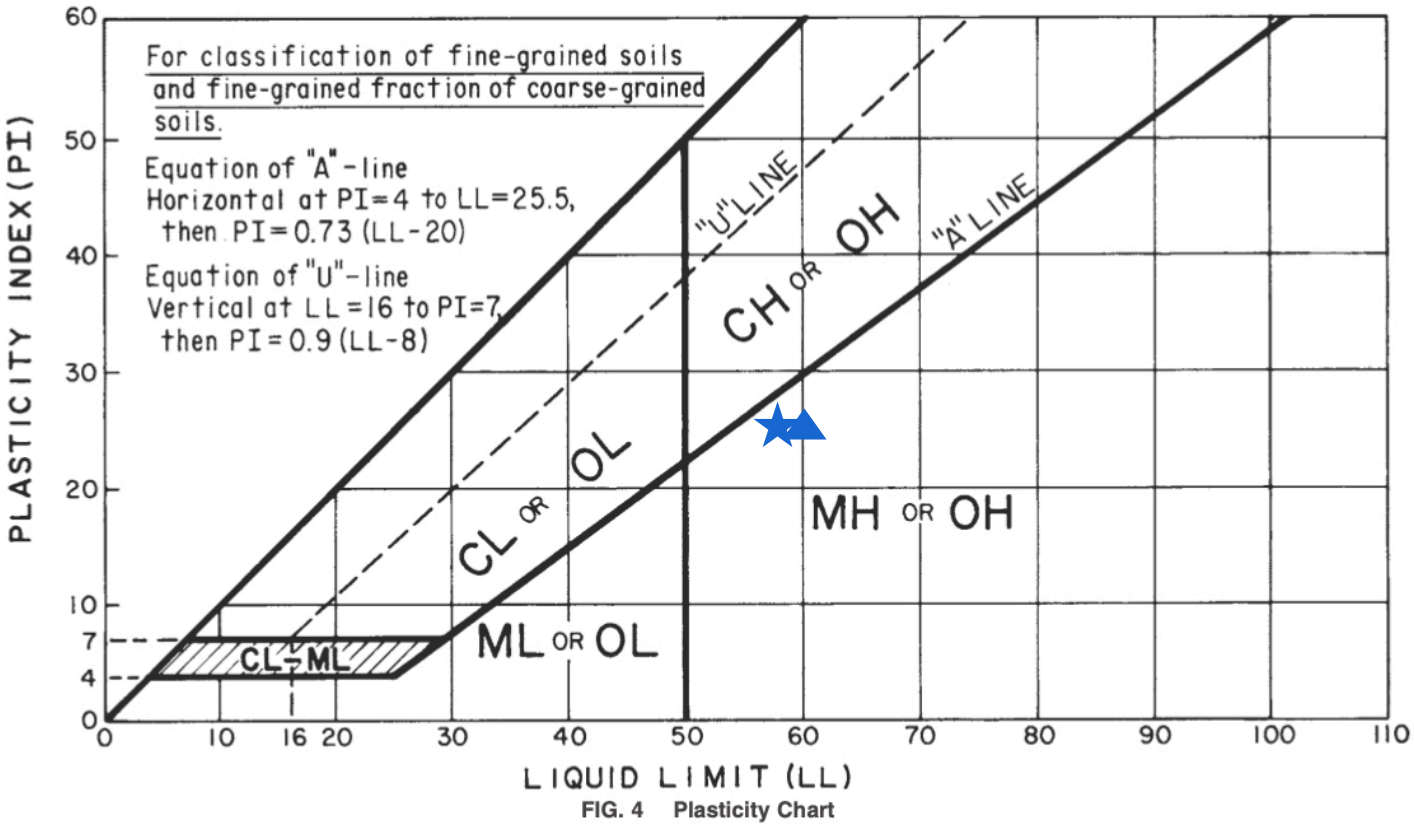


FIG. 4 Plasticity Chart

Cooke Engineering and Testing Company

Laboratory Testing Summary Table, Page 1 of 2

Project Name:	Estill Co. Middle School	Date:	January 2, 2025
Project Location:	Irvine, KY	Reviewed by:	Joe Cooke, PE
Client:	Deco Architects	CETCO Project Number:	1606-24-0102

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Percent Passing #200 (%)	Pyritic Sulfur (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
P-1	0-1	25.6	60	34	56.8		91.5	27.4
P-2	0-4	28.2	58	32	82.0		90.8	26.2
B-1	0.0-1.5	18.2						
B-1	1.5-2.7	22.0						
B-1	4.0-4.4	9.9						
B-1	6.5-6.7	7.2						
B-2	0.0-1.5	20.3						
B-2	1.5-3.0	24.4						
B-2	4.0-4.3	11.6						
B-3	0.0-1.5	19.2						
B-3	1.5-2.0	16.0						
B-3	4.0-4.1	8.4						
B-4	42-44					4.2		
B-4	56-58					2.7		
B-4	64-66					2.0		
B-4	69-70					2.4		
B-6	9-11					2.1		

LABORATORY STANDARDS AND 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 or “by hand” stiffness), color and texture. These classification descriptions are included on our "Boring Logs” or “Test Pit Logs”

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 D2487). 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.

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 D4318.

Moisture Content: The Moisture Content is determined according to ASTM D2216.

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.

“Proctor” (Moisture-Density Test): Often called by it’s original author’s name, the “Proctor” test is a moisture-density relationship test to determine “maximum dry density” and “optimum moisture content” curves using a set amount of force of “compaction” at variable moisture contents in a pre-determined mold size. The test is typically ASTM D698, method A, for standard effort. For a “modified” effort (higher amount of force), ASTM D 1557, again method A, is usually used. Due to high amounts of clay as well as typical compaction construction equipment used, the standard Proctor (ASTM D698) is the most common method used. For materials with larger grain sizes, methods B, C and D of each ASTM method can be used.

CBR: California Bearing Ratio (CBR) testing is often performed on soils to assist in pavement design. The test involves compacting soil into an approximate “0.075 cubic foot” volume at specified density and moisture content and then soaking the compacted sample with a surcharge weight (for a time period of usually at least 96 hours). Then, the sample is “loaded” using a fixed strain penetration piston and the penetration resistance and stress is recorded (as stress in pounds per square inch-psi) at 0.1 inches and 0.2 inches penetration. The resistant stress is then compared (as a “ratio”) to the standard resistant stress, hence the value is reported as unit-less. The test is typically conducted in general accordance with ASTM D1883.

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.

FIELD SERVICES STANDARDS AND PROCEDURES

Field Operations: The general field procedures employed by CETCO are summarized in ASTM D420 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, in situ methods and test pits as well as borings.

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

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 our field personnel (typically engineers). 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 D2488 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 D1586.

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 D2113 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".

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". 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.

Rock Classification: Rock classifications (if any) 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 Boring Records.

Test Pits: Occasionally, our field sampling includes the use of “test pits”. Similarly to soil test borings, our classifications on the materials observed and sampled are performed in general accordance with ASTM standards. These excavations are performed by excavators of various sizes and the width/length/depth of the excavations vary as well. Typically, only the soil or “loose” rock areas can be sampled or excavated. The samples taken are usually taken at highly variable depths and the engineer or field personnel have extreme discretion on the sample sizes and locations. These are typically sealed in “zip lock” type baggies and transported back to our office for lab testing and further classification. Visual descriptions of rock materials (sand, gravel, cobbles, boulders, etc.) are provided on both samples taken and observations of spoils removed and sides of excavations. Typically, photos of both the mass excavation and spoil pile are provide on the test pit logs in our reports. Groundwater levels are noted and can include water flow at the excavation bottom or at points of depth in the excavation sides. “Refusal” usually means that the excavator cannot remove additional materials at the excavation bottom. Some excavations may also have very large boulders than cannot be removed by the excavator used. Depths indicated on the logs are usually measured with steel tape or cloth tape. Final complete details of the test pit findings and opinions are provided in the “Test Pit Logs” in our reports. Lastly, test pit excavations have no set standards and are performed at our engineers discretion.

Field and Lab Procedures