September 14, 2023

GEOTECHNICAL REPORT

BUILD READY PAD- FLEMING #4 INDUSTRIAL PARK

FLEMINGSBURG, KY

CETCO

Cooke Engineering and Testing Company

September 14, 2023

Mr. Glen Ross, PE
MSE of Kentucky, Inc
via email: glenross@mselex.com

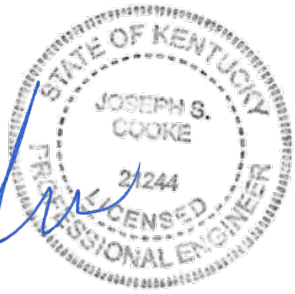
Subject: **Geotechnical Report**
Proposed Build-Ready Pad, Fleming #4 Industrial Park
Flemingsburg, Fleming County, Kentucky
CETCO Project No. 1776-23-0122

Dear Mr. Ross:

CETCO appreciates the opportunity to provide our services to you and the Owner (Flemingsburg-Fleming County Industrial Authority). As follows, we are providing our geotechnical report. Our services were provided in general accordance with our proposal number CET 1776-23-0224, dated, July 31, 2023. Also, please note the report appendix which contains many detailed findings as well as our standard of care for providing our services.

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



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

Attachments: Geotechnical Report and Appendix

Cooke Engineering and Testing Company

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Build-Ready Pad, Flemingsburg Industrial Park

FLEMINGSBURG, KENTUCKY

GEOTECHNICAL REPORT SUMMARY

We provided our services in general accordance with our previous discussions and our proposal number 1776-23-0224, dated July 31, 2023 and approved by the IDA. CETCO has consulted with your office and discussed the need for CETCO to provide geotechnical services including sampling and exploration with soil test borings, a 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 build ready pad project. The project plans are in the preliminary stage, and may change. CETCO should be advised on any changes from the information presented in our report. The site is located off of Maysville Road in Flemingsburg, Kentucky. Potential concept plans indicate a 150,000 square foot build ready pad as part of the Flemingsburg-Fleming County Industrial Park (#4 Industrial Park location). 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 design and construction purposes.

In general, we encountered the typical, mostly brown lean to fat clay found in Flemingsburg. No groundwater was encountered in the soil overburden or in our borings. Limestone bedrock was encountered in all borings ranging from 3.5 to 13 feet at the site, but mostly at least 6 to 10 feet deep. The native clay soils were typically stiff.

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

The primary concerns for the site are the "normal" Flemingsburg, KY risks of: ***swelling clays and slope construction****.* ***Some areas of shallow bedrock were also encountered****. Normal construction and planning practices of the Flemingsburg area are expected. Details for these issues and recommendations for design and construction as well as our other recommendations are discussed in the report.*

1 PROJECT BACKGROUND

1.1 CETCO SCOPE OF SERVICES

Our scope of services included conducting an exploration of the subsurface conditions for the proposed new building pad site. This including using five soil test borings, observing site and site area conditions and providing geotechnical analysis. We have completed our field work, analysis and we are issuing the 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 pad layout on the site.	MSE of Lexington

The following information summarizes our understanding of the project conditions

Condition	Specifics
Building/Structure Information	The building pad will be at 150,000 square feet in size. No building types are known at this time, but typical medium sized industrial building types are expected.
Site Grading	The site is moderately to mildly sloped. Therefore, it is anticipated to have cuts/fills of at least 5 to 10 feet.

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.

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1.3 PUBLISHED SITE AND AREA INFORMATION

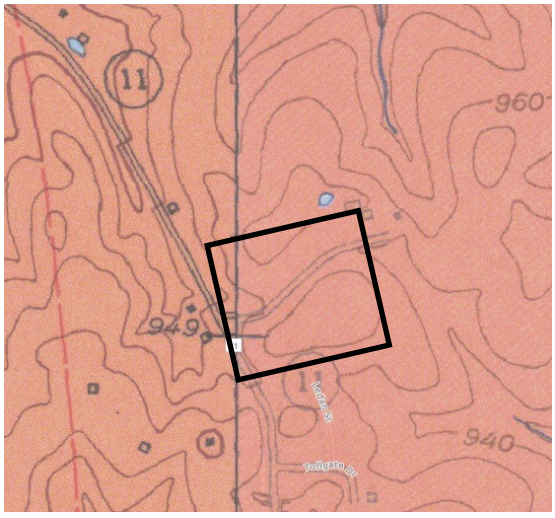
We have reviewed the following published/public domain site information.

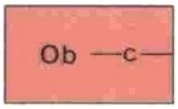
AREA TOPOGRAPHY AND PHYSIOGRAPHY

The site is located in the “Outer Bluegrass Region” of Kentucky. These areas can have rolling to hilly upland of low to moderately high relief, which are often dissected by sinkholes, springs, entrenched rivers, intermittent and perennial streams. The region is mostly underlain by interbedded Upper Ordovician limestone and shale, which are more easily eroded than limestones of the inner bluegrass. The region has less karst features, with fewer sinkholes and rolling hills. The southern boundary of this physiographic region in Kentucky consists of knobs which consist of hundreds of steep sloping cone shaped hills. The specific site topography consists of elevations ranging from 590 to 1420 feet. Elevations within the site vicinity generally ranged from 950 to 1000 feet.

SITE GEOLOGY

The Kentucky Geologic Survey public information was reviewed including the USGS mapped geologic information for the site (the Flemingsburg Geological Quadrangle). Available geologic mapping indicates the site vicinity is underlain by the Bull Fork formation primarily consisting of interbedded limestone and shale. The limestone in this area can be described as medium light gray to bluish gray, with irregular bedding, fine to coarse grained, and weathers yellowish brown. Limestone is slightly to moderately dolomitic in the upper 40 feet. Shale commonly occurs as gray to grayish green and weathers dusky yellow, calcareous, and becomes plastic when wet. See the images on the next page for more information on geologic mapping. Karst (sinkholes/caves) risk is low to none for the site geology.



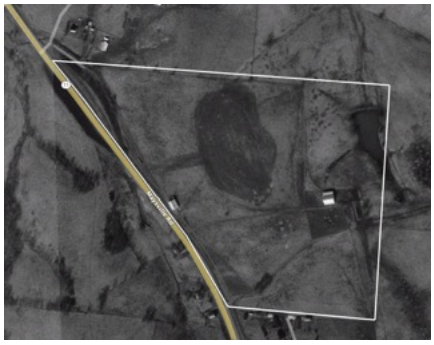


Bull Fork Formation
c, *top of horn coral bed*

Image from the KGS website showing Original GQ Image: Site location is the black rectangle.

AERIAL MAPPING

Aerial information back as far as 1995 was readily available for the site. Images showing site progression. Photo on the left is the aerial from 1995, showing undeveloped farm land where the structures (including the main barn) currently on site are still there. Of note is a small former pond just west of the barn in the 1995 to 2010 photos which has been filled/drained in the 2022 photo. Otherwise, there were minimal changes throughout the site area, with the exception of hay bales placed along a fence corner near the center of the outlined area.



1995 : Aerial from Google Earth

2010 : Aerial from Google Earth

2022 : Aerial from Google Earth

SITE SOIL SURVEY MAPPING

The Soil Survey of the site area was also reviewed. Issues affecting the site development included: shrink/swell of soil and slope construction. We are providing recommendations to address these issues. Also, the soil survey lists the some of the site as having “high risk” for corrosion of steel. Typically, the main risk for corrosion would be for steel reinforcement in concrete foundations and slabs. The primary means to address this risk is to specify at least 2 inches of concrete cover over all steel reinforcement for concrete exposed to soil.

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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. Graduate geotechnical professionals provided our field services including a site reconnaissance and logging of the borings in the field, during the exploration on August 17, 2023.

2.1 CURRENT SITE SURFACE CONDITIONS AND OBSERVATIONS

The site is located off of Maysville Road in Flemingsburg, Kentucky. It is primarily farmland with slight to moderate rolling hills with few structures onsite. Upon turning off of Maysville road there is a single lane gravel driveway leading to the gated entrance just southwest of the proposed building pad area. The gravel road runs through the proposed building pad and leads to a barn with several small fenced in areas. The proposed building pad is just south of the barn where it is an open grassy pasture with few trees along the road. The northern section of the site has rows of hay bales along the fence line separating the open grassy area and the pasture where cattle was. South of the road is a grassy uphill slope leading to the property fence line, where there is a small neighborhood. There is one pond onsite, located northeast of the barn, which is likely a few hundred feet north of the proposed building area. The higher elevations are on the northern and southern most sections of the site and the lowest elevations are near the road on the west side.

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, as the weather conditions prior to drilling drilling included rainy days, but no large-scale ponding of water due to the rain was observed and minimal muddy conditions were observed.

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

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Project Photos

Description	Photo
Showing example view of B-1 at approximately the southeast building pad corner near the gravel road entrance. Facing west.	
Example showing drilling location of B-3 at the southwest building pad corner near the hay bales. Facing north.	

Project Site Photos (cont.)

Description	Photo
Example view of open grassy areas southeast of the building pad location, also location of S-2. Facing west.	
Example view of fence-line near the northwest building pad corner. Also showing the barn in the background. Facing northeast.	

Project Site Photos (cont.)-1

Description	Photo
Example view showing elevated areas near the building pad corners, with the lower elevations near the center and along the gravel road. Facing north.	
Example view of northeast drilling location, showing the barn and cattle in the background. Facing northeast.	

2.2 SUBSURFACE INFORMATION SUMMARY

A total of 8 soil boring tests were utilized to explore the subsurface conditions at the site. The borings were drilled in locations to provide an indication of the site subsurface conditions with proximity to the 4 building pad corners and one in the center. Additionally two boring soundings were drilled along higher elevations onsite. The boring location plan in the appendix shows the approximate drilling locations.

SUBSURFACE CONDITIONS: At our sampling locations, we encountered native lean to fat clay soils that were generally brown to yellowish brown in coloring, overlying weathered limestone rock. Below is a table summarizing the soil conditions at the site. Detailed findings are in the Appendix boring logs and laboratory testing pages.

BEDROCK AND GROUNDWATER CONDITIONS: Free water or “wet” conditions were not encountered in any of the borings.

Strata	Thickness	Notes
Topsoil	4-9 inches	
Native soils: mostly lean clay with few organics, brown in coloring and generally “moist” and “firm”.	1-3 feet	All borings showed this
Native soils: mostly lean to fat clay, brown to yellow in coloring and generally “moist” and “stiff”.	2-3 feet	All borings showed this
Bottom strata native soils: mostly fat clay, brown to gray in coloring with gravel layers and generally “slightly moist” and “very stiff”	2-3 feet	Most borings encountered rocky zones
Bedrock: Weathered limestone	N/A	

Auger refusal was encountered in all of the borings. Auger refusal is interpreted at the top of limestone bedrock. The table below shows depth to bottom of borehole with the two borings encountering bedrock listed. (i.e., Auger Refusal listed as AR)

Boring Number	Depth to bottom of AR (feet)
B-1	13.3
B-2	7.0
B-3	3.4
B-3A	7.8
B-4	6.0
B-5	10.4
S-1	6.7
S-2	12.5

3 OPINIONS AND DISCUSSION

SUMMARY: In general, the project site is suitable for the proposed new development and site improvements. 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.

- Shrink-Swell of Clay Soils
- Slope Construction
- Some Areas of Shallow Bedrock
- Former Pond and Existing Barn Area

Shrink-Swell of Clay Soils

Most of the soil on-site has a low to moderate potential for swelling and shrinkage due to the low to moderate plasticity of the soil (fat clay soil). **The areas most prone to swell/shrink are building slabs**. **Means to limit this potential include a strict moisture control of the soils during mass fill placement/earthwork and slab subgrade preparation. Also, maintaining the construction schedule to avoid slab concrete placement during the hottest/driest times of the year (typically avoiding July, August and September) is a prudent means to limit "drying" of the slab subgrade prior slab placement.** Lastly, roof gutter downspouts should be piped/carried directly into storm drains and not flow onto site soils within 50 feet of the building pad. These are further discussed throughout the report.

Slope Construction

The site geology and soil survey (as well as our experience in Fleming County) suggest that tall slopes (greater than 15 feet) can be problematic for future instability. This is due to the soil types (mostly clay with moderate silt content), variable depths to bedrock and interbedded shale and limestone bedrock. Slopes into bedrock can also encountered some wet shale

layers. No large-scale mapped slope issues or landslides were within close proximity to the site, but care should be taken for any slope construction. We have provided general slope construction and design guidelines. **If any slopes are taller than 15 feet, CETCO should be contacted for additional recommendations**.

Some Areas of Shallow Bedrock

Our borings encountered the top of bedrock in **three of the eight borings from about 3 to 6 feet deep**. Most of our borings exceeded this depth (i.e., ranging from 7 to 10 or more feet deep). There did not seem to be any correlation with locations being shallower to bedrock than others. Excavations at or near this depth will encounter limestone bedrock with some shale seams which will require “rock removal” techniques such as blasting or hoe-ramming to remove. Also, this interbedded limestone/shale has shown to be “slow” to remove via hoe-ramming.

Former Pond and Existing Barn Area

The building pad (and areas of potential borrow sources) appears to be located in mostly undisturbed site areas. However, an area just west of the existing barn (currently a small calving pen area) was once a small pond. This area likely has “pond muck” type materials and would require additional undercutting and the soil spoils are likely not suitable for re-use for structural fill.

Also, the existing barn area (as is typical for most similarly used structures) may contain manure or other waste materials for farm usage (deeper old hay/mulch pits or similar). Such materials should be wasted and not used for structural fill.

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4 RECOMMENDATIONS

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

SITE PREPARATION

We recommend that site grading should take place between about late April to early November. Earthwork taking place outside this time period will likely encounter wet conditions and weather conditions that will provide little to no assistance with drying the soils. Additionally, 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;
- Care should be taken for borrow areas at or near the existing barn. Former pond much materials and other organic soils may be present in larger quantities in the area;
- 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 existing gravel road materials may remain in-place, if the areas pass a proof roll.** Other existing site features (fences, any building remnants, etc.) should be removed;
- 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;
- CETCO should observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered.

4.2 EARTHWORK

Before new fill construction, representative samples should be obtained of the proposed fill material to determine the moisture-density and overall classification of the material. The tests also would assist in determining if the material is suitable for use as structural fill.

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

Mass Earthwork

- Based on our observations and laboratory testing, the on-site soils appear to be suitable for use as structural fill;
- Fill placement guidelines:
    - 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 35.
    - Some of the soils tested on-site were close to this 35 limit. Therefore, it should be assumed that some of the on-site soils (especially those deeper than about 5 feet) may not meet the requirement.
- Quality control testing guidelines:
    - 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. **Moisture content should be from minus 1 to plus 3 percent of optimum moisture content (range is such due to moderately high plasticity of the on-site clay soils)**;
    - Soil should never be placed “dry” (dusty). CETCO should observe fill placement to determine acceptable soil 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.

Again, we recommend that site grading be started in the period from about late April to about November in order to prevent additional undercutting due to wet conditions. Drying of the site soils during other portions of the year is typically difficult.

Slopes

We have not been provided with information on any planned slope. We have assumed that no large slopes (those greater than 15 feet high or steeper than 2H:1V) are planned. If such large slopes are planned, CETCO should be contacted for additional recommendations. A slope stability analysis may be needed. Such analysis was beyond our scope of services.

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.

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.

- 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;
- **Future building structure roof drains should be piped into proper storm drainage systems;**
- Diversion ditches should be used at the toe of all slopes to keep surface water from accumulating at or near site structures;
- For excavations during construction, most free water from the subsurface conditions could likely be removed via sump pumps and open channel flow (ditches) at or near the source of seepage. 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, we recommend a Seismic SITE CLASS "C" 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 (sandy soils at the site are very clayey), and surface rupture due to faulting or lateral spreading resulting from earthquake motions is low.

4.4 FUTURE FOUNDATIONS

The following recommendations are also based on the previously described project information, typical single story industrial building types, 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 pad will be constructed according to our recommendations.

Once the exact future type building is known, additional borings should be drilled to verify conditions at that time and a full 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 native soils or compacted engineered fill.*** 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 ***36 inches below finished exterior grade*** (due to soil swelling considerations);

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.
- 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 FUTURE FLOOR SLABS

Normal conventional type slabs can be supported by engineered fill soils or native/existing soils 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 CONSTRUCTION RECOMMENDATIONS

We understand an entrance driveway will be part of the building pad construction. Our recommendations address the construction of that access road. Considerations for final entrance asphalt pavement and end-user requirements for the road should be addressed at that later date.

Please refer the Earthwork section of this report for 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 used for construction access and is not likely to be paved in the near future, we recommend an initial layer of #3, 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 a building pad. We do not have information on future building(s) types or sized or any applicable information for the design and construction of that building(s). Therefore, additional geotechnical exploration and reporting for that future project will be required at that time. Our current report cannot address final conditions and project needs for such projects.

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.

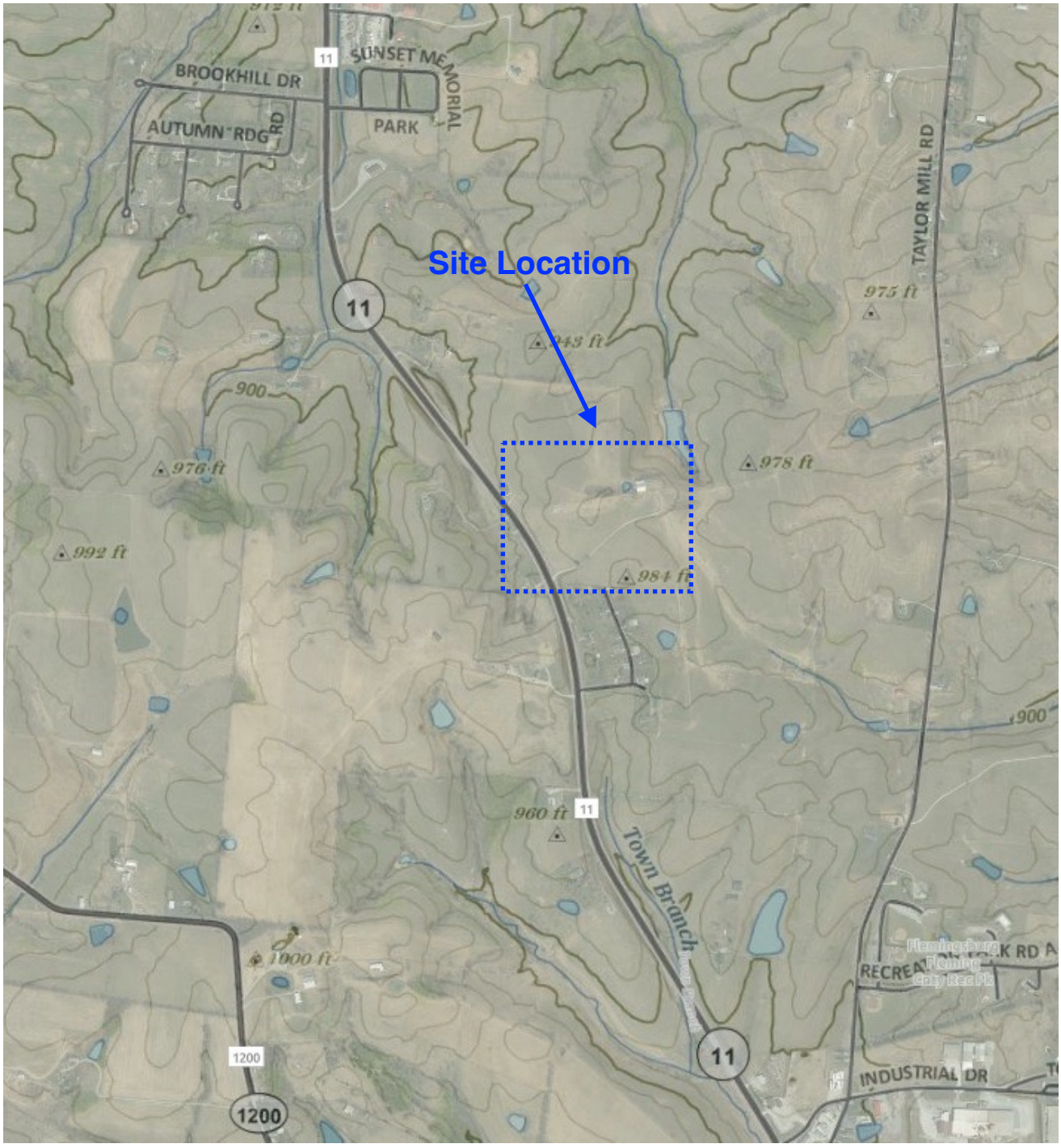
We recommend that the owner retain CETCO to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of the recommendations.

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 samples collected and making them available for inspection for 30 days. The samples are then discarded unless you request otherwise.

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.

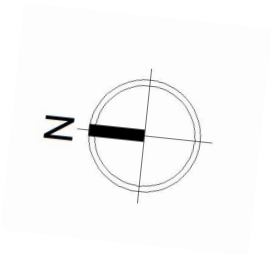
N

CETCO, PLLC
624 Wellington Way
Lexington, KY 40515
859.475.3933
www.cetcopllc.com

SITE LOCATION PLAN
for Fleming County Build Ready Pad

Flemingsburg, Kentucky

CETCO Project: 1776-23-0122
Date: August 30, 2023
Drawn by: Hunter Hawkins
Checked by: Joe Cooke, PE
Drawing: 1 of 1



Boring location plan adapted from Google Earth, dated August, 2022 with further adaptations from CETCO professionals.

Legend

Boring Location, B-# or S-#

CETCO, PLLC
624 Wellington Way
Lexington, KY 40503
859.475.3933
www.cetcopllc.com

BORING LOCATION PLAN
For Fleming County Build Ready Pad

Flemingsburg, Kentucky

CETCO Project: 1776-23-0122
Date: August 30, 2023
Drawn by: Hunter Hawkins
Checked by: Joe Cooke, PE
Drawing: 1 of 1

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

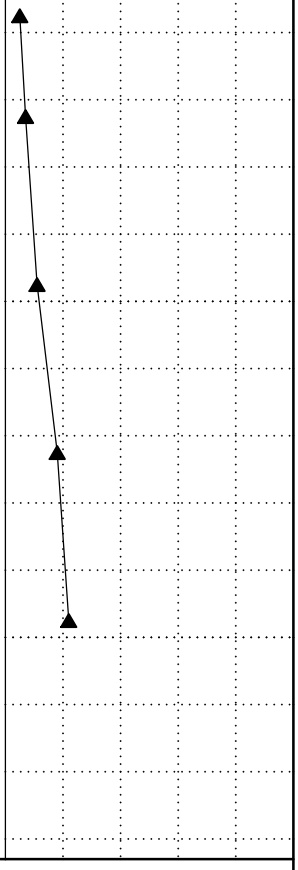
BORING NUMBER B-1

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Mostly Sunny, 80'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)
0		TOPSOIL (8")					
		Brown silty LEAN CLAY (CL), with few fine organics, moist, FIRM	SPT S-1	83	1-3-2 (5)		
		Brown LEAN CLAY (CL), with few black oxide nodules, moist, FIRM	SPT S-2	100	2-3-4 (7)		
5		Brown LEAN to FAT CLAY (CL-CH), with few brown oxide nodules and few gravel, moist, STIFF	SPT S-3	100	5-5-6 (11)		
			SPT S-4	100	7-8-10 (18)		
10		Brown LEAN to FAT CLAY (CL-CH), with some gravel, moist, VERY STIFF	SPT S-5	100	5-8-14 (22)		
		Weathered LIMESTONE					

Refusal at 13.3 feet.
Bottom of borehole at 13.3 feet.

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



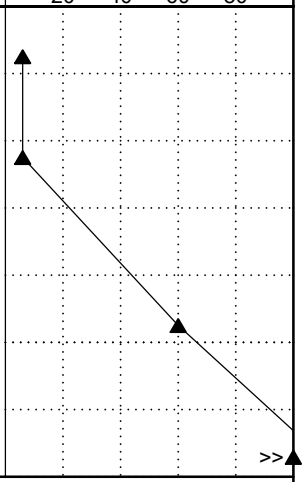
CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-2

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Mostly Sunny, 80'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)
0		TOPSOIL (10")	SPT S-1	61	1-3-3 (6)		
		Brown silty LEAN CLAY (CL), with few fine organics, moist, FIRM					
		Brownish orange LEAN to FAT CLAY (CL-CH), with few fine oragnics, moist, FIRM	SPT S-2	100	2-3-3 (6)		
		Brown LEAN to FAT CLAY (CL-CH), with few gravel, moist, FIRM into VERY STIFF					
5			SPT S-3	100	10-39-21 (60)		
		Weathered LIMESTONE and brown LEAN CLAY (CL), slightly moist, HARD					
		Weathered LIMESTONE	SPT S-4	60	50/5"		

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



Refusal at 7.0 feet.
Bottom of borehole at 7.0 feet.

CETCO
624 Wellington Way
Lexington, KY 40503
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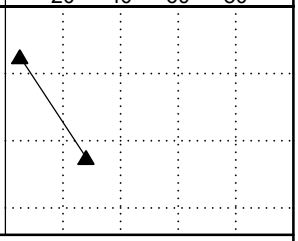
BORING NUMBER B-3

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Mostly Sunny, 80'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)
0		TOPSOIL (4")					
		Brownish orange silty LEAN CLAY (CL), with few fine organics, slightly moist, FIRM	SPT S-1	100	3-3-2 (5)		
		Browinsh green LEAN to FAT CLAY (CL-CH), with some gray mottling, moist, FIRM into VERY STIFF					
		Weathered LIMESTONE and brown LEAN CLAY (CL), slightly moist, VERY STIFF	SPT S-2	100	3-9-19 (28)		
		Weathered LIMESTONE					

Refusal at 3.4 feet.
Bottom of borehole at 3.4 feet.

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



CETCO
624 Wellington Way
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BORING NUMBER B-3A

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Mostly Sunny, 80'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)
0		TOPSOIL (4") - Offset 10' SW from B-3					
		SOUNDING ONLY : Cuttings appeared to be brownish orange silty LEAN CLAY (CL)					
		SOUNDING ONLY : Cuttings appeared to be browinsh LEAN to FAT CLAY (CL-CH)					
5		Brown LEAN CLAY (CL) and weathered LIMESTONE, slightly moist, VERY STIFF	SPT S-1	100	18-17-15 (32)		
		Weathered LIMESTONE	SPT S-2	93	13-27-50/3"		

Refusal at 7.8 feet.
Bottom of borehole at 7.8 feet.

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

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

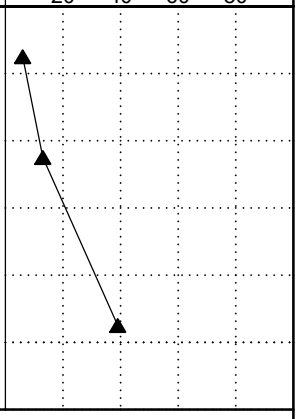
BORING NUMBER B-4

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Mostly Sunny, 80'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)
0		TOPSOIL (10")					
		Brown silty LEAN CLAY (CL), with few fine organics, moist, FIRM	SPT S-1	89	3-3-3 (6)		
		Brownish LEAN to FAT CLAY (CL-CH), with few gravel, moist, STIFF	SPT S-2	72	4-6-7 (13)		
5		Brown LEAN CLAY (CL) and weathered LIMESTONE, slightly moist, VERY STIFF	SPT S-3	100	12-24-15 (39)		
		Weathered LIMESTONE					

Refusal at 6.0 feet.
Bottom of borehole at 6.0 feet.

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



CETCO
624 Wellington Way
Lexington, KY 40503
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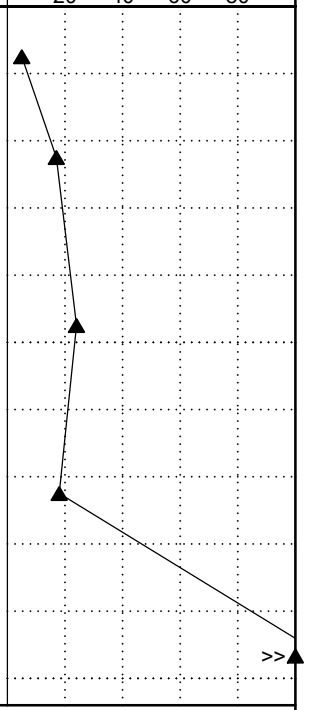
BORING NUMBER B-5

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Mostly Sunny, 80'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)
0		TOPSOIL 5")					
		Brown silty LEAN CLAY (CL), with few fine organics and black oxides, moist, FIRM into VERY STIFF	SPT S-1	89	2-3-2 (5)		
			SPT S-2	50	2-2-15 (17)		
		Rocky gravel zone					
5		Brownish LEAN to FAT CLAY (CL-CH), with few gravel, moist, VERY STIFF	SPT S-3	100	5-6-18 (24)		
			SPT S-4	100	9-8-10 (18)		
10		Weathered LIMESTONE	SPT S-5	94	8-27-50/4"		



Refusal at 10.4 feet.
Bottom of borehole at 10.4 feet.

CETCO
624 Wellington Way
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BORING NUMBER S-1

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Mostly Sunny, 80'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		SOUNDING ONLY : Topsoil (4")						
		Cuttings appeared to be brown silty LEAN CLAY (CL)						
		Cuttings appeared to be brown LEAN to FAT CLAY (CL), with some gravel						
5		Weathered LIMESTONE						

Refusal at 6.7 feet.
Bottom of borehole at 6.7 feet.

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

BORING NUMBER S-2

CLIENT Fleming County EDA
PROJECT NAME Fleming Co. Build Ready Pad
PROJECT NUMBER 1776-23-0121
PROJECT LOCATION Flemingsburg, Kentucky
DATE STARTED 8/17/23 **COMPLETED** 8/17/23
GROUND ELEVATION _____ **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING ---
NOTES Mostly Sunny, 80'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		SOUNDING ONLY : Topsoil (4")						
		Cuttings appeared to be brown silty LEAN CLAY (CL) and gravel						
5		Cuttings appeared to be brown LEAN to FAT CLAY (CL), with some gravel						
10		Weathered LIMESTONE						

Refusal at 12.5 feet.
Bottom of borehole at 12.5 feet.

Cooke Engineering and Testing Company

Laboratory Testing Summary Table

Project Name:	Fleming Co Industrial Park Build-Ready Pad	Date:	September 14, 2023
Project Location:	Flemingsburg, KY	Reviewed by:	Joe Cooke, PE
Client:	Flemingsburg-Fleming County IDA	CETCO Project Number:	1776-23-0122

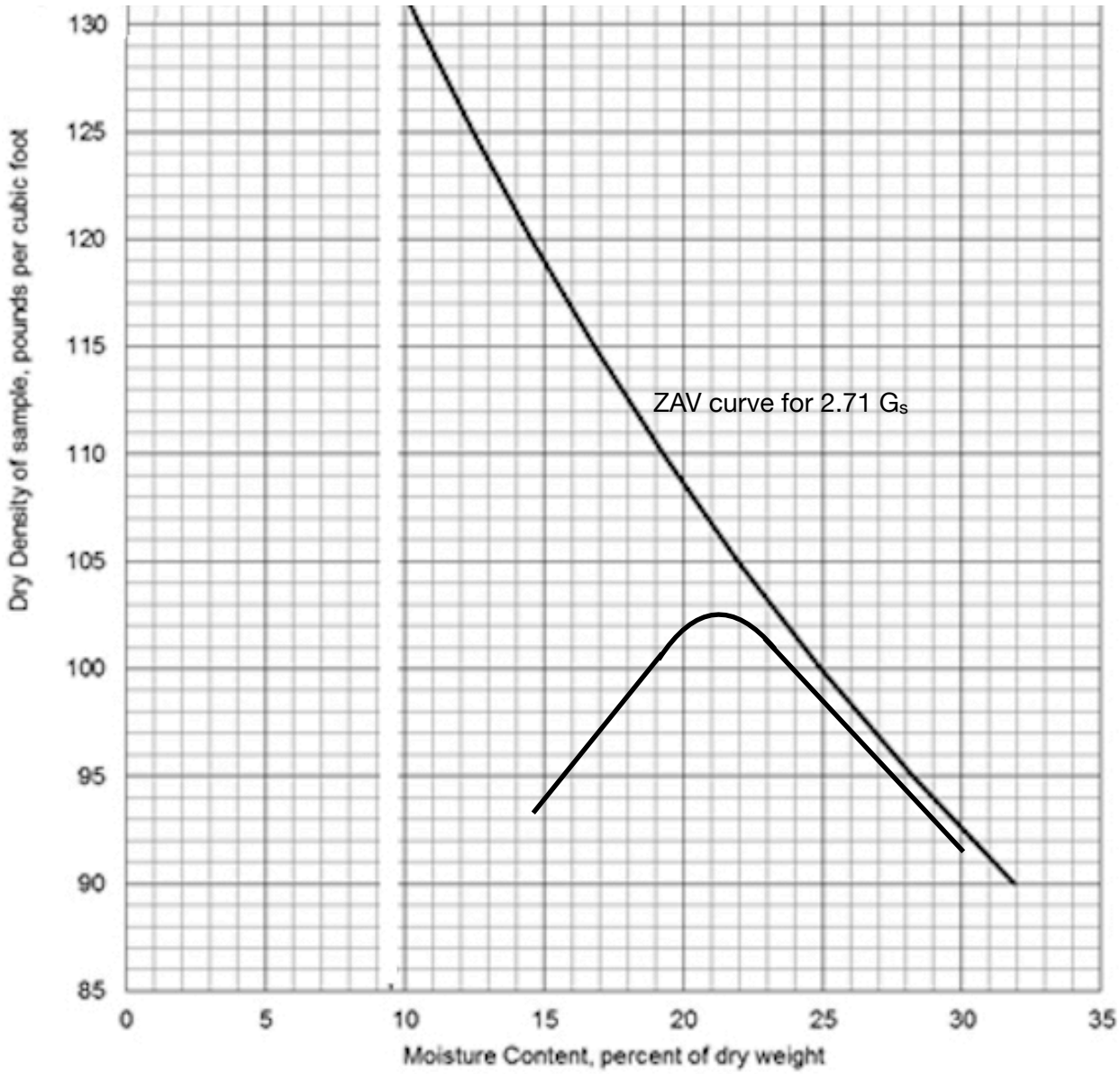
Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
P-1	1-5	25.6	55	23	32	89.2	102.7	21.3
B-1	0.0-1.5	19.4						
B-1	1.5-3.0	24.5						
B-1	4.0-5.5	22.4						
B-1	6.5-8.0	24.9						
B-1	9.0-10.5	14.1						
B-2	1.5-3.0	32.6						
B-3	1.5-3.0	20.0						
B-3	4.0-5.5	14.4						
B-4	1.5-3.0	32.5						
B-5	0.0-1.5	27.1						
B-5	1.5-3.0	26.3						
B-5	4.0-5.5	21.3	41	20	21	83.3		
B-5	6.5-8.0	16.3						
B-5	9.0-10.5	19.6						

Cooke Engineering and Testing Company

Moisture-Density (“Proctor”) Sheet

Project Name:	Fleming Co Industrial Park Build-Ready Pad	Date:	September 14, 2023
Project Location:	Flemingsburg, KY	Reviewed by:	Joe Cooke, PE
Client:	Flemingsburg-Fleming County IDA	CETCO Project Number: 1776-23-0122	
		“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, 1’-5’	25.6	55	32	102.7	21.3	89.2



Cooke Engineering and Testing Company

Atterberg Limits Chart

Project Name:	Fleming Co Industrial Park Build-Ready Pad	Date:	September 14, 2023
Project Location:	Flemingsburg, KY	Reviewed by:	Joe Cooke, PE
Client:	Flemingsburg-Fleming County IDA	CETCO Project Number: 1776-23-0122	
		"Atterberg Limits", ASTM D4318	

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve
P-1, 1'-5' ▲	1-5	25.6	55	23	32	89.2
B-5, 4.0'-5.5' ★	4.0-5.5	21.3	41	20	21	83.3

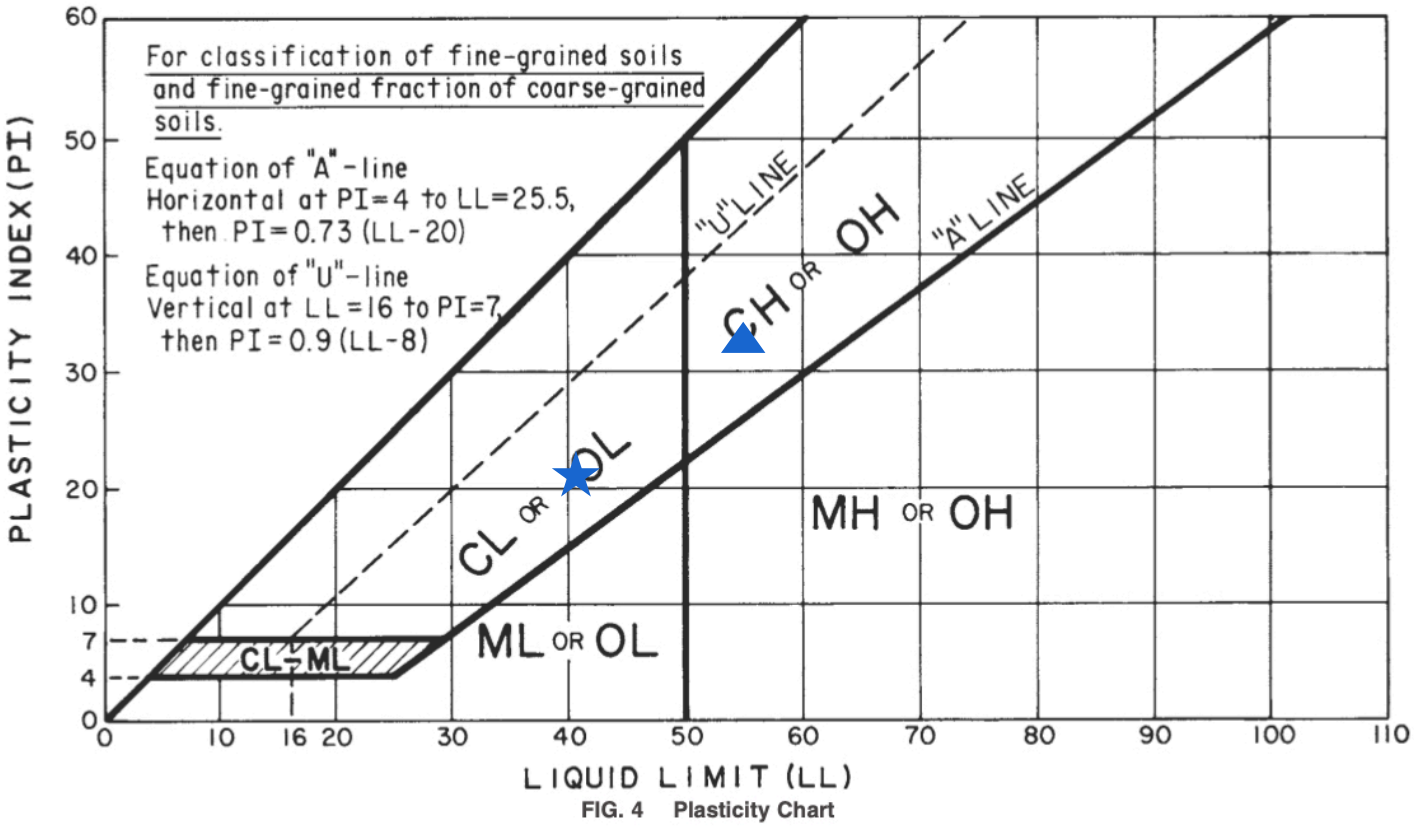


FIG. 4 Plasticity Chart

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