Todd County Industrial Foundation
John E. Walton Business Park Site Development

# ADDENDUM No. 2

**July 14, 2026**

This ADDENDUM to plans, specifications and bidding documents for the subject project modifies the referenced items to the extent described herein. Items not modified by this ADDENDUM remain unchanged and in full effect. Bidders are required to acknowledge receipt of this ADDENDUM on the Bid Form.

1. Appendix 3 (Soils Report): **Add** Geotechnical Report prepared by Vector Engineers, Inc. (dated October 12, 2016) with random soil borings on the affected site. (Attachment: 29 pages).

END OF ADDENDUM NO. 2 TEXT
This ADDENDUM consists of a total of 1 pages.

October 12, 2016

Mike McGhee, PE
McGhee Engineering, Inc.
202 South Ewing Street
Guthrie, KY 42234

Subject: Report of Preliminary Geotechnical Exploration
**Elkton Commercial Site**
Elkton, Kentucky
Vector Project 16-2919

Dear Mr. McGhee,

VECTOR Engineers, Inc., has completed a preliminary geotechnical engineering exploration for the site in Elkton, Kentucky. This exploration was in general accordance with our proposal No. 16-142, dated July 21, 2016, which was accepted by Mr. Mike McGhee with McGhee Engineering on September 8, 2016. The purpose of this exploration was to assess the site conditions and provided preliminary recommendations to prepare the property for listing on the state economic development website. This report describes our understanding of the project, summarizes our findings, discusses the geotechnical concerns, and contains our preliminary recommendations.

## PROJECT INFORMATION

Project information was provided to us through conversations with Mr. McGhee as well as through aerial photographs and a topographic computer-aided design (CAD) file. Project information is conceptual at this time. The site is being prepared for listing with the Kentucky Cabinet for Economic Development; therefore, there are no specific plans for structures currently proposed for the site. We have assumed a large commercial of industrial building will be constructed on the 25-acre lot.

For the purposes of providing preliminary recommendations, we have assumed a steel framed, single-story, warehouse building with a 20-foot eve height. The structural loads are assumed to be carried predominately be steel columns supporting less than

100 kips per column and load bearing walls, if any, will support less than 4 kips per linear foot. The grade supported floor slab will support less than 200 psf. Settlement tolerance for the building is assumed to be ¾ inches differential and 1-inch total. A high capacity warehouse with automated rail system and heavy floor loads is beyond our recommendations.

Based on the topographic contours provides to us, we anticipate up to 4 feet of cut or fill to develop the site. We have assumed there will be not below grade structures or retaining walls.

## FINDINGS

As part of our geotechnical site characterization, we observed site conditions, reviewed regional geological maps, performed a subsurface exploration, and observed the groundwater conditions. The following sections report our findings.

### Site Surface Conditions

Mr. Seth Barnett, geologist, with Vector Engineers visited the site on Wednesday, September 21, 2016, to observe surface conditions to aid in interpreting the subsurface data and to detect conditions which could affect future development at this site. The following is a general description of the site.

Photograph 1: View of the site from the middle of the east side looking west. The gently sloping site was cultivated with corn and Tabaco.

The site is located on farmland northeast of downtown Elkton, KY. The site is bordered to the north by the Highway 68-80 Bypass. It is bordered to the east and west by open farmland, and to the south by residential housing. Further south, approximately 850 feet south of the site, is old Hwy 68 / E. Jefferson Davis Highway

At the time of our exploration, corn had recently been shelled and the site was primarily covered in the remaining stalks (Photograph 1). The terrain slopes gently at about 1 percent grade downhill from north to south. The site drainage was visually judged to be fair without areas of standing water.

**Area Geology**

The Geologic Map of the Elkton Quadrangle, Kentucky, (GQ-650, 1967), published by the U.S. Geological Survey indicates the site is underlain by the Renault Limestone formation of the Upper Mississippian age. This formation consists of very-light to medium-light gray and light olive gray, very fine to coarse grained, dolomitic limestone. The limestone contains chert in places.

We reviewed the Kentucky Geological Survey (KGS) for Karst potential and for closed depressions. A few closed depressions (i.e. – sinkholes) were mapped at distances less than 1/2 mile from the site (Figure 1). We did not observe any obvious surface indications of sinkhole activity within the project boundaries; however, the site and surrounding areas have been plowed and graded, thus covering signs of sinkhole activity. The KGS mapping of the area indicates a high potential for solutioning of the rock in the project area.

Sinkholes are typical of Karst regions and occur due to solutioning activity of the underlying limestone formation which is generally soluble in slightly acidic groundwater. Rainfall infiltration penetrates the surface vegetation and moves through fractures in the limestone. As water penetrates the rock joints, solutioning of the bedrock occurs over long periods of time and cavities in the rock develop. As the cavity continues to grow, the cavity roof arch can no longer support the soil overburden load, the overlying soil begins to sag, and then collapses thus creating closed depressions (bowl-shaped areas).

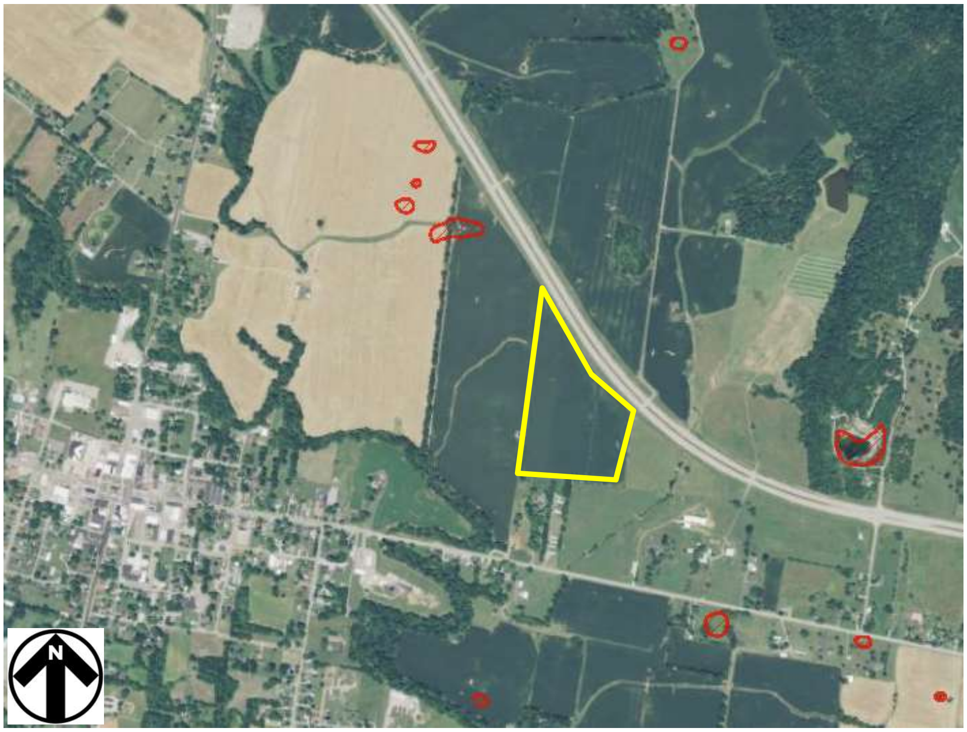



Figure 1: Aerial photograph of the site and surrounding area. The site is outlined in yellow. The red outlines indicate sinkholes mapped by the USGS.

**Subsurface Exploration**

After researching the readily available published geological information, a preliminary subsurface profile is formulated. The soil boring program is a means to substantiate the assumptions made in our preliminary profile and assist us in developing a representative subsurface profile of the site. The subsurface conditions will vary between borings thereby making the development of a representative and reliable profile dependent upon the number of borings or data points obtained during the field operations. The following discusses our interpretation of the subsurface profile on the site based on the published information and the results of our borings. The individual Boring Logs attached to this report will have specific details at the location of the boring.

<u>Field Exploration and Laboratory Testing Methods</u>

The procedures used by Vector Engineers for field and laboratory sampling and testing are in general accordance with ASTM procedures and established engineering practice. A brief summary of the field and laboratory procedures is included in the attachments.

We drilled six borings to explore the subsurface conditions across the site. Mr. Barnett, geologist, under the guidance of Mr. Matthew Slusser, PE, directed drilling operations. The boring locations staked by McGhee Engineering. Boring surface elevations. The stratification lines shown on the Boring Logs represent the approximate boundaries between soil or rock types. The transitions may be more gradual than shown.

We obtained soil samples using a split-barrel sampler driven by an automatic hammer assembly in general accordance with ASTM D1586. The soil samples were sealed in the field and returned to our laboratory where Mr. Slusser assigned the applicable laboratory tests. The soil samples were visually classified, by Mr. Slusser, the project geotechnical engineer, according to the Unified Soil Classification System (USCS, ASTM D2487). We conducted moisture contents on several soil samples. Atterberg limits tests were performed on selected soil samples to determine the engineering properties of the soil. The laboratory data and descriptions of these tests are included in the attachments.

Subsurface Conditions

Beneath about 4 inches of topsoil in borings B-5 and B-6 and at the surface in our other four borings, a reddish brown lean clay was encountered extending to depths ranging from 6 to 8½ feet. Standard penetration (SPT) N-values within the stratum ranged from 2 to 16 blows per foot (bpf) with a median value of 7 bpf. The penetration values indicate generally firm soil consistency. Soil plasticity tests (Atterberg limits) performed on two soil samples. The sample from Borings B-3 at about 7½ feet deep had a liquid limit of 45 and plasticity index of 27 indicating a moderate plasticity lean clay. The sample from Boring B-6 had a liquid limit of 33 and a plasticity index of 9 inidicating a low plasticity borderline clay/silt. Using these laboratory tests and the USCS, we classified soil samples as “CL” (a low to moderate plasticity clay).

At depths ranging from 6 to 8½ feet, the lean clay transitioned to a reddish brown to yellowish brown fat clay that extended to refusal. SPT N-values within the stratum generally ranged from 8 to 24 bpf with a median value of 14 bpf. The penetration values indicate generally stiff to very stiff soil consistency. An SPT N-value of 3 bpf, soft clay, was encountered in Boring B-2 at 15 feet deep. Using visual-manual methods, we classified soil samples as "CH" (a moderate to high plasticity clay). The borings encountered auger refusal at depths ranging from about 11 to 20 feet.

**Groundwater**

Perched groundwater was encountered in Boring B-2 at a depth of 5 feet during soil augering. Groundwater was not encountered in our remaining five borings at the completion of soil augering. We believe the water encountered in Boring B-2 is perched or trapped groundwater and not linked to the more stable groundwater table which typical occurs below the bedrock surface in Karst geology formations.

Groundwater levels fluctuate with seasonal and cyclical climatic variations in precipitation and may be either higher or lower at other times. Typically, water conditions affecting construction projects in the site area are related to trapped or perched water which occurs in irregular, discontinuous locations within the soil overburden, or near the soil/rock interface. When these water bearing strata are exposed in excavations, such as cut slopes, utility or footing trenches, they can produce widely varying seepage durations and rates depending on recent rainfall activity and other site specific characteristics of the area. These perched water sources are often not linked to the more continuous relatively stable ground water table that typically occurs at greater depths. In Karst areas, the static groundwater table is typically well below the rock surface.

## DISCUSSION

Based on the results of our borings and our understanding of the proposed project, we believe the project site is suitable for the development of a warehouse or light industrial buildings and new pavements. However, the Karst conditions at this site represent a geotechnical challenge and financial impact to the proposed development. Many sites have with sinkhole potential have been developed successfully throughout central Kentucky. We do not believe the risk of sinkhole development on this site is any greater than others sites in Todd County, Kentucky. The following subsections provide additional details and discuss other geotechnical concerns.

**Karst Topography**

Areas underlain by potentially soluble rock (i.e. – limestone or dolomite) are at some risk due to solution and sinkhole activity. We did not observe obvious signs of Karst activity in and around the property. As previously stated, the Kentucky Geological Survey rated the site with a high the risk of sinkhole development based on the underlying rock formation. Boring B-2 encountered soft soils at about 15 feet deep along with several rock fragments. The soft soils may indicate Karst activity. We recommended the site be further explored with track hoe excavated test pits.

Development of other similar sites in the area has been successfully performed in the past. Based on our observations, we do not believe the risk of sinkhole development at this site is any larger than the surrounding area.

If a solution feature is encountered during grading and/or underground utility construction, the solution feature can be repaired. When sinkholes are encountered, the common practice is to excavate all of the soil from within the solution feature down to hard bedrock. Several methods are available to repair the solution feature at this point. The two most common methods of remediation are a concrete plug or an inverted filter. An engineering evaluation of each encountered sinkhole should be performed to assess the proper remediation procedures.

**Refusal Depths and Rock Excavations**

Refusal material (rock) was encountered in our borings. The depths to auger refusal were varied - ranging from about 11 to 20 feet. Depending on the grading of the site, rock may be encountered during foundation excavation, especially if there will be below grade structures. Our experience indicates the top of rock on this site will likely be irregular and pinnacled in areas. Rock may be encountered at elevations both higher and lower than indicated by the borings.

Based on experience at similar sites, we anticipate that the upper 1 to 2 feet of the bedrock will likely be weathered and the rock excavation can be performed with mechanical means. However, blasting may be necessary to efficiently remove more resistant rock and large boulders which may be encountered. Mechanical removal will likely produce large limestone slabs which will not be suitable for use as fill material beneath buildings or pavements. Blasting may be required to produce the fragmentation of the limestone portion of the bedrock so that it may be used as fill material in other areas of the site.

**High Plasticity Clays**

High plasticity clay soil (classified as CH according to the USCS) was encountered at depths greater than about 5 to 6 feet in our borings. Based on empirical correlations with soil plasticity index, these plastic clays found on-site are moderately susceptible to volume change with variations in moisture content. These fat clay soils will remain stable so long as they are not subject to long term exposure to high moisture or dry conditions.

Building and site drainage should be designed to minimize exposure of these soils to moisture fluctuations, especially near building foundations. Construction planning should minimize exposure of these soils to excessive wetting or drying. These materials are likely suitable for use as fill provided the soil moisture contents are stringently controlled in the field.

## LIMITATIONS OF RECOMMENDATIONS

This report has been prepared for the exclusive use of McGhee Engineering, Inc. for specific application to the project site. Our preliminary recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the Commonwealth of Kentucky. No other warranty is expressed or implied. This company is not responsible for the conclusions, opinions, or recommendations of others based on these data. Additionally, our conclusions and recommendations are based on the information provided to us, the data obtained from our subsurface exploration, and our past experience. They do not reflect variations in the subsurface conditions which are likely to exist between borings and in unexplored areas of the site. These variations result from geologic variability of the subsurface conditions. This exploration was intended for preliminary purposes only and must not be used for final design. For more information on the use and limitations of this report, please read the ASFE document included in the attachments.

## PRELIMINARY RECOMMENDATIONS

### Foundation Bearing

We recommend use of a maximum allowable net soil bearing pressure of 2,500 psf (pounds per square foot) for preliminary design of footings. For foundations bearing directly on limestone bedrock, we would likely recommend use of an allowable net rock bearing pressure of 5,000 psf if the rock is not explored further. If rock bearing pressures exceeding 5,000 psf are desired, we recommend sampling and testing the bedrock as part of the supplementary geotechnical exploration. We recommend supporting a structure entirely on soil or entirely on rock, but not on combinations of both.

The exterior foundations should be designed with a minimum 30-inch embedment to protect against frost heave. We also recommend foundations have a minimum footing width of 24 inches to lessen the risk of differential settlement and to reduce the risk of punching failure. This footing width also allows for entry into the excavation to remove loose debris and for placement of the reinforcing steel. Reinforcing steel should be clean and dry prior to concrete placement.

### Floor Slab

We anticipate the existing soil will be supporting the slab-on-grade floor slab. We recommend a k-value (modulus of subgrade reaction) of 60 pounds per cubic inch (pci) be used in determining the slab thickness.

### Seismic Site Classification

The current seismic design procedures outlined in the NEHRP (National Earthquake Hazard Reduction Program) guidelines mandate structural design loads be based on the seismic accelerations of the site. Based on the results of our exploration and the geology of the area, we assigned a site seismic classification of “C”. Using the

U.S. Seismic "Design Maps" Web Application from the USGS website and the site coordinates, the seismic design values from the 2010 ASCE-7 Standard were determined and are listed in the attachment.

**Future Exploration**

When the design and location for structure(s) on site have been determined, supplementary exploration must be performed prior to final design of the foundations. This supplementary exploration will include obtaining additional soil data at the locations of the proposed structure(s) to provide specific recommendations. If conditions are different than those encountered in our preliminary exploration, it will be necessary for us to re-evaluate our conclusions and recommendations based upon on-site observation of the conditions.

## Valediction

Vector Engineers, Inc. appreciates the opportunity to provide you with these geotechnical services. Should you have questions or require any additional information, please contact us.

Respectfully submitted,
**VECTOR ENGINEERS, INC.**

Matthew J. Slusser, PE
Project Engineer
Licensed Kentucky 32059

STATE OF KENTUCKY
MATTHEW JONATHAN SLUSSER
32059
LICENSED
PROFESSIONAL ENGINEER

W. Robert Folsom, PE
Chief Engineer

Attachments:

- ASFE - Important Information about This Geotechnical-Engineering Report
- Site Location Map
- Aerial Photograph
- Boring Location Plan
- Boring Logs
- Field Testing Procedures
- Laboratory Data Summary
- Atterberg Limits
- Laboratory Testing Procedures
- USGS Design Maps Summary Report

# Important Information about This

# Geotechnical-Engineering Report

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

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

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

## You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## This Report May Not Be Reliable

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

## Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

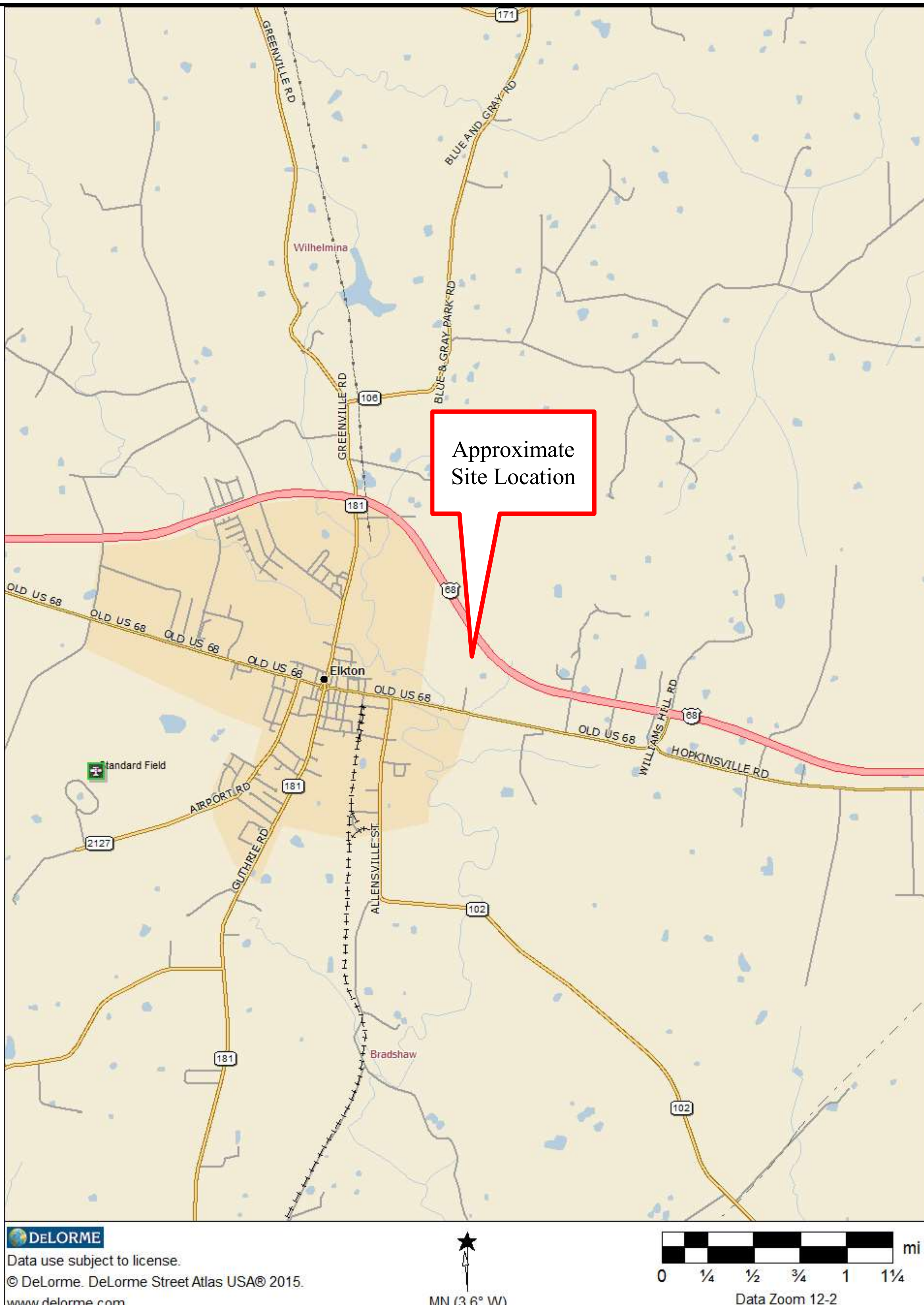
The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

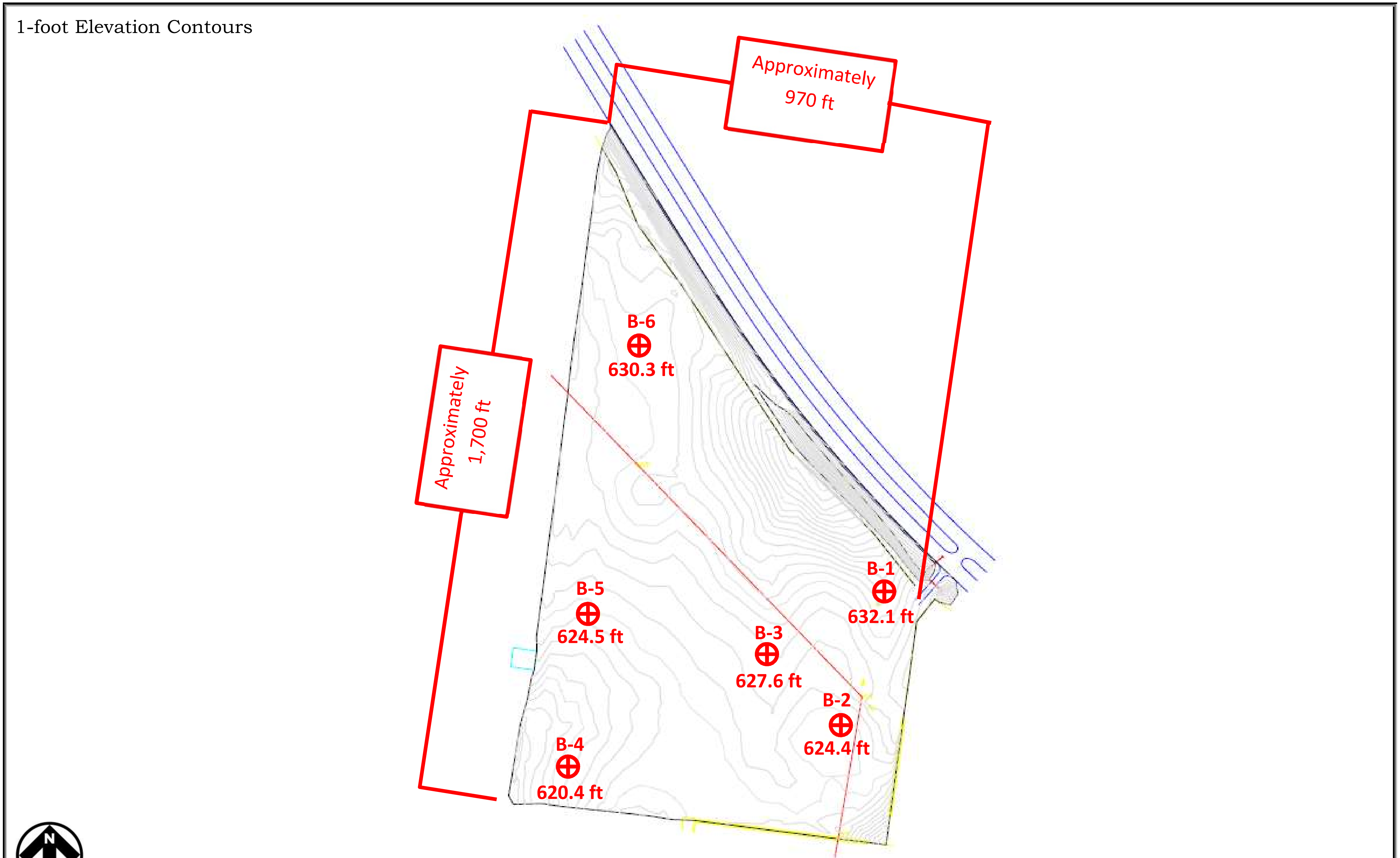
Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org




| McGhee Engineering, Inc. | VECTOR ENGINEERS, INC<br>GEOTECHNICAL · MATERIALS · GEOSCIENCES | **Site Location Map**<br>**Elkton Commercial Site**<br>Elkton, Kentucky<br>Vector Project 16-2919 |
|---|---|---|


Source: Google Earth

| McGhee Engineering, Inc. | VECTOR ENGINEERS, INC<br>GEOTECHNICAL • MATERIALS • GEOSCIENCES | Aerial Photograph<br>Elkton Commercial Site<br>Elkton, Kentucky<br>Vector Project 16-2919 |
| --- | --- | --- |




Source: Topographic CAD file prepared by McGhee Engineering

| LEGEND | VECTOR ENGINEERS, INC<br>GEOTECHNICAL • MATERIALS • GEOSCIENCES | **Boring Location Plan** |
|---|---|---|
| ⊕ **Boring Location (from McGhee Engineering Survey)** | | **Elkton Commercial Site**<br>Elkton, Kentucky<br>Vector Project 16-2919 |

**VECTOR ENGINEERS, INC**
GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

Elev: 632.1 feet

Boring: B-1



**Project: 16-2919 Elkton Commercial Site** — **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Northeast corner |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Dry upon completion | | **Weather:** Sunny, 80s F |
| **Geologist** Seth Barnett : Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 3.5 | FIRM to STIFF, reddish brown, LEAN CLAY (CL) - moist | | 1 | SS | 3, 3, 5 | 18 | 8 | | | | | |
| | | | | 2 1/2 | SS | 7, 7, 9 | 18 | 16 | | | | | |
| 3.5 | 6.0 | VERY STIFF, dark brown, LEAN CLAY (CL) with few rock fragments and black oxide staining - moist | | 5 | SS | 13, 11, 13 | 18 | 24 | | | | | |
| 6.0 | 10.9 | VERY STIFF, reddish brown to yellowish brown, FAT CLAY (CH) - moist | | 7 1/2 | SS | 11, 8, 11 | 18 | 19 | | | | | |
| | | | | 10 | SS | 4, 5, 9 | 18 | 14 | | | | | |
| 10.9 | | **Auger Refusal at 10.9 feet** | | | | | | | | | | | |

**VECTOR ENGINEERS, INC**
GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

**Elev: 624.4 feet**

**Boring: B-2**



**Project: 16-2919 Elkton Commercial Site** **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Middle of east side |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Wet sample at 5 feet | | **Weather:** Sunny, 80s F |
| **Geologist:** Seth Barnett<br>Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 2.0 | FIRM, reddish brown, LEAN CLAY (CL) - moist | | 1 | SS | 3, 3, 3 | 18 | 6 | | | 23% | | |
| 2.0 | 8.5 | SOFT, brown, silty LEAN CLAY (CL) - damp/wet<br>*Lense of rock fragments at ~4 feet* | | 2 1/2 | SS | 1, 1, 1 | 12 | 2 | | | 26% | | |
| | | | | 5 | SS | 12, 1, 2 | 12 | 3 | | | 25% | | |
| | | | | 7 1/2 | SS | 1, 2, 4 | 18 | 6 | | | 23% | | |
| 8.5 | 12.5 | FIRM to STIFF, reddish brown, LEAN to FAT CLAY (CL/CH) - moist | | 10 | SS | 4, 6, 9 | 18 | 15 | | | 20% | | |
| 12.5 | 18.3 | SOFT, reddish brown, FAT CLAY (CH) - moist<br>*Rock fragments at 15.3 feet* | | 15 | SS | 2, 1, 2 | 18 | 3 | | | 23% | | |
| 18.3 | | **Auger Refusal at 18.3 feet** | | | | | | | | | | | |

**VECTOR ENGINEERS, INC**
GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

Elev: 627.6 feet



**Project: 16-2919 Elkton Commercial Site** — **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Middle of site |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Dry upon completion | | **Weather:** Sunny, 80s F |
| **Geologist:** Seth Barnett : Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.5 | SOFT, reddish brown, LEAN CLAY (CL) - moist | | 1 | SS | 2, 2, 2 | 18 | 4 | | | | | |
| 1.5 | 8.5 | FIRM to STIFF, reddish brown, LEAN CLAY (CL) - moist | | 2 1/2 | SS | 2, 4, 4 | 18 | 8 | | | | | |
| | | | | 5 | SS | 2, 5, 4 | 18 | 9 | | | | | |
| | | | | 7 1/2 | SS | 4, 4, 5 | 18 | 9 | | 45, 27 | 19% | | |
| 8.5 | 16.9 | STIFF to VERY STIFF, reddish brown, FAT CLAY (CH) - moist | | 10 | SS | 6, 7, 9 | 18 | 16 | | | | | |
| | | | | 15 | SS | 4, 5, 5 | 18 | 10 | | | | | |
| 16.9 | | **Auger Refusal at 16.9 feet** | | | | | | | | | | | |

**VECTOR ENGINEERS, INC**
GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

Elev: 620.4 feet



**Project: 16-2919 Elkton Commercial Site** — **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Southwest corner |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Dry upon completion | | **Weather:** Sunny, 80s F |
| **Geologist** Seth Barnett : Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 6.0 | FIRM, reddish brown, LEAN CLAY (CL) - moist | | 1 | SS | 4, 1, 4 | 18 | 5 | | | | | |
| | | | | 2 1/2 | SS | 3, 3, 3 | 18 | 6 | | | | | |
| | | | | 5 | SS | 2, 2, 3 | 18 | 5 | | | | | |
| 6.0 | 17.2 | STIFF, reddish brown, FAT CLAY (CH) - moist | | 7 1/2 | SS | 4, 5, 6 | 18 | 11 | | | | | |
| | | | | 10 | SS | 4, 5, 9 | 18 | 14 | | | | | |
| | | | | 15 | SS | 4, 6, 9 | 18 | 15 | | | | | |
| 17.2 | | **Auger Refusal at 17.2 feet** | | | | | | | | | | | |

**VECTOR ENGINEERS, INC**
GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

**Elev: 624.5 feet**

**Boring: B-5**



**Project: 16-2919 Elkton Commercial Site** — **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Middle of west side |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Dry upon completion | | **Weather:** Sunny, 80s F |
| **Geologist** Seth Barnett : Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.4 | TOPSOIL (5 inches) | | 1 | SS | 4, 3, 4 | 18 | 7 | | | | | |
| 0.4 | 8.5 | FIRM to STIFF, reddish brown, LEAN CLAY (CL) - moist | | 2 1/2 | SS | 4, 4, 5 | 18 | 9 | | | | | |
| | | | | 5 | SS | 3, 3, 5 | 18 | 8 | | | | | |
| | | | | 7 1/2 | SS | 3, 4, 4 | 18 | 8 | | | | | |
| 8.5 | 20.0 | FIRM to STIFF, mottled reddish brown, and yellowish brown FAT CLAY (CH) - moist *Rock fragments in spoon at 19.9 feet* | | 10 | SS | 3, 4, 6 | 18 | 10 | | | | | |
| | | | | 15 | SS | 4, 6, 7 | 18 | 13 | | | | | |
| | | | | 20 | SS | WOH, 2, 50/0 | 8 | - | | | | | |
| 20.0 | | **Split Spoon Refusal at 20.0 feet** | | | | | | | | | | | |

**VECTOR ENGINEERS, INC**

GEOTECHNICAL • MATERIALS • GEOSCIENCES

# Sounding Log

**Elev: 630.3 feet**



**Project: 16-2919 Elkton Commercial Site** — **Elkton, KY**

| | | |
|---|---|---|
| **Method:** H.S.A. | **Date:** 21-Sep-16 | **Location:** Northwest corner |
| **Diameter:** 2¼ in. ID | **Rig Type:** CME-45 | **Hammer Type:** Automatic |
| **Groundwater:** Dry upon completion | | **Weather:** Sunny, 80s F |
| **Geologist** Seth Barnett<br>**:** Pete Nemeth | **Notes:** | |

| From (ft) | To (ft) | Material Description | Symbol | Sample Depth (ft) | Sample Type | Blows per 6-inch increment | Recovery (in) | SPT-N value | Rock Quality (RQD,%) | Atterberg Limits (LL, PI) | Moisture Content (%) | % Fines (clay & silt) | Unconfined Compressive Strength (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.4 | TOPSOIL (5 inches) | | 1 | SS | 3, 3, 4 | 18 | 7 | | | | | |
| 0.4 | 6.0 | FIRM to STIFF, brown to reddish brown, LEAN CLAY (CL) - moist | | 2 1/2 | SS | 3, 4, 4 | 18 | 8 | | 33, 9 | 23% | | |
| | | | | 5 | SS | 3, 4, 6 | 18 | 10 | | | | | |
| 6.0 | 12.2 | STIFF, reddish brown, FAT CLAY (CH) - moist | | 7 1/2 | SS | 4, 7, 8 | 18 | 15 | | | | | |
| | | | | 10 | SS | 4, 6, 8 | 18 | 14 | | | | | z |
| 12.2 | | **Auger Refusal at 12.2 feet** | | | | | | | | | | | |

## FIELD TESTING PROCEDURES

Vector Engineers performs field tests in general accordance with the American Society for Testing and Materials (ASTM). These procedures are generally recognized as the basis for uniformity and consistency of test results in the geotechnical engineering profession. All work is initiated and supervised by qualified geotechnical professionals.

Subsequent portions of this attachment present briefly describe of our field testing procedures. Where applicable, we have referenced these procedures to ASTM standards which contain specific descriptions of apparatus, procedures, reporting, etc.

### SOIL TEST BORING, ASTM D-1586

The borings were made with a hollow-stem auger powered by a drill rig. At regular intervals, soil samples were obtained through the hollow augers with a standard 1.4-inch I.D., 2.0-inch O.D. split-tube sampler.

The sampler was initially 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 as the *standard penetration resistance (SPT N-value)*. Penetration resistance, when properly evaluated, is an index to soil consistency and strength.

In the field, our geotechnical professional logged and described the samples as they were obtained. Representative portions of each soil sample were labeled and sealed, then transported to our laboratory. The samples were examined by a graduate geotechnical engineer or geologist to visually check the field descriptions. Boring data, including sample intervals, penetration resistances, soil descriptions, and groundwater level are shown on the attached Test Boring Records.

### AUGER REFUSAL MATERIALS

Auger refusal is a term that describes subsurface materials sufficiently competent to prevent further penetration by our drilling augers. Our criterion for auger refusal is the inability of our drill rig to advance the augers with 300 psi down pressure. Typically, refusal materials exhibit penetration resistances in excess of 100 blows per foot. Refusal materials can be hard cemented soil, soft weathered rock, coarse gravel or boulders, rubble or other hard debris, 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.

CORRELATION
OF
STANDARD
PENETRATION RESISTANCE
WITH
RELATIVE COMPACTNESS AND CONSISTENCY

## Sand and Gravel

| Standard Penetration Resistance Blows/Foot | Relative Compactness |
|---|---|
| 0-4 | Very Loose |
| 5-10 | Loose |
| 11-20 | Firm |
| 21-30 | Very Firm |
| 31-50 | Dense |
| Over 50 | Very Dense |

## Silt and Clay

| Standard Penetration Resistance Blows/Foot | Consistency |
|---|---|
| 0-2 | Very Soft |
| 3-4 | Soft |
| 5-8 | Firm |
| 9-15 | Stiff |
| 16-30 | Very Stiff |
| 31-50 | Hard |
| Over 50 | Very Hard |

# Laboratory Data Summary

**PROJECT NAME:** *Elkton Commercial Site*

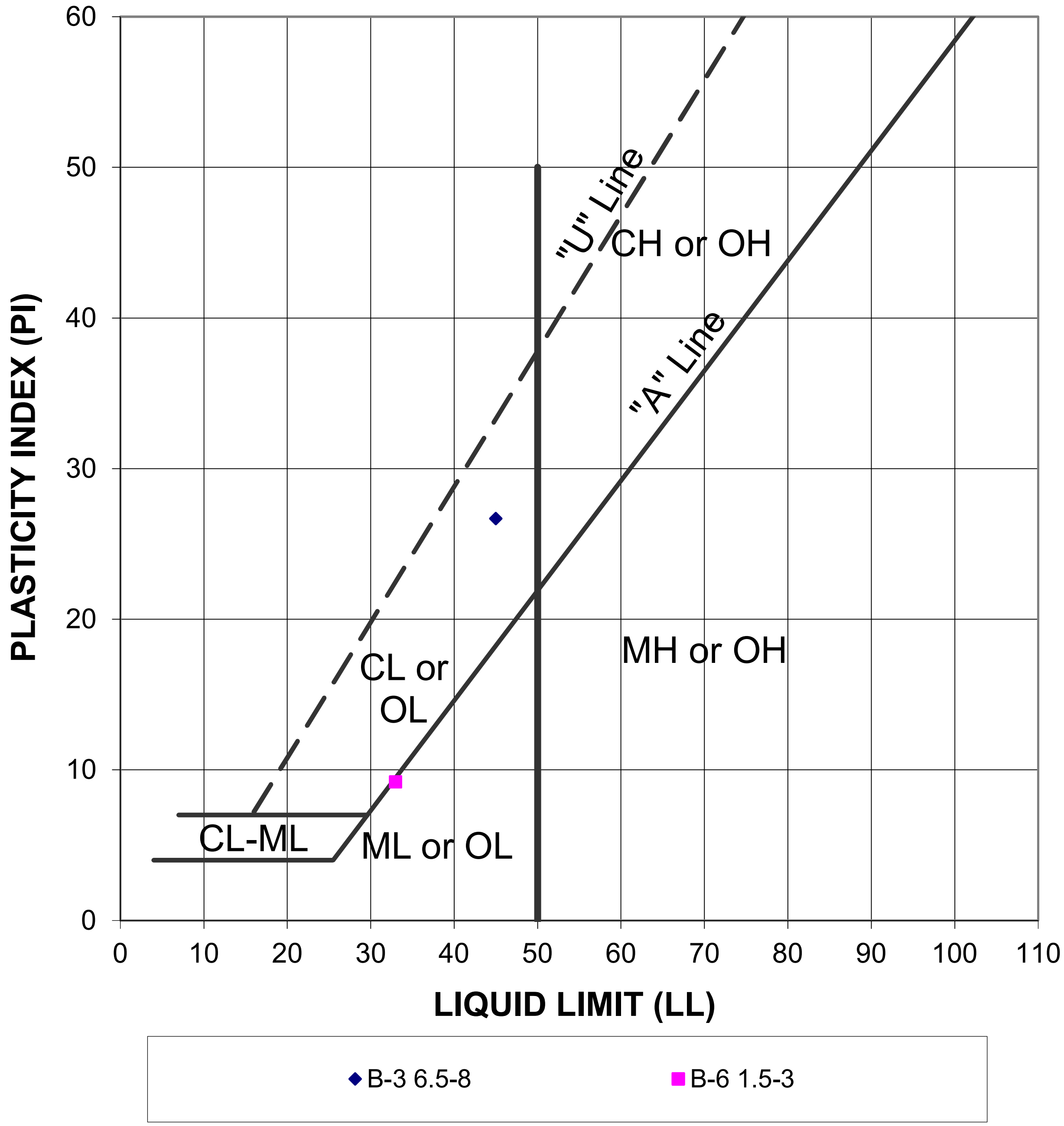
**PROJECT NUMBER:** *16-2919*
**REPORT DATE:** *10/03/16*

| BORING NO. | SAMPLE DEPTH, FT. | SAMPLE TYPE* | USCS | NATURAL MOISTURE CONTENT, % | ATTERBERG LIMITS | | | MAX. DRY DENSITY PCF /OPTIMUM MOISTURE % | UNIT WEIGHT, PCF | | UNCONFINED COMPRESSIVE STRENGTH, PSF | MATERIAL FINER THAN NO. 200, % | ORGANIC CONTENT, % | CBR, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L.L. | P.L. | P.I. | | WET | DRY | | | | |
| B-2 | 0-1.5 | SS | | 22.6 | | | | | | | | | | |
| B-2 | 1.5-3 | SS | | 25.9 | | | | | | | | | | |
| B-2 | 4-5.5 | SS | | 24.8 | | | | | | | | | | |
| B-2 | 6.5-8 | SS | | 23.4 | | | | | | | | | | |
| B-2 | 9-10.5 | SS | | 19.7 | | | | | | | | | | |
| B-2 | 14-15.5 | SS | | 23.2 | | | | | | | | | | |
| B-3 | 6.5-8 | SS | CL | 18.7 | 45 | 18 | 27 | | | | | | | |
| B-6 | 1.5-3 | SS | CL | 22.7 | 33 | 24 | 9 | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

# Atterberg Limits
## (ASTM D4318)

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | *Elkton Commercial Site* | **PROJECT NO.:** | *16-2919* |
| **SAMPLE RECEIVED:** | *09/27/16* | **TECHNICIAN:** | *EH* |
| **TEST DATE:** | *09/30/16* | **REVIEWED BY:** | |
| **METHOD:** | *Multipoint* | **REPORT DATE:** | *10/03/16* |

| Sample ID / Location | Depth | LL | PL | PI | Moist, % | Est. % retained on No. 40 sieve | Classification - Description |
|---|---|---|---|---|---|---|---|
| B-3 | 6.5-8 | 45 | 18 | 27 | 18.7 | <5 | Reddish orangle Lean Clay (CL) |
| B-6 | 1.5-3 | 33 | 24 | 9 | 22.7 | <5 | Brown silty Lean Clay (CL) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



## LABORATORY TESTING PROCEDURES

Vector Engineers generally subcontracts our laboratory tests to experienced labs with whom we have developed a confidence through past projects. The laboratory tests are performed in general accordance with the American Society for Testing and Materials (ASTM). These procedures are generally recognized as the basis for uniformity and consistency of test results in the geotechnical engineering profession. The tests are performed by skilled technicians trained in ASTM procedures. The laboratory equipment is well maintained and calibrated at least yearly.

Subsequent portions of this attachment present briefly describe of our testing procedures. Where applicable, we have referenced these procedures to ASTM standards which contain specific descriptions of apparatus, procedures, reporting, etc.

### MOISTURE CONTENT DETERMINATION, ASTM D-2216

The moisture content of soils is an indicator of various physical properties, including strength and compressibility. Selected samples obtained during exploratory drilling were taken from their sealed containers. Each sample was weighed and then placed in an oven heated to 110°C ± 5°. The sample remained in the oven until the free moisture had evaporated. The dried sample was removed from the oven, allowed to cool, and re-weighed. The moisture content was computed by dividing the weight of evaporated water by the weight of the dry sample. The results, expressed as a percent.

### ATTERBERG LIMITS DETERMINATION, ASTM D-4318

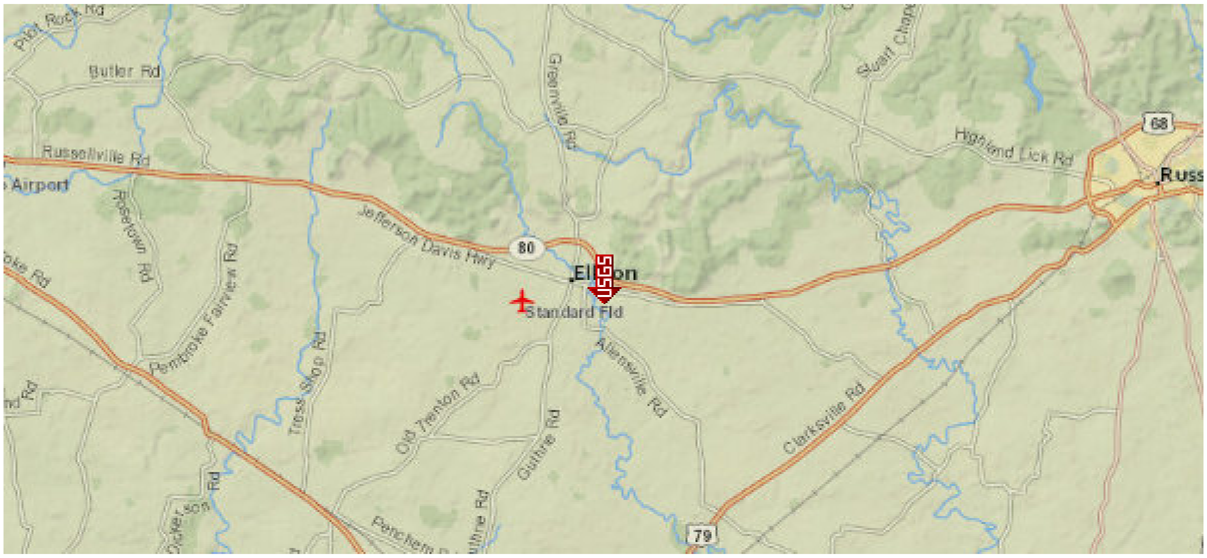
Representative samples were subjected to Atterberg limits testing to determine the soil's plasticity characteristics. The plasticity index (PI) is the range of moisture content through which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes wet enough to flow as a viscous fluid. To determine the liquid limit, a soil specimen is first washed through a No. 40 sieve. The materials finer than the No. 40 sieve are retained and dried until the soil is in a viscous fluid state. A portion of this soil is then placed in a brass cup of standardized dimensions. A groove is cut through the middle of the soil specimen with a grooving tool of standard dimensions. The cup is attached to a cam that lifts the cup 10 mm, and then allows the cup to fall onto a hard rubber base. The cam is rotated at about 2 cps until the two halves of the soil specimen come in contact at the bottom of the groove for a distance of 1/2 inch. The number of blows required to achieve this 1/2 inch contact is recorded, and part of the specimen is subjected to a moisture content determination. The remainder of the specimen is allowed to air dry for a short time, and the grooving process and cam action repeated. This testing sequence is repeated until more than 25 blows is required to achieve the required groove contact. After the number of blows vs. moisture content for the various test points are plotted on arithmetic graph paper, the moisture content corresponding to 25 blows is designated the liquid limit.

The plastic limit (PL) is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into threads 1/8" in diameter. The plastic limit is determined by taking a pat of soil remaining from the liquid limit test, and repeatedly rolling, kneading, and air drying it until the soil breaks into threads about 1/8 inches in diameter and 3/8 inches long. The moisture content of these soil threads is then determined, and is designated the plastic limit.

# USGS Design Maps Summary Report

## User–Specified Input

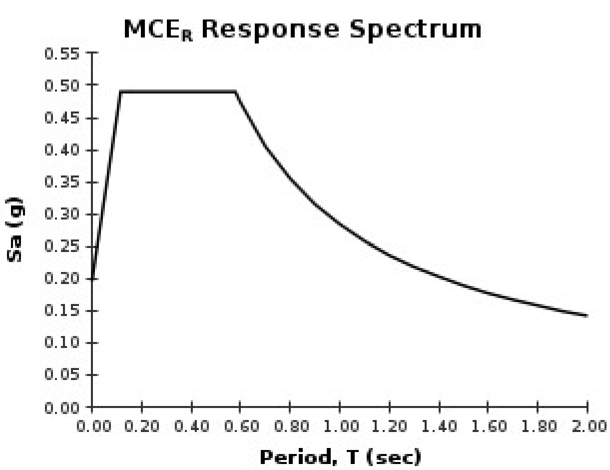
| | |
|---|---|
| **Report Title** | Elkton Commercial Site<br>Mon October 3, 2016 17:10:27 UTC |
| **Building Code Reference Document** | ASCE 7-10 Standard<br>(which utilizes USGS hazard data available in 2008) |
| **Site Coordinates** | 36.81088°N, 87.13949°W |
| **Site Soil Classification** | Site Class C – "Very Dense Soil and Soft Rock" |
| **Risk Category** | I/II/III |

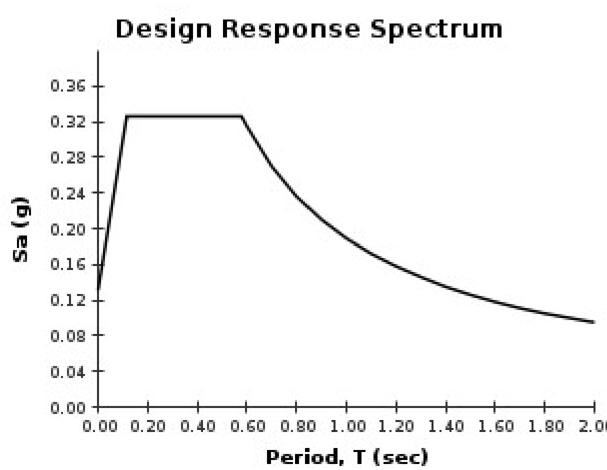



## USGS–Provided Output

| | | | | | |
|---|---|---|---|---|---|
| $S_S$ = | 0.408 g | $S_{MS}$ = | 0.490 g | $S_{DS}$ = | 0.326 g |
| $S_1$ = | 0.175 g | $S_{M1}$ = | 0.284 g | $S_{D1}$ = | 0.189 g |

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.




For $PGA_M$, $T_L$, $C_{RS}$, and $C_{R1}$ values, please view the detailed report.