REPORT OF GEOTECHNICAL EXPLORATION

AMERICAN ENGINEERS, INC.

JUNE 2018

FRANKFORT PLANT BOARD

FRANKFORT PLANT BOARD SUBSTATION
EROSION AND DRAINAGE MITIGATION

FRANKFORT, KY

AMERICAN ENGINEERS, INC.

June 22, 2018

Travis McCullar
Frankfort Plant Board
305 Hickory Drive
Frankfort, KY 40601

Re: Report of Geotechnical Exploration
Frankfort Plant Board Substation Erosion and Drainage Mitigation
Frankfort, KY
AEI Project No. 218-121

Dear Mr. McCullar:

American Engineers, Inc. is pleased to submit this geotechnical report that details the results of our geotechnical exploration performed at the above referenced site.

The attached report describes the site and subsurface conditions and also details our recommendations for the proposed project. The Appendices to the report contains a drawing with a boring layout, typed boring logs, and the results of all laboratory testing.

We appreciate the opportunity to be of service to you on this project and hope to provide further support on this and other projects in the future. Please contact us if you have any questions regarding this report.

Respectfully,
AMERICAN ENGINEERS, INC.

Jacob Cowan, EIT
Geotechnical Engineer

Dennis Mitchell, PE, PMP
Director of Geotechnical Services

REPORT OF GEOTECHNICAL EXPLORATION
FRANKFORT PLANT BOARD SUBSTATION EROSION AND DRAINAGE MITIGATION
FRANKFORT, KENTUCKY

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REPORT OF GEOTECHNICAL EXPLORATION
FRANKFORT PLANT BOARD SUBSTATION EROSION
AND DRAINAGE MITIGATION
FRANKFORT, KENTUCKY

1 SITE AND PROJECT DESCRIPTION

The site of the proposed erosion mitigation and drainage improvements is located at the existing Frankfort Plant Board substation on Hickory Drive in Frankfort, Kentucky. At the time of the exploration the site was covered with a growth mixed grasses and aggregate base pavement. The topography of the site is described as moderately to strongly sloping within the outer limits and very steeply sloping near the substation perimeter with decreasing elevation to the southwest. Currently, these slopes lie at approximately 8H:1V within the outer limits of the site and 5H:3V near the substation perimeter. Topographic relief on the site is on the order of about 30 feet.

It is our understanding that soil and water are infiltrating into the aggregate base within the substation due to cyclical rainfall events; this is degrading the stability of the subgrade in the form of excessive rutting. The project consists of remediating the aggregate base within the substation, regrading the proximate slopes and removing weathered bedrock at the adjacent exposed rock face. The purpose of this investigation was to evaluate site and subsurface conditions and provide site improvement recommendations within the limits of the project.

2 GENERAL SITE GEOLOGY

Available geologic mapping (*Geologic Map of the Frankfort East Quadrangle, Franklin and Woodford Counties Kentucky, USGS, 1968*), and the Kentucky Geologic Survey geologic online map service indicates the site to be underlain at the surface by Middle Ordovician-aged deposits of Tanglewood Limestone Member No. 1 and No. 2, Brannon Member and Lower part of Lexington Limestone. The primary lithology of the formations predominantly consists of limestone and minor instances of shale. The limestone was typically described as light gray to dark gray in color, fine to coarse grained, very thin irregularly bedded, bioclastic and argillaceous. The shale was typically described as gray to dark gray in color and laminated to thin bedded.

Karst potential mapping was also reviewed and indicates the potential for development of karst features in this area is very high. As with most karst landscapes, overburden thickness commonly varies greatly due to the differential rates of chemical weathering and patterns of surface drainage. The No other geologic hazards were readily apparent during the investigation or upon review of mapping, however it should be noted that it is impossible to fully identify the presence or extent of all geologic hazards during the course of a typical geotechnical investigation.

3 SCOPE OF WORK PERFORMED

The geotechnical exploration consisted of one soil test boring with rock core and three rockline soundings. The soil test boring was advanced to a depth of about 27 feet. The rockline soundings were advanced to auger refusal.

The borings were drilled by an AEI drill crew using a truck-mounted drill rig equipped with continuous flight hollow-stem augers and NQ-2 coring equipment. A graduate Geologist was on site throughout the investigation to log the recovered soils encountered during drilling operations. During logging, particular attention was given to the soil color, texture, consistency and apparent moisture content. Standard Penetration Tests (SPT's) were performed continuously due to the shallow depth to bedrock. Soil samples were collected from the split-barrel samplers and stored in sealed plastic bags at the site. All recovered samples were transported to our laboratory for further classification and testing. The individual soil samples were visually classified by experienced laboratory technicians and verified by a Professional Geologist based on texture, strength and plasticity. A copy of the boring logs is included in Appendix B.

The natural moisture content of the soil samples was determined in the laboratory. The natural moisture content is denoted as (W%) and shown as a percentage of the dry weight of the soil on the boring logs. In addition, Atterberg limits tests were performed on samples representative of the predominant soil horizons. The results of the laboratory tests are summarized in Appendix C.

The soils were classified in the laboratory in general accordance with the Unified Soil Classification System (USCS). The Unified symbol for each stratum is shown on the legend for the typed boring logs. The testing was performed in accordance with the generally accepted standard for such tests.

4 RESULTS OF THE EXPLORATION

4.1 GENERAL

Information provided in the Appendices for this report includes a boring layout, typed boring logs, results of the laboratory tests and other relevant geotechnical information. A description of the subsurface soil, bedrock and groundwater conditions follows.

4.2 SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring locations, including descriptions of the various strata and their depths and thicknesses are presented on the Typed Boring Logs in Appendix B.

Topsoil was encountered at the immediate ground surface in the soil test boring with a thickness of 12 inches. Beneath the topsoil, low to moderate plasticity clay was encountered that was typically described as lean clay with gravel, reddish brown in color, moist of the presumed optimum moisture content for compaction and stiff in soil strength consistency.

An SPT-N value of four blows per foot (bpf) was obtained in the soil test boring, excluding blow counts that exceed 50+ bpf. Corresponding Qp values ranged from 3.0 to 3.5 tons per square foot (tsf), with most values between 2.0 and 4.0 tons per square foot. Together, the SPT-N and Qp values are generally indicative of soft to stiff in soil strength consistencies.

Atterberg Limits testing was performed on a sample representative of the predominant soil horizons with the results indicating that the soils classify as CH (Clay of High plasticity), fat clay, in accordance with the Unified Soil Classification System (USCS). Test results yielded a liquid limit value of 52 percent with a corresponding plasticity index of 26 percent, respectively. Natural moisture content yielded a moisture content of 27 percent. Typically, the soils are near to one percent wet of the plastic limit.

4.3 Bedrock Conditions

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where either essentially no downward progress can be made by the auger, where the N-value indicates essentially no penetration of the split-spoon sampler. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface. Auger refusal was encountered in all of the borings at depths ranging from less than one foot to two feet beneath the surface. Limestone with intermittent shale (less than 10 percent) was encountered in the rock core boring. Weathered limestone was encountered at auger refusal to a depth of 11 feet beneath the surface. The limestone with intermittent shale was typically described as light gray to dark gray in color, fine grained to coarse crystalline, thin to thick bedded and hard. Rock core recovery ranged from 98 to 100 percent and rock quality designation (RQD) ranged from six to 90 percent, with most values ranging between 64 and 90 percent. The table below summarizes the auger refusal depths for each corresponding boring.

Boring Number	Auger Refusal Depth (feet)	Auger Refusal Elevation (feet)
B-1	2.2	711.8
S-1	0.7	697.3
S-2	2.0	701
S-3	1.2	708.8

4.4 GROUNDWATER CONDITIONS

Groundwater was not encountered in any of the borings at the site during the investigation. To accurately determine the long-term groundwater level, as well as the seasonal and precipitation induced fluctuations of the groundwater level, it is necessary to install piezometers in the borings and monitor them for an extended length of time. Frequently, groundwater conditions affecting construction in this region are caused by trapped or perched groundwater, which occurs within the soil materials at irregular, discontinuous locations. If these water bodies are encountered during excavation, they can produce seepage durations and rates that will vary depending on the recent rainfall activity and the hydraulic conductivity of the material.

5 ANALYSES AND RECOMMENDATIONS

The recommendations that follow are based on our conceptual understanding of the project. As the site design is advanced, please notify us of any significant design changes so that our recommendations can be reviewed and modified as necessary.

5.1 GENERAL SITE RECOMMENDATIONS

5.1.1 Aggregate Base Remediation

Due to the relatively shallow depth to bedrock within the substation, we recommend removing the saturated-clay-filled aggregate base. Existing aggregate pavement sections may remain in place if the aggregate base is free of saturated soils within the matrix and must be proof-rolled to verify the subgrade stability.

Prior to aggregate placement, the excavated surface should be exposed bedrock that is free of soil and water. We recommend the aggregate base to consist of dense graded aggregate (DGA) or crushed stone base (CSB) meeting the requirements of Section 805 of the KDOH Standard Specifications, 2012 Edition. The aggregate base should be placed in maximum 4-inch thick horizontal lifts, with each lift being compacted in accordance with the control strip guidelines set forth in Section 302.03.04A of the KDOH Standard Specifications, 2012 Edition.

5.1.2 Cut Slope Recommendations

It is our understanding that a 2 Horizontal: 1 Vertical (2H: 1V) maximum cut slope is desired for the project. Rock removal will be required to achieve this cut slope. It is recommended that the slope be covered with KYTC Type IV geotextile fabric and KYTC Type II Channel lining.

The geotechnical data obtained from Boring B-1 does not indicate the presence of large quantities of shale within the upper bedrock surface. However, if excessive quantities of shale are encountered during excavation, contact AEI immediately for further guidance.

5.1.3 Site Drainage Recommendations

Cyclical runoff is converging at the substation. Final site grading should be accomplished in such a manner as to divert surface runoff away from the substation. Additionally, drainage ditches may be necessary to divert excessive runoff from the substation. The contractor should anticipate rock removal when excavating drainage ditches.

5.2 PAVEMENT CONSIDERATIONS

Pavement Designs were performed for heavy-duty pavements utilizing ESAL's (equivalent 18-kip single axle loads) of 170,000. Traffic loading conditions were based on assumed parameters of 5 trucks per day.

Our analysis was made using the AASHTO Guide for Design of Pavement Structures (1993 Edition) and the following parameters:

- Subgrade Resilient Modulus (M_r)= 22,500 psi
- CBR value = 15
- Initial Serviceability = 4.5
- Terminal Serviceability = 2.25
- Reliability = 95%
- Standard Deviation = 0.45
- ESAL's = 170,000 (Heavy Duty)
- Design Life = 20 Years
- Drainage Coefficient = 1.0
- Layer Coefficient = 0.42 for asphaltic surface, 0.40 for asphaltic base, 0.14 for crushed aggregate base, 0.08 for subbase.

This pavement design is only applicable to aggregate pavements placed on bedrock. Pavement slopes should have a minimum gradient of two percent where possible. Pavement edges should be "daylighted", or provided a means where water trapped in the aggregate base can escape by extending the aggregate base course through the sides of drainage channels.

5.2.1 Aggregate Pavement

Using the design parameters previously outlined, a recommended minimum heavy-duty pavement would consist of an 8-inch stone base consisting of KY No. 2 stone capped with 4-inch dense graded aggregate (DGA) or crushed stone base (CSB). This design would be appropriate for an average of five trucks per day.

6 LIMITATIONS

The conclusions and recommendations presented herein are based on information gathered from the borings advanced during this exploration using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between the borings. We will retain samples acquired for this project for a period of 30 days subsequent to the submittal date printed on the cover of this report. After this period, the samples will be discarded unless otherwise requested.

APPENDIX A

Boring Layout

FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide *disturbed* samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide *undisturbed* samples and obtained when warranted in general accordance with ASTM D 1587.

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.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached 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. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

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

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

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

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 designate 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.

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 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 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 as 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.

Sampling Terminology

Undisturbed Sampling: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the "Boring Logs."

Bag Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS
(Clay, Silt, and Mixtures)

CONSISTENCY	SPT N-VALUE	Qu/Qp (tsf)
Very Soft	2 blows/ft or less	0 – 0.25
Soft	2 to 4 blows/ft	0.25 – 0.49
Medium Stiff	4 to 8 blows/ft	0.50 – 0.99
Stiff	8 to 15 blows/ft	1.00 – 2.00
Very Stiff	15 to 30 blows/ft	2.00 – 4.00
Hard	30 blows/ft or more	> 4.00

PLASTICITY

Degree of Plasticity	Plasticity Index (PI)
Low	0 – 7
Medium	8 – 22
High	over 22

NON-COHESIVE SOILS
(Silt, Sand, Gravel, and Mixtures)

DENSITY	SPT N-VALUE
Very Loose	4 blows/ft or less
Loose	4 to 10 blows/ft
Medium Dense	10 to 30 blows/ft
Dense	30 to 50 blows/ft
Very Dense	50 blows/ft or more

PARTICLE SIZE IDENTIFICATION

Boulders	12 inch diameter or more
Cobbles	3 to 12 inch diameter
Gravel	Coarse – 1 to 3 inch
	Medium – ½ to 1 inch
	Fine – ¼ to ½ inch
Sand	Coarse – 0.6mm to ¼ inch
	Medium – 0.2mm to 0.6mm
	Fine – 0.05mm to 0.2mm
Silt	0.05mm to 0.005mm
Clay	0.005mm

RELATIVE PROPORTIONS

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

NOTES

Classification – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard "N" Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill long (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2nd and 3rd penetration counts (i.e., N = 8 + 7 = 15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index	mdd:	Maximum Dry Density

LEGEND

- SOIL TEST BORING WITH STANDARD PENETRATION TESTS AND ROCK CORE
- ROCKLINE SOUNDING

DRAWING NOT TO SCALE

NOTE: ALL BORING LOCATIONS ARE APPROXIMATE

NO.	DATE	REVISIONS DESCRIPTION

BORING LAYOUT

CLIENT: FRANKFORT PLANT BOARD

PROJECT: FRANKFORT PLANT BOARD SUBSTATION EROSION AND DRAINAGE MITIGATION

PLANS PREPARED AND SUBMITTED BY:
DESIGN CONSULTANT

AEI
AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

Branch Offices
2500 Nelson Miller Parkway
Louisville, KY 40222
(502) 245-3813
1634 White Circle, Suite 101
Marietta, GA 30066
(770) 421-8422
www.aei.cc

SCALE: NTS

DATE: 6/18/2018

DRAWN BY: J. COWAN

CHECKED BY: D. MITCHELL

FILE: T:PROJECTSÚ-121 FPB Substation Erosion and Drainage Mitigation\Geotech\Reports\Support Information

SHEET: B1

APPENDIX B

Boring Logs

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

B-1

CLIENT Frankfort Plant Board
PROJECT NAME FPB Substation Erosion and Drainage Mitigation
PROJECT NUMBER 218-121
PROJECT LOCATION Franklin, KY
DATE STARTED 5/24/18 **COMPLETED** 5/24/18
GROUND ELEVATION 714 ft
DRILLER Jim Powers
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Nathaniel Blackburn **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	REMARKS
0		TOPSOIL (12 inches)	SPT 1	100	1-1-3 (4)	3.5					
		(CH) fat CLAY with gravel, reddish brown, moist, soft to stiff	SPT 2	100	5-50	3.0	26	52	26	26	
		weathered LIMESTONE, light gray, fine grained to coarse crystalline, thick bedded, hard	RC 1	100 (9)							
5			RC 2	100 (6)							Clay seam encountered at 7.7' to 7.8'
10		LIMESTONE, intermittent shale, light gray to dark gray, fine grained to coarse crystalline, thin to thick bedded, hard	RC 3	100 (68)							
15			RC 4	100 (64)							
20			RC 5	98 (90)							
25											

Refusal at 2.2 feet.
Bottom of borehole at 26.7 feet.

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

S-1

CLIENT Frankfort Plant Board
PROJECT NAME FPB Substation Erosion and Drainage Mitigation
PROJECT NUMBER 218-121
PROJECT LOCATION Franklin, KY
DATE STARTED 5/24/18 **COMPLETED** 5/24/18
GROUND ELEVATION 698 ft
DRILLER Jim Powers
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Nathaniel Blackburn **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		OVERBURDEN									

Refusal at 0.7 feet.
Bottom of borehole at 0.7 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 6/18/18 10:00 - T:\18 PROJECTS\218-XXX FRANKFORT FPB - HICKORY DRIVE\GEOTECH\REPORTS\FRANKFORT FPB HICKORY DR SOILS.GPJ

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

S-2

CLIENT Frankfort Plant Board
PROJECT NAME FPB Substation Erosion and Drainage Mitigation
PROJECT NUMBER 218-121
PROJECT LOCATION Franklin, KY
DATE STARTED 5/24/18 **COMPLETED** 5/24/18
GROUND ELEVATION 703 ft
DRILLER Jim Powers
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Nathaniel Blackburn **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	REMARKS
0		OVERBURDEN									

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

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

S-3

CLIENT Frankfort Plant Board
PROJECT NAME FPB Substation Erosion and Drainage Mitigation
PROJECT NUMBER 218-121
PROJECT LOCATION Franklin, KY
DATE STARTED 5/24/18 **COMPLETED** 5/24/18
GROUND ELEVATION 710 ft
DRILLER Jim Powers
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Nathaniel Blackburn **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		OVERBURDEN									

Refusal at 1.2 feet.
Bottom of borehole at 1.2 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 6/18/18 10:01 - T:\18 PROJECTS\218-XXX FRANKFORT FPB - HICKORY DRIVE\GEOTECH\REPORTS\FRANKFORT FPB HICKORY DR SOILS.GPJ

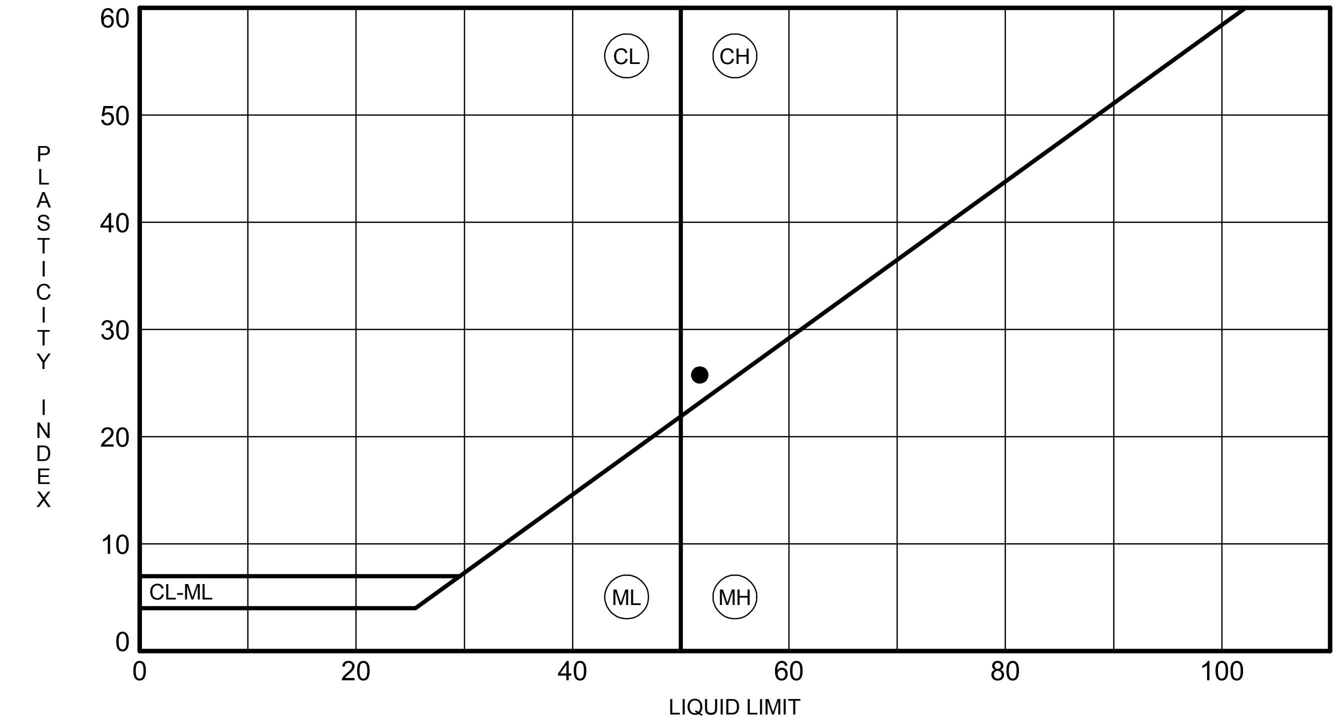
APPENDIX C

Laboratory Testing Results

ATTERBERG LIMITS RESULTS

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

CLIENT Frankfort Plant Board
PROJECT NAME FPB Substation Erosion and Drainage Mitigation
PROJECT NUMBER 218-121
PROJECT LOCATION Franklin, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-1**	**1.5**	**52**	**26**	**26**		**fat CLAY with gravel, reddish brown**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 6/18/18 10:00 - T:\18 PROJECTS\218-XXX FRANKFORT FPB - HICKORY DRIVE\GEOTECH\REPORTS\FRANKFORT FPB HICKORY DR SOILS.GPJ

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

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

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.

The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs Should not be Re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.

AEI

AMERICAN ENGINEERS, INC.

PROFESSIONAL ENGINEERING

65 Aberdeen Drive
Glasgow, KY 42141
270-651-7220