COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC APPLICATION OF KENTUCKY	)	
UTILITIES COMPANY FOR A CERTIFICATE OF	)	
PUBLIC CONVENIENCE AND NECESSITY FOR	)	**CASE NO. 2022-00066**
THE CONSTRUCTION OF TRANSMISSION	)	
FACILITIES IN HARDIN COUNTY, KENTUCKY	)	

RESPONSE OF
KENTUCKY UTILITIES COMPANY
TO
COMMISSION STAFF'S FOURTH REQUEST FOR INFORMATION
DATED MAY 11, 2022

FILED: MAY 20, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Robert M. Conroy**, being duly sworn, deposes and says that he is Vice President, State Regulation and Rates, for Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

Robert M. Conroy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 16th day of May 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Elizabeth J. McFarland**, being duly sworn, deposes and says that she is Vice President, Transmission, for Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge, and belief.

Elizabeth J. McFarland

Elizabeth J. McFarland

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 19th day of May 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 11, 2022

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 1

Responding Witness: Elizabeth J. McFarland

Q-1. Refer to KU's response to Wade Family Farm Management, LLC's Second Request for Information (Wade Family's Second Request), Item 11, and KU's Response to Commission Staff's Third Request for Information (Staff's Third Request), Item 2. Provide any summaries, reports, or presentations produced in relation to any wetland delineation survey, geotechnical exploration, or field soil resistivity survey, or any other on-site field study KU has conducted in relation to the Glendale Megasite. Consider this an ongoing request during the pendency of this application.

A-1. For substations, on-site field studies are still underway by KU on the Glendale Megasite for the substation locations. Phase 1 studies have been completed for the substation locations and the resulting Geophysics reports are attached. Phase 2 on-site field studies for the substation locations are ongoing, and reports will be provided upon completion.

For the transmission lines, geotechnical reports received to date are attached. The wetland delineation report has been completed for the proposed 200 foot right-of-way for the 345 kV transmission lines and is attached.

GEOPHYSICAL EVALUATION

LG&E-KU GLENDALE SOUTH SUBSTATION

Glendale, Kentucky

PREPARED FOR:

Matt Hambright, P.E.
Black & Veatch
3550 Green Court
Ann Arbor, MI 48105-1579

PREPARED BY:

Atlas Technical Consultants LLC
14 Sunnen Drive, Suite 143
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May 5, 2022

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May 5, 2022

Atlas No. 322013SWG
Report No. 1

MR. MATT HAMBRIGHT, P.E.
BLACK & VEATCH
3550 GREEN COURT
ANN ARBOR, MI 48105-1579

Subject: Geophysical Evaluation
LG&E-KU Glendale South Substation Project
Glendale, Kentucky

Dear Mr. Hambright:

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale South Substation Project located in Glendale, Kentucky. Specifically, our services included the performance of seven high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, seven two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and seven Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
Atlas Technical Consultants LLC

Eric R. Carlson, EI (MO)
Project Geophysicist/Engineer

Patrick F. Lehrmann, P.G. (CA, OR, MO) P.Gp.(CA)
Principal Geologist/Geophysicist

ASB/ERC/PFL/erc/ds

Distribution hambrightm@bv.com

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1. INTRODUCTION

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale South Substation Project located in Glendale, Kentucky (Figure 1). Specifically, our services included the performance of seven high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, seven two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and seven Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

2. SCOPE OF SERVICES

Our scope of services included the performance of seven Sting-ERT, seven MASW and seven 1D ReMi profiles at preselected locations within the study area. Specifically, we conducted the following scope of services for the project:

- Collection of electrical resistivity data along seven predetermined Sting-ERT traverses, STL-101 through STL-107, using an AGI SuperSting R8 resistivity meter and 56 stainless steel electrodes.
- Collection of 2D MASW data along seven predetermined MASW traverses, ML-101 through ML-107, using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. Compilation and geophysical analysis of the data collected.
- Collection of 1D ReMi data at seven predetermined locations, RL-101 through RL-106. The ReMi data was collected using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones.
- Compilation, processing, and analysis of the data obtained.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is located to the southeast of the intersection of Shipp Lane and Jaggers Road in Glendale, Kentucky (Figure 1). The site consists of open farm fields with varied grass and vegetation. A small dirt road runs through the western portion of the study area. To the south of the study area, an overhead power line runs in a generally east-west orientation.

Based on our discussions with project stakeholders, it is our understanding that the project site is in an area prone to karst features.

4. GEOPHYSICAL INSTRUMENTATION AND APPLICATIONS

Our evaluation included conducting seven Sting-ERT traverses, seven MASW traverses and seven 1D ReMi traverses for the purpose of delineating geophysical anomalies potentially associated with karst and to estimate depth to bedrock at our evaluated locations at the project site. The methodology of each geophysical technique applied is described in more detail below.

4.1 Sting-ERT Method

An AGI SuperSting R8 electrical resistivity meter was used to conduct electrical resistivity profiles at the site to characterize the electrical properties of the subsurface. Seven Sting-ERT profiles (STL-101 through STL-107) conducted along predetermined traverses are illustrated on Figure 2. It should be noted that STL-102 and STL-104 were relocated slightly to avoid surface obstructions (large brush piles). Electrical current was injected into the ground through 56 stainless steel electrodes and the electric potential difference between multiple electrodes pairs was measured simultaneously. When necessary, the area around the electrodes was moistened with a relatively small amount of salt water (potable water with a small amount of added table salt, sodium chloride) to reduce the contact resistance. The data was collected using a Dipole-Dipole with Strong Gradient electrode configuration. An 8-foot electrode spacing was used for each of the Sting-ERT traverses to achieve optimal resolution and the desired depth of investigation. The Sting-ERT transects performed were acquired using a roll-along configuration, with some overlap, to achieve the desired profile lengths of 888 feet for STL-101, 1,336 feet for STL-102, 888 feet for STL-103, 888 feet for STL-104, 888 feet for STL-105, 888 feet for STL-106, and 776 feet for STL-107. Table 1 shows the coordinates of each of the end stations for the Sting-ERT lines.

Table 1: Sting ERT Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.59571783 37.5970692	-85.90161657 -85.89906802	STL-101 Station 0 STL-101 Station 888
37.59513208 37.59717331	-85.90165904 -85.89783144	STL-102 Station 0 STL-102 Station 1336
37.5949558 37.5963143	-85.90004598 -85.89750981	STL-103 Station 0 STL-103 Station 888
37.59493258 37.59692519	-85.90006155 -85.9018233	STL-104 Station 0 STL-104 Station 888
37.59692577 37.59492833	-85.90060628 -85.8988548	STL-105 Station 0 STL-105 Station 888
37.59698127 37.5949862	-85.89929047 -85.89753036	STL-106 Station 0 STL-106 Station 888
37.59497673 37.59710507	-85.90078011 -85.90088777	STL-107 Station 0 STL-107 Station 776

The Sting-ERT data was processed, corrected for terrain (relative elevation) variations, and analyzed using EarthImager 2-D™ V2.1.7, a two-dimensional resistivity inversion software. The inversion results are presented in color gradient apparent resistivity models that illustrate the electrical resistivity contrasts in the subsurface materials.

4.2 2D MASW Method

Surface waves (specifically, Rayleigh waves) recorded along lines ML-101 through ML-107 were performed at the same location and orientation as the Sting ERT profiles (Figure 2). It should be noted that ML-105 was shifted longitudinally to avoid surface obstructions and that due to the roll-along nature of the Sting-ERT traverses, the endpoints of the Sting-ERT lines continue further than those of the MASW traverses. Surface waves, generated by a hammer and plate (shot), were recorded using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. The geophones were coupled to the ground surface using a Geostuff Landstreamer with geophones stationed 4 feet apart and shots conducted off the end of the lines. Prior to the collection of surface wave data, near and far field effects were evaluated for several shot offset distances at each traverse. The results indicated that the optimum offset distance for the shot point of the MASW study ranged from 40 feet to 72 feet for each traverse.

Three records, one second long, were recorded at each shot location. After each shot, the shot location and geophones were shifted 8 feet longitudinally along the profile direction and the line was reshot. The number of shots, spread length, and start and end stations are presented in Table 2. The station numbers (start and end points of the line) and their associated coordinates are shown in Table 3.

The recorded MASW data were processed using SurfSeis® (Kansas Geological Survey, 2012), a MASW software program. One dimensional (1-D) shear-wave (S-wave) velocity (Vs) profiles were generated for each shot location which represent the average condition across the length of the geophone array. Each individual 1-D profile is spatially plotted at the center of each geophone array. A two-dimensional color gradient model was then created from the 1-D models using the SurfSeis® interpolation scheme with relative elevation corrections. It should be emphasized that the 2-D profile represents the area between the midpoint of the first shot location and the midpoint of the last shot location. The actual model section length and start and end stations for the sections are also listed in Table 2.

Table 2: MASW Array Geometry

Line No.	No. of Shots	Total Spread Length (feet)	Profile Length/Start and End Stations (feet)
ML-101	100	892	800/(0-800)
ML-102	167	1428	1336/(0-1336)
ML-103	101	900	808/(0-808)
ML-104	101	900	808/(0-808)
ML-105	101	900	808/(95-903)
ML-106	101	900	808/(0-808)
ML-107	88	796	704/(0-704)

Table 3: MASW Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.59571783 37.59693661	-85.90161657 -85.89932157	ML-101 Station 0 ML-101 Station 800
37.59513208 37.59717331	-85.90165904 -85.89783144	ML-102 Station 0 ML-102 Station 1336
37.5949558 37.59617934	-85.90004598 -85.8977607	ML-103 Station 0 ML-103 Station 808
37.59493258 37.59672858	-85.90006155 -85.9016475	ML-104 Station 0 ML-104 Station 808
37.59692577 37.59488	-85.90060628 -85.898812	ML-105 Station 0 ML-105 Station 903
37.59698127 37.5951844	-85.89929047 -85.89770325	STL-106 Station 0 STL-106 Station 808
37.59497673 37.59690862	-85.90078011 -85.90087772	STL-107 Station 0 STL-107 Station 704

4.3 1D ReMi

The passive source 1-D ReMi technique uses recorded surface waves (specifically Rayleigh waves) that are contained in background noise to develop a shear-wave velocity profile of the study area down to a depth, in this case, of approximately 100 feet below existing ground surface at seven predetermined locations at the study area. The depth of exploration is dependent on the length of the line and the frequency content of the background noise. The results of the ReMi method, displayed as a one-dimensional profile, represents the average condition across the length of the line. The ReMi method does not require an increase of material velocity with depth; therefore, low velocity zones (velocity inversions) are detectable with ReMi. The mid-point locations of each ReMi traverse are detailed in Table 4.

Table 4: ReMi Mid-point Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.596675	-85.899815	RL-101
37.595403	-85.901144	RL-102
37.596706	-85.898702	RL-102N
37.595129	-85.899712	RL-103
37.596461	-85.901414	RL-104
37.596041	-85.899832	RL-105
37.595605	-85.898081	RL-106

A total of 15 records, each 32 seconds in duration, were recorded for lines RL-101 through RL-106; 10 records utilizing passive data collection of ambient ground vibration noise; and 5 records utilizing an active source generated by a 20-pound sledgehammer and a HDPE plastic strike plate. The active source data gathers included conducting hammer blows approximately

30 feet off the end of the geophone array. Data collected was then downloaded to a field computer and the data were later processed using Surface Plus 9.1 - Advanced Surface Wave Processing Software (Geogiga Technology Corp., 2020), which uses the refraction microtremor method (Louie, 2001) and other surface wave analysis methods. The program generates phase-velocity dispersion curves for each record and provides an interactive dispersion modeling tool to determine the best fitting model. The result is a 1-D shear-wave velocity model of the site with roughly 85 to 95 percent accuracy.

5. FINDINGS AND CONCLUSIONS

As previously discussed, the primary purpose of our study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock. Our study utilized Sting-ERT, MASW and ReMi methods. Figures 2, 3a and 3b present the approximate location of our traverses and the general conditions at the study areas, respectively.

Figures 4a through 4g depict the results from the Sting-ERT and MASW lines STL-101 through STL-107 and ML-101 through ML-107, respectively. The figures are presented in color gradient form with warm colors (red) representing relatively higher resistivity/shear wave velocity for the ERT/MASW, respectively. The cool colors (blue) representing relatively higher conductivity and lower shear wave velocity, respectively. The measured contact resistance (resistances between the electrode and the adjacent soil) along our transects were very low which resulted in good quality data and repeatable results for the ERT data. Strong winds presented some challenges in the collection of the MASW data; however, overall data quality (dispersion curves) for the MASW data was good. In general, our Sting-ERT profiles illustrate layers of somewhat resistive materials in the very near-surface, then several layers of relatively conductive materials, and more resistive materials at depth. Conductive and resistive pockets are also evident in the data.

Please note the 2D MASW seismic models depicted on the figures start at the mid-point of the first geophone array and terminate at the mid-point of the last geophone array. As illustrated in Figures 4a through 4g, the models regularly depict a thin horizon of relatively high velocity material in the near surface, underlain by relatively low velocity material, and higher velocity materials with increasing depth.

The shear wave velocity results and ERT results are relatively consistent, with some localized lateral and vertical variations in shear wave velocity and resistivity values. The responses observed between approximately 30 to 40 feet below existing ground surface are consistent with the typical the contrast in physical properties observed between soil and weathered bedrock/bedrock.

Also noted on Figures 4a through 4g are numerous anomaly locations on both the Sting-ERT and MASW profiles. Often, karst features have a combination of higher and/or lower resistive zones (depending on the saturation of the soils/rock) coupled with a lower velocity zone. Several anomaly locations noted along the profiles have both resistivity anomalies and lower velocity anomalies which can be consistent with karst. Additional anomalies on either the Sting-ERT or the MASW profiles are noted which could also be associated with karst.

As discussed, the purpose of our ReMi study was to develop 1D shear-wave velocity profiles to be used for design and construction at the study site. Table 5 and Figures 5a through 5g present the results from our ReMi evaluation. It should be noted that when the 1-D ReMi surface wave velocity results (analogous to shear wave) show an IBC Vs100 velocity value that is close to the "border line" boundary between two IBC Vs100 Site Classes, the project geotechnical engineering consultant of record should be consulted regarding existing available site information and whether obtaining additional new geotechnical evaluation data such as boreholes, surface to downhole seismic (ASTM D7400), cross hole seismic (ASTM D4428), and/or additional 1-D ReMi data collections would be advisable. The project geotechnical engineering consultant of record may wish to consider the subsurface geologic stratigraphy and structure, soil mechanics, and soil modulus, along with the initial 1D ReMi results when assessing a "borderline" IBC Vs100 Seismic Site Class and whether additional geophysical or geotechnical evaluations are needed.

Table 5 – ReMi Vs 100' Results

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
RL-101 (SW-NE)	0-5	855	1,298 ft/s	C
	5-13	756		
	13-20	521		
	20-25	950		
	25-42	1,654		
	42-66	1,751		
	66-100	1,884		
RL-102 (SW-NE)	0-5	992	1,339 ft/s	C
	5-13	851		
	13-20	598		
	20-26	690		
	26-41	1,709		
	41-64	1,831		
	64-100	1,935		
RL-102N (SW-NE)	0-5	1,036	1,323 ft/s	C
	5-13	656		
	13-20	574		
	20-22	674		
	22-41	1,704		
	41-63	1,696		
	63-100	1,896		

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
RL-103 (SE-NW)	0-5	1,005	1,375 ft/s	C
	5-13	784		
	13-19	475		
	19-24	1,426		
	24-40	1,830		
	40-64	1,854		
	64-100	1,874		
RL-104 (SE-NW)	0-5	873	1,309 ft/s	C
	5-12	904		
	12-20	485		
	20-25	655		
	25-41	1,853		
	41-66	1,878		
	66-100	1,906		
RL-105 (SE-NW)	0-5	620	1,311 ft/s	C
	5-12	697		
	12-19	693		
	19-24	588		
	24-41	1,839		
	41-64	1,852		
	64-100	1,979		
RL-106 (SE-NW)	0-5	737	1,265 ft/s	C
	5-13	709		
	13-20	673		
	20-27	610		
	27-42	1,820		
	42-65	1,834		
	65-100	1,890		

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Atlas should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

7. SELECTED REFERENCES

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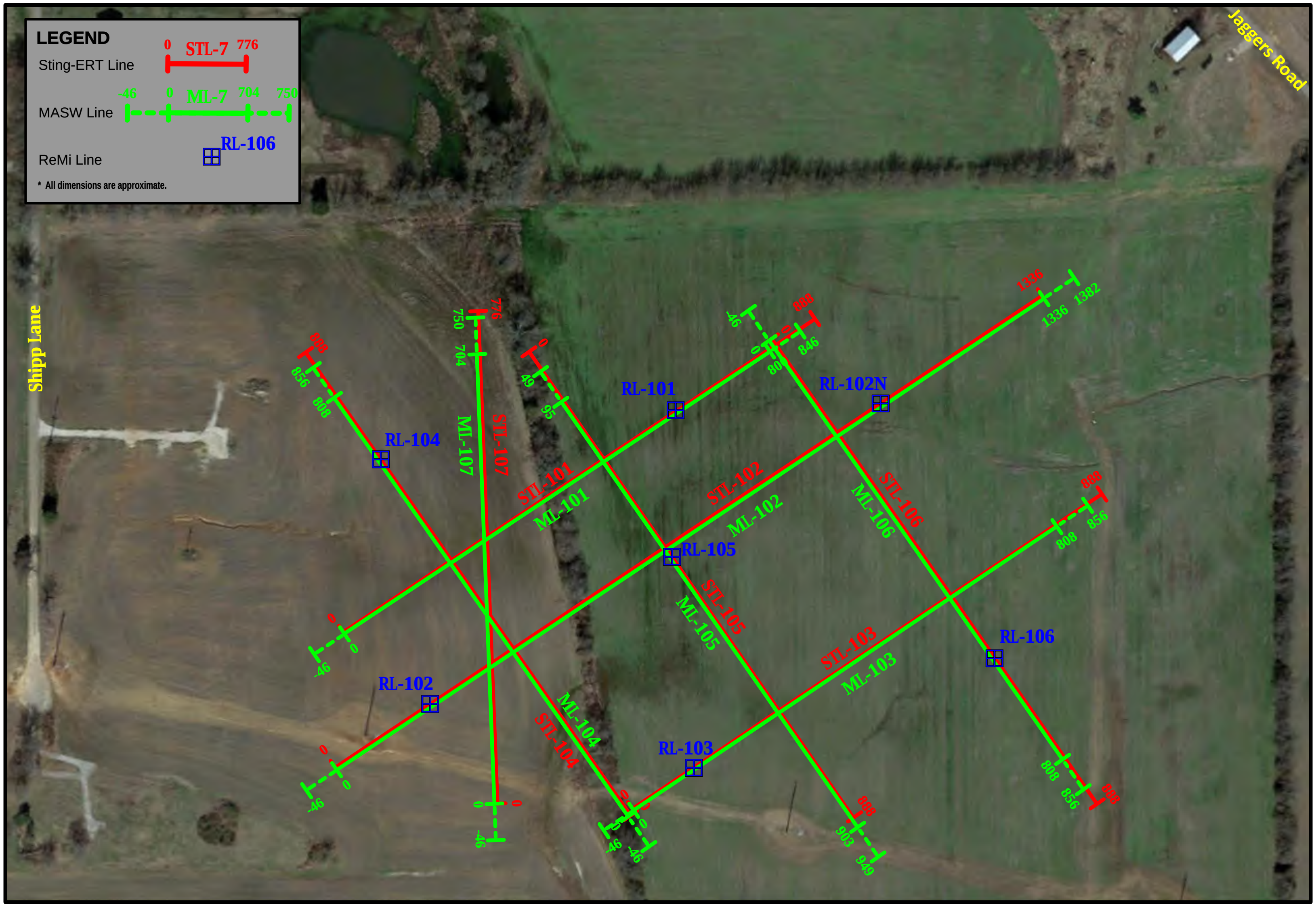
SITE LOCATION MAP	N	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG — Date: 05/22	ATLAS Figure 1



LINE LOCATION MAP

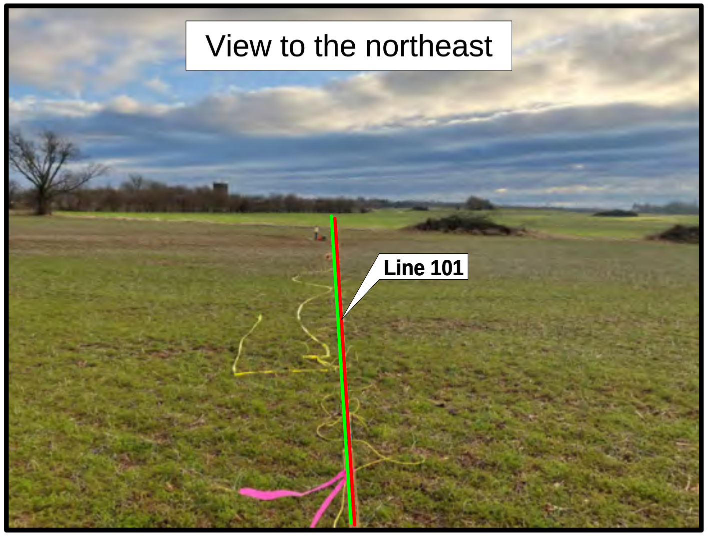
N

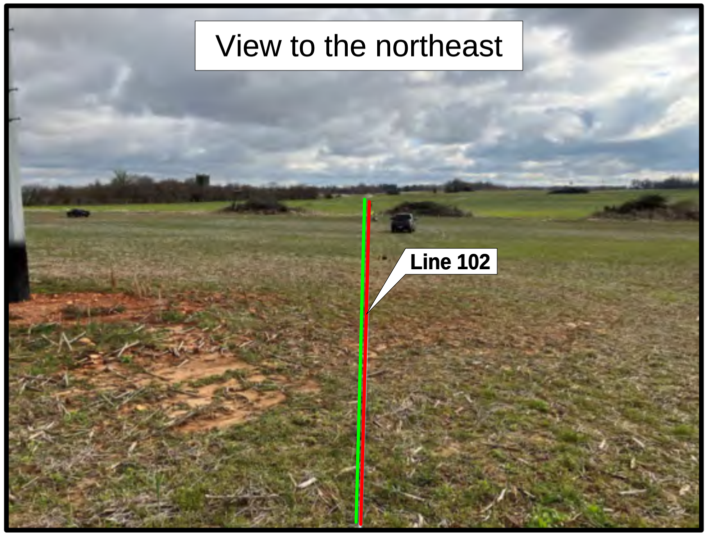
LG&E-KU Glendale South Substation
Glendale, Kentucky

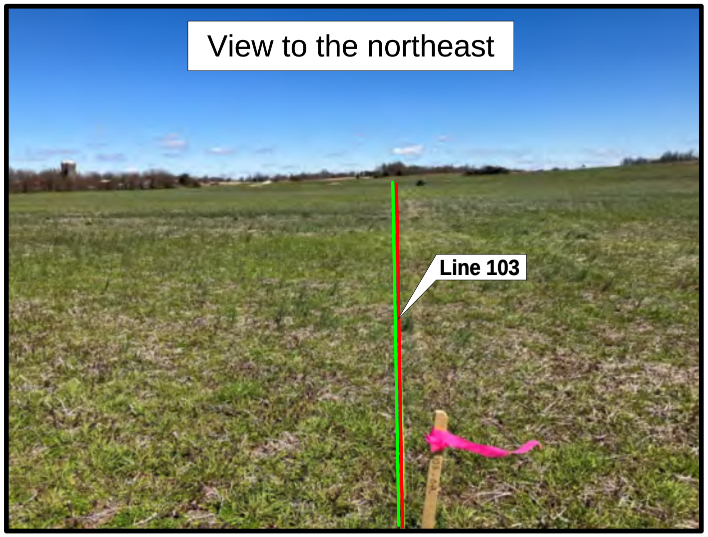
Project No.: 322013SWG | Date: 05/22

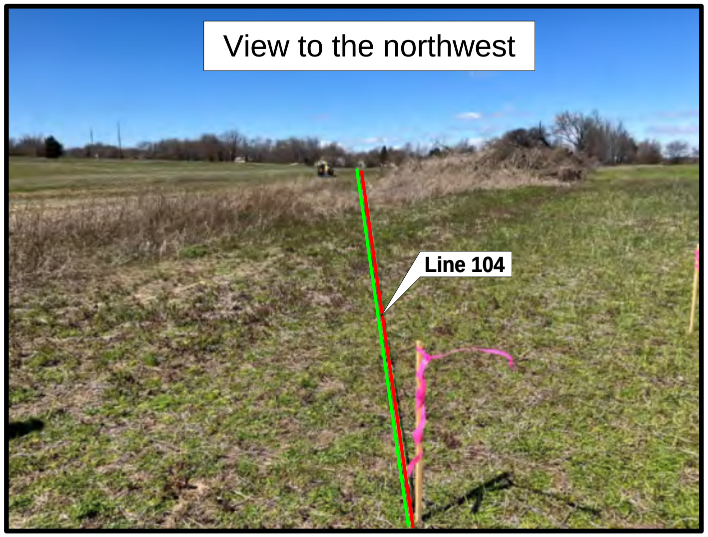
ATLAS
Figure 2

0 200 400
approximate scale in feet

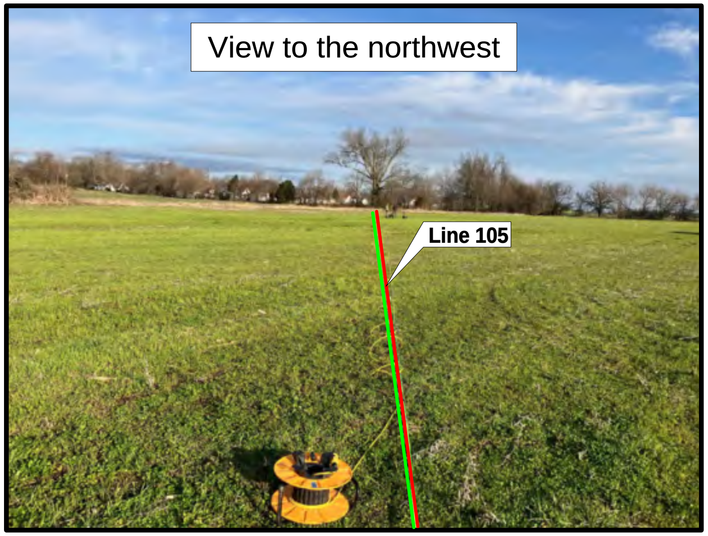


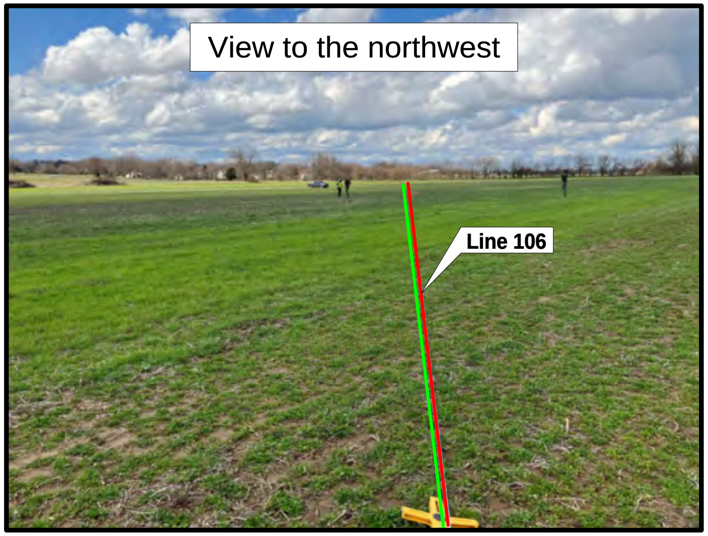


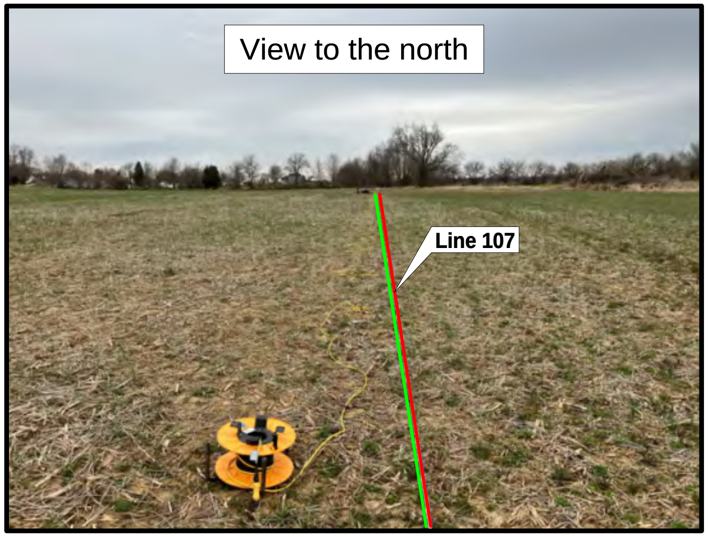




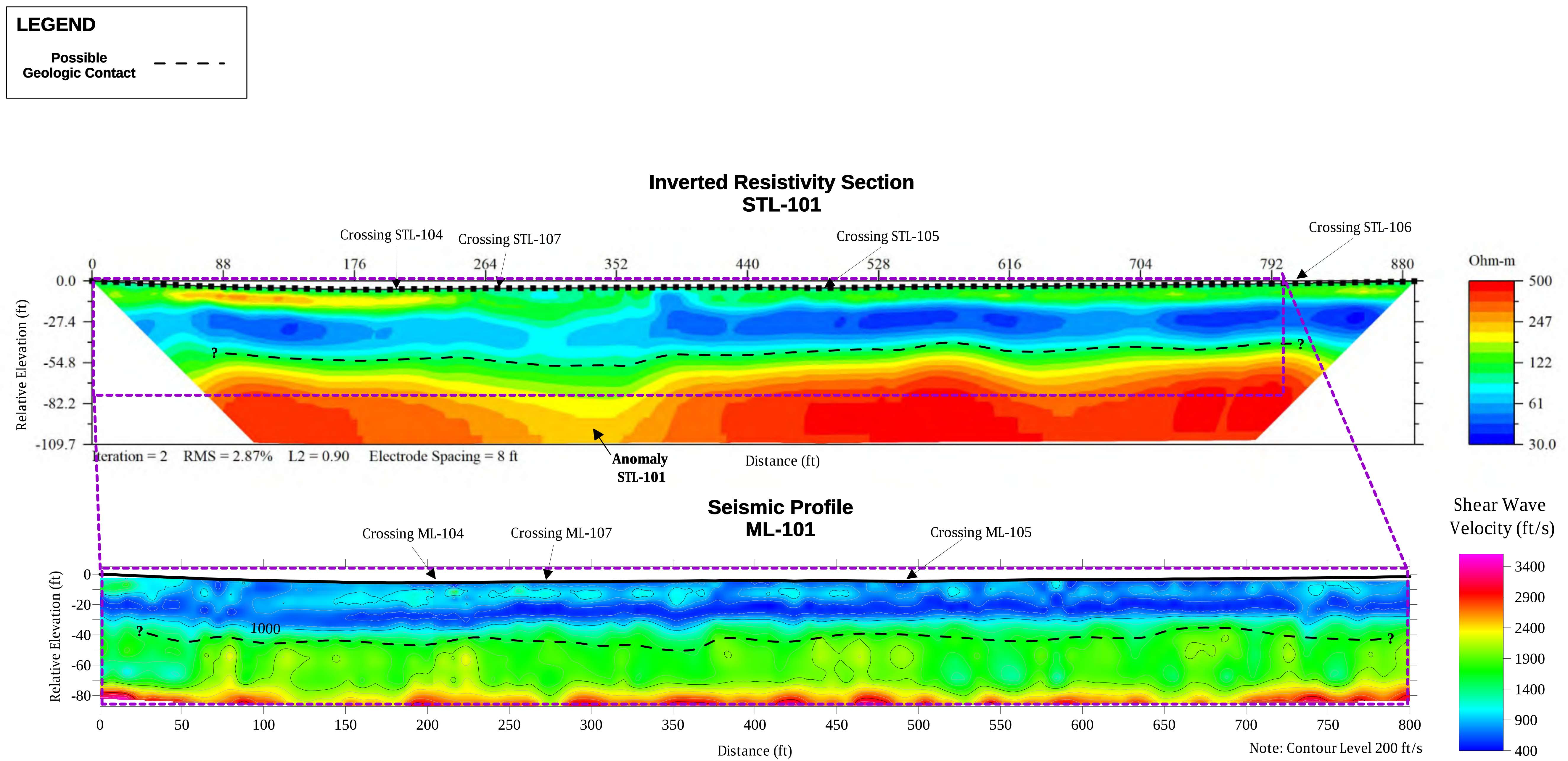
SITE PHOTOGRAPHS (Profiles 101 Through 104)	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG Date: 05/22	ATLAS Figure 3a



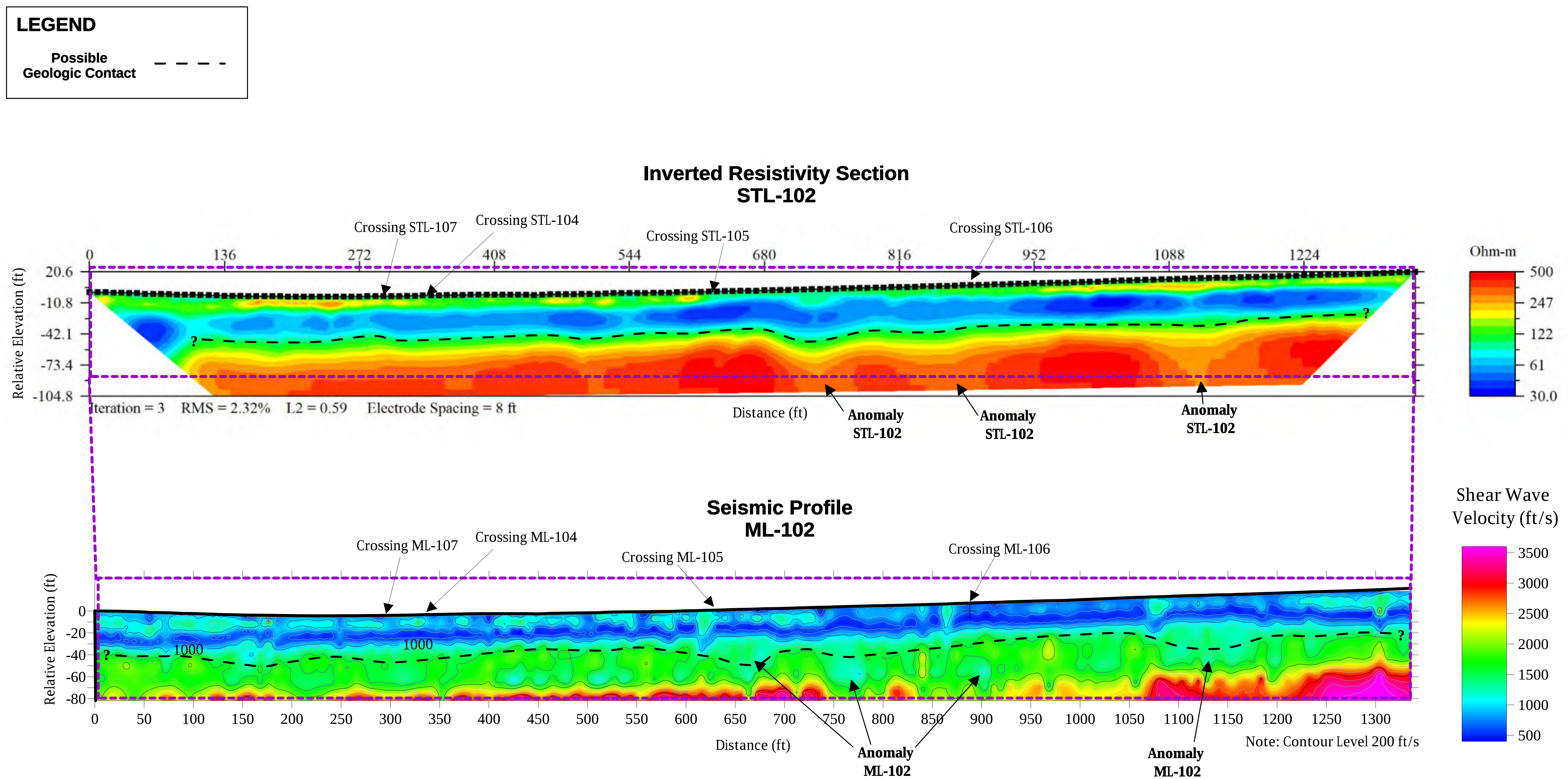




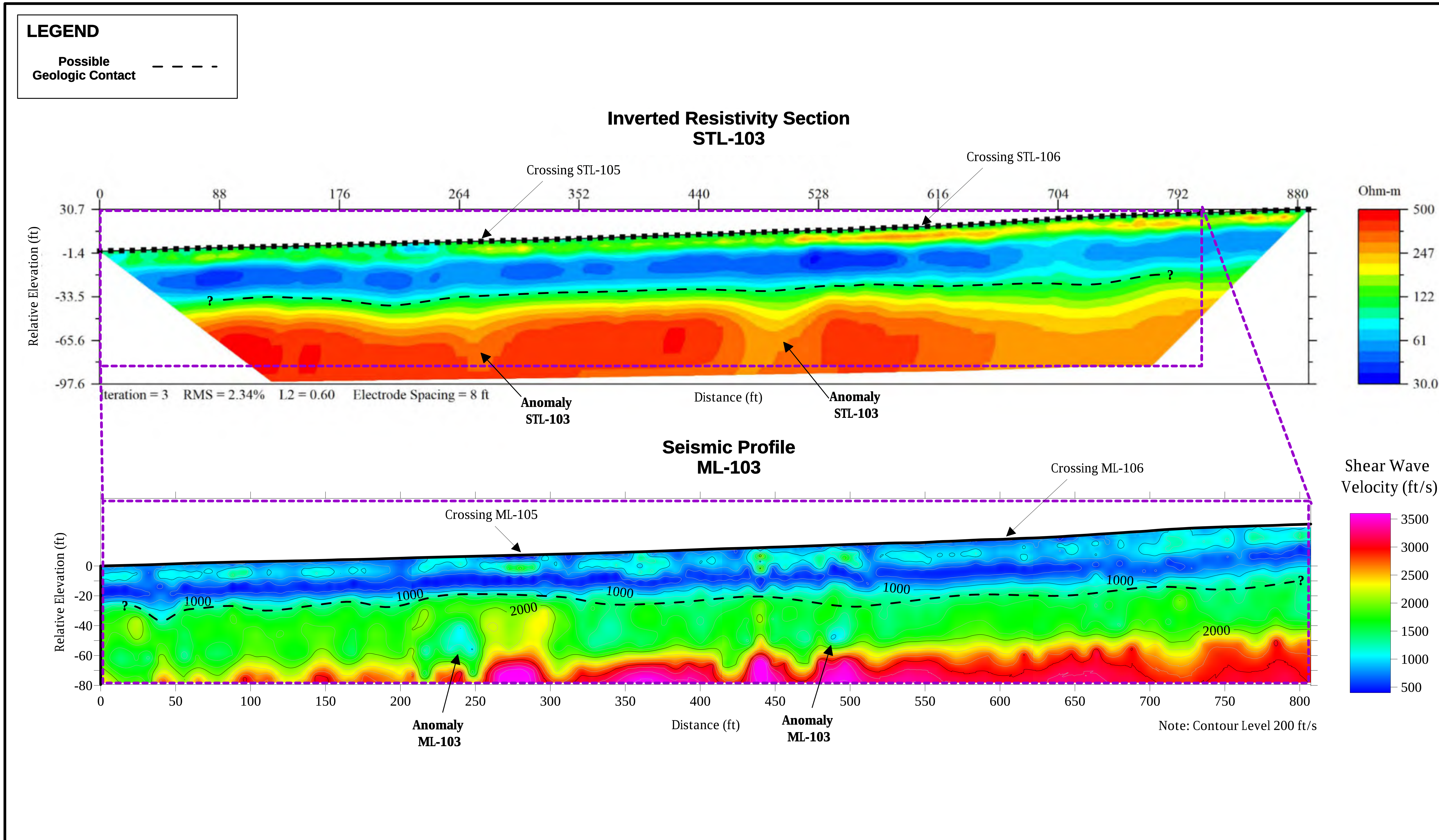
SITE PHOTOGRAPHS (Profiles 105 Through 107)	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG — Date: 05/22	ATLAS Figure 3b



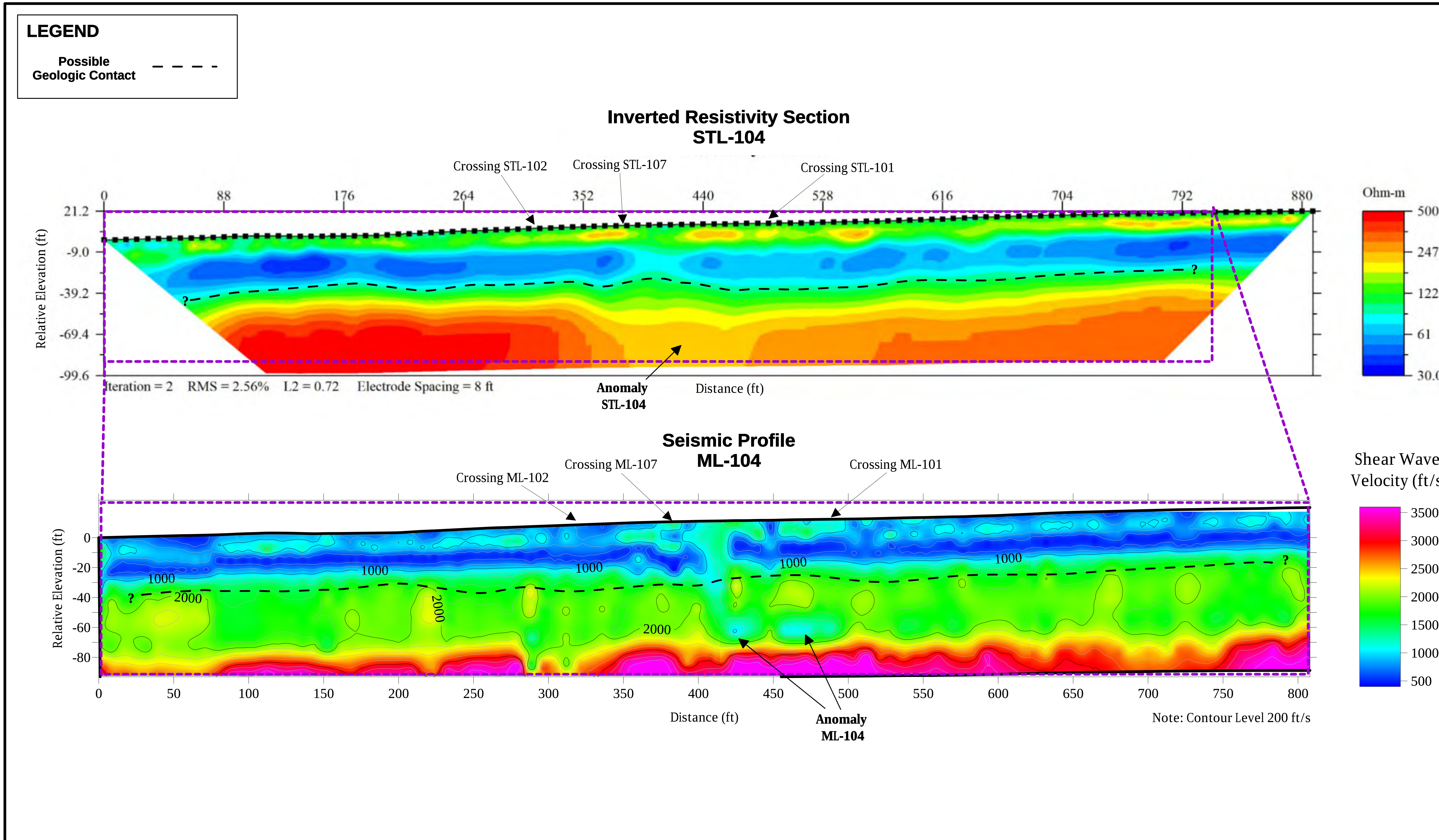
STING-ERT AND MASW PROFILE Line 101	LG&E-KU Glendale South Substation Glendale, Kentucky		ATLAS Figure 4a
	Project No.: 322013SWG	Date: 05/22	



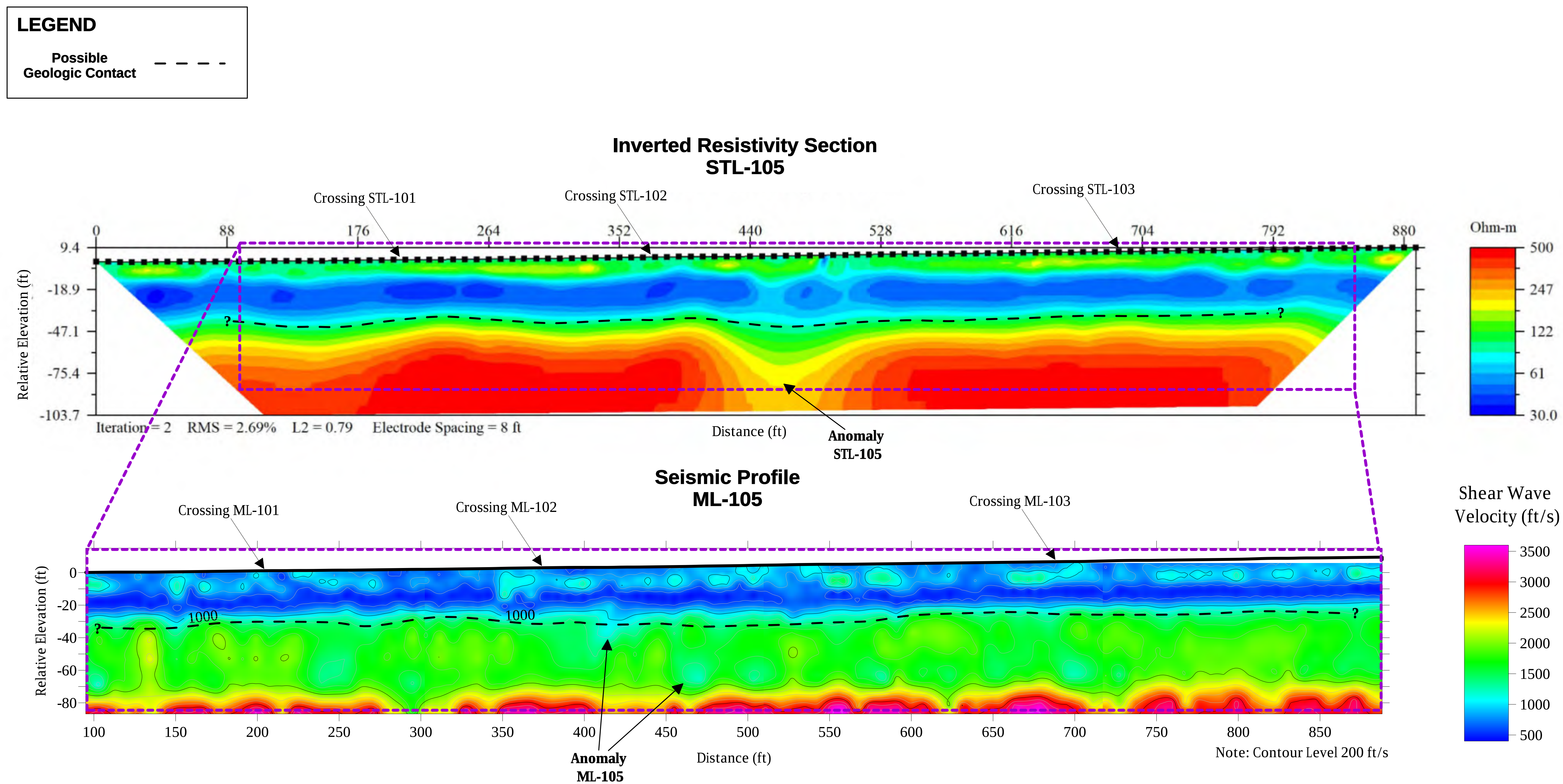
STING-ERT AND MASW PROFILE Line 102	LG&E-KU Glendale South Substation Glendale, Kentucky	ATLAS
	Project No.: 322013SWG / Date: 05/22	Figure 4b



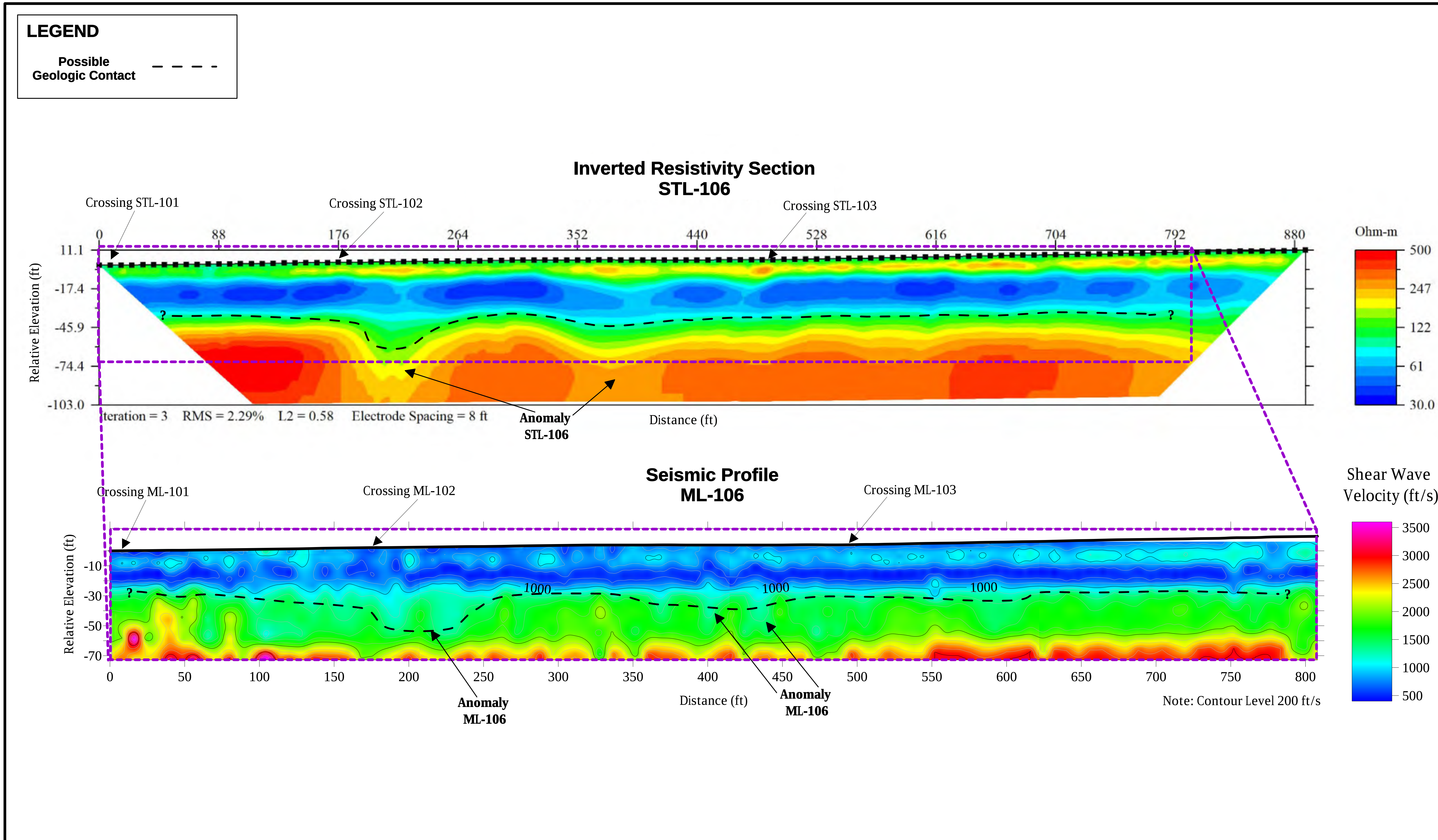
STING-ERT AND MASW PROFILE Line 103	LG&E-KU Glendale South Substation Glendale, Kentucky	ATLAS Figure 4c
	Project No.: 322013SWG / Date: 05/22	



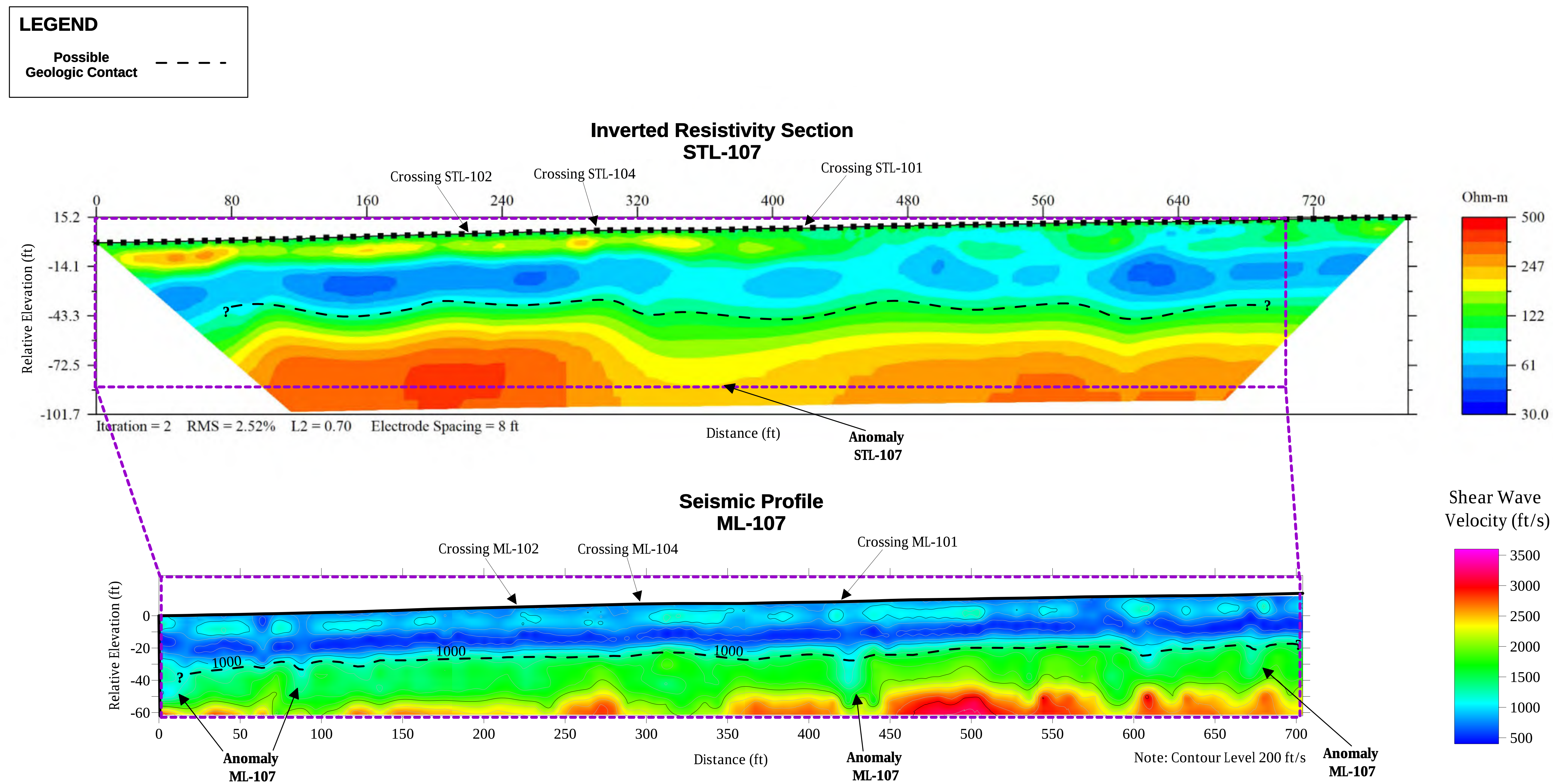
STING-ERT AND MASW PROFILE Line 104	LG&E-KU Glendale South Substation Glendale, Kentucky		ATLAS Figure 4d
	Project No.: 322013SWG	Date: 05/22	



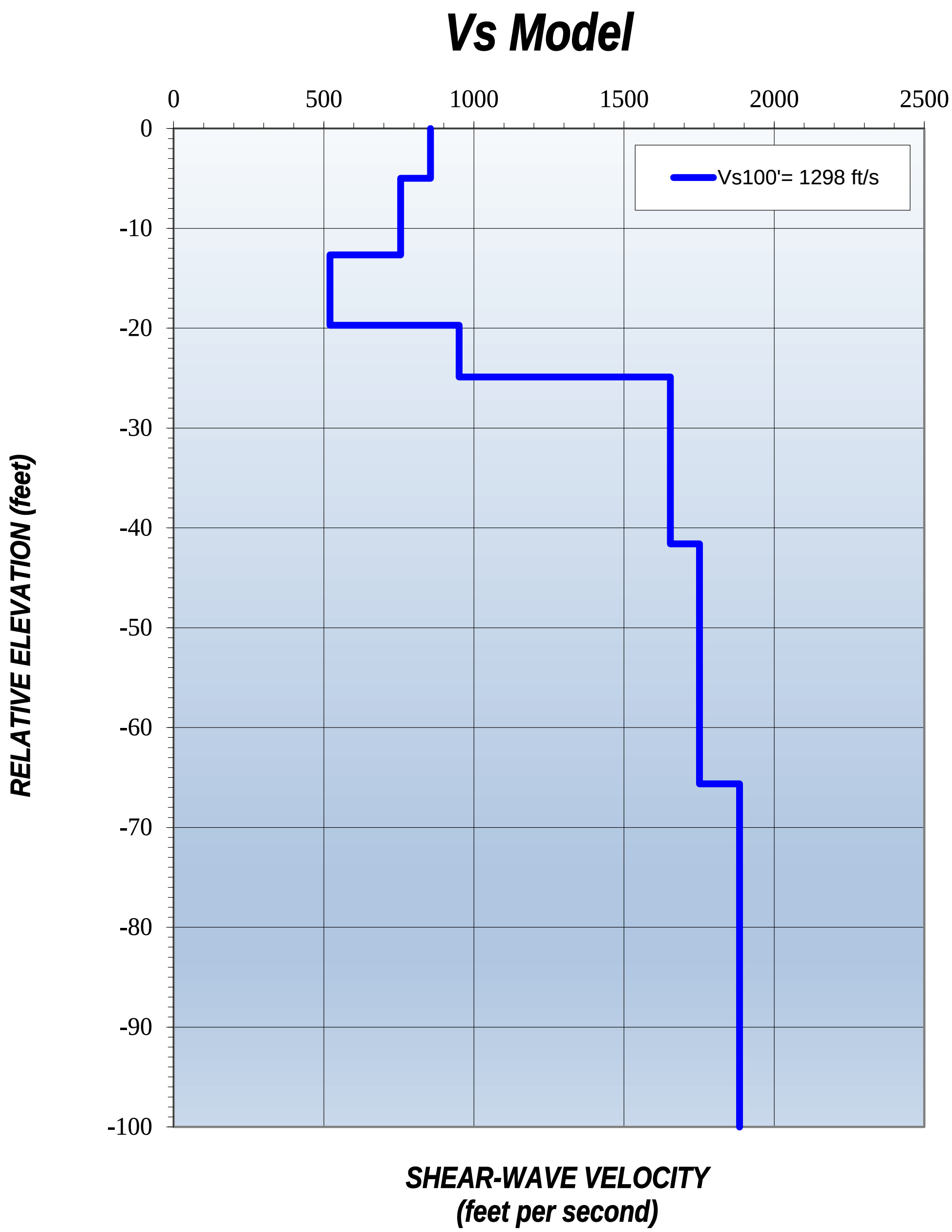
STING-ERT AND MASW PROFILE Line 105	LG&E-KU Glendale South Substation Glendale, Kentucky		ATLAS Figure 4e
	Project No.: 322013SWG	Date: 05/22	



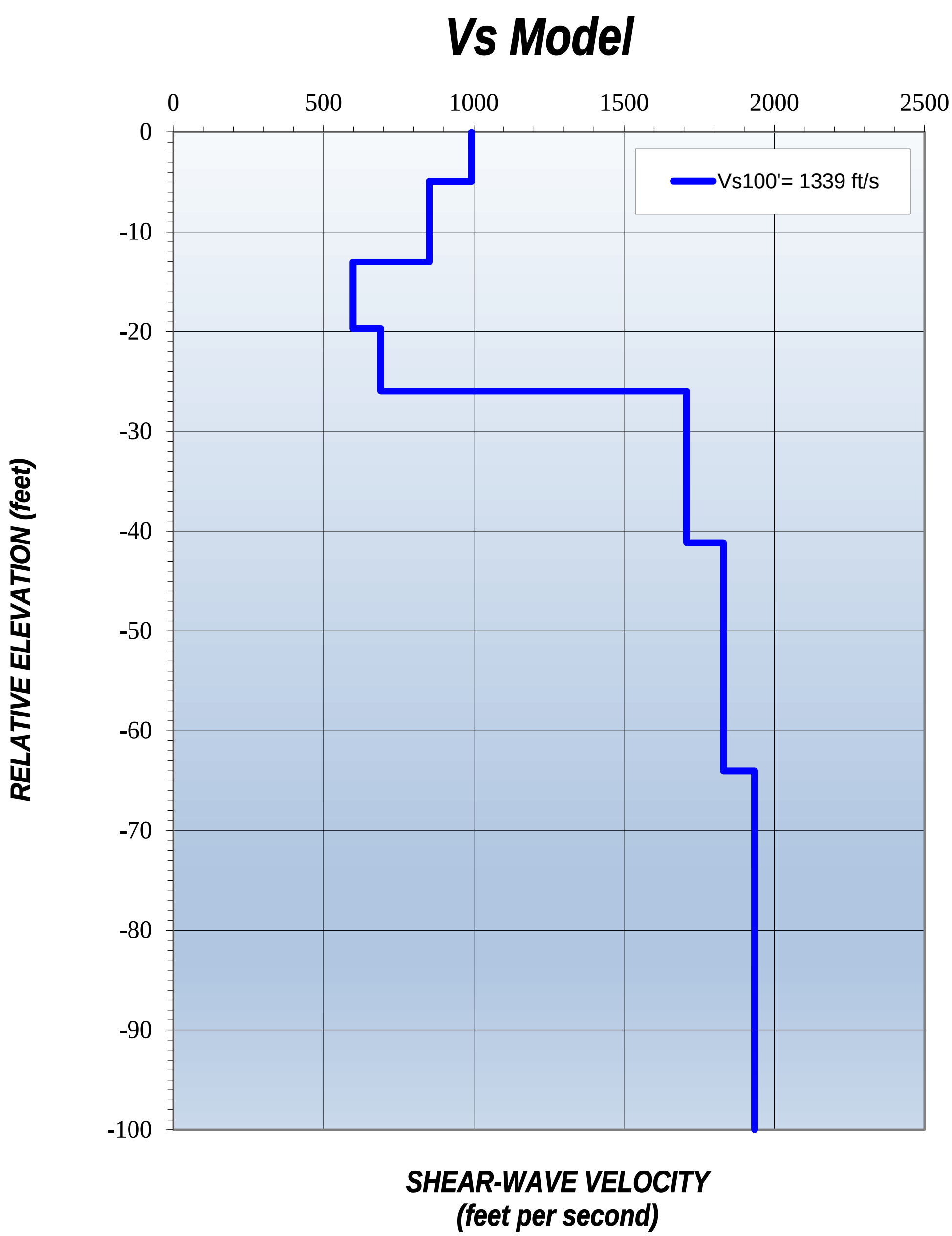
STING-ERT AND MASW PROFILE Line 106	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG Date: 05/22	ATLAS Figure 4f



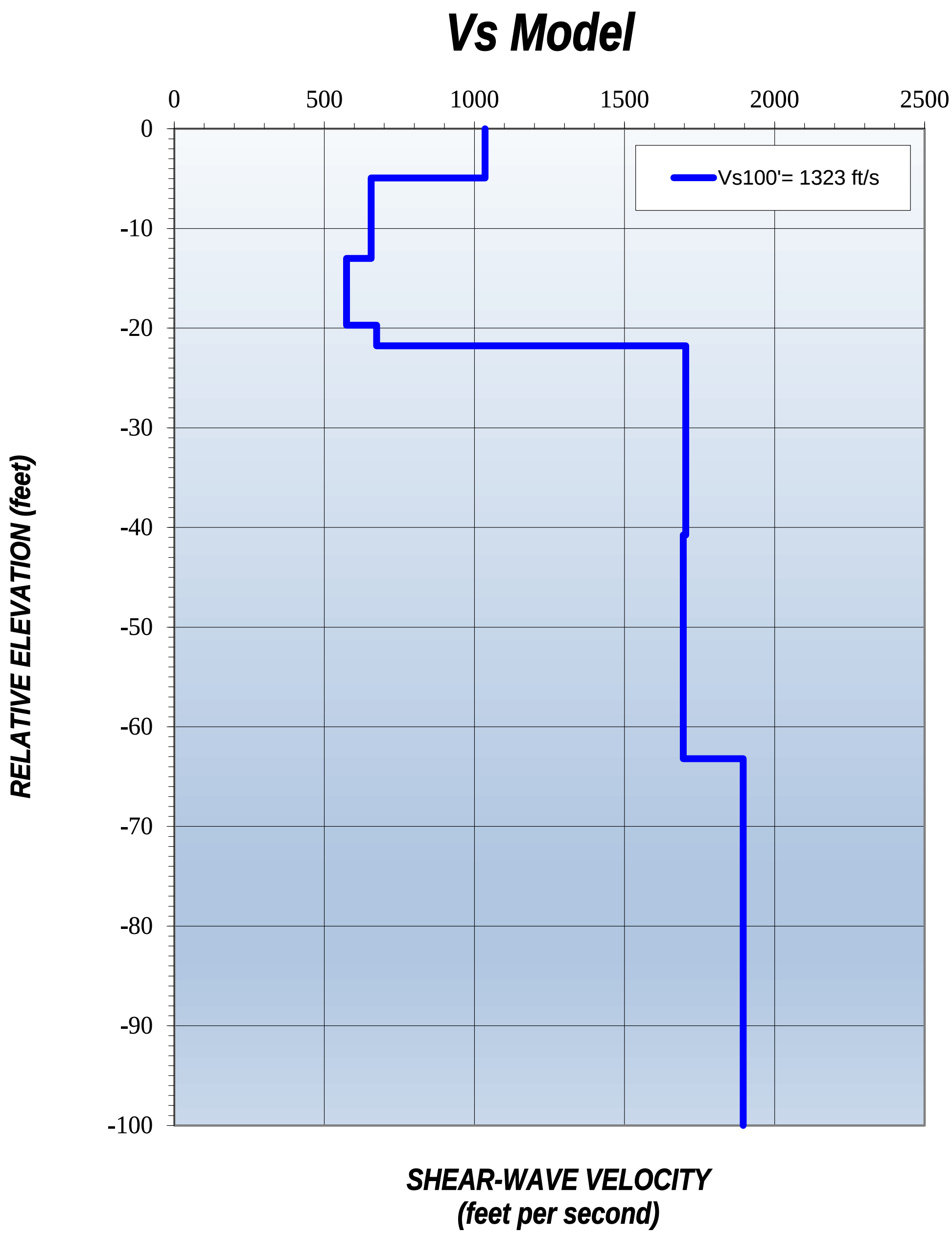
STING-ERT AND MASW PROFILE Line 107	LG&E-KU Glendale South Substation Glendale, Kentucky	ATLAS Figure 4g
	Project No.: 322013SWG · Date: 05/22	



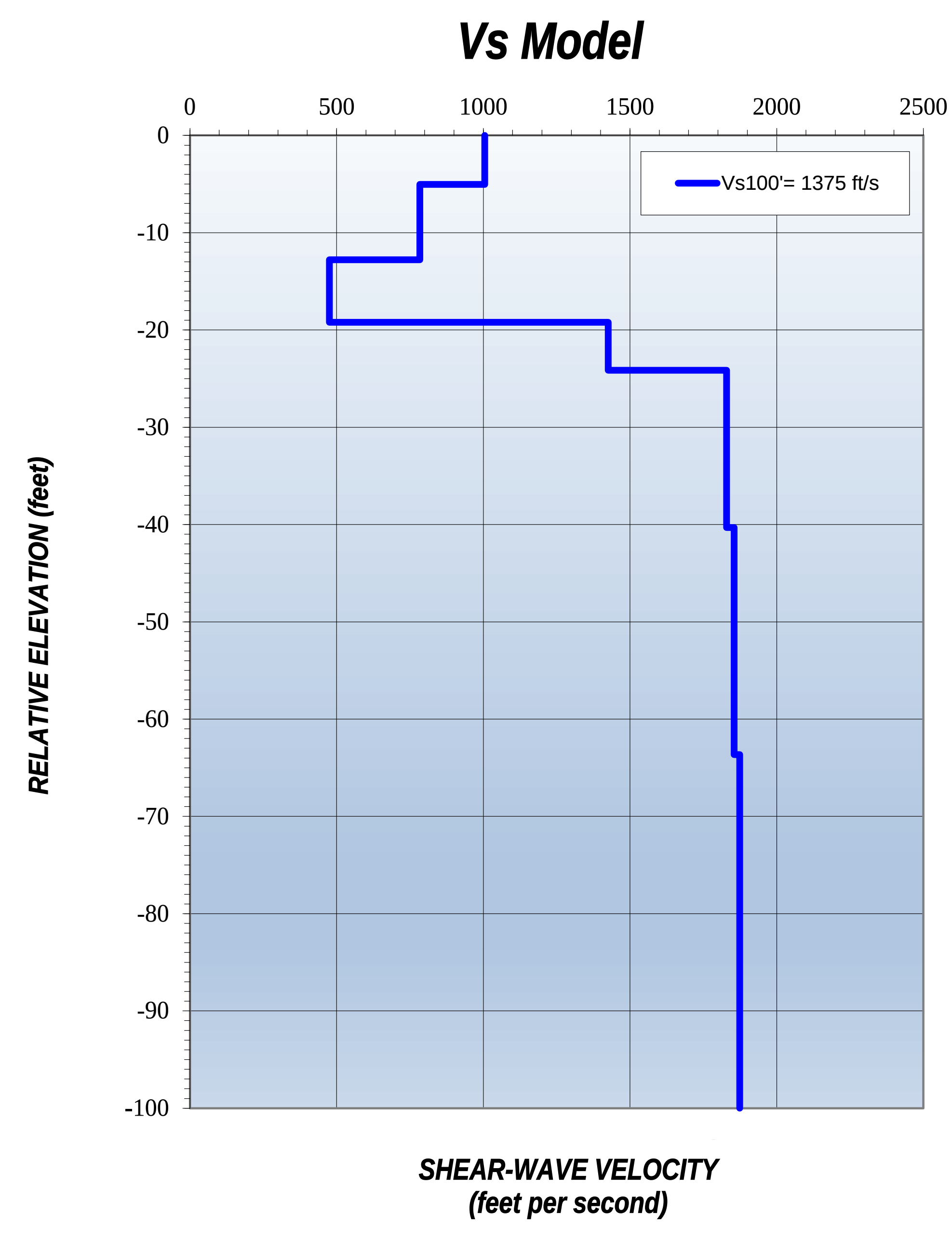
ReMi RESULTS RL-101	LG&E-KU Glendale South Substation Glendale, Kentucky		ATLAS Figure 5a
	Project No.: 322013SWG	Date: 05/22	



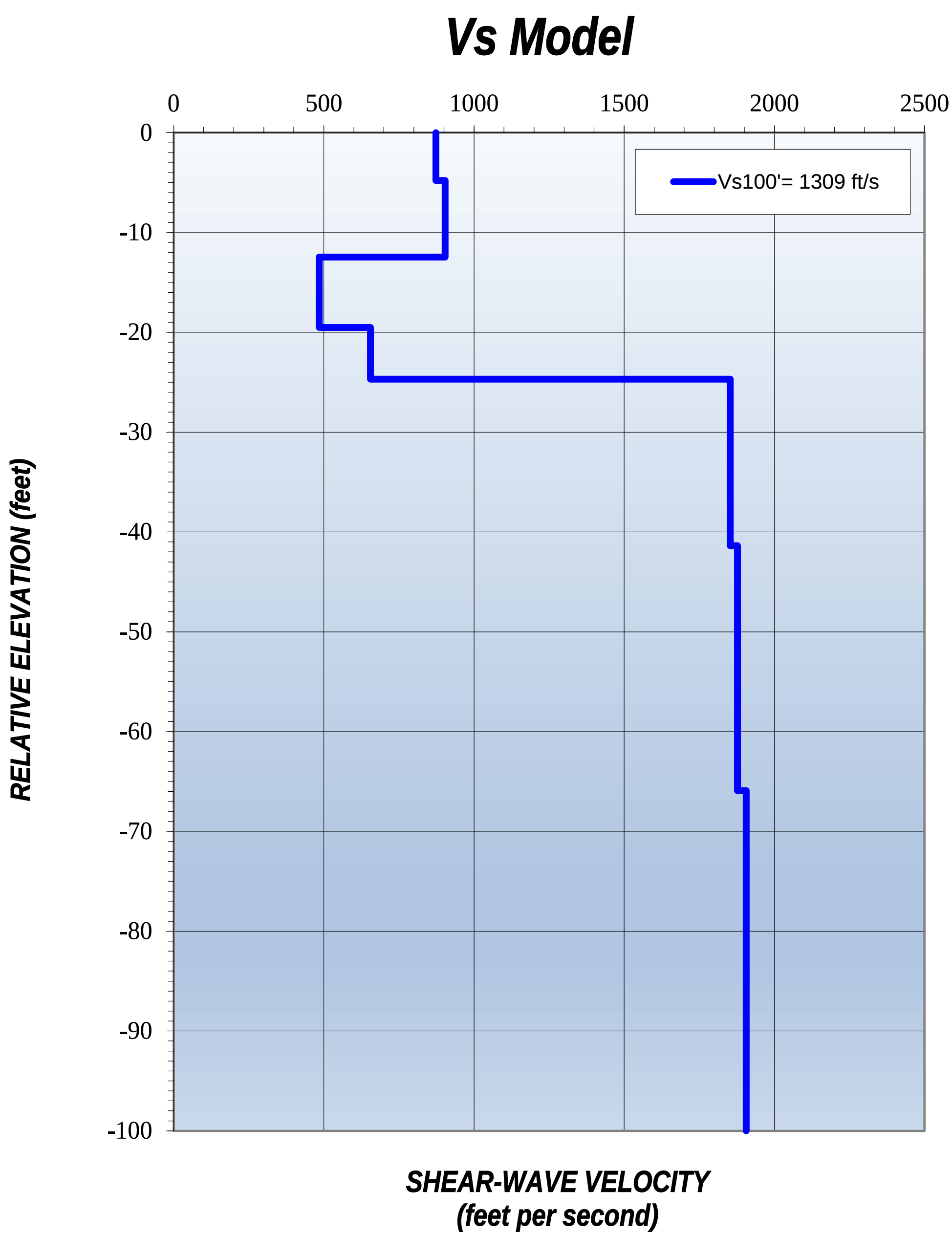
ReMi RESULTS **RL-102**	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG — Date: 05/22	ATLAS Figure 5b



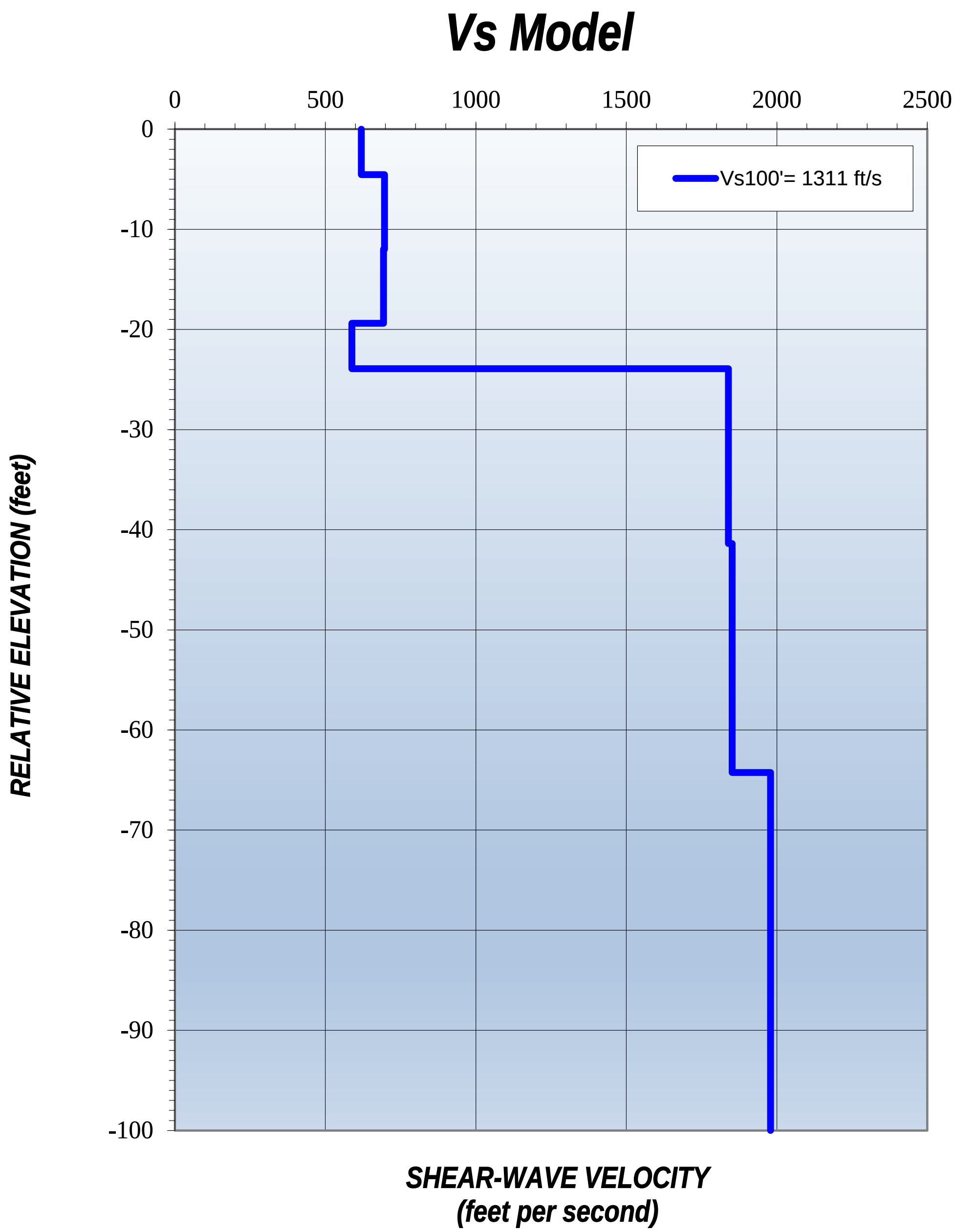
ReMi RESULTS RL-102N	LG&E-KU Glendale South Substation Glendale, Kentucky		ATLAS Figure 5c
	Project No.: 322013SWG	Date: 05/22	



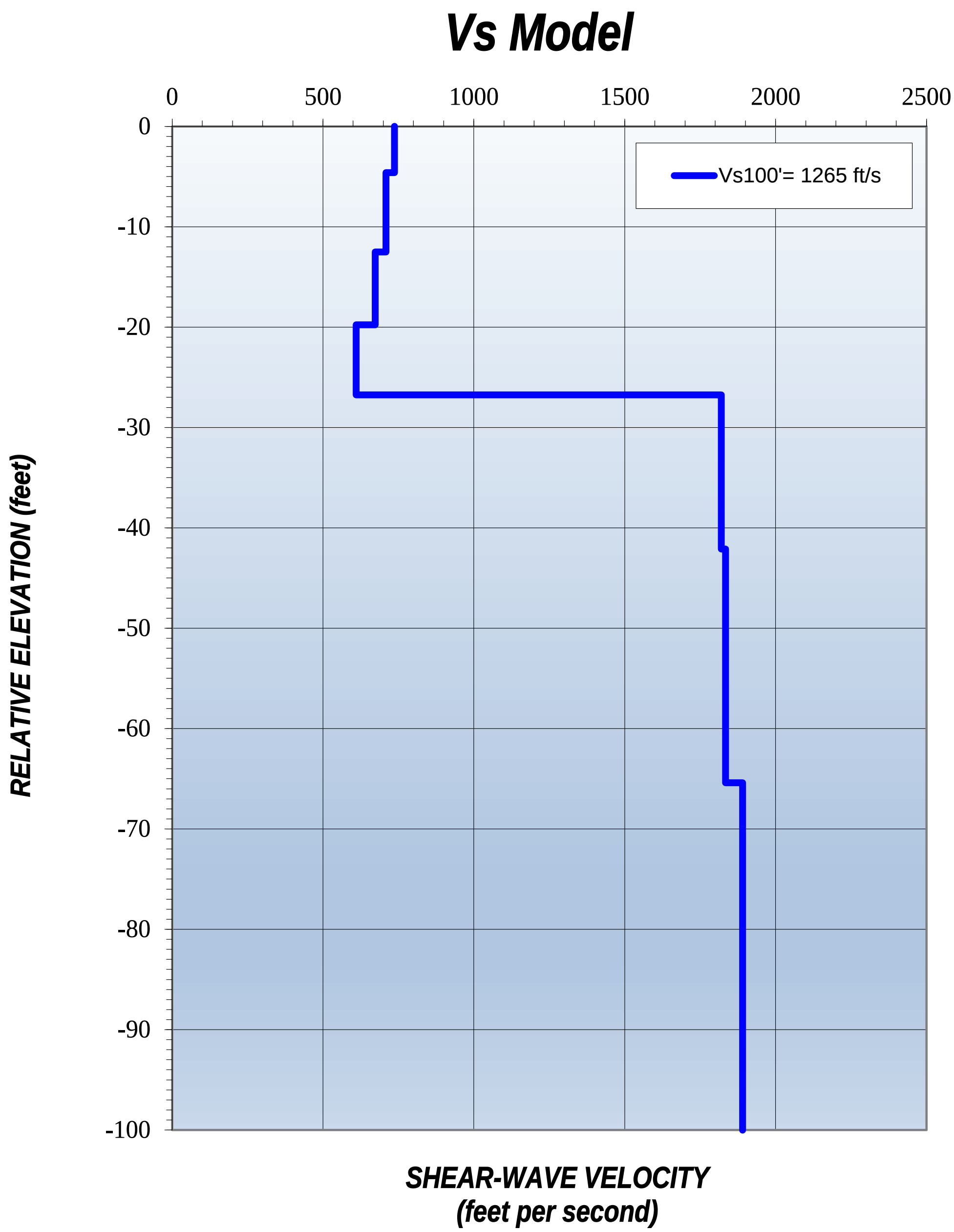
ReMi RESULTS **RL-103**	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG — Date: 05/22	ATLAS Figure 5d



ReMi RESULTS **RL-104**	LG&E-KU Glendale South Substation Glendale, Kentucky Project No.: 322013SWG — Date: 05/22	ATLAS Figure 5e



ReMi RESULTS RL-105	LG&E-KU Glendale South Substation Glendale, Kentucky	ATLAS Figure 5f
	Project No.: 322013SWG / Date: 05/22	



ReMi RESULTS RL-106	LG&E-KU Glendale South Substation Glendale, Kentucky	ATLAS Figure 5g
	Project No.: 322013SWG / Date: 05/22	

GEOPHYSICAL EVALUATION

LG&E-KU GLENDALE INDUSTRIAL SUBSTATION

Glendale, Kentucky

PREPARED FOR:

Matt Hambright, P.E.
Black & Veatch
3550 Green Court
Ann Arbor, MI 48105-1579

PREPARED BY:

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May 5, 2022

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May 5, 2022

Atlas No. 322014SWG
Report No. 1

MR. MATT HAMBRIGHT, P.E.
BLACK & VEATCH
3550 GREEN COURT
ANN ARBOR, MI 48105-1579

Subject: Geophysical Evaluation
LG&E-KU Glendale Industrial Substation Project
Glendale, Kentucky

Dear Mr. Hambright:

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale Industrial Substation Project located in Glendale, Kentucky. Specifically, our services included the performance of five high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, five two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and six Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
Atlas Technical Consultants LLC

Eric R. Carlson, EI (MO)
Project Geophysicist/Engineer

Patrick F. Lehrmann, P.G. (CA, OR, MO) P.Gp.(CA)
Principal Geologist/Geophysicist

ASB/ERC/PFL/erc/ds

Distribution: hambrightm@bv.com

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

In accordance with your authorization, Atlas performed a geophysical evaluation pertaining to the LG&E-KU Glendale Industrial Substation Project located in Glendale, Kentucky (Figure 1). Specifically, our services included the performance of five high-resolution multi-electrode electrical resistivity tomography (Sting-ERT) traverses, five two-dimensional (2D) Multichannel Analysis of Surface Wave (MASW) seismic profiles, and six Refraction Microtremor (ReMi) one-dimensional (1D) profiles at preselected areas of the project site. The primary purpose of the study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock at our evaluated locations. Our services were conducted on March 21 through April 11 of 2022. This report presents the methodology, equipment used, analysis, and findings.

2. SCOPE OF SERVICES

Our scope of services included the performance of five Sting-ERT, five MASW and six 1D ReMi profiles at preselected locations within the study area. Specifically, we conducted the following scope of services for the project:

- Collection of electrical resistivity data along five predetermined Sting-ERT traverses, STL-201 through STL-205 using an AGI SuperSting R8 resistivity meter and 56 stainless steel electrodes.
- Collection of 2D MASW data along five predetermined MASW traverses, ML-201 through ML-205 using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. Compilation and geophysical analysis of the data collected.
- Collection of 1D ReMi data at six predetermined locations, RL-201 through RL-205. The ReMi data was collected using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones.
- Compilation, processing, and analysis of the data obtained.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is located to the northeast of the intersection of Gilead Church Road and Jaggers Road in Glendale, Kentucky (Figure 1). The site consists of open farm fields with partially cut corn stalks and varied other vegetation. A small pond is located directly west of the study area.

Based on our discussions with project stakeholders, it is our understanding that the project site is in an area prone to karst features.

4. GEOPHYSICAL INSTRUMENTATION AND APPLICATIONS

Our evaluation included conducting five Sting-ERT traverses, five MASW traverses and six 1D ReMi traverses for the purpose of delineating geophysical anomalies potentially associated with karst and to estimate depth to bedrock at our evaluated locations at the project site. The methodology of each geophysical technique applied is described in more detail below.

4.1 Sting-ERT Method

An AGI SuperSting R8 electrical resistivity meter was used to conduct electrical resistivity profiles at the site to characterize the electrical properties of the subsurface. Five Sting-ERT profiles (STL-201 through STL-205) conducted along predetermined traverses are illustrated on Figure 2. Electrical current was injected into the ground through 56 stainless steel electrodes and the electric potential difference between multiple electrodes pairs was measured simultaneously. When necessary, the area around the electrodes was moistened with a relatively small amount of salt water (potable water with a small amount of added table salt, sodium chloride) to reduce the contact resistance. The data was collected using a Dipole-Dipole with Strong Gradient electrode configuration. An 8-foot electrode spacing was used for each of the Sting-ERT traverses to achieve optimal resolution and the desired depth of investigation. The Sting-ERT transects performed were acquired using a roll-along configuration, with some overlap, to achieve the desired profile lengths of 888 feet for STL-201, 776 feet for STL-202, 776 feet for STL-203, 552 feet for STL-204, and 552 feet for STL-205. Table 1 below shows the coordinates of each of the end stations for the Sting-ERT lines.

Table 1: Sting ERT Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.580045	-85.884607	STL-201 Station 0
37.579638	-85.881590	STL-201 Station 888
37.580498	-85.884249	STL-202 Station 0
37.578869	-85.882529	STL-202 Station 776
37.580324	-85.882980	STL-203 Station 0
37.578694	-85.881257	STL-203 Station 776
37.580174	-85.882561	STL-204 Station 0
37.579204	-85.884022	STL-204 Station 552
37.579996	-85.881333	STL-205 Station 0
37.579024	-85.882791	STL-205 Station 552

The Sting-ERT data was processed, corrected for terrain (relative elevation) variations, and analyzed using EarthImager 2-D™ V2.1.7, a two-dimensional resistivity inversion software. The inversion results are presented in color gradient apparent resistivity models that illustrate the electrical resistivity contrasts in the subsurface materials.

4.2 2D MASW Method

Surface waves (specifically, Rayleigh waves) recorded along lines ML-201 through ML-205 were performed at the same location and orientation as the Sting ERT profiles (Figure 2). It should be noted that due to the roll-along nature of the Sting-ERT traverses, the endpoints of the Sting-ERT lines continue further than those of the MASW traverses for Line 201, 202, and 203. Surface waves, generated by a hammer and plate (shot), were recorded using a 24-channel Geometrics Geode seismograph and 24, 4.5-Hz vertical component geophones. The geophones were coupled to the ground surface using a Geostuff Landstreamer with geophones stationed 4 feet apart and shots conducted off the end of the lines. Prior to the collection of surface wave data, near and far field effects were evaluated for several shot offset distances at each traverse. The results indicated that the optimum offset distance for the shot point of the MASW study ranged from 40 feet to 72 feet for each traverse.

Three records, one second long, were recorded at each shot location. After each shot, the shot location and geophones were shifted 8 feet longitudinally along the profile direction and the line was reshot. The number of shots, spread length, and start and end stations are presented in Table 2. The station numbers (start and end points of the line) and their associated coordinates are shown in Table 3.

The recorded MASW data were processed using SurfSeis® (Kansas Geological Survey, 2012), a MASW software program. One dimensional (1-D) shear-wave (S-wave) velocity (Vs) profiles were generated for each shot location which represent the average condition across the length of the geophone array. Each individual 1-D profile is spatially plotted at the center of each geophone array. A two-dimensional color gradient model was then created from the 1-D models using the SurfSeis® interpolation scheme with relative elevation corrections. It should be emphasized that the 2-D profile represents the area between the midpoint of the first shot location and the midpoint of the last shot location. The actual model section length and start and end stations for the sections are also listed in Table 2.

Table 2: MASW Array Geometry

Line No.	No. of Shots	Total Spread Length (feet)	Profile Length/Start and End Stations (feet)
ML-201	106	940	848/(0-848)
ML-202	94	844	752/(0-752)
ML-203	94	844	752/(0-752)
ML-204	69	644	552/(0-552)
ML-205	69	644	552/(0-552)

Table 3: MASW Line Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.580045	-85.884607	ML-201 Station 0
37.579652	-85.881726	ML-201 Station 848
37.580498	-85.884249	ML-202 Station 0
37.578920	-85.882581	ML-202 Station 752
37.580324	-85.882980	ML-203 Station 0
37.578744	-85.881309	ML-203 Station 752
37.580174	-85.882561	ML-204 Station 0
37.579204	-85.884022	ML-204 Station 552
37.579996	-85.881333	ML-205 Station 0
37.579024	-85.882791	ML-205 Station 552

4.3 1D ReMi

The passive source 1-D ReMi technique uses recorded surface waves (specifically Rayleigh waves) that are contained in background noise to develop a shear-wave velocity profile of the study area down to a depth, in this case, of approximately 100 feet below existing ground surface at seven predetermined locations at the study area. The depth of exploration is dependent on the length of the line and the frequency content of the background noise. The results of the ReMi method, displayed as a one-dimensional profile, represents the average condition across the length of the line. The ReMi method does not require an increase of material velocity with depth; therefore, low velocity zones (velocity inversions) are detectable with ReMi. The mid-point locations of each ReMi traverse are detailed in Table 4.

Table 4: ReMi Mid-point Coordinates (WGS 84)

Latitude	Longitude	Line Number and Station
37.57994	-85.88389	RL-201
37.57921	-85.88288	RL-202
37.57909	-85.88168	RL-203
37.57931	-85.88384	RL-204
37.57990	-85.88295	RL-204N
37.57970	-85.88176	RL-205

A total of 15 records, each 32 seconds in duration, were recorded for lines RL-201 through RL-205; 10 records utilizing passive data collection of ambient ground vibration noise; and 5 records utilizing an active source generated by a 20-pound sledgehammer and a HDPE plastic strike plate. The active source data gathers included conducting hammer blows approximately 30 feet off the end of the geophone array. Data collected was then downloaded to a field computer and the data were later processed using Surface Plus 9.1 - Advanced Surface Wave Processing Software (Geogiga Technology Corp., 2020), which uses the refraction microtremor method

(Louie, 2001) and other surface wave analysis methods. The program generates phase-velocity dispersion curves for each record and provides an interactive dispersion modeling tool to determine the best fitting model. The result is a 1-D shear-wave velocity model of the site with roughly 85 to 95 percent accuracy.

5. FINDINGS AND CONCLUSIONS

As previously discussed, the primary purpose of our study was to detect geophysical anomalies potentially related to karst and to estimate depth to bedrock. Our study utilized Sting-ERT, MASW and ReMi methods. Figures 2 and 3 present the approximate location of our traverses and the general conditions at the study areas, respectively.

Figures 4a through 4e depict the results from the Sting-ERT and MASW lines STL-201 through STL-205 and ML-201 through ML-205, respectively. The figures are presented in color gradient form with warm colors (red) representing relatively higher resistivity/shear wave velocity for the ERT/MASW, respectively. The cool colors (blue) representing relatively higher conductivity and lower shear wave velocity, respectively. The measured contact resistance (resistances between the electrode and the adjacent soil) along our transects were very low which resulted in good quality data and repeatable results for the ERT data. The presence of corn stalks in the fields coupled with days of high winds presented some challenges in the collection of the MASW data; however, overall data quality (dispersion curves) for the MASW data was good. In general, our Sting-ERT profiles illustrate layers of somewhat resistive materials in the very near-surface, then several layers of relatively conductive materials, and more resistive materials at depth. Conductive and resistive pockets are also evident in the data.

Please note the 2D MASW seismic models depicted on the figures start at the mid-point of the first geophone array and terminate at the mid-point of the last geophone array. As illustrated in Figures 4a through 4e, the models regularly depict a thin horizon of relatively high velocity material in the near surface, underlain by relatively low velocity material, and higher velocity materials with increasing depth.

The shear wave velocity results and ERT results are relatively consistent, with some localized lateral and vertical variations in shear wave velocity and resistivity values. The responses observed between approximately 30 to 40 feet below existing ground surface are consistent with the typical the contrast in physical properties observed between soil and weathered bedrock/bedrock.

Also noted on Figures 4a through 4e are numerous anomaly locations on both the Sting-ERT and MASW profiles. Often, karst features have a combination of higher and/or lower resistive zones (depending on the saturation of the soils/rock) coupled with a lower velocity zone. Several anomaly locations noted along the profiles have both resistivity anomalies and lower velocity anomalies which can be consistent with karst. Additional anomalies on either the Sting-ERT or the MASW profiles are noted which could also be associated with karst.

As discussed, the purpose of our ReMi study was to develop 1D shear-wave velocity profiles to be used for design and construction at the study site. Table 5 and Figures 5a through 5f present the results from our ReMi evaluation. It should be noted that when the 1-D ReMi surface wave velocity results (analogous to shear wave) show an IBC Vs100 velocity value that is close to the "border line" boundary between two IBC Vs100 Site Classes, the project geotechnical engineering consultant of record should be consulted regarding existing available site information and whether obtaining additional new geotechnical evaluation data such as boreholes, surface to downhole seismic (ASTM D7400), cross hole seismic (ASTM D4428), and/or additional 1-D ReMi data collections would be advisable. The project geotechnical engineering consultant of record may wish to consider the subsurface geologic stratigraphy and structure, soil mechanics, and soil modulus, along with the initial 1D ReMi results when assessing a "borderline" IBC Vs100 Seismic Site Class and whether additional geophysical or geotechnical evaluations are needed.

Table 5: ReMi Vs 100' Results

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
RL-201 (W-E)	0-5	776	1,279 ft/s	C
	5-15	1,001		
	15-24	703		
	24-32	745		
	32-50	1,744		
	50-67	1,776		
	67-86	1,808		
	86-100	1,818		
RL-202 (SE-NW)	0-4	539	1,283 ft/s	C
	4-16	915		
	16-25	1,031		
	25-33	760		
	33-50	1,721		
	50-67	1,760		
	67-86	1,792		
	86-100	1,818		
RL-203 (SE-NW)	0-4	563	1,301 ft/s	C
	4-15	921		
	15-23	718		
	23-29	815		
	29-50	1,721		
	50-67	1,786		
	67-86	1,836		
	86-100	1,850		

ATLAS

Line Number (Orientation)	Depth (ft)	Shear-Wave Velocity (feet/second)	Average Shear-Wave Velocity (Vs100)	Site Class (IBC, 2019)
RL-204 (SW-NE)	0-4	969	1,352 ft/s	C
	4-15	1,154		
	15-18	711		
	18-28	602		
	28-50	1,778		
	50-67	1,824		
	67-86	1,857		
	86-100	1,864		
RL-204N (SW-NE)	0-4	832	1,317 ft/s	C
	4-16	999		
	16-19	751		
	19-30	636		
	30-50	1,760		
	50-67	1,832		
	67-86	1,864		
	66-100	1,920		
RL-205 (SW-NE)	0-4	515	1,284 ft/s	C
	4-15	959		
	15-19	759		
	19-29	712		
	29-50	1,800		
	50-67	1,784		
	67-86	1,832		
	86-100	1,856		

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Atlas should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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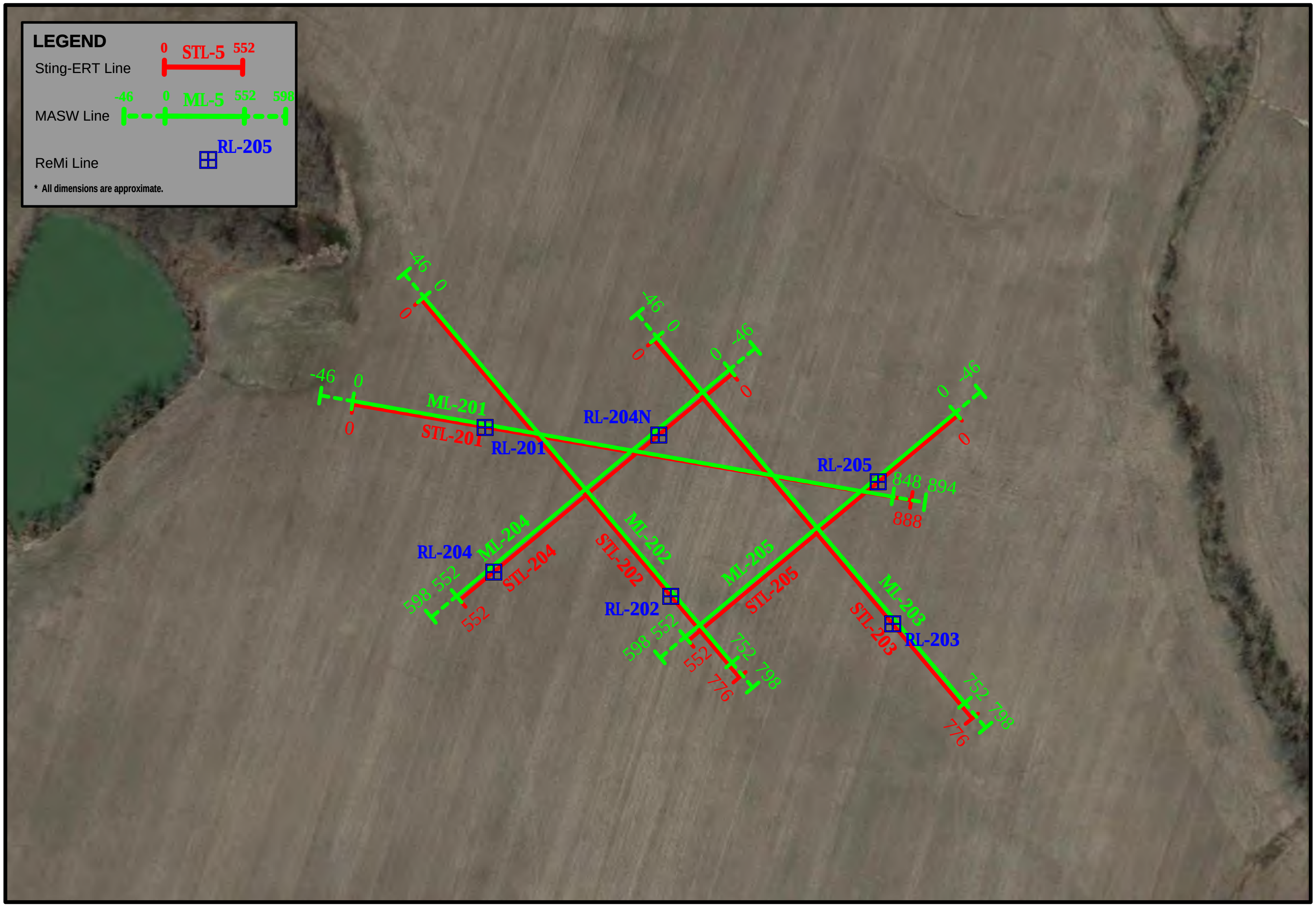
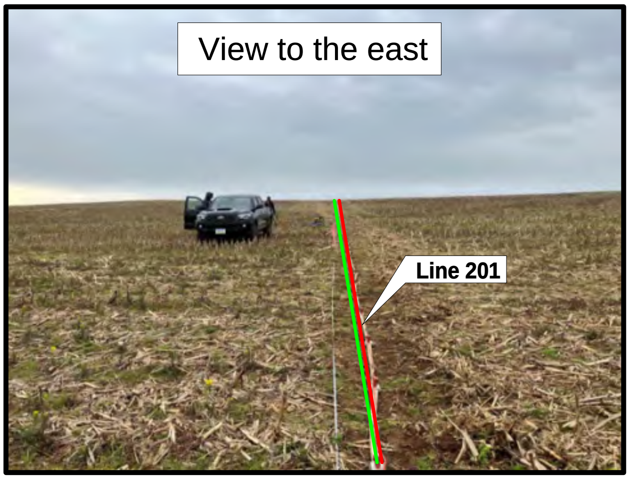
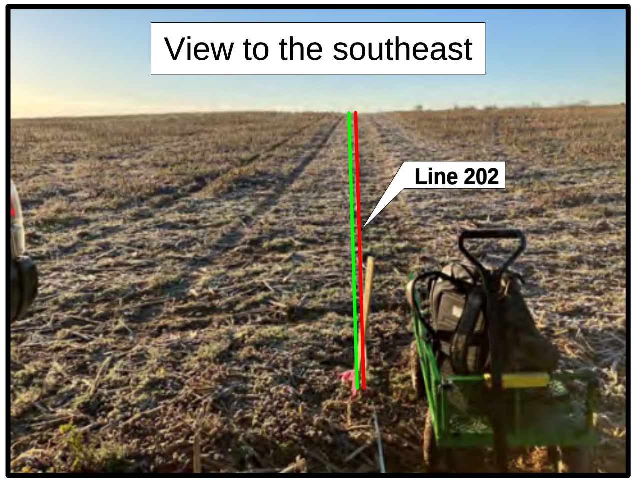
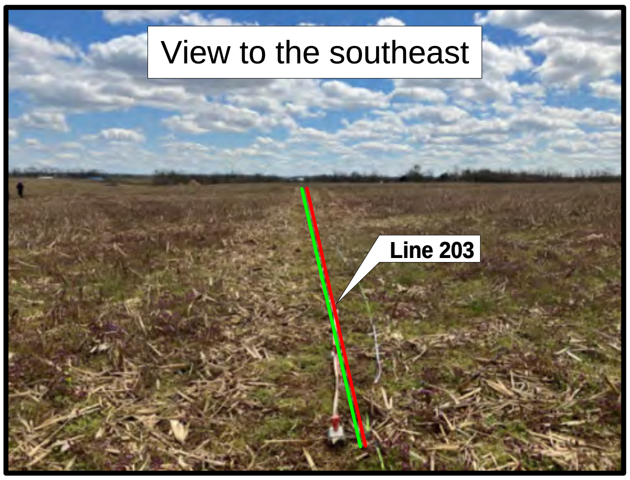
SITE LOCATION MAP	N	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 1

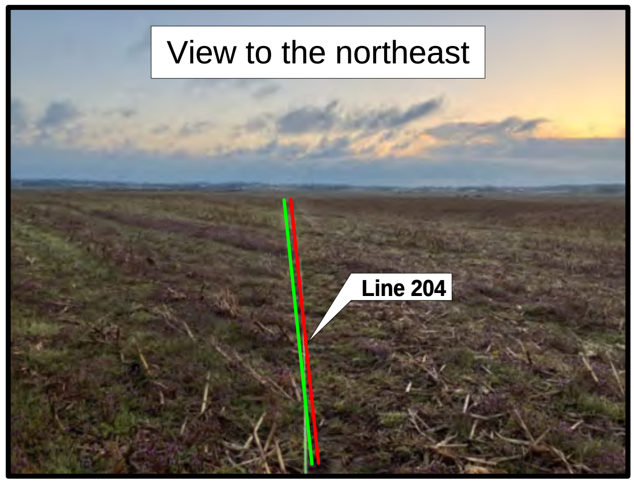


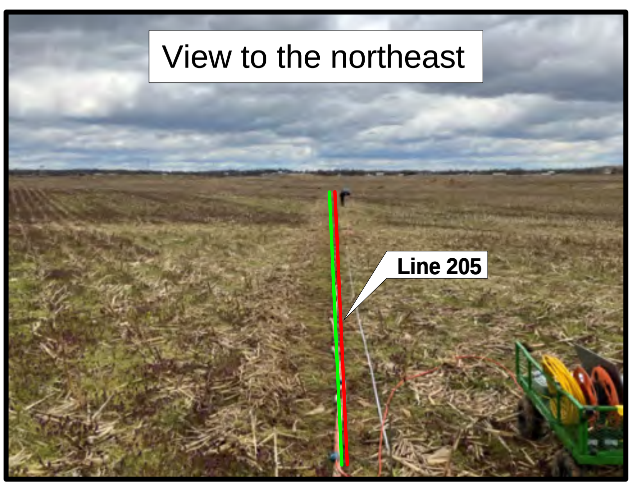
LINE LOCATION MAP	N	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG Date: 05/22	ATLAS Figure 2	0 200 400 **approximate scale in feet**







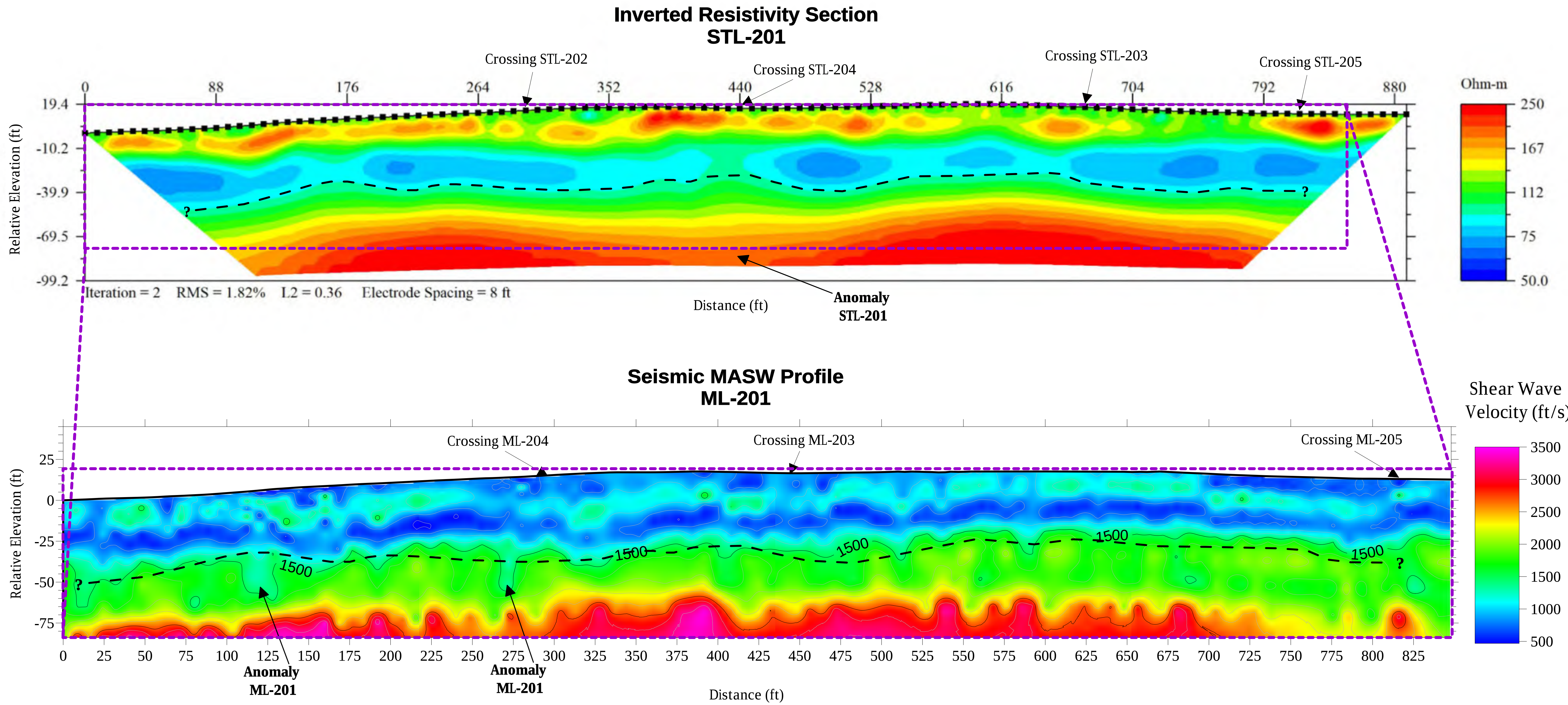




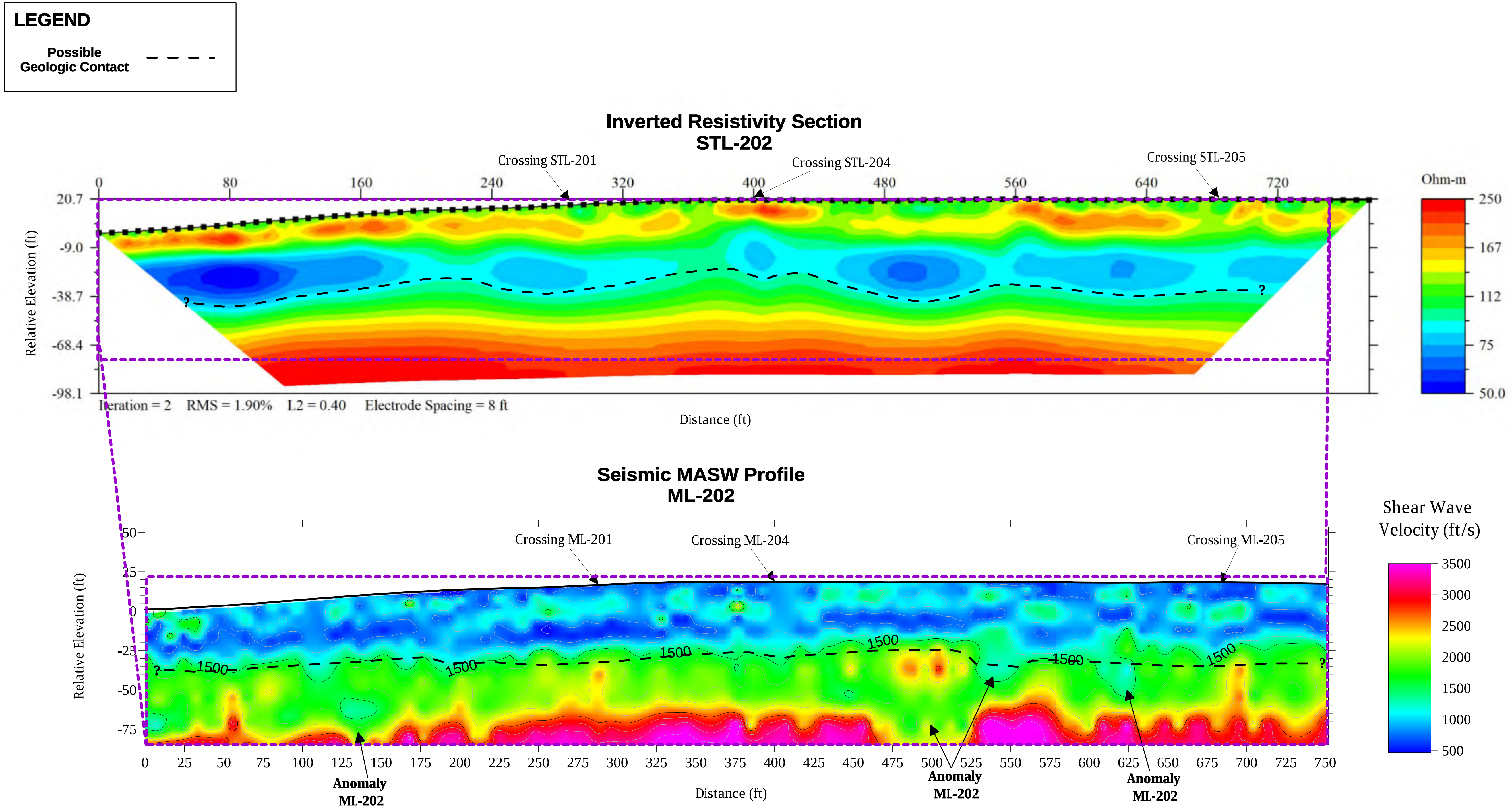
SITE PHOTOGRAPHS	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 3

LEGEND

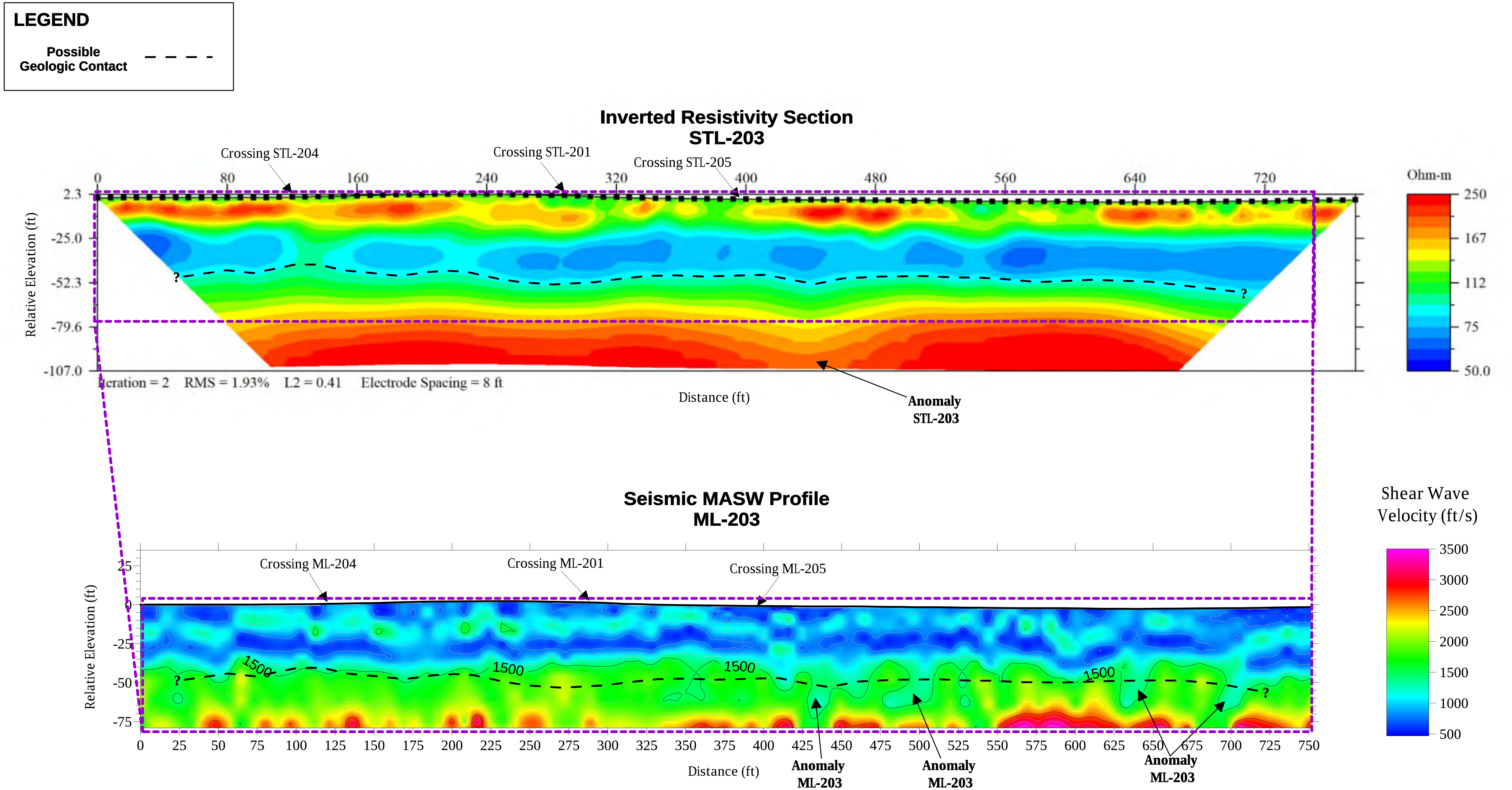
Possible Geologic Contact – – – –



STING-ERT AND MASW PROFILE Line 201	LG&E-KU Glendale Industrial Substation Glendale, Kentucky		ATLAS Figure 4a
	Project No.: 322014SWG	Date: 05/22	



STING-ERT AND MASW PROFILE Line 202	LG&E-KU Glendale Industrial Substation Glendale, Kentucky		ATLAS Figure 4b
	Project No.: 322014SWG	Date: 05/22	

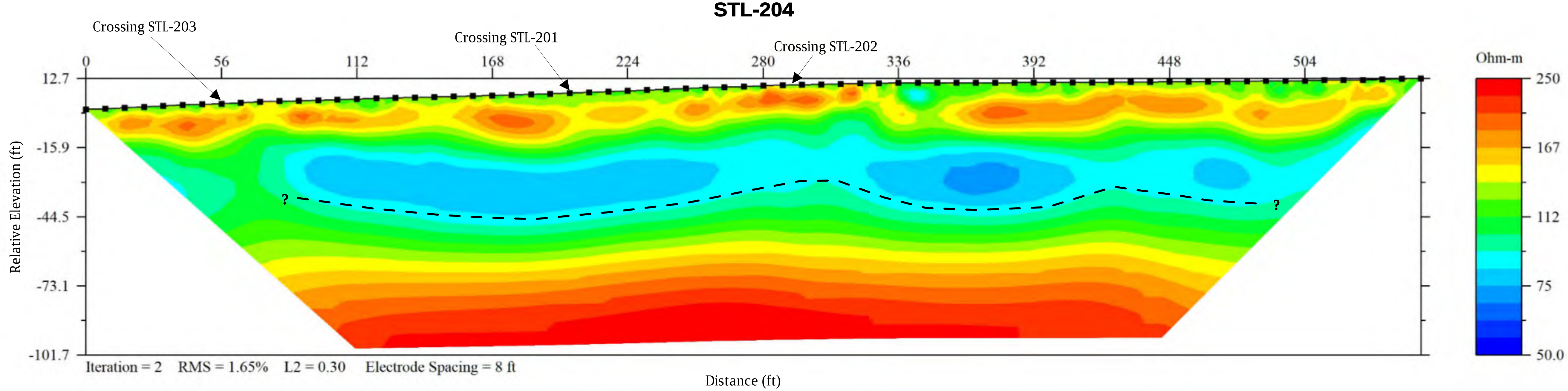


STING-ERT AND MASW PROFILE **Line 203**	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG Date: 05/22	ATLAS Figure 4c

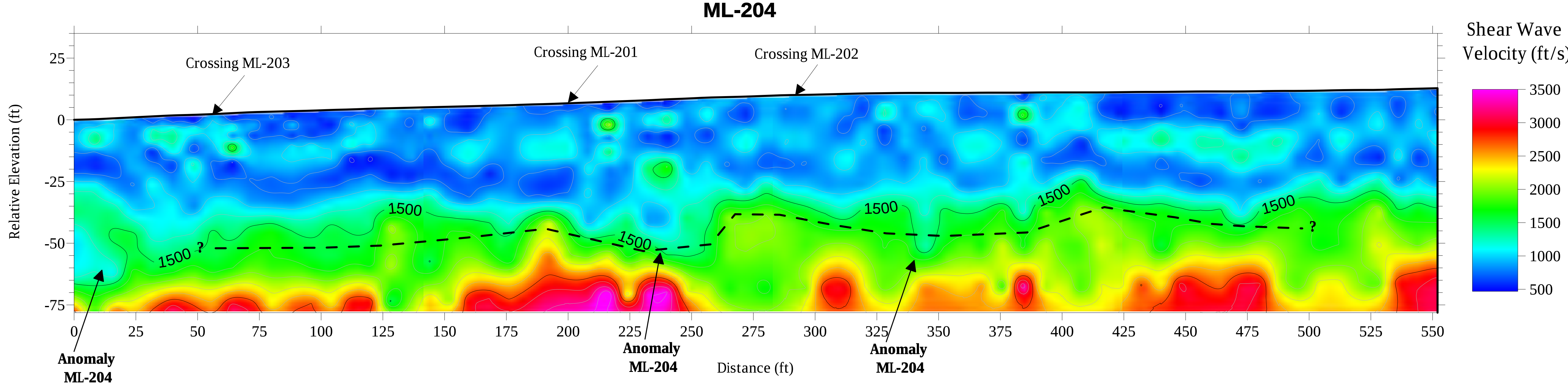
LEGEND

Possible Geologic Contact - - - -

Inverted Resistivity Section
STL-204



Seismic MASW Profile
ML-204

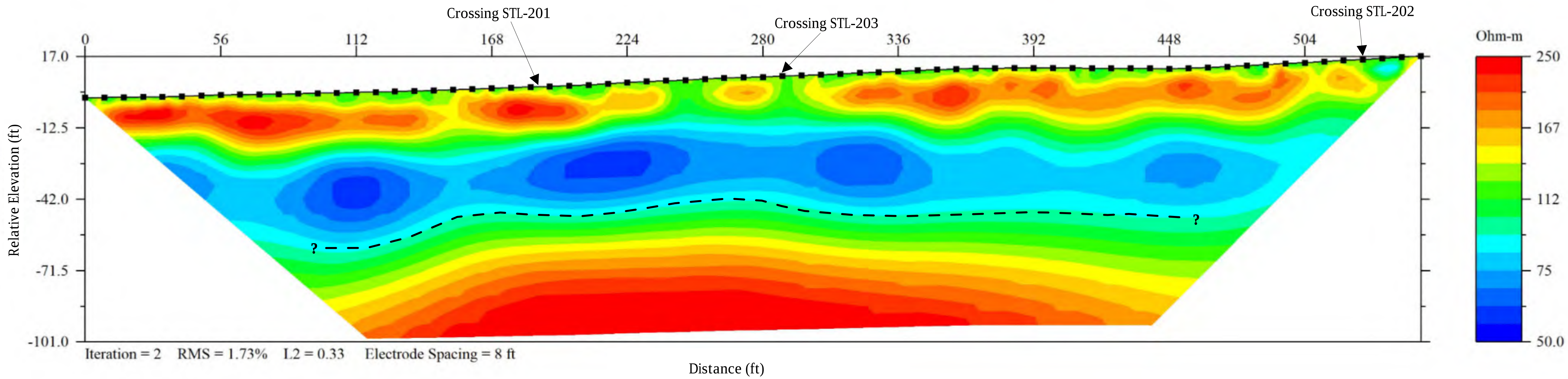


STING-ERT AND MASW PROFILE Line 204	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG Date: 05/22	ATLAS Figure 4d

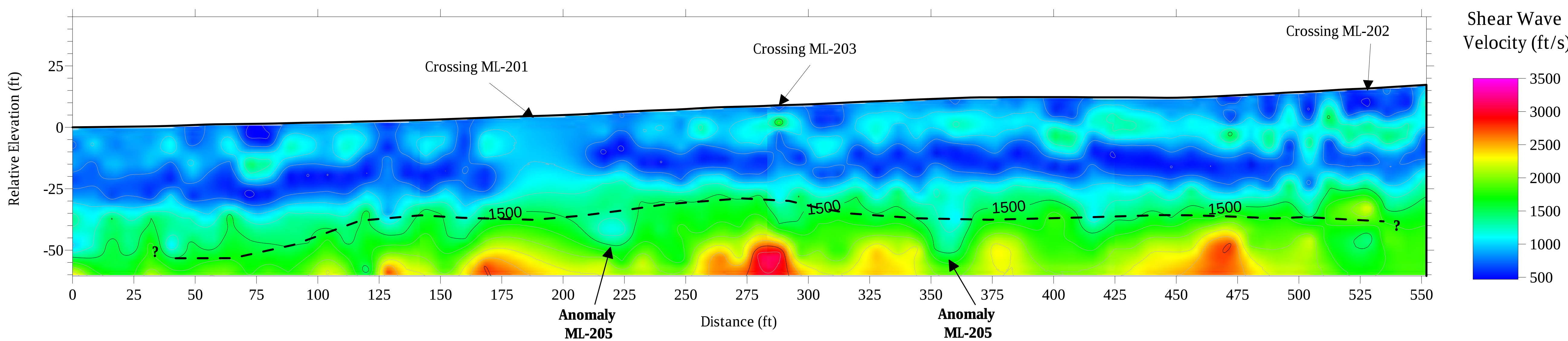
LEGEND

Possible Geologic Contact - - - -

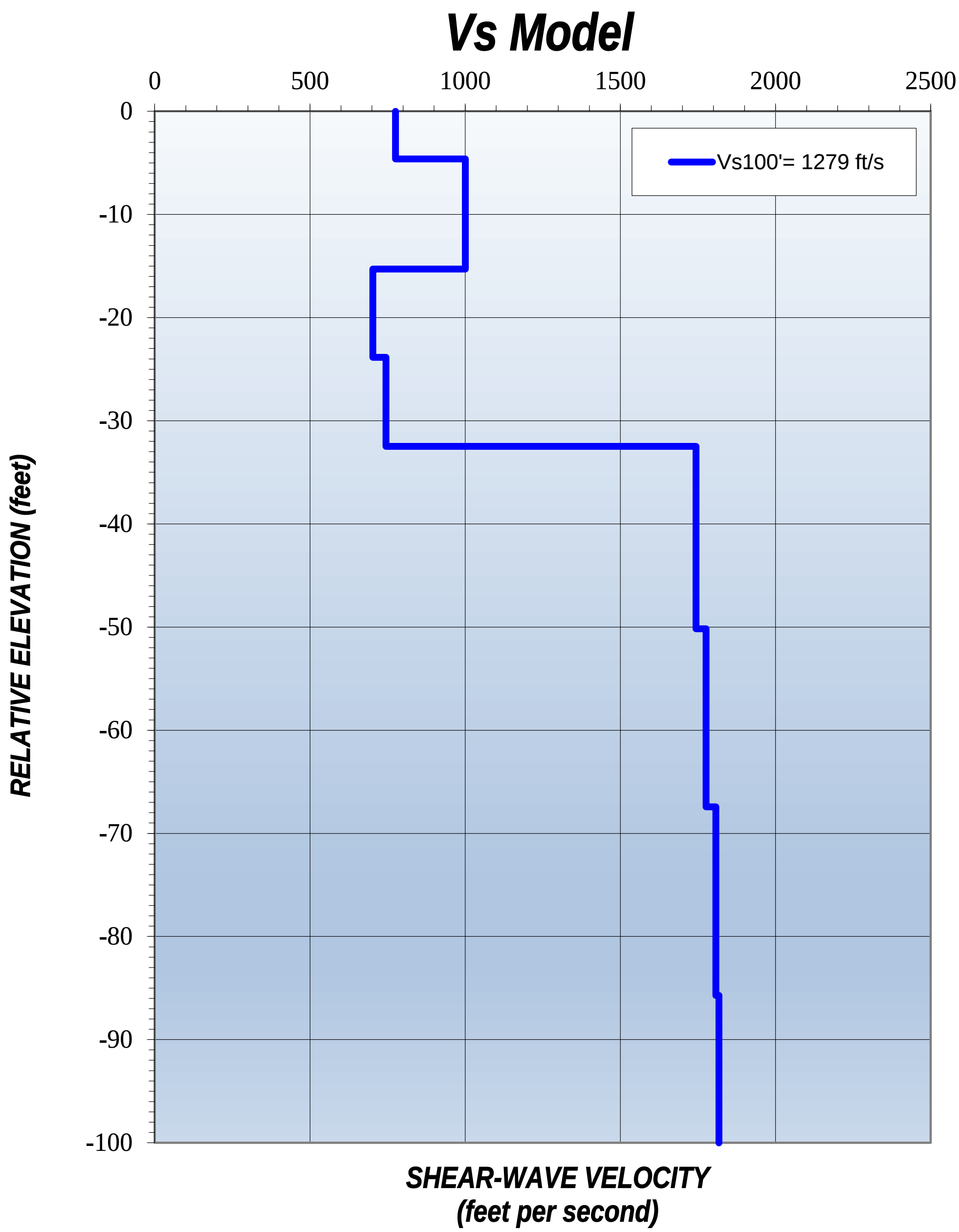
Inverted Resistivity Section STL-205



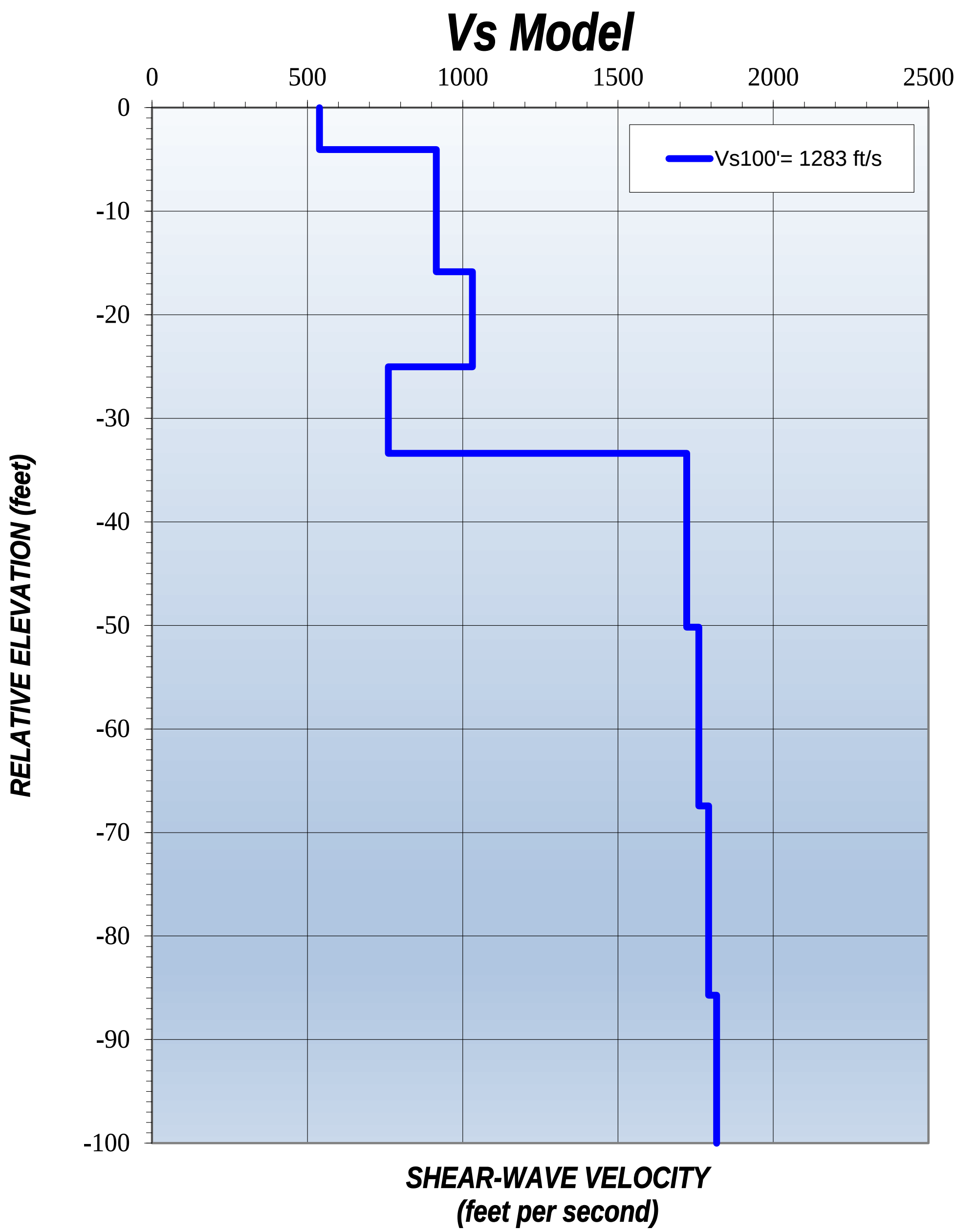
Seismic MASW Profile ML-205



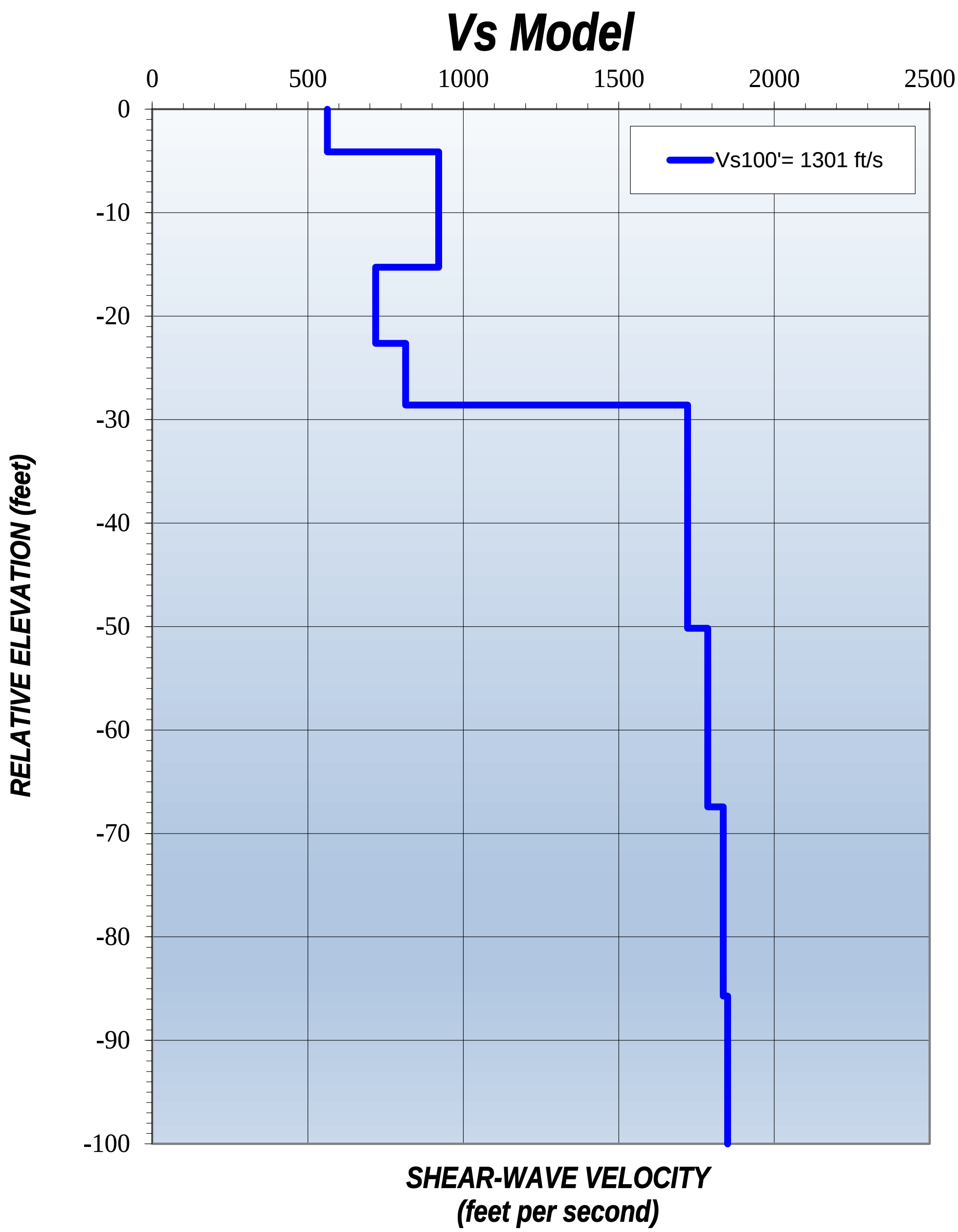
STING-ERT AND MASW PROFILE Line 205	LG&E-KU Glendale Industrial Substation Glendale, Kentucky		ATLAS Figure 4e
	Project No.: 322014SWG	Date: 05/22	



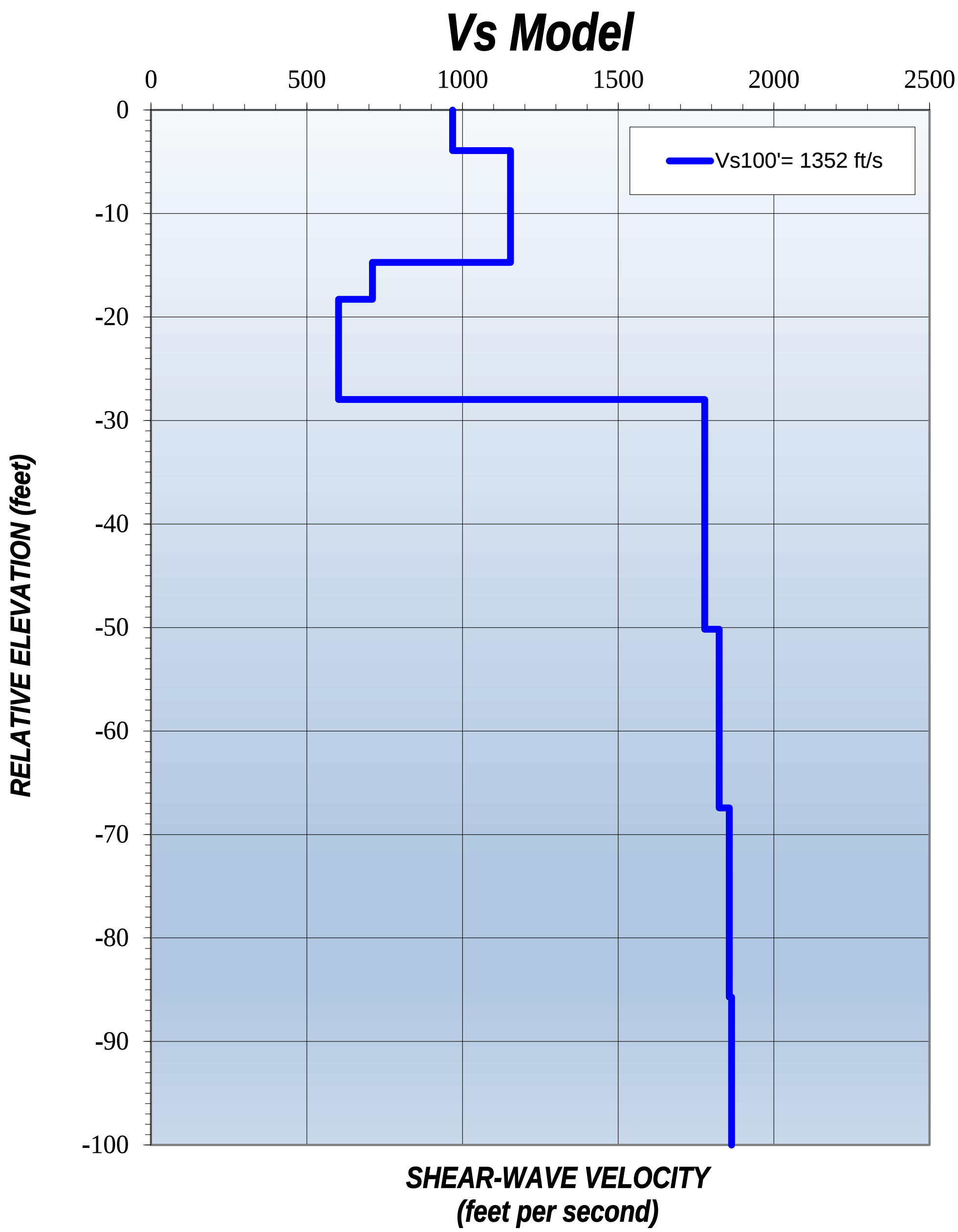
ReMi RESULTS **RL-201**	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 5a



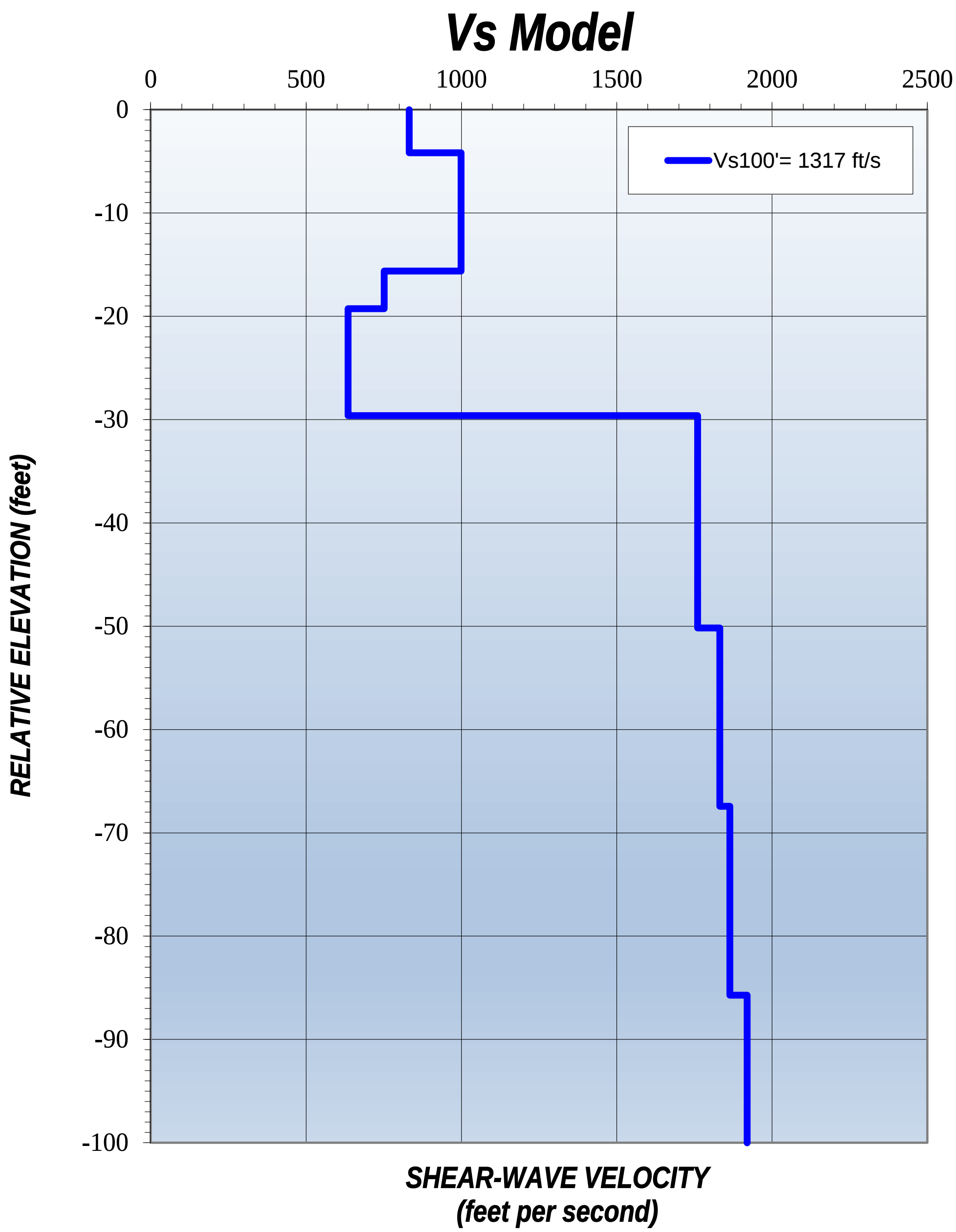
ReMi RESULTS RL-202	LG&E-KU Glendale Industrial Substation Glendale, Kentucky		ATLAS Figure 5b
	Project No.: 322014SWG	Date: 05/22	



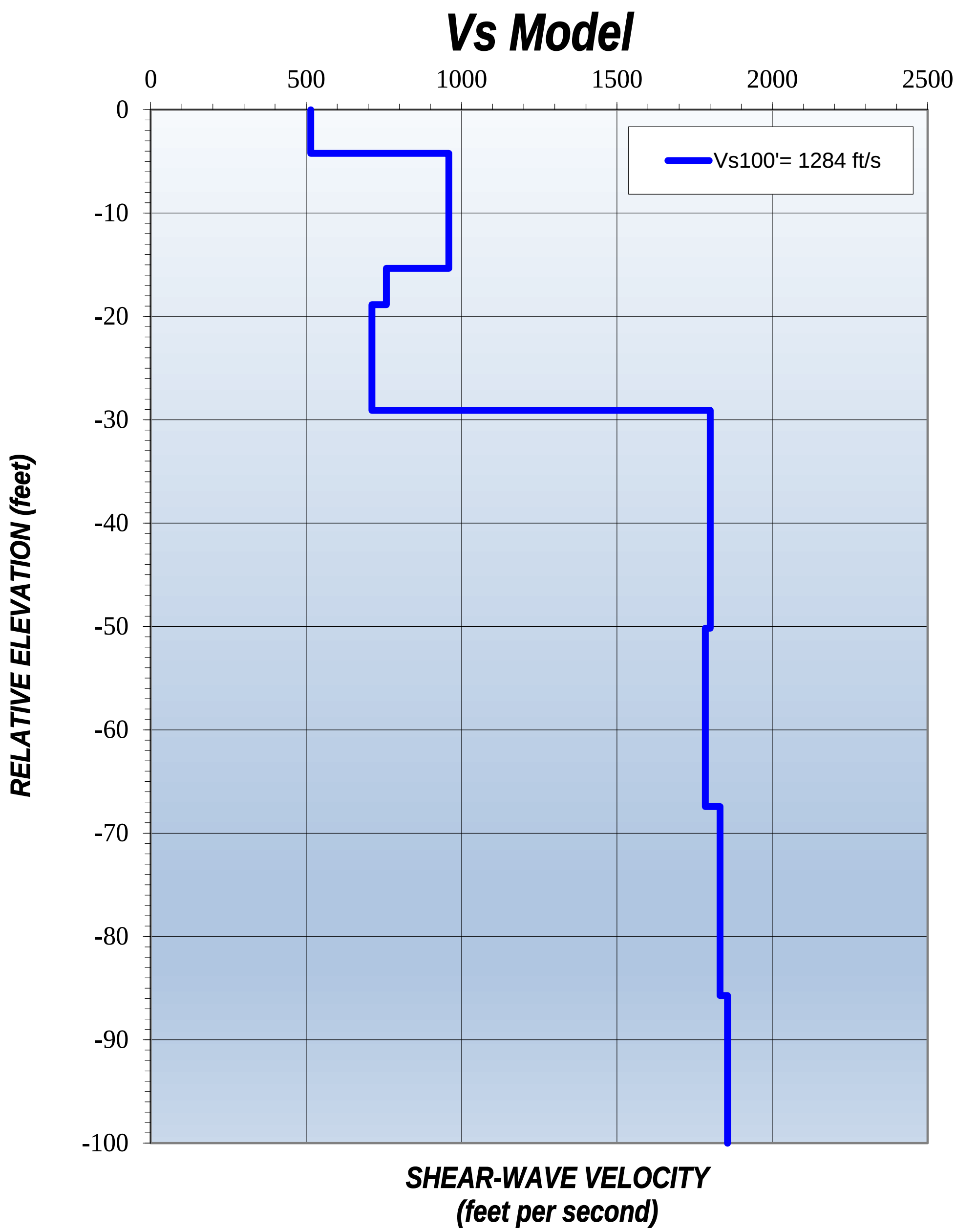
ReMi RESULTS **RL-203**	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 5c



ReMi RESULTS RL-204	LG&E-KU Glendale Industrial Substation Glendale, Kentucky		ATLAS Figure 5d
	Project No.: 322014SWG	Date: 05/22	



ReMi RESULTS **RL-204N**	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 5e



ReMi RESULTS RL-205	LG&E-KU Glendale Industrial Substation Glendale, Kentucky Project No.: 322014SWG — Date: 05/22	ATLAS Figure 5f

AMERICAN ENGINEERS, INC.

May 3, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 1E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East project in Glendale, KY. This summary is provided for Structure 1E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
1E	Double Circuit	75	709.9	37°35’43.55”N	85°54’8.56”W	3,168	2,132

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 43 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of ten inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as yellowish brown in color, moist and stiff in soil strength consistency. The fat clay was described as reddish brown to light brown in color, containing varying amounts of gravel, moist to saturated and medium stiff to very stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 1E	37°35’43.55”N	85°54’8.56”W	707.8	42.9	664.9

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1E	CL	5.0-14.0	1.7	1.0
STR 1E	CH	14.0-33.0	1.5	0.8
STR 1E	CH	33.0-42.9	1.5	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 1E	CL	5.0-14.0	0.01	200
STR 1E	CH	14.0-33.0	0.01	200
STR 1E	CH	33.0-42.9	0.007	200

5.2 **Axial Design Parameters** –Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 1E	CL	5.0-14.0	125.0	1.7	0.9
STR 1E	CH	14.0-33.0	120.0	1.5	1.0
STR 1E	CH	33.0-42.9	57.6	1.5	1.0

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

◎ SOIL TEST BORING

DRAWING NOT TO SCALE

ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS (NO. / DATE / DESCRIPTION)	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 1E GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
SHEET:	A-1

APPENDIX B

Boring Log

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 2^{nd} and 3^{rd} 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

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

STR #1E

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NUMBER 222-032
DATE STARTED 3/30/22 **COMPLETED** 3/30/22
DRILLING CONTRACTOR Strata Group, LLC
DRILLING METHOD Hollow Stem Auger
LOGGED BY Jacob Cowan **CHECKED BY** Aaron Anderson
NOTES Offset 10' North due to overhanging powerlines

PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT LOCATION Glendale, KY
GROUND ELEVATION 707.82 ft
GROUND WATER LEVELS:
▽ **AT TIME OF DRILLING** 33.00 ft / Elev 674.82 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (10 INCHES)	SPT 1	93	4-4-5 (9)	1.5	22				
	(CL) lean CLAY, yellowish brown, moist, stiff									
5		ST 1	100		3.5	24	47	20	27	Qu = 4,460 psf
10		SPT 2	100	3-5-8 (13)	3.0	20				
15	(CH) fat CLAY, reddish brown, moist, very stiff	ST 2	100		4.5+	29	56	27	29	Qu = 4,500 psf
20	(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff to medium stiff	SPT 3	100	3-5-7 (12)	3.0	38				
25		ST 3	90		4.5+	37				Shely Tube refused on cobble
30		SPT 4	100	4-3-5 (8)	1.5	38				
35	▽ (CH) fat CLAY, some gravel, light brown to reddish brown, saturated to wet, stiff	ST 4	100		1.75	34				
40		SPT 5	100	3-4-8 (12)	1.5	28				

Refusal at 42.9 feet.
Bottom of borehole at 42.9 feet.

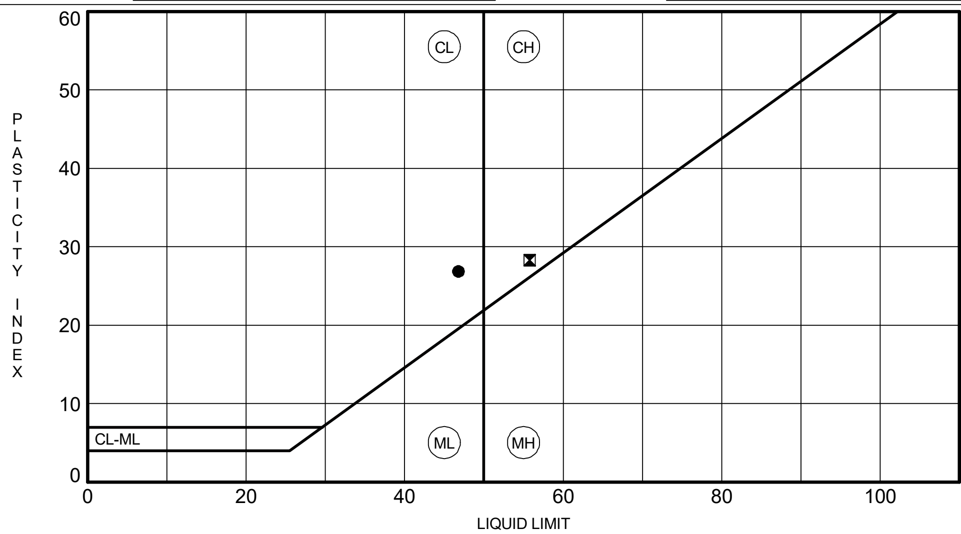
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

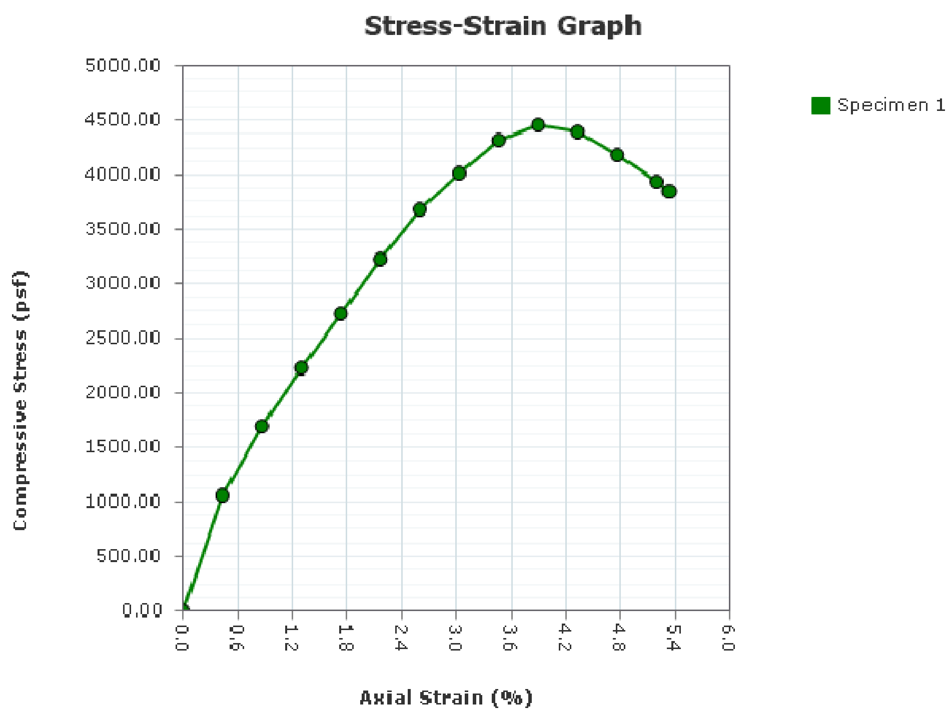
CLIENT LG&E and KU | **PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032 | **PROJECT LOCATION** Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #1E**	**4.0**	**47**	**20**	**27**		**(CL) LEAN CLAY**
⊠	**STR #1E**	**14.0**	**56**	**27**	**29**		**(CH) FAT CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	24.5							
Wet Density (pcf)	124.6							
Dry Density (pcf)	100.1							
Saturation (%):	95.8							
Void Ratio:	0.697							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4460.76							
Undrained Shear Strength (psf)	2230.38							
Strain at Failure (%):	3.90							

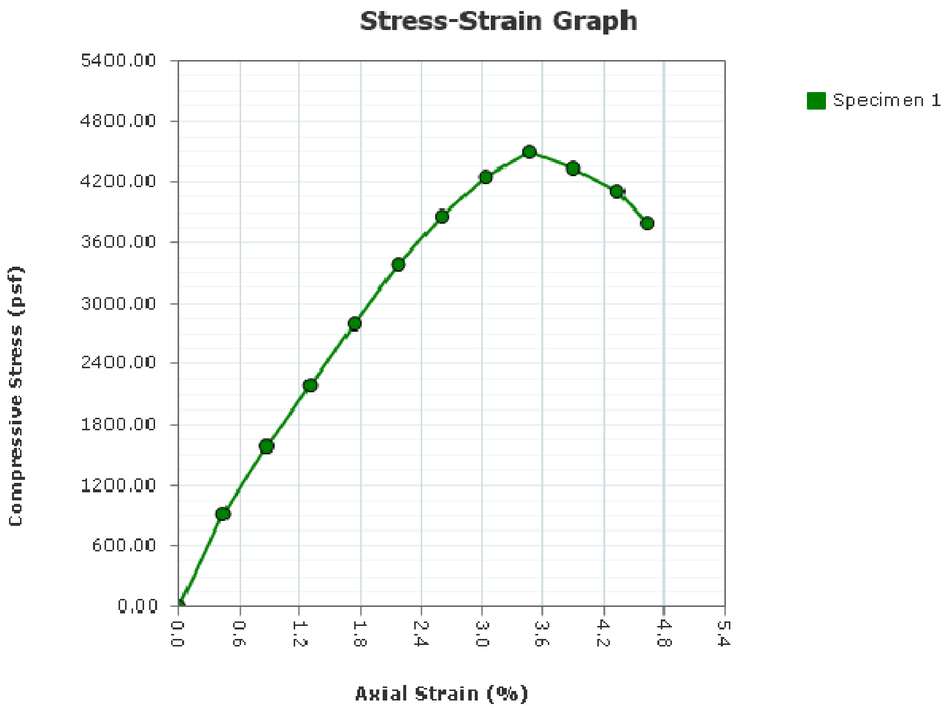
Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	47
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 1E
Location:	Glendale KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.2							
Wet Density (pcf)	121.4							
Dry Density (pcf)	94.0							
Saturation (%):	98.4							
Void Ratio:	0.807							
Height (in)	5.7700							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4505.25							
Undrained Shear Strength (psf)	2252.63							
Strain at Failure (%):	3.47							

Specific Gravity:	2.72	Plastic Limit:	27	Liquid Limit:	56
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 1E
Location:	Glendale KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN
ENGINEERS, INC.

May 3, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 2E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East project in Glendale, KY. This summary is provided for Structure 2E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
2E	Double Circuit	80	704.7	37°35’40.77”N	85°54’8.42”W	6,740	1,582

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 53 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of eight inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown in color, moist and medium stiff to very stiff in soil strength consistency. The fat clay was described as reddish brown to yellowish brown in color, containing trace to some gravel and trace amounts of sand, moist to saturated and medium stiff to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 2E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 2E	37°35’40.77”N	85°54’8.42”W	702.1	52.5	649.6

5. FOUNDATION DESIGN PARAMETERS

5.1 <u>**Lateral Design Parameters**</u> – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 2E	CL	5.0-9.0	1.8	1.0
STR 2E	CH	9.0-34.0	1.3	0.8
STR 2E	CH	34.0-52.5	0.8	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 5 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 2E	CL	5.0-9.0	0.02	200
STR 2E	CH	9.0-34.0	0.01	200
STR 2E	CH	34.0-52.5	0.02	-

5.2 **<u>Axial Design Parameters</u>** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 2E	CL	5.0-9.0	125.0	1.8	0.9
STR 2E	CH	9.0-34.0	120.0	1.3	1.0
STR 2E	CH	34.0-52.5	57.6	0.8	0.9

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND
SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS	NO. / DATE / DESCRIPTION
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 2E GLENDALE, KY
	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #2E\Support Information
SHEET:	A-1

APPENDIX B

Boring Logs

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR #2E

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/31/22 **COMPLETED** 3/31/22
GROUND ELEVATION 702.1 ft
DRILLING CONTRACTOR Strata Group, LLC
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 33.40 ft / Elev 668.70 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (8 INCHES)	SPT 1	100	3-2-5 (7)	1.25	21				
	(CL) lean CLAY, brown, moist, medium stiff to very stiff	ST 1	65		3.5	23	40	17	23	Qu = 5,620 psf
10	(CH) fat CLAY, reddish brown, moist to wet, stiff	SPT 2	100	4-6-5 (11)	2.0	27				
		ST 2	100		2.0	36				
20		SPT 3	100	3-5-4 (9)	2.0	44				
		ST 3	70		3.5	26				
30	(CH) fat CLAY, trace sand and gravel, reddish brown, moist to wet, stiff	SPT 4	80	4-6-7 (13)	0.75	35				
	▽	ST 4	20		4.5+	24				
40	(CH) fat CLAY, trace gravel, yellowish brown, wet to saturated, medium stiff	SPT 5	100	0-3-3 (6)	1.5	40				
50		SPT 6	100	8-5-3 (8)	0.25	44				

Refusal at 52.5 feet.
Bottom of borehole at 52.5 feet.

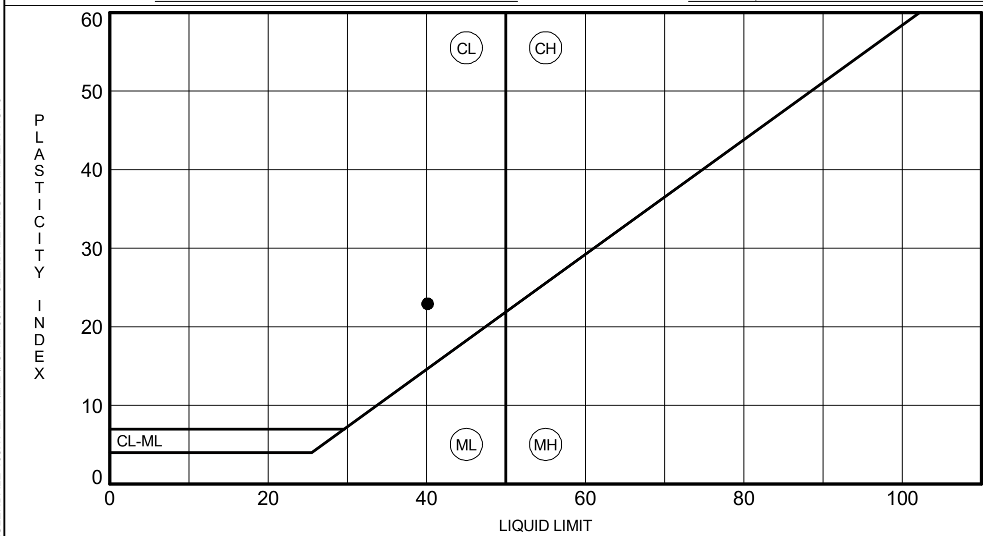
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

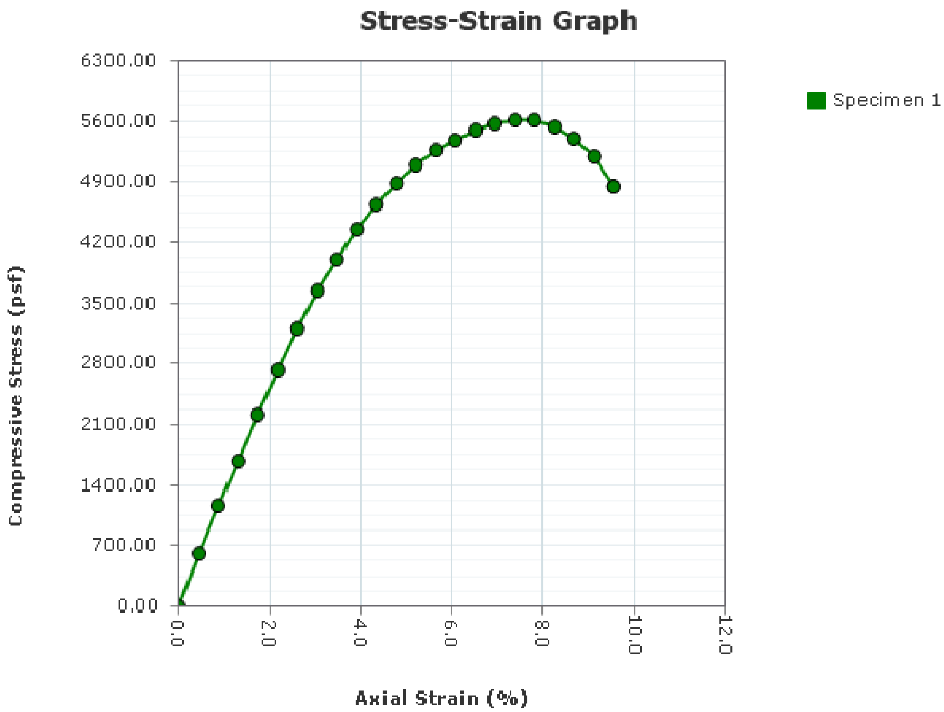


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #2E**	**4.0**	**40**	**17**	**23**		**LEAN CLAY (CL)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 5/3/22 14:42 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 2E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.9							
Wet Density (pcf)	125.7							
Dry Density (pcf)	102.3							
Saturation (%):	94.4							
Void Ratio:	0.660							
Height (in)	5.7600							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	5620.50							
Undrained Shear Strength (psf)	2810.25							
Strain at Failure (%):	7.81							

Specific Gravity:	2.72	Plastic Limit:	17	Liquid Limit:	40
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 1
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Boring Number:	STR 2E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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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

AMERICAN ENGINEERS, INC.

April 8, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 5E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 5E, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
5E	Double Circuit	85	703.9	37°35'41.361"N	85°53'50.411"W	7,408	1,852

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 48 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately eight inches. Beneath the surface material, lean clay was encountered to refusal depth in the boring. The lean clay was typically described as gray to brown in color, containing varying amounts of sand and gravel, wet to saturated relative to optimum moisture content and very stiff to soft.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 5E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 5E	37°35’41.361”N	85°53’50.411”W	701.9	48.6	653.3

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 5E	CL	5.0-16.0	0.5	0.3
STR 5E	CL	16.0-48.6	0.35	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 5E	CL	5.0-16.0	0.03	-
STR 5E	CL	16.0-48.6	0.03	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 5E	CL	5.0-16.0	125.0	0.5	0.7
STR 5E	CL	16.0-48.6	62.6	0.35	0.5

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

NO. / DATE / REVISIONS / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST
AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	03-22-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:\PROJECTS22 222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East\STR #5E\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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 2^{nd} and 3^{rd} 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

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

STR #5E
PAGE 1 OF 1

CLIENT LG&E and KU	**PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032	**PROJECT LOCATION** Glendale, KY
DATE STARTED 3/2/22 **COMPLETED** 3/2/22	**GROUND ELEVATION** 701.9 ft
DRILLING CONTRACTOR Wayne Tucker	**GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger	▽ **AT TIME OF DRILLING** 16.60 ft / Elev 685.30 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson	**AT END OF DRILLING** ---
NOTES	**AFTER DRILLING** ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (8 inches)									
	(CL) lean CLAY, brown and gray, moist, medium stiff to soft	ST 1	75		4.5+	25				Qu = 1,248 psf
10	(CL) lean CLAY, trace gravel, trace to some sand, brown, wet to saturated, very stiff	SPT 2	67	13-13-14 (27)	0.5	18				
▽										
20		ST 3	54		4.5+	27	34	16	18	
30	(SC) sandy lean CLAY, brown, saturated, very soft to soft	SPT 4	87	2-1-1 (2)	0.5	41	39	16	23	
40		ST 5	85		0.0	38	38	12	26	Qu = 724 psf

Refusal at 48.6 feet.
Bottom of borehole at 48.6 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 4/8/22 09:56 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

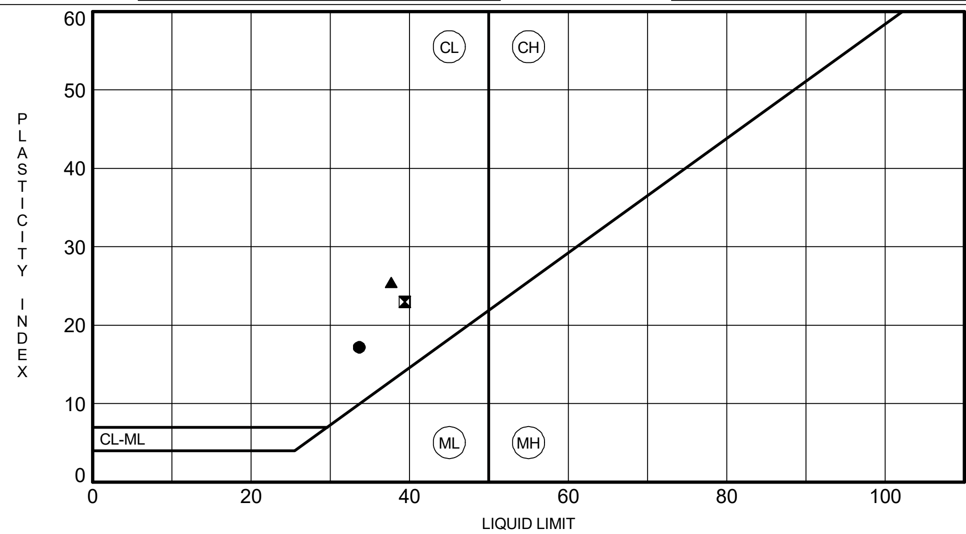
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY



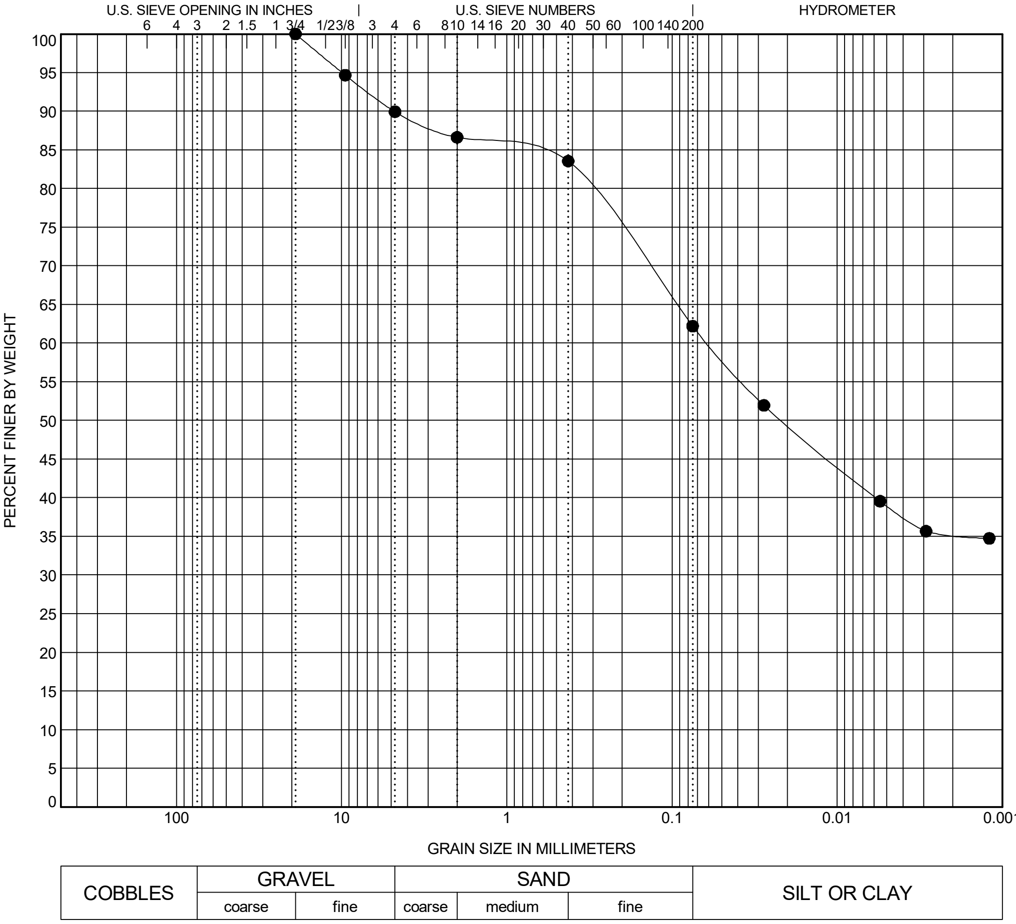
	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #5E**	**19.0**	**34**	**16**	**18**		**LEAN CLAY (CL)**
⊠	**STR #5E**	**29.0**	**39**	**16**	**23**	**62**	**SANDY LEAN CLAY (CL)**
▲	**STR #5E**	**39.0**	**38**	**12**	**26**		**LEAN CLAY (CL)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/22/22 13:57 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

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

GRAIN SIZE DISTRIBUTION

CLIENT LG&E and KU **PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY

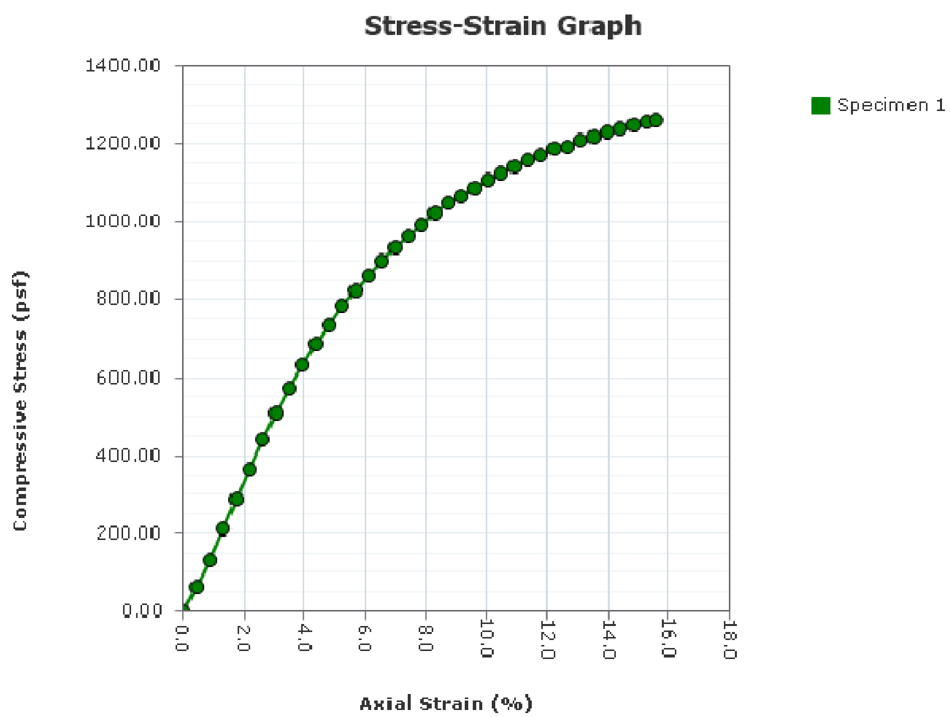


	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**STR #5E**	**29.0**	**SANDY LEAN CLAY (CL)**	**39**	**16**	**23**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**STR #5E**	**29.0**	**19**	**0.061**			**10.1**	**27.7**	**23.2**	**39.0**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

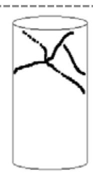
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	26.5							
Wet Density (pcf)	120.2							
Dry Density (pcf)	95.0							
Saturation (%):	91.6							
Void Ratio:	0.787							
Height (in)	5.7300							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1248.52							
Undrained Shear Strength (psf)	624.26							
Strain at Failure (%):	14.83							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

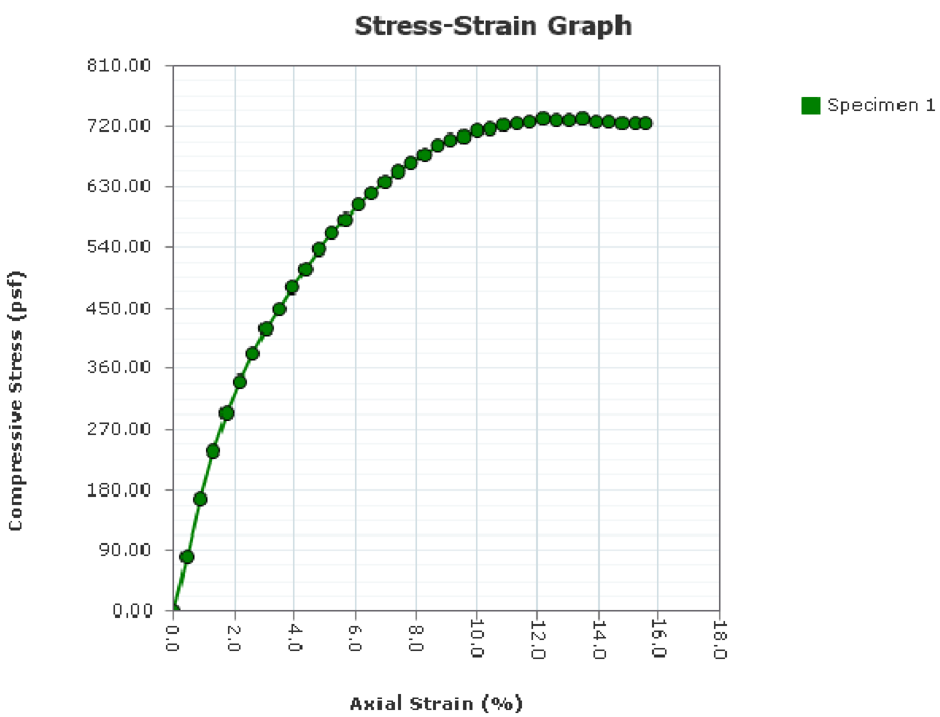
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	34.0							
Wet Density (pcf)	115.1							
Dry Density (pcf)	85.9							
Saturation (%):	94.6							
Void Ratio:	0.978							
Height (in)	5.7500							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	724.43							
Undrained Shear Strength (psf)	362.21							
Strain at Failure (%):	14.78							

Specific Gravity:	2.72	Plastic Limit:	12	Liquid Limit:	38
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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.

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING

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

AMERICAN ENGINEERS, INC.

April 8, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 6E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 6E, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
6E	Double Circuit	85	703.5	37°35'43.903"N	85°53'50.552"W	5,436	2,244

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 44 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately nine inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as brown to reddish brown in color, containing varying amounts of gravel, moist to saturated relative to optimum moisture content and very stiff to medium stiff. The fat clay was typically described as gray, wet to saturated and stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 6E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 6E	37°35’43.903”N	85°53’50.552”W	703.4	43.6	659.8

5. FOUNDATION DESIGN PARAMETERS

5.1 **__Lateral Design Parameters__** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 6E	CL	5.0-18.0	2.3	0.8
STR 6E	CL	18.0-44.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 6E	CL	5.0-18.0	0.02	400
STR 6E	CL	18.0-44.0	0.02	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 6E	CL	5.0-18.0	125.0	2.3	1.0
STR 6E	CL	18.0-44.0	62.6	1.0	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS
NO. | DATE | DESCRIPTION

BORING LAYOUT

CLIENT: LG&E and KU

PROJECT: FORD 138kV GLENDALE INDUSTRIAL EAST

AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

SCALE: NTS
DATE: 03-23-2022
DRAWN BY: A. ANDERSON
CHECKED BY: D. BARRETT
FILE: T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #6E\Support Information
SHEET: A-1

APPENDIX B

Boring Log

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

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STR #6E
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/1/22 **COMPLETED** 3/2/22
GROUND ELEVATION 703.4 ft
DRILLING CONTRACTOR Wayne Tucker
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 17.90 ft / Elev 685.50 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (9 Inches)									
		(CL) lean CLAY, brown to reddish brown, gray mottle, moist, stiff to very stiff	ST 1	85		4.0	22				Qu = 3,555 psf
5			ST 2	100		4.5+	20	31	17	14	Qu = 5,859 psf
10		(CL) lean CLAY, reddish brown, gray mottle, moist to saturated, stiff	SPT 3	47	6-6-7 (13)	3.5	22				
15											
20		(CL) lean CLAY, with gravel, reddish brown, saturated, very stiff to medium stiff	SPT 4	40	8-9-15 (24)	0.0	23				
25											
30			ST 5	50		1.5	29	49	22	27	Qu = 1,588 psf
35											
40		(CH) fat CLAY, gray, moist to wet, stiff	SPT 6	67	3-4-6 (10)	0.5	37				

Refusal at 43.6 feet.
Bottom of borehole at 43.6 feet.

APPENDIX C

Laboratory Testing Results

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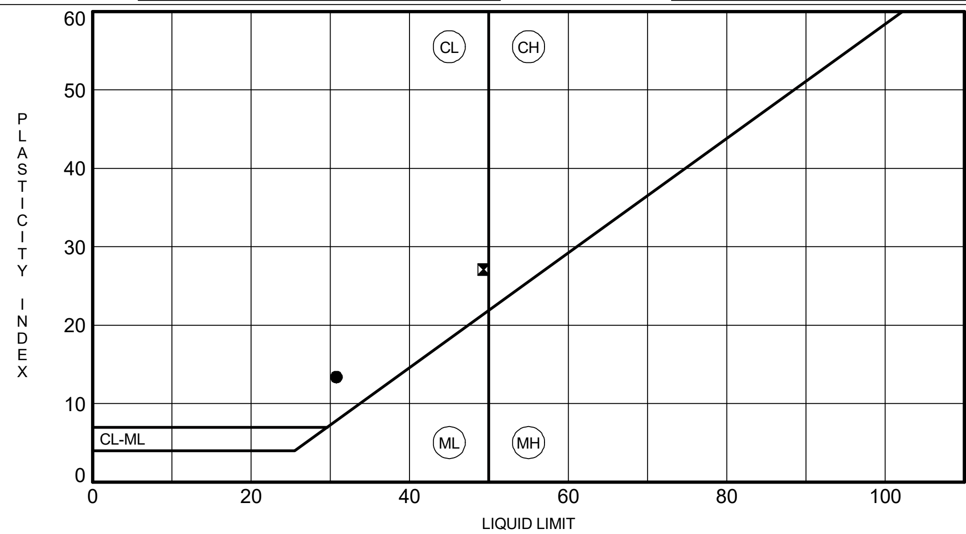
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

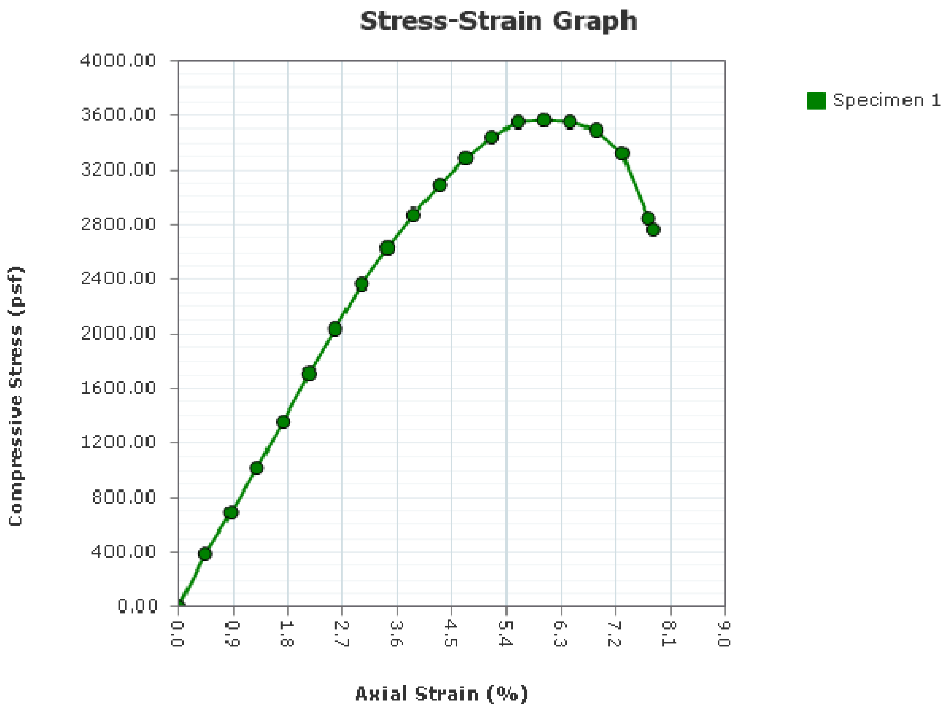


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #6E**	**4.0**	**31**	**17**	**14**		**LEAN CLAY (CL)**
⧗	**STR #6E**	**29.0**	**49**	**22**	**27**		**LEAN CLAY (CL)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/22/22 15:24 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/3/2022
Sampling Date:	3/3/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

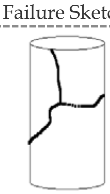
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.1							
Wet Density (pcf)	126.9							
Dry Density (pcf)	104.0							
Saturation (%):	94.9							
Void Ratio:	0.633							
Height (in)	5.8200							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	3555.04							
Undrained Shear Strength (psf)	1777.52							
Strain at Failure (%):	6.44							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/3/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

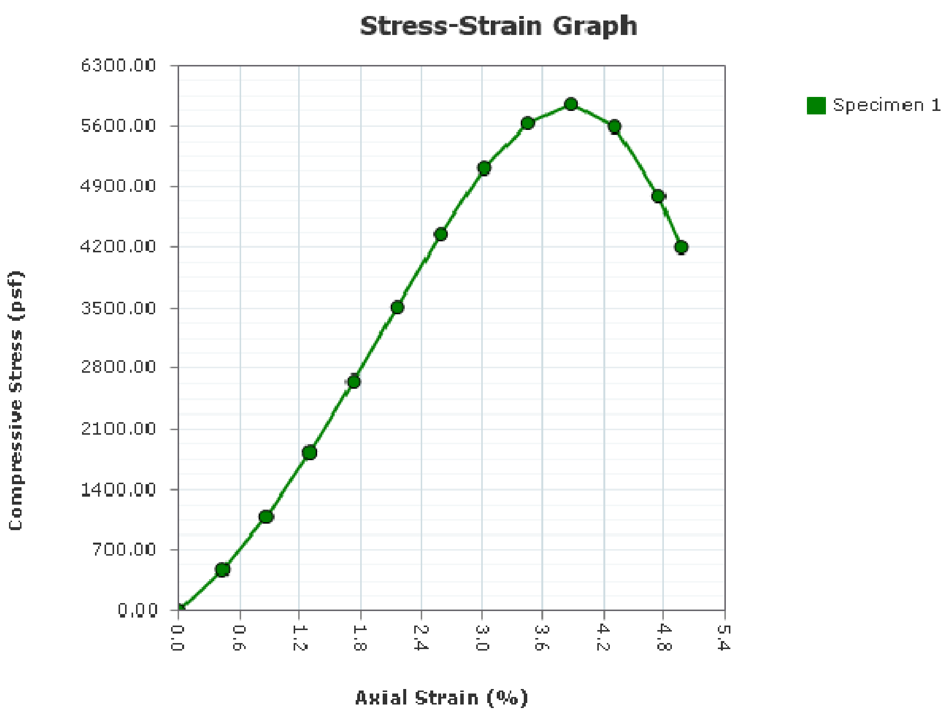
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/3/2022
Sampling Date:	3/3/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	19.5							
Wet Density (pcf)	129.6							
Dry Density (pcf)	108.4							
Saturation (%):	93.8							
Void Ratio:	0.566							
Height (in)	5.8000							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	5859.32							
Undrained Shear Strength (psf)	2929.66							
Strain at Failure (%):	3.88							

Specific Gravity:	2.72	Plastic Limit:	23	Liquid Limit:	31
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/3/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

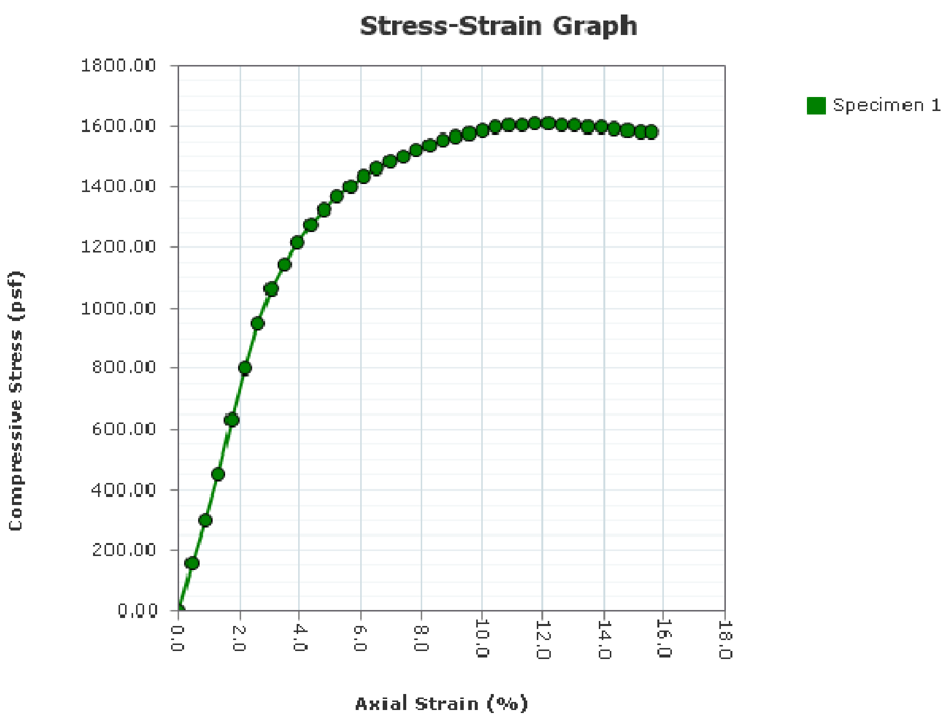
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/3/2022
Sampling Date:	3/3/2022
Sample Number:	ST 3
Sample Depth:	29.0-31.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	28.9							
Wet Density (pcf)	122.6							
Dry Density (pcf)	95.1							
Saturation (%):	100.1							
Void Ratio:	0.785							
Height (in)	5.7500							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1588.30							
Undrained Shear Strength (psf)	794.15							
Strain at Failure (%):	14.78							

Specific Gravity:	2.72	Plastic Limit:	22	Liquid Limit:	49
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/3/2022
Sample Number:	ST 3
Sample Depth:	29.0-31.0 ft
Boring Number:	STR #6E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Test Date: 3/3/2022 Checked By: ________________ Date: ____________

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.

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING

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

AMERICAN ENGINEERS, INC.

April 14, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 9E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 9E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
9E	Double Circuit	85	725.6	37°35'49.184"N	85°53'39.077"W	1,640	2,330

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 65 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately six inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as light brown to reddish brown in color, containing trace to some sand, wet to moist and very stiff to stiff in soil strength consistency. The fat clay was described as reddish brown in color, containing varying amounts of gravel and sand, wet and very soft to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 9E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 9E	37°35'49.184"N	85°53'39.077"W	725.2	49.4	675.8

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 9E	CL	5.0-19.0	2.7	1.5
STR 9E	CH	19.0-50.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 9E	CL	5.0-19.0	0.03	400
STR 9E	CH	19.0-50.0	0.01	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 9E	CL	5.0-19.0	125.0	2.7	1.2
STR 9E	CH	19.0-50.0	120.0	0.5	0.8

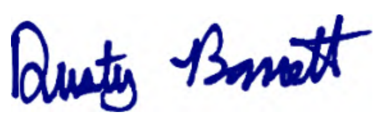
*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer



Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

◉ SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 9E
AEI	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-06-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #9E\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR #9E

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/9/22 **COMPLETED** 3/9/22
GROUND ELEVATION 725.2 ft
DRILLING CONTRACTOR Wayne Tucker
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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 (6 INCHES)									
		(CL) lean CLAY, trace to some sand, light brown to reddish brown, wet to moist, very stiff to stiff	ST 1	100		4.5+	22				Qu = 3,800 psf
5			ST 2	85		4.5+	20	37	16	21	Qu = 7,060 psf
10			SPT 1	100	3-5-8 (13)	4.5+	20				
15											
20		(CH) sandy fat CLAY, trace gravel, reddish brown, wet to moist, very soft to stiff	ST 3	80		0.25	35				Qu = 670 psf
25											
30			SPT 2	100	3-4-6 (10)	1.75	24				
35											
40		(CH) fat CLAY, reddish brown, wet, soft	ST 4	100		0.0	28	56	19	37	Qu = 1,160 psf
45											

(Continued Next Page)

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

STR #9E
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
		(CH) fat CLAY, reddish brown, wet, soft *(continued)*									
50		Boulders	SPT 3	75	50		11				
55		LIMESTONE, light gray, medium grained, moderately hard to hard	RC 1	55 (0)							
			RC 2	68 (34)							Void (56.8'-57.6')
60											Void (59.5'-61.1')
			RC 3	40 (8)							Void (62.3'-64.3')
65											

Refusal at 49.4 feet.
Bottom of borehole at 65.3 feet.

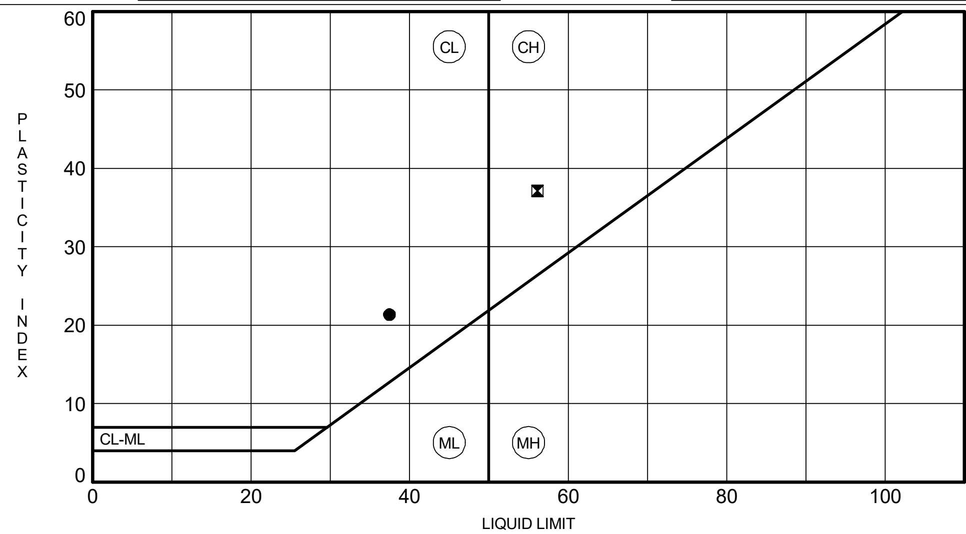
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

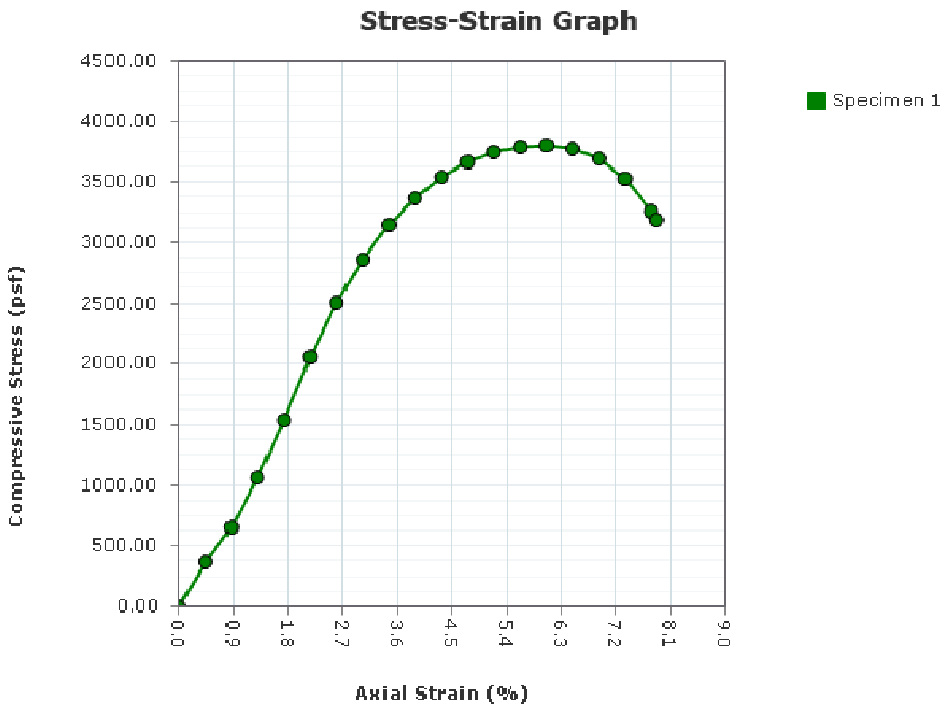


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #9E**	**4.0**	**37**	**16**	**21**		**(CL) LEAN CLAY**
⊠	**STR #9E**	**39.0**	**56**	**19**	**37**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/6/22 11:35 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	21.6							
Wet Density (pcf)	128.7							
Dry Density (pcf)	105.9							
Saturation (%):	97.2							
Void Ratio:	0.604							
Height (in)	5.7800							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	3802.34							
Undrained Shear Strength (psf)	1901.17							
Strain at Failure (%):	6.06							

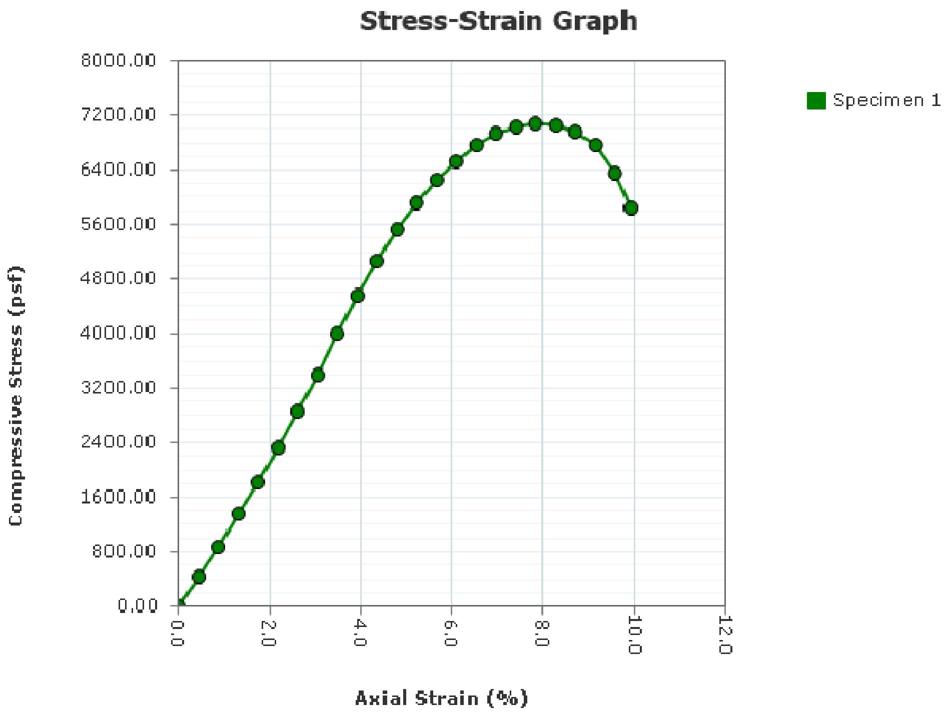
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

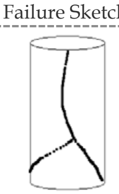
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.4							
Wet Density (pcf)	129.6							
Dry Density (pcf)	107.6							
Saturation (%):	96.2							
Void Ratio:	0.578							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	7062.83							
Undrained Shear Strength (psf)	3531.41							
Strain at Failure (%):	8.28							

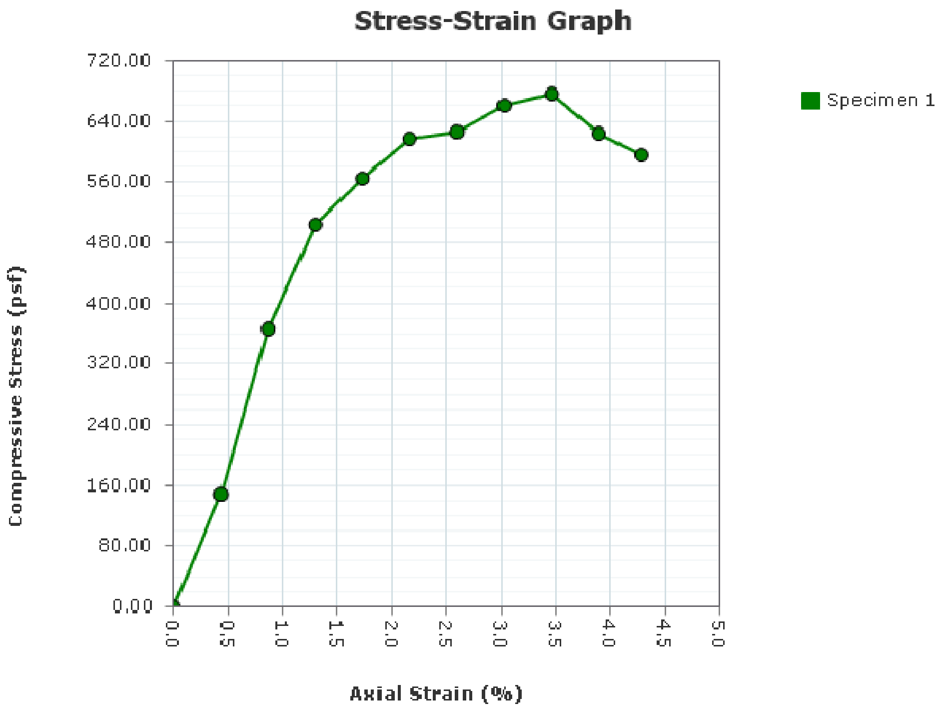
Specific Gravity:	2.72	Plastic Limit:	16	Liquid Limit:	37
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	34.9							
Wet Density (pcf)	109.4							
Dry Density (pcf)	81.1							
Saturation (%):	86.8							
Void Ratio:	1.095							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	676.56							
Undrained Shear Strength (psf)	338.28							
Strain at Failure (%):	3.46							

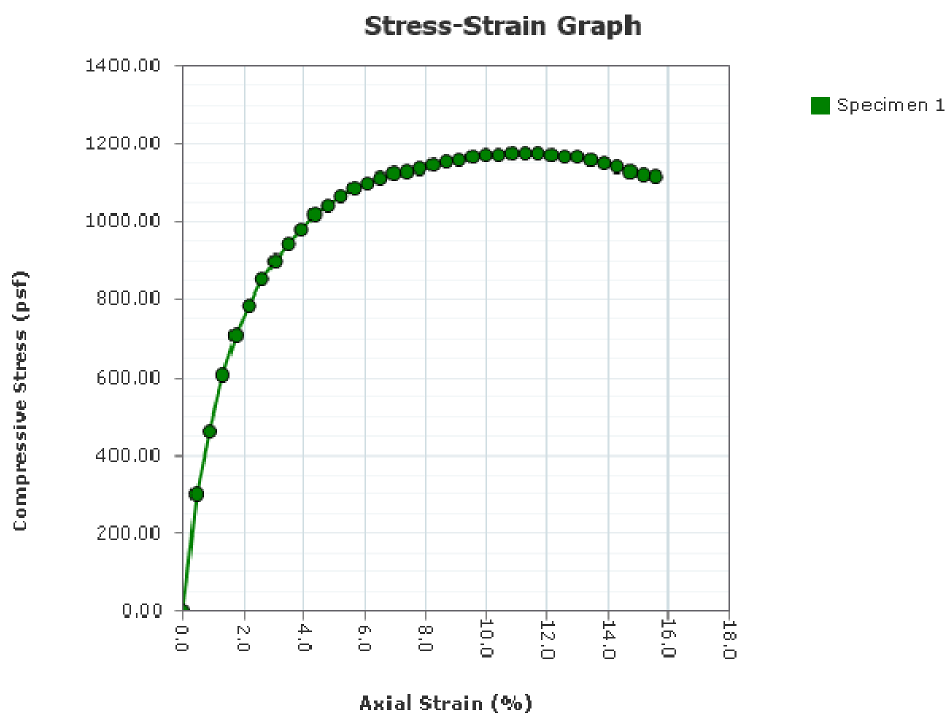
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	28.4							
Wet Density (pcf)	121.9							
Dry Density (pcf)	94.9							
Saturation (%):	98.0							
Void Ratio:	0.789							
Height (in)	5.7700							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1164.86							
Undrained Shear Strength (psf)	582.43							
Strain at Failure (%):	13.00							

Specific Gravity:	2.72	Plastic Limit:	19	Liquid Limit:	56
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #9E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 2, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 14E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 14E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
14E	Double Circuit	90	717.2	37°35’55.719”N	85°53’12.314”W	5,160	2,054

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 54 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as light brown to gray in color, containing varying amounts of sand, wet and stiff to medium stiff in soil strength consistency. The fat clay was described as reddish brown in color, containing some sand, wet to moist and medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 14E	37°35’55.719”N	85°53’12.314”W	714.5	40.6	673.9

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 14E	CL	5.0-16.0	0.7	0.4
STR 14E	CH	16.0-40.6	0.7	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 14E	CL	5.0-16.0	0.02	200
STR 14E	CH	16.0-40.0	0.008	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 14E	CL	5.0-16.0	125.0	0.7	0.7
STR 14E	CH	16.0-40.0	57.6	0.7	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS
NO. | DATE | DESCRIPTION

BORING LAYOUT

CLIENT: LG&E and KU

PROJECT: FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 14E

AEI
AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

SCALE: NTS
DATE: 04-06-2022
DRAWN BY: A. ANDERSON
CHECKED BY: D. BARRETT
FILE: T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #14E\Support Information
SHEET: A-1

APPENDIX B

Boring Log

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

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

STR #14E
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/14/22 **COMPLETED** 3/14/22
GROUND ELEVATION 714.5 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING 16.30 ft / Elev 698.20 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (8 INCHES)									
		(CL) lean CLAY, light brown, gray mottle, wet, stiff	ST 1	90		2.5	21				Qu = 2,080 psf
5			ST 2	80		2.0	22	33	14	19	Qu = 3,060 psf
10		(CL) lean CLAY, trace to some sand, gray, wet, medium stiff	SPT 1	93	3-3-3 (6)	1.5	22				
15											
		(CH) fat CLAY, some sand, reddish brown, wet to moist, medium stiff									
20			ST 3	85		3.25	35	53	27	26	Qu = 1,540 psf
25											
30			SPT 2	100	2-4-4 (8)	1.5	26				
35											
40			ST 4	31			30				
		weathered LIMESTONE, light gray, medium grained, moderately hard to hard, thin to thick bedded	RC 1	68 (47)							
45											Clay seam (43.4'-45.0')

(Continued Next Page)

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/2/22 08:36 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

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

STR #14E
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
45		weathered LIMESTONE, light gray, medium grained, moderately hard to hard, thin to thick bedded *(continued)*	RC 2	36 (0)							. Clay filled void (47.2'-48.6')
50			RC 3	54 (20)							. Void (49.4'-50.5') .

Refusal at 40.6 feet.
Bottom of borehole at 54.4 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/2/22 08:36 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

APPENDIX C

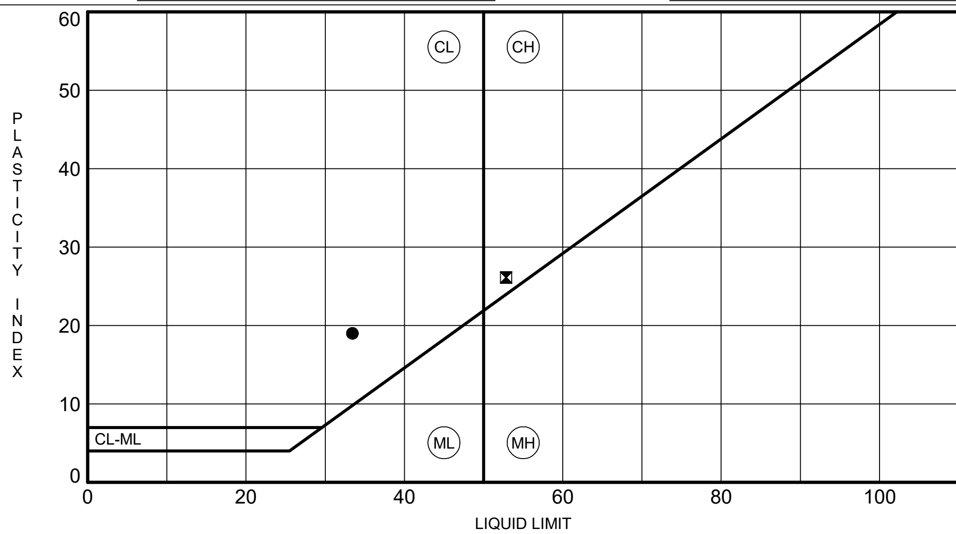
Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU **PROJECT NAME** Ford 138kV Glendale Industrial East

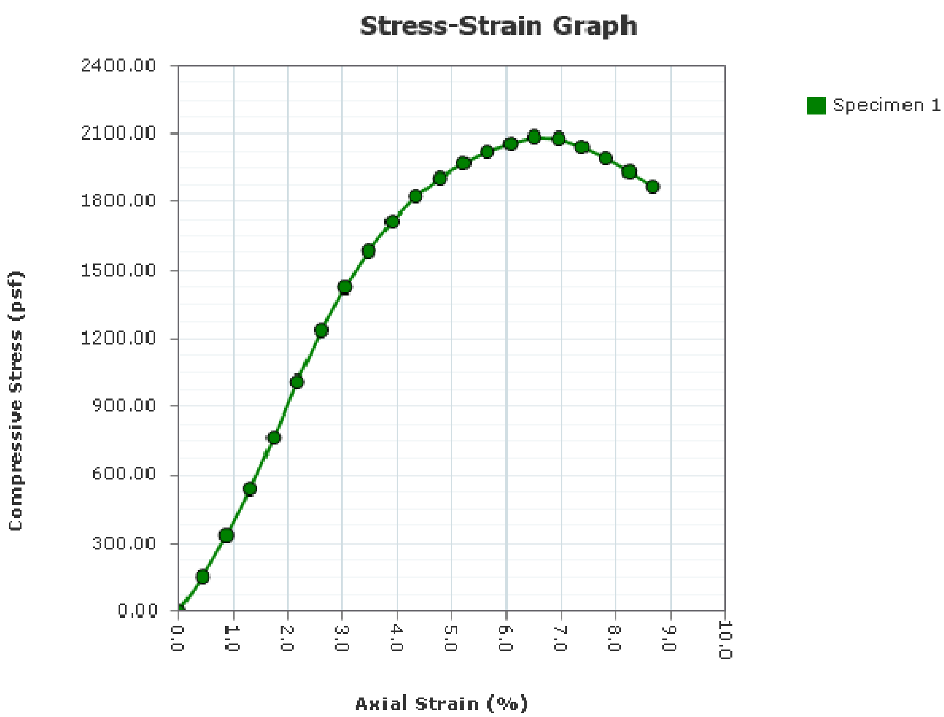
PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #14E**	**4.0**	**33**	**14**	**19**		**(CL) LEAN CLAY**
⊠	**STR #14E**	**19.0**	**53**	**27**	**26**		**(CH) FAT CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

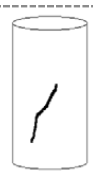
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.9							
Wet Density (pcf)	129.6							
Dry Density (pcf)	107.2							
Saturation (%):	97.5							
Void Ratio:	0.584							
Height (in)	5.7600							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2079.12							
Undrained Shear Strength (psf)	1039.56							
Strain at Failure (%):	6.94							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

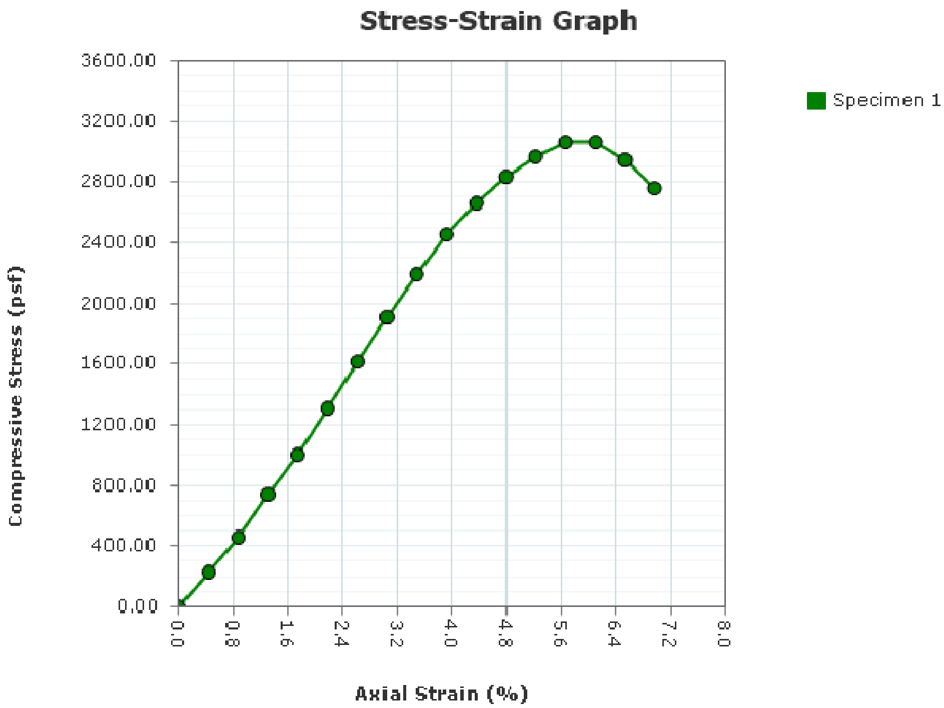
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.2							
Wet Density (pcf)	131.4							
Dry Density (pcf)	107.5							
Saturation (%):	104.4							
Void Ratio:	0.579							
Height (in)	5.7400							
Diameter (in)	2.8150							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	3063.01							
Undrained Shear Strength (psf)	1531.50							
Strain at Failure (%):	6.10							

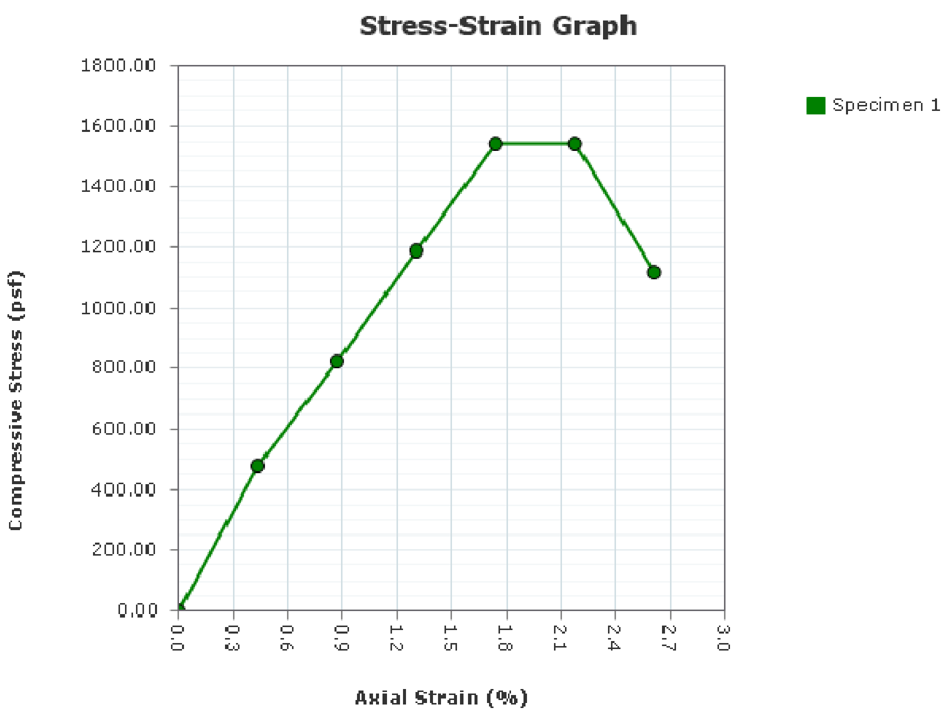
Specific Gravity:	2.72	Plastic Limit:	14	Liquid Limit:	33
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	35.4							
Wet Density (pcf)	119.9							
Dry Density (pcf)	88.5							
Saturation (%):	104.9							
Void Ratio:	0.918							
Height (in)	5.7400							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1541.24							
Undrained Shear Strength (psf)	770.62							
Strain at Failure (%):	2.18							

Specific Gravity:	2.72	Plastic Limit:	27	Liquid Limit:	53
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #14E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AEI
AMERICAN ENGINEERS, INC.

May 3, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 15E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 15E, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
15E	Double Circuit	95	719.9	37°35'52.52"N	85°53'5.45"W	5,267	2,104

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about seven inches. Beneath the surface material, lean clay was encountered to the pre-determined termination depth (50 feet). The lean clay was typically described as brown to gray to reddish brown in color, containing varying amounts of sand and gravel, moist to saturated and medium stiff to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was **not** encountered in Structure 15E.

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 15E	CL	5.0-27.0	1.4	0.8
STR 15E	CL	27.0-50.5	0.8	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 15E	CL	5.0-27.0	0.02	200
STR 15E	CL	27.0-50.0	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 15E	CL	5.0-27.0	125.0	1.4	0.9
STR 15E	CL	27.0-50.0	62.6	0.8	0.8

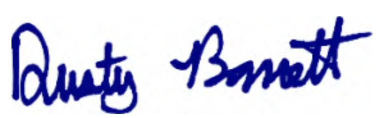
*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer



Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

◎ SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 15E
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-07-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:\22 PROJECTS\22-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East STR #15E Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR #15E
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/15/22 **COMPLETED** 3/15/22
GROUND ELEVATION 718 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 27.60 ft / Elev 690.40 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (7 INCHES)									
		(CL) lean CLAY, brown to gray, wet to moist, medium stiff to stiff	ST 1	70		0.75	24				Qu = 2,075 psf
			ST 2	90		3.75	19	28	17	11	Qu = 3,650 psf
10		(CL) lean CLAY, some sand, reddish brown, moist to wet, stiff to medium stiff	SPT 1	67	5-6-8 (14)	1.0	20				
20			ST 3	85		1.0	20	41	21	20	Qu = 3,000 psf
	▽										
30			SPT 2	100	3-3-4 (7)	2.25	31				
40		(CL) lean CLAY, trace gravel, reddish brown, saturated, medium stiff	ST 4	80		0.5	33	46	24	22	Qu = 1,840 psf
50		(CL) lean CLAY, with sand, gray, wet to saturated	SPT 3	100	4-2-3 (5)	0.75	32				

Bottom of borehole at 50.5 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 4/7/22 06:53 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

APPENDIX C

Laboratory Testing Results

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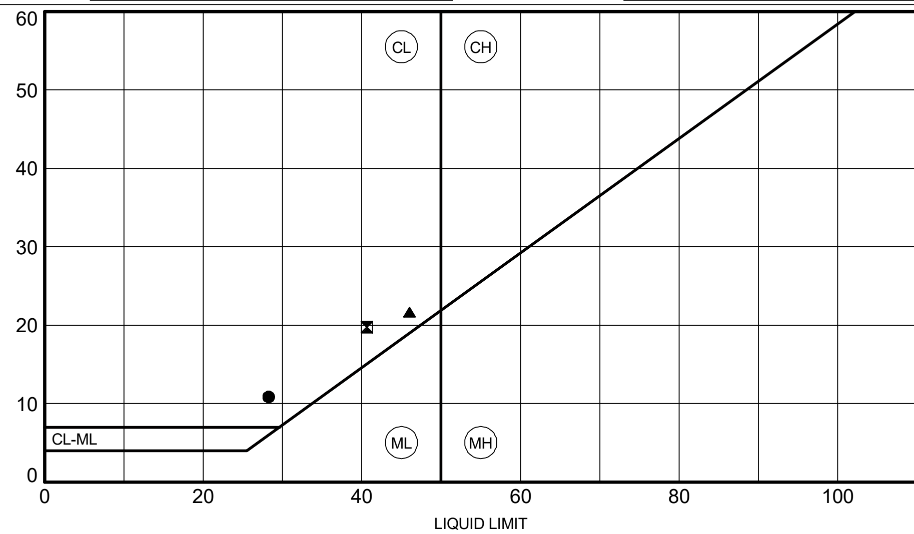
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU **PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY

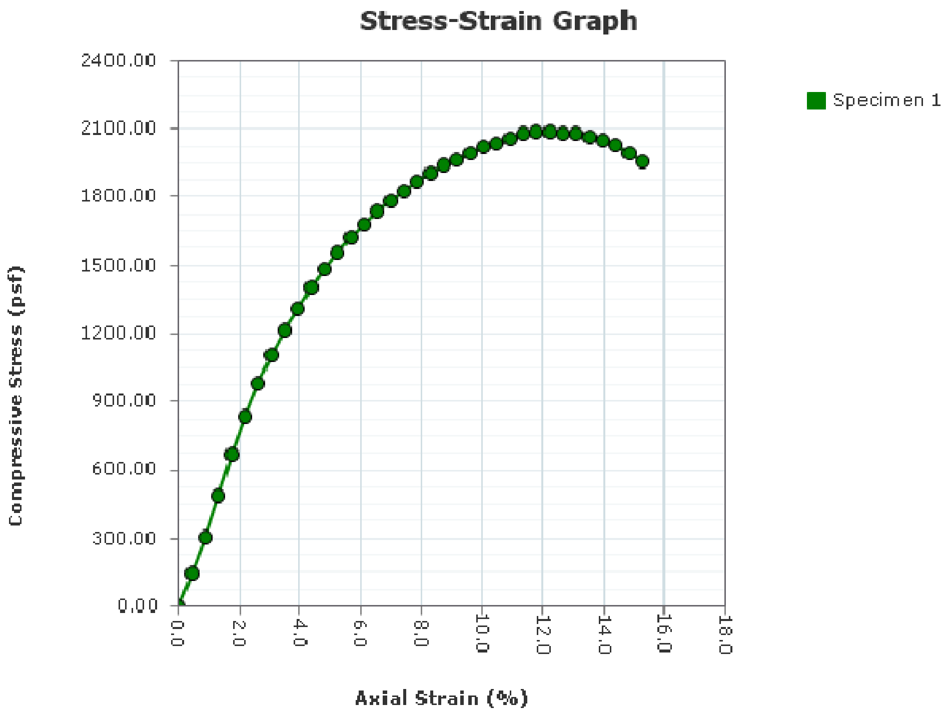


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #15E**	**4.0**	**28**	**17**	**11**		**(CL) LEAN CLAY**
⧗	**STR #15E**	**19.0**	**41**	**21**	**20**		**(CL) LEAN CLAY**
▲	**STR #15E**	**39.0**	**46**	**24**	**22**		**(CL) LEAN CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/6/22 16:12 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	24.4							
Wet Density (pcf)	123.4							
Dry Density (pcf)	99.2							
Saturation (%):	93.2							
Void Ratio:	0.711							
Height (in)	5.7300							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	2078.59							
Undrained Shear Strength (psf)	1039.30							
Strain at Failure (%):	13.09							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

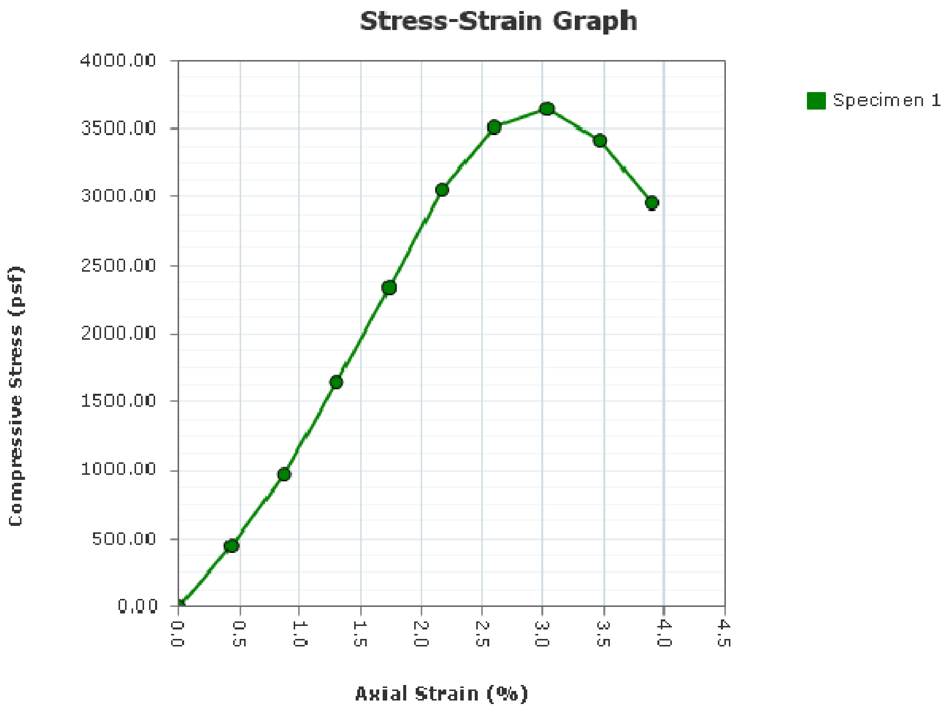
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

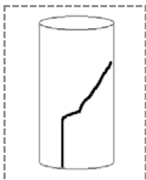
ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	18.7							
Wet Density (pcf)	132.1							
Dry Density (pcf)	111.3							
Saturation (%):	96.7							
Void Ratio:	0.526							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	3652.86							
Undrained Shear Strength (psf)	1826.43							
Strain at Failure (%):	3.03							

Specific Gravity:	2.72	Plastic Limit:	17	Liquid Limit:	28
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

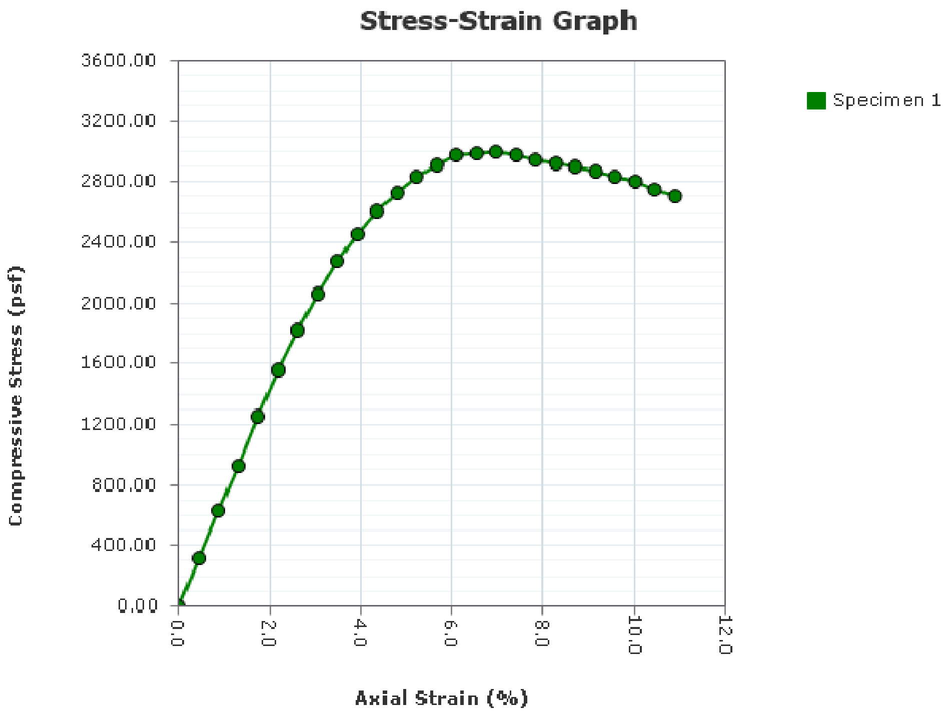
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	25.6							
Wet Density (pcf)	126.7							
Dry Density (pcf)	100.9							
Saturation (%):	102.1							
Void Ratio:	0.683							
Height (in)	5.7400							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	3000.35							
Undrained Shear Strength (psf)	1500.17							
Strain at Failure (%):	6.97							

Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	41
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

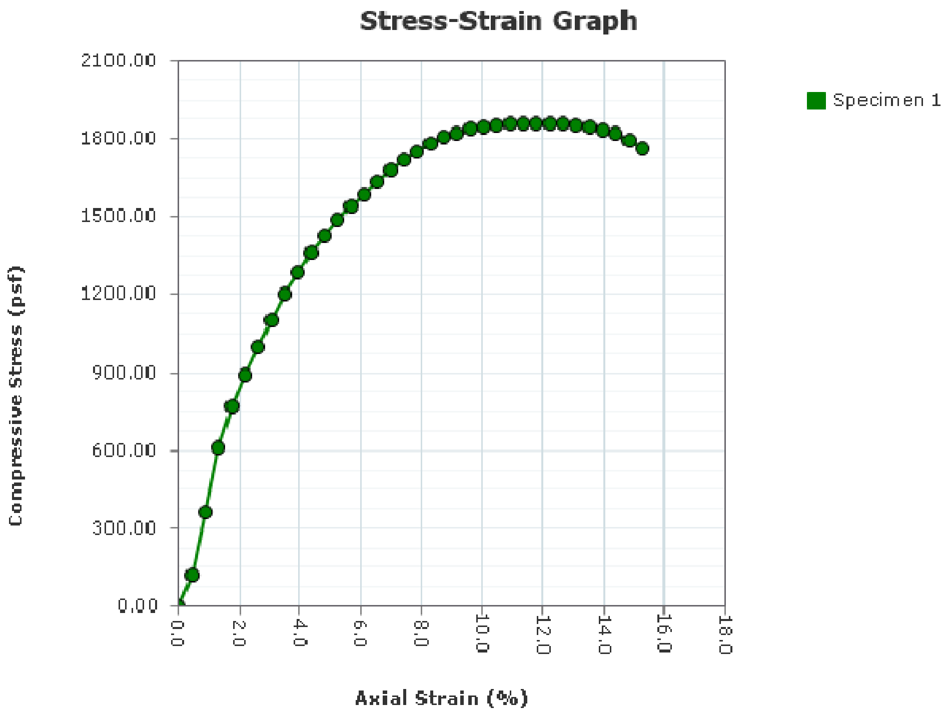
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

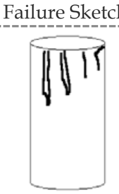
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	27.3							
Wet Density (pcf)	128.2							
Dry Density (pcf)	100.7							
Saturation (%):	108.2							
Void Ratio:	0.686							
Height (in)	5.7300							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1844.38							
Undrained Shear Strength (psf)	922.19							
Strain at Failure (%):	13.53							

Specific Gravity:	2.72	Plastic Limit:	24	Liquid Limit:	46
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR 15E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AEI
AMERICAN ENGINEERS, INC.

May 3, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 18E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 18E, a single circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
18E	Single Circuit	110	713.1	37°35'37.74"N	85°53'8.66"W	494	210

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the boring termination depth. The lean clay was typically described as brown to gray in color, wet to moist and stiff in soil strength consistency. The fat clay was typically described as reddish brown to light brown in color, containing varying amounts of sand and gravel, moist to saturated and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 18E.

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 18E	CL	5.0-9.0	1.2	0.8
STR 18E	CH	9.0-26.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 18E	CL	5.0-9.0	0.02	200
STR 18E	CH	9.0-26.0	0.01	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the

Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 18E	CL	5.0-9.0	125.0	1.2	0.7
STR 18E	CH	9.0-26.0	120.0	1.0	0.8

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 18E
AEI	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-11-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #18E\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

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STR #18E
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/15/22 **COMPLETED** 3/15/22
GROUND ELEVATION 713 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 20.00 ft / Elev 693.00 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (8 INCHES)									
		(CL) lean CLAY, brown to gray, wet to moist, stiff	ST 1	90		2.75	22				Qu = 2,490 psf .
5			ST 2	95		4.5+	19	29	18	11	Qu = 2,510 psf .
10		(CH) fat CLAY, some sand, trace gravel, reddish brown, wet to moist, stiff to medium stiff	SPT 1	100	5-6-7 (13)	3.75	23				
15			ST 3	100		3.25	19	65	31	34	Qu = 1,940 psf .
20		▽ (CH) fat CLAY with gravel, light brown, wet to saturated, medium stiff	SPT 2	100	3-4-4 (8)	1.0	41				
25			ST 4	70		0.5	41				

Bottom of borehole at 26.0 feet.

APPENDIX C

Laboratory Testing Results

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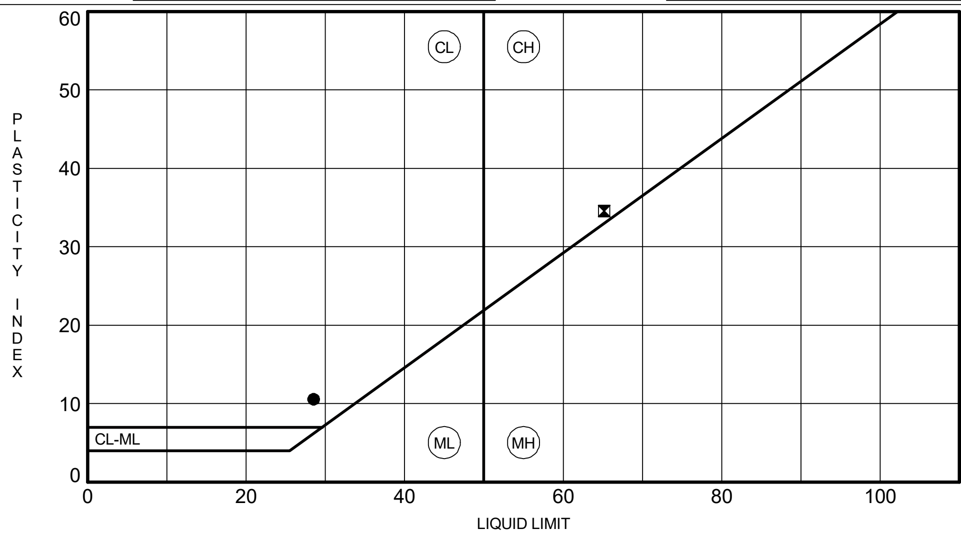
ATTERBERG LIMITS' RESULTS

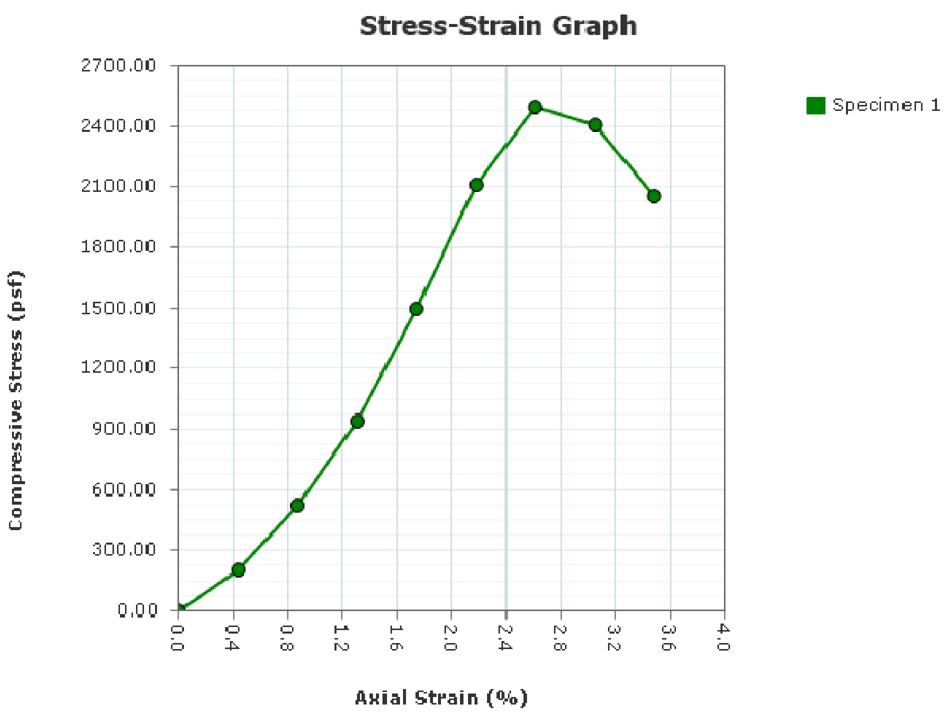
CLIENT LG&E and KU **PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #18E**	**4.0**	**29**	**18**	**11**		**(CL) LEAN CLAY**
⊠	**STR #18E**	**14.0**	**65**	**31**	**34**		**(CH) FAT CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	17.8							
Wet Density (pcf)	131.4							
Dry Density (pcf)	111.6							
Saturation (%):	92.8							
Void Ratio:	0.522							
Height (in)	5.7400							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2493.42							
Undrained Shear Strength (psf)	1246.71							
Strain at Failure (%):	2.61							

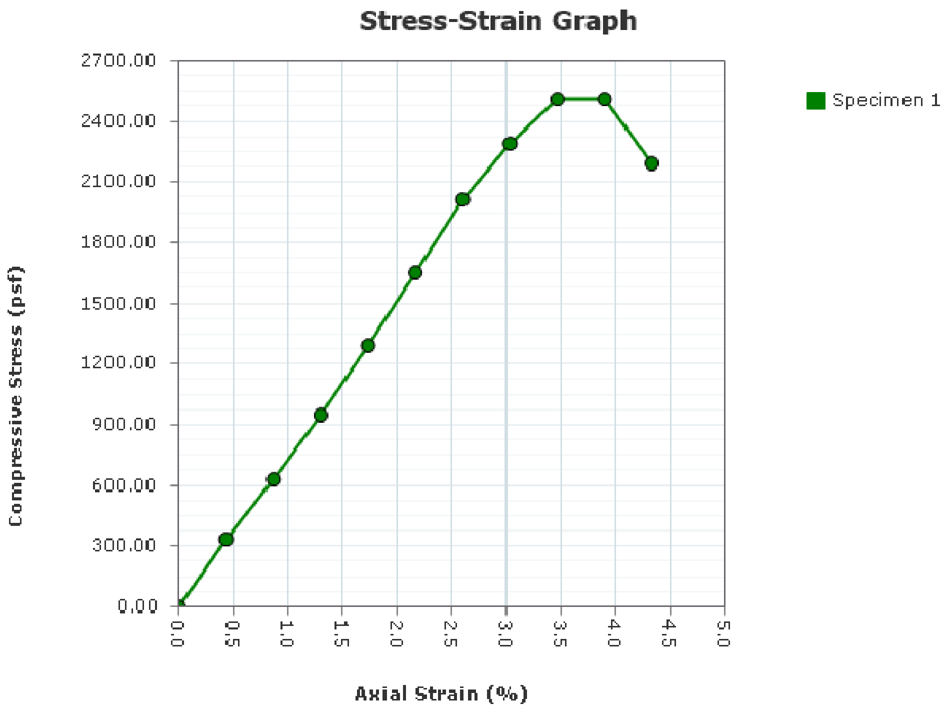
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/16/2022
Sampling Date:	3/16/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	19.4							
Wet Density (pcf)	130.2							
Dry Density (pcf)	109.1							
Saturation (%):	94.8							
Void Ratio:	0.557							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	2512.69							
Undrained Shear Strength (psf)	1256.34							
Strain at Failure (%):	3.90							

Specific Gravity:	2.72	Plastic Limit:	18	Liquid Limit:	29
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/16/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

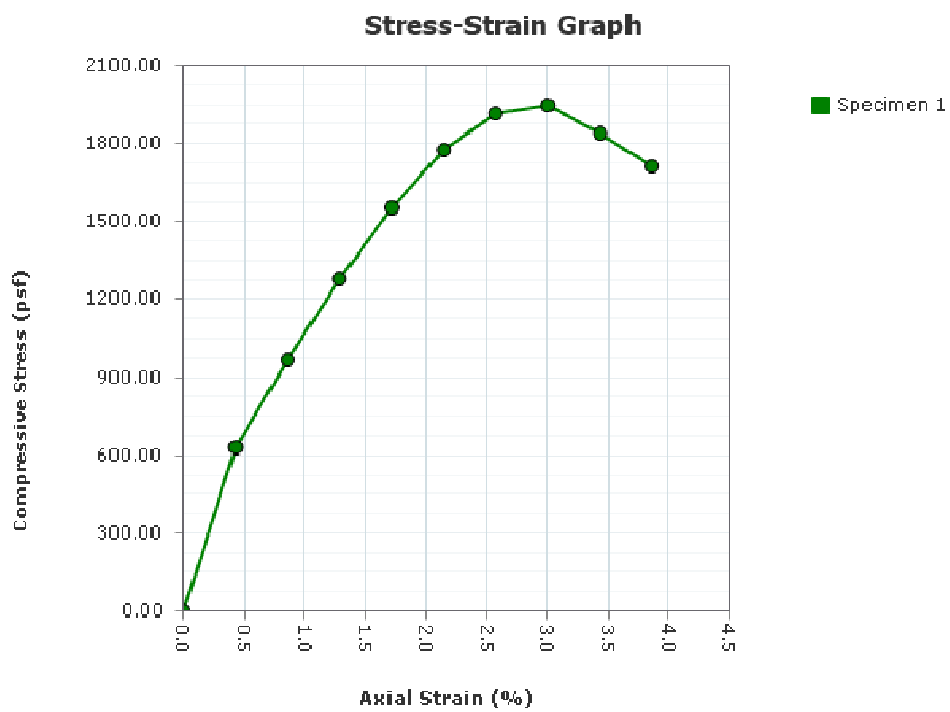
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/17/2022
Sampling Date:	3/17/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

Specimen Number								
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	35.2							
Wet Density (pcf)	113.8							
Dry Density (pcf)	84.2							
Saturation (%):	94.1							
Void Ratio:	1.017							
Height (in)	5.8300							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	1944.10							
Undrained Shear Strength (psf)	972.05							
Strain at Failure (%):	3.00							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/17/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR #18E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 3, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 26E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 26E, a single circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
26E	Single Circuit	110	690.8	37°34’54.11”N	85°53’18.12”W	485	209

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the boring termination depth. The lean clay was typically described as brown to gray in color, containing trace gravel, wet and soft to stiff in soil strength consistency. The fat clay was typically described as brown to reddish brown in color, containing trace gravel, wet to saturated and medium stiff to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 26E.

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 26E	CL	5.0-14.0	0.5	0.3
STR 26E	CH	14.0-26.0	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 26E	CL	5.0-14.0	0.01	-
STR 26E	CH	14.0-26.0	0.02	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the

Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 26E	CL	5.0-14.0	125.0	0.5	0.6
STR 26E	CH	14.0-26.0	57.6	1.0	0.8

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS
NO. DATE DESCRIPTION

BORING LAYOUT

CLIENT: LG&E and KU

PROJECT: FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 26E

AEI
AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE

SCALE: NTS
DATE: 04-11-2022
DRAWN BY: A. ANDERSON
CHECKED BY: D. BARRETT
FILE:
SHEET: A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR #26E

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/17/22 **COMPLETED** 3/17/22
GROUND ELEVATION 690.4 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
∇ **AT TIME OF DRILLING** 16.50 ft / Elev 673.90 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (8 INCHES)									
		(CL) lean CLAY, trace gravel, brown to gray, wet, soft to stiff	ST 1	80		0.5	23				Qu = 1,1110 psf
5			ST 2	90		2.75	21	31	18	13	Qu = 1,050 psf
10			SPT 1	73	3-4-6 (10)	1.75	24				
15		(CH) fat CLAY, trace gravel, brown to reddish brown, wet to saturated, medium stiff to stiff ∇	ST 3	100		2.5	30				Qu = 1,550 psf
20			SPT 2	100	5-4-6 (10)	2.25	39				
25			ST 4	90		1.0	40	66	31	35	Qu = 2,590 psf

Bottom of borehole at 26.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/3/22 15:11 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

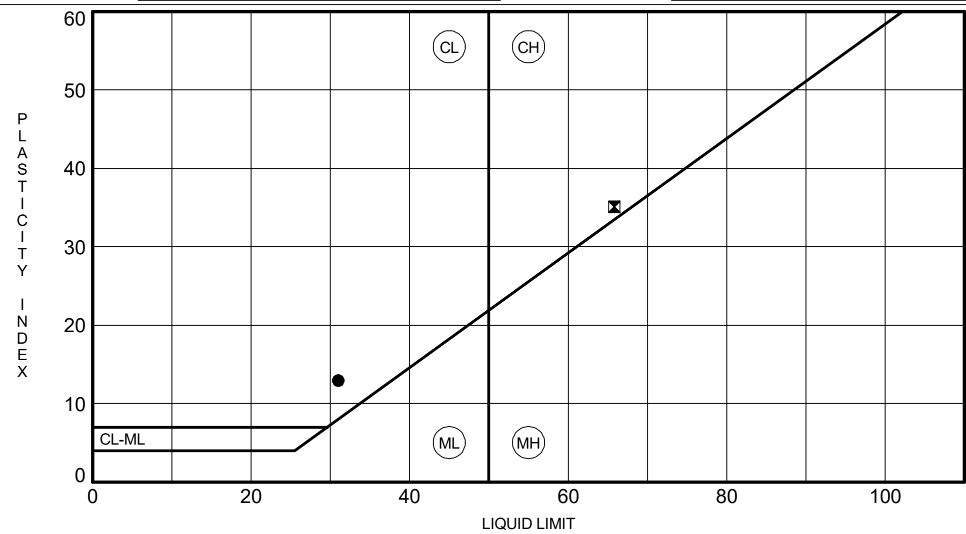
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

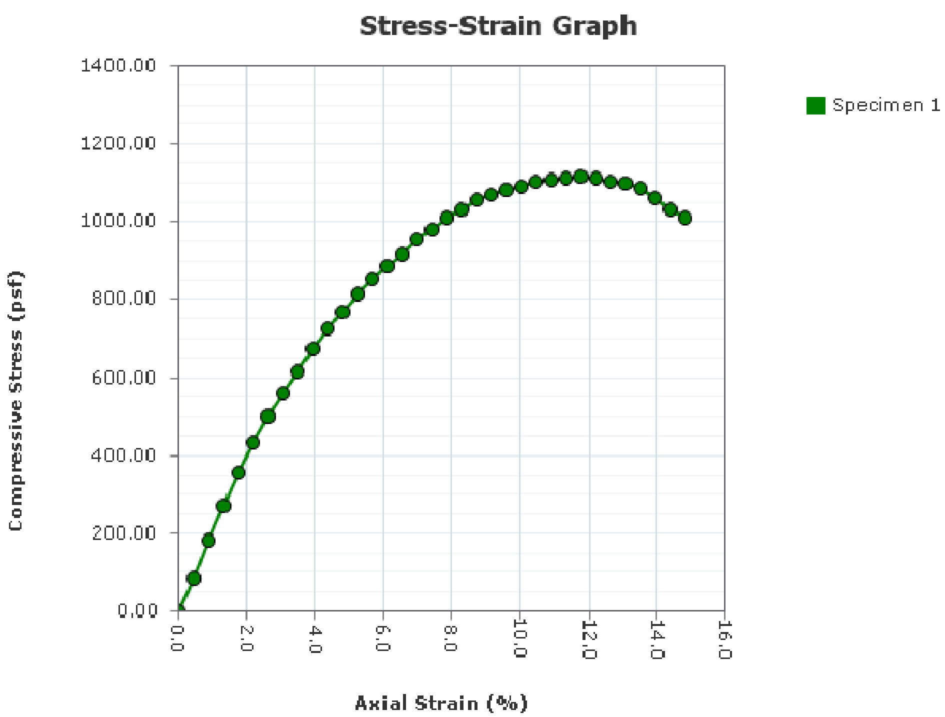
CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #26E**	**4.0**	**31**	**18**	**13**		**(CL) LEAN CLAY**
☒	**STR #26E**	**24.0**	**66**	**31**	**35**		**(CH) FAT CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	23.4							
Wet Density (pcf)	126.2							
Dry Density (pcf)	102.3							
Saturation (%):	96.4							
Void Ratio:	0.660							
Height (in)	5.7300							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1112.19							
Undrained Shear Strength (psf)	556.09							
Strain at Failure (%):	12.22							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

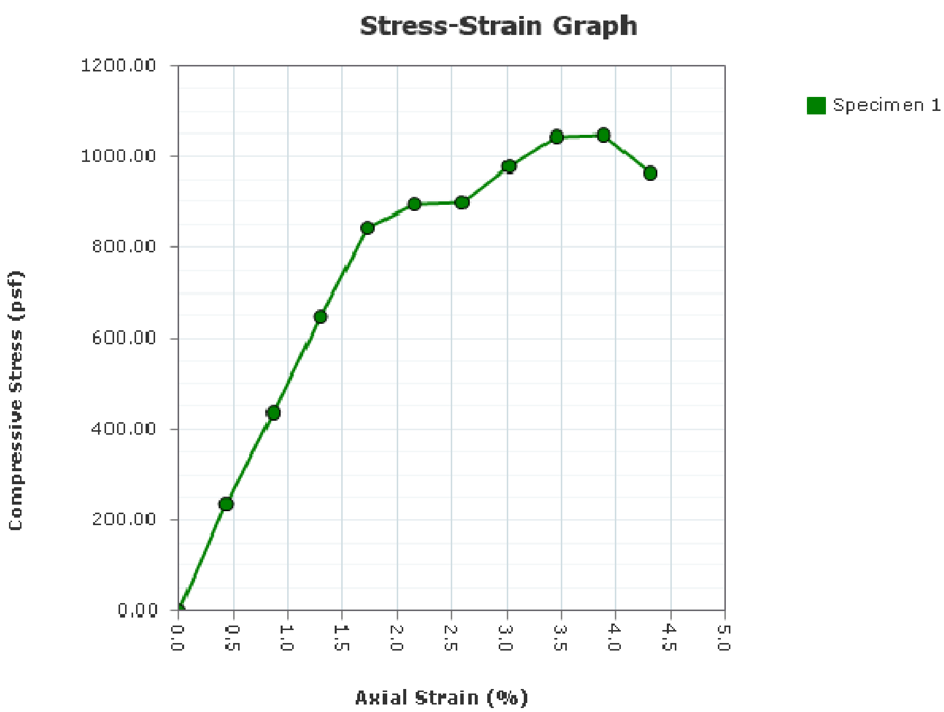
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 26E
Location:	Glendale
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.9							
Wet Density (pcf)	128.3							
Dry Density (pcf)	106.2							
Saturation (%):	94.8							
Void Ratio:	0.599							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1048.71							
Undrained Shear Strength (psf)	524.35							
Strain at Failure (%):	3.89							

Specific Gravity:	2.72	Plastic Limit:	18	Liquid Limit:	31
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 26E
Location:	Glendale
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

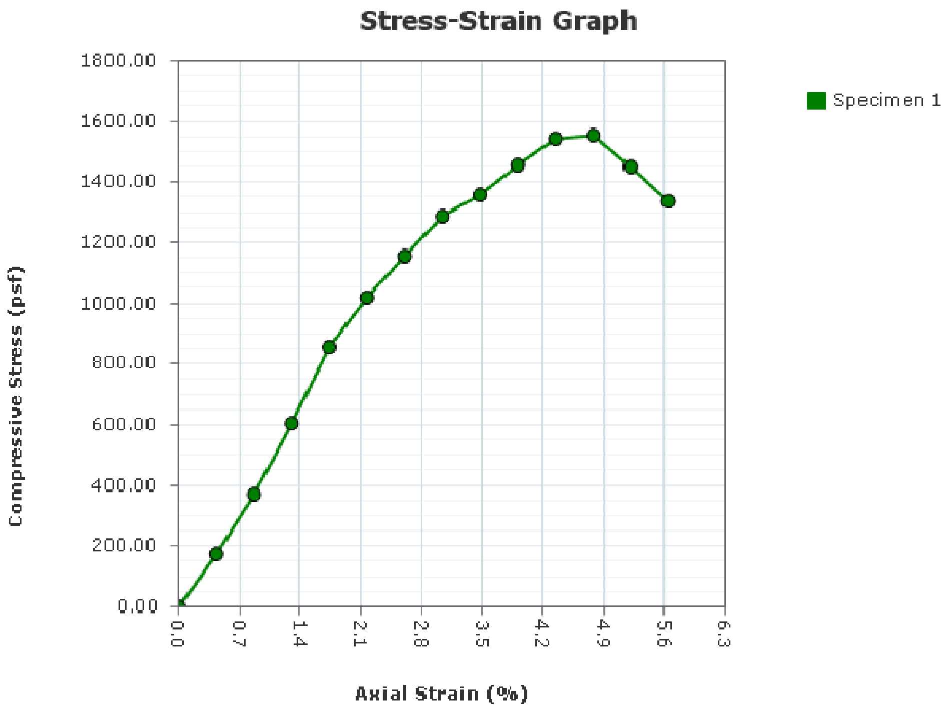
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.2							
Wet Density (pcf)	121.9							
Dry Density (pcf)	94.4							
Saturation (%):	99.4							
Void Ratio:	0.799							
Height (in)	5.7600							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1556.60							
Undrained Shear Strength (psf)	778.30							
Strain at Failure (%):	4.77							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

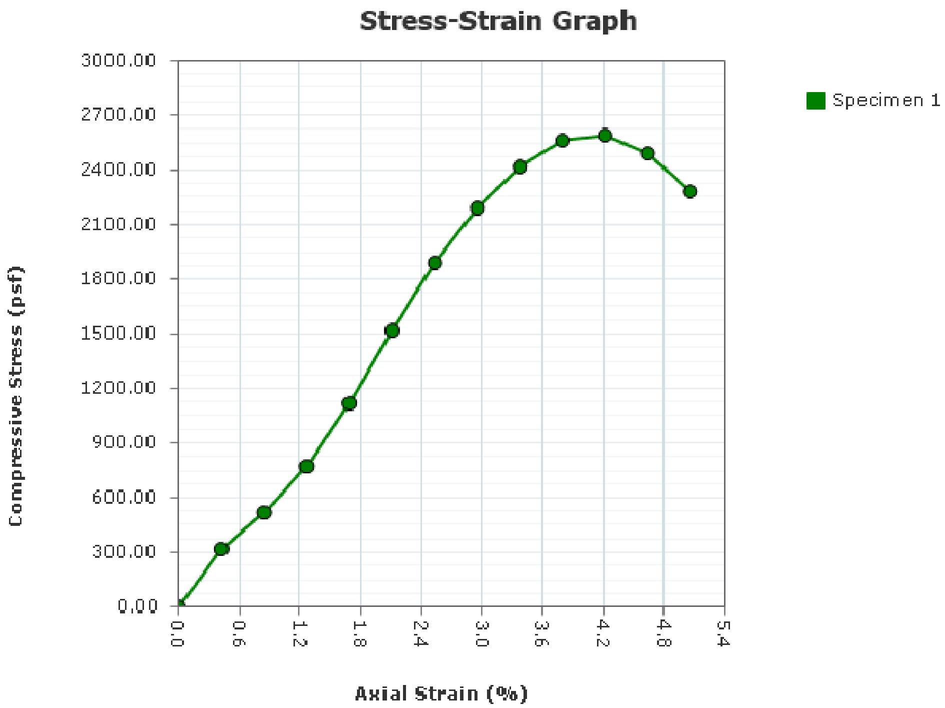
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 4
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	41.4							
Wet Density (pcf)	112.8							
Dry Density (pcf)	79.8							
Saturation (%):	99.9							
Void Ratio:	1.129							
Height (in)	5.9300							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.10							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.69							
Unconfined Compressive Strength (psf)	2590.46							
Undrained Shear Strength (psf)	1295.23							
Strain at Failure (%):	4.22							

Specific Gravity:	2.72	Plastic Limit:	31	Liquid Limit:	66
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 4
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 26E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

April 21, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 28E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 28E, a double circuit, angle dead end steel pole which will be supported by drilled shaft.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
28E	Double Circuit	90	688.9	37°34'43.39"N	85°53'20.45"W	4266	834

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 57 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eleven inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as dark brown to reddish brown in color, wet and very soft in soil strength consistency. The fat clay was typically described as reddish brown to gray in color, containing varying amounts of gravel, wet and medium stiff to hard in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 28E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 28E	37°34'43.39"N	85°53'20.45"W	688.8	35.9	652.9

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 28E	CL	5.0-9.0	0.5	0.3
STR 28E	CH	9.0-36.0	1.2	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 28E	CL	5.0-9.0	0.02	-
STR 28E	CH	9.0-36.0	0.02	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 28E	CL	5.0-9.0	125.0	0.5	0.5
STR 28E	CH	9.0-36.0	120.0	1.2	0.9

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 28E
AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-11-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #28E\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

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

STR #28E

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/17/22 **COMPLETED** 3/17/22
GROUND ELEVATION 688.8 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (11 INCHES)									
		(CL) lean CLAY, dark brown to reddish brown, wet, very soft to stiff	ST 1	95		0.75	26				Qu = 520 psf
5			ST 2	70		2.5	32	45	25	20	Qu = 2,260 psf
10		(CH) fat CLAY, trace to some gravel, reddish brown to gray, wet, medium stiff to hard	SPT 1	80	4-4-3 (7)	2.25	35				
15											
20			ST 3	100		4.5+	35	51	26	25	Qu = 3,350 psf
25											
30			SPT 2	100	30-22-12 (34)	0.25	27				Cobble encountered while driving spoon
35											
		weathered LIMESTONE, light gray, medium grained, moderately hard to hard, thin to thick bedded	RC 1	45 (23)							
40			RC 2	16 (0)							Clay seam (38.4'-39.0'); Fractured layer (39.1'-44.0')
45			RC 3	68 (0)							

(Continued Next Page)

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Glasgow, KY 42141
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STR #28E
PAGE 2 OF 2

CLIENT LG&E and KU | **PROJECT NAME** Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032 | **PROJECT LOCATION** Glendale, KY

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
		weathered LIMESTONE, light gray, medium grained, moderately hard to hard, thin to thick bedded *(continued)*									
50		LIMESTONE, light gray, medium grained, moderately hard to hard, thin to thick bedded	RC 4	72 (20)							
55			RC 5	100 (43)							Vertical fracture (53.3'-54.3')

Refusal at 35.9 feet.
Bottom of borehole at 57.0 feet.

APPENDIX C

Laboratory Testing Results

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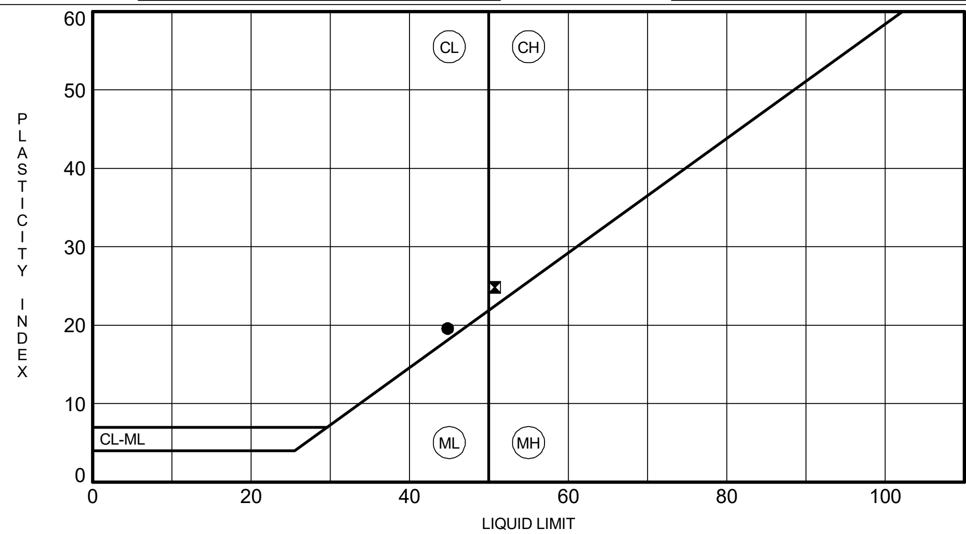
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

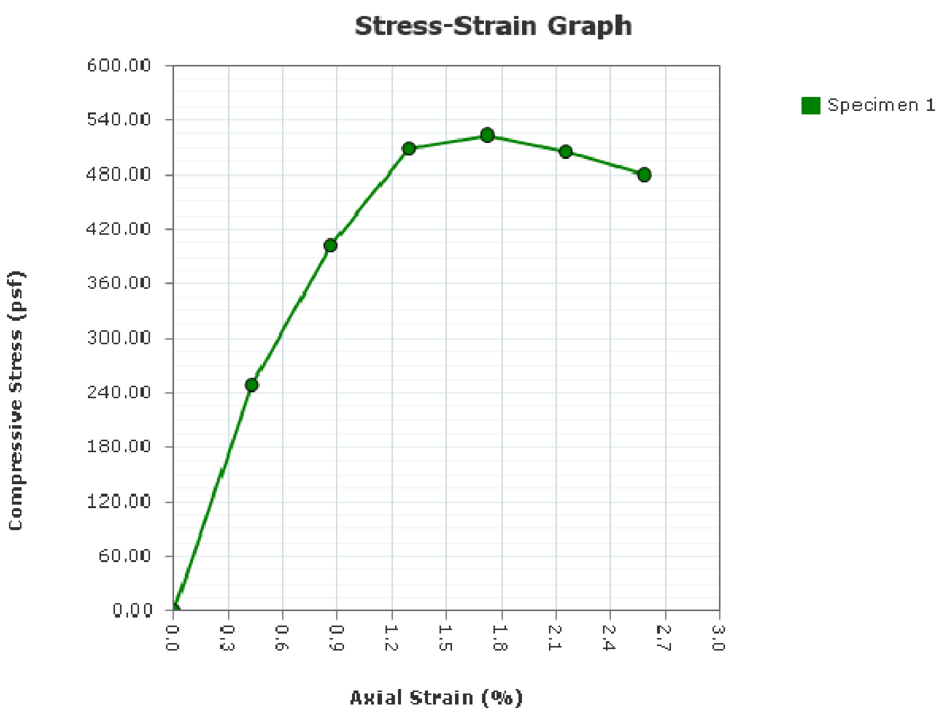


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #28E**	**4.0**	**45**	**25**	**20**		**(CL) LEAN CLAY**
⧗	**STR #28E**	**19.0**	**51**	**26**	**25**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/11/22 14:59 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV EAST\LAB\FORD 138KV GLENDALE INDUSTRIAL EAST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 28E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

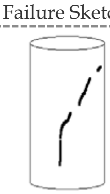
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	25.7							
Wet Density (pcf)	118.3							
Dry Density (pcf)	94.1							
Saturation (%):	86.9							
Void Ratio:	0.805							
Height (in)	5.8000							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	523.06							
Undrained Shear Strength (psf)	261.53							
Strain at Failure (%):	1.72							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 28E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

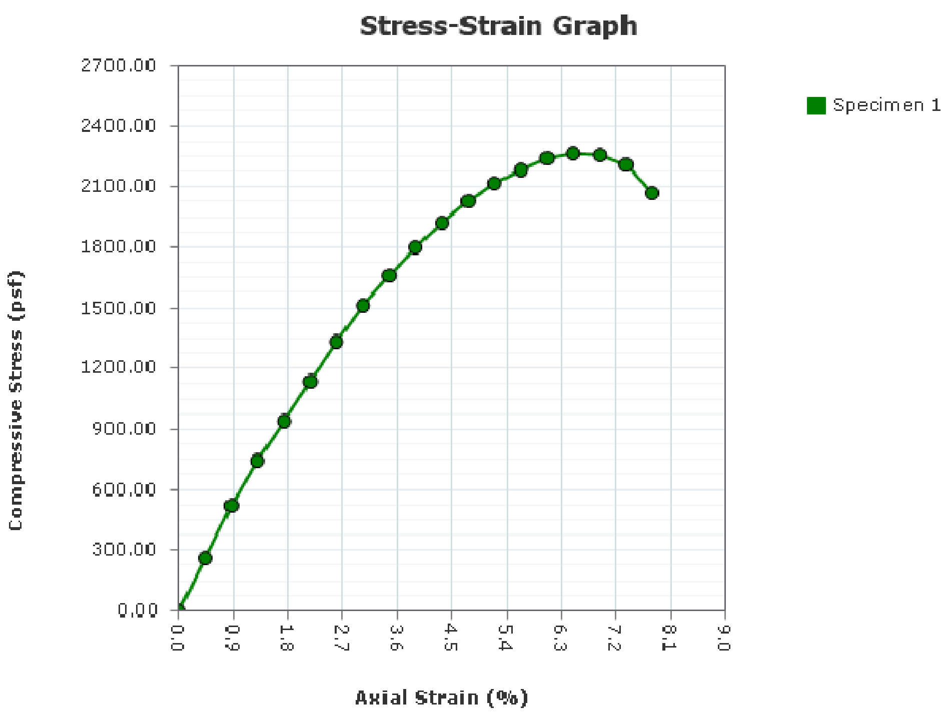
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 28
Location:	Glenadale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Moisture Content (%):	32.4							
Wet Density (pcf)	118.6							
Dry Density (pcf)	89.6							
Saturation (%):	98.4							
Void Ratio:	0.895							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	2262.03							
Undrained Shear Strength (psf)	1131.02							
Strain at Failure (%):	6.93							

Specific Gravity:	2.72	Plastic Limit:	25	Liquid Limit:	45
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 28
Location:	Glendadale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

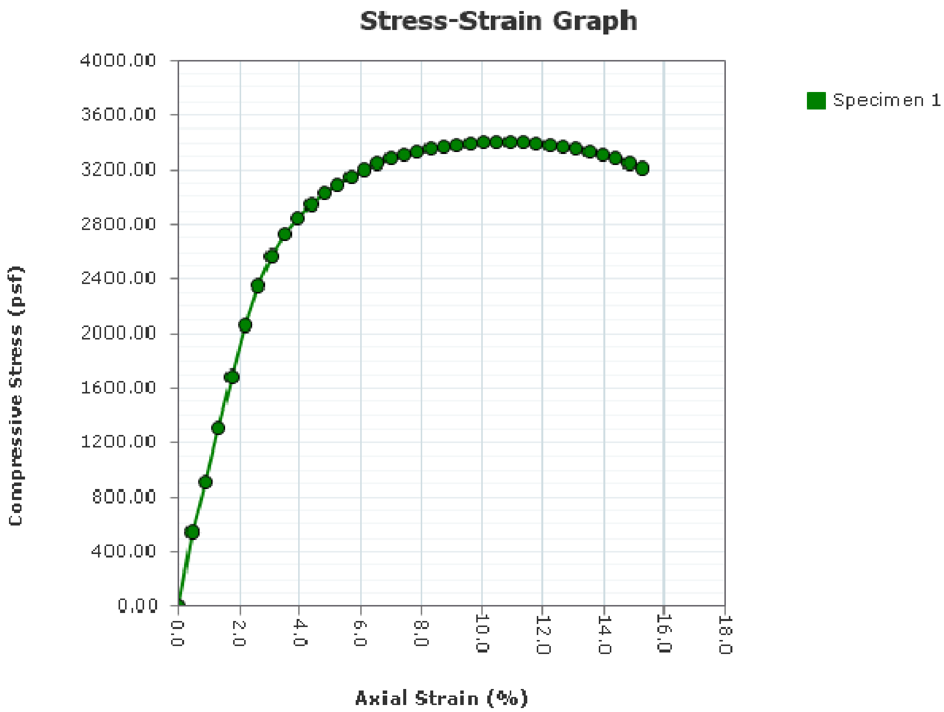
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 28
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	34.7							
Wet Density (pcf)	119.1							
Dry Density (pcf)	88.4							
Saturation (%):	102.5							
Void Ratio:	0.921							
Height (in)	5.7300							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	3354.08							
Undrained Shear Strength (psf)	1677.04							
Strain at Failure (%):	13.09							

Specific Gravity:	2.72	Plastic Limit:	26	Liquid Limit:	51
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 28
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 3, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial East
Structure 31E
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial East in Glendale, KY. This summary is provided for Structure 31E, a double circuit, angle dead end steel pole which will be supported by drilled shaft.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
31E	Double Circuit	85	697.3	37°34’41.03”N	85°53’3.26”W	2,686	1,268

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 60 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface to a depth of about nine inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as brown in color, wet and soft to very stiff in soil strength consistency. The fat clay was typically described as reddish brown to gray in color, containing varying amounts of sand and gravel, wet and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 31E – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 31E	37°34’41.03”N	85°53’3.26”W	697.1	49.5	647.6

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 31E	CL	5.0-9.0	1.3	0.8
STR 31E	CH	9.0-49.5	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 31E	CL	5.0-9.0	0.03	200
STR 31E	CH	9.0-49.5	0.03	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 31E	CL	5.0-9.0	125.0	1.3	0.8
STR 31E	CH	9.0-49.5	120.0	1.0	1.0

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL EAST STRUCTURE 31E
AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-12-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV East \STR #31E\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

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STR #31E
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/18/22 **COMPLETED** 3/21/22
GROUND ELEVATION 697.1 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (9 INCHES)									
	(CL) lean CLAY, brown, wet, soft to very stiff	ST 1	100		1.75	24				Qu = 710 psf
5		ST 2	95		2.75	22	37	19	18	Qu = 4,600 psf
10	(CH) fat CLAY, trace to some gravel, reddish brown, moist to wet, stiff to medium stiff	SPT 1	100	5-6-7 (13)	3.5	25				
15										
20		ST 3	85		1.5	30				Qu = 5,090 psf
25										
30		SPT 2	40	5-3-5 (8)	2.0	35				
35										
40	(CH) fat CLAY with sand, trace to some gravel, gray, wet, medium stiff	ST 4	100		0.75	35	68	24	44	Qu = 1,630 psf
45										

(Continued Next Page)

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STR #31E

CLIENT LG&E and KU | **PROJECT NAME** Ford 138kV Glendale Industrial East

PROJECT NUMBER 222-032 | **PROJECT LOCATION** Glendale, KY

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
		(CH) fat CLAY with sand, trace to some gravel, gray, wet, medium stiff *(continued)*									
50			SPT 3	60	50		8				
		LIMESTONE, gray to white, moderately hard to hard, thin to thick bedded, highly fractured	RC 1	63 (13)							
55			RC 2	98 (20)							highly weathered zone (56.1'-57.1') .

Refusal at 49.5 feet.
Bottom of borehole at 59.3 feet.

APPENDIX C

Laboratory Testing Results

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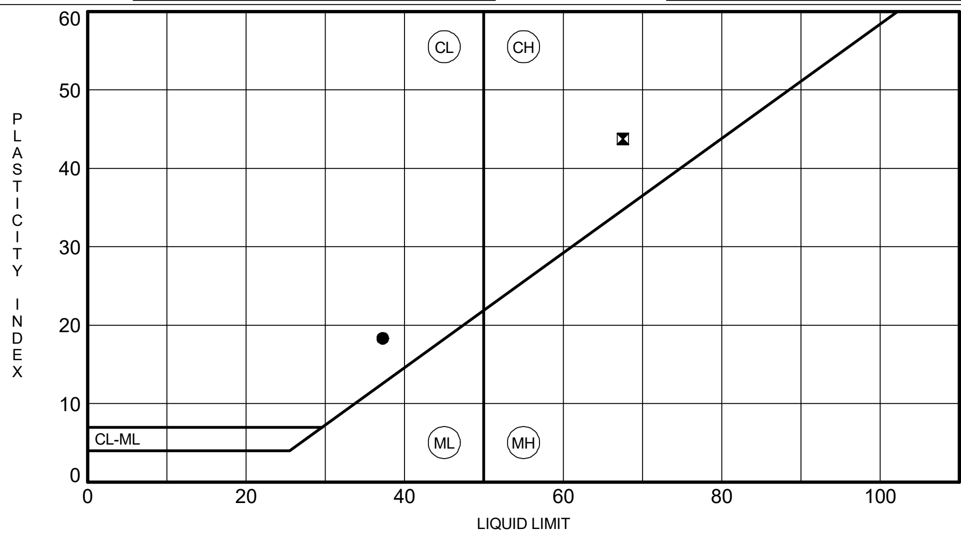
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

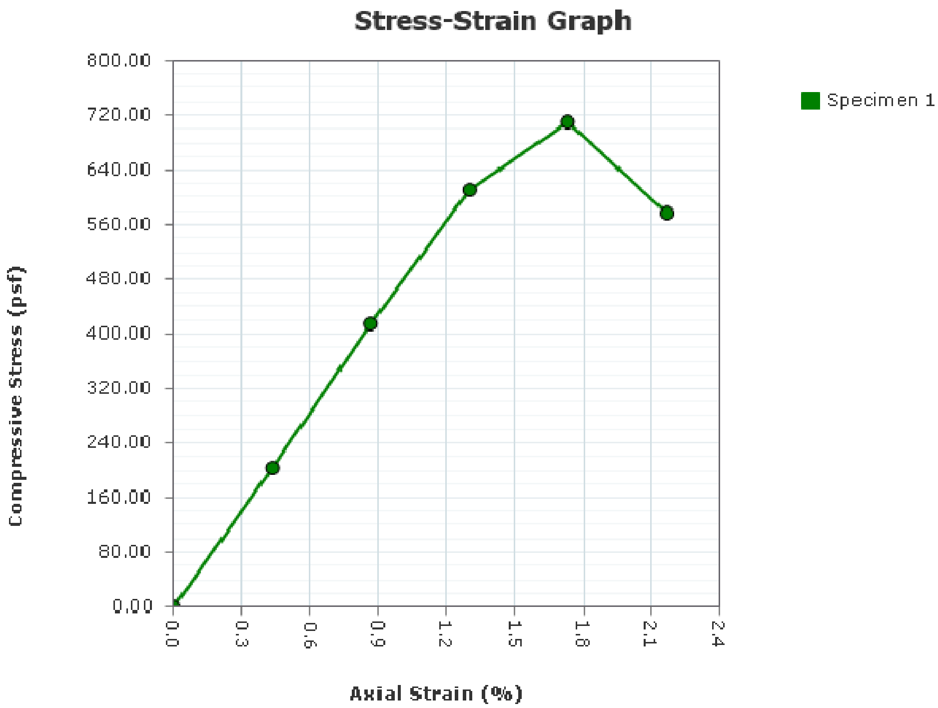
CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial East
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #31E**	**4.0**	**37**	**19**	**18**		**(CL) LEAN CLAY**
⊠	**STR #31E**	**39.0**	**68**	**24**	**44**		**(CH) FAT CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/21/2022
Sampling Date:	3/21/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	24.5							
Wet Density (pcf)	122.0							
Dry Density (pcf)	98.0							
Saturation (%):	90.9							
Void Ratio:	0.732							
Height (in)	5.7700							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	710.98							
Undrained Shear Strength (psf)	355.49							
Strain at Failure (%):	1.73							

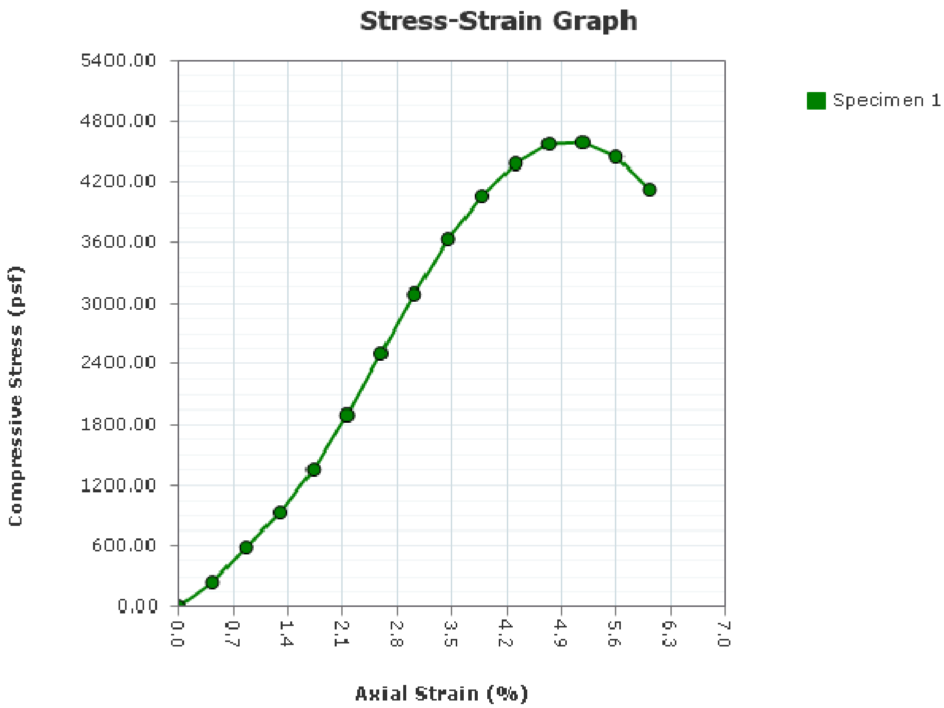
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/21/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/21/2022
Sampling Date:	3/21/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.4							
Wet Density (pcf)	126.2							
Dry Density (pcf)	103.1							
Saturation (%):	94.4							
Void Ratio:	0.647							
Height (in)	5.8000							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	4603.95							
Undrained Shear Strength (psf)	2301.98							
Strain at Failure (%):	5.17							

Specific Gravity:	2.72	Plastic Limit:	19	Liquid Limit:	37
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/21/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

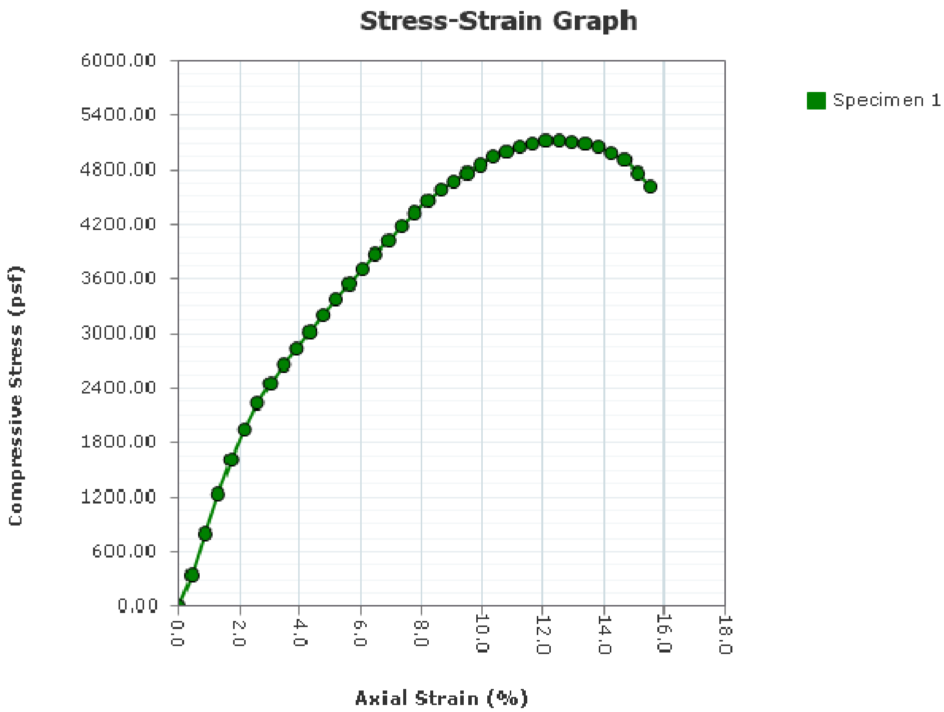
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/21/2022
Sampling Date:	3/21/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.7							
Wet Density (pcf)	120.2							
Dry Density (pcf)	92.6							
Saturation (%):	97.1							
Void Ratio:	0.834							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	5092.33							
Undrained Shear Strength (psf)	2546.16							
Strain at Failure (%):	13.39							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/21/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

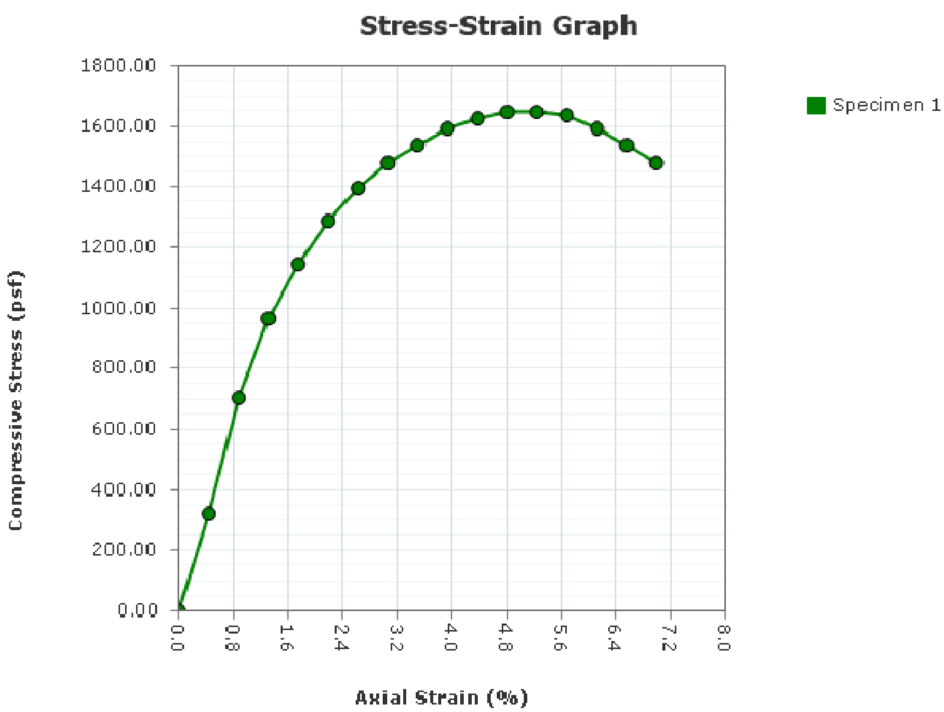
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Received Date:	3/21/2022
Sampling Date:	3/21/2022
Sample Number:	ST 4
Sample Depth:	39.0-40.2 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	35.3							
Wet Density (pcf)	117.1							
Dry Density (pcf)	86.6							
Saturation (%):	99.9							
Void Ratio:	0.962							
Height (in)	5.7200							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.00							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1638.54							
Undrained Shear Strength (psf)	819.27							
Strain at Failure (%):	5.68							

Specific Gravity:	2.72	Plastic Limit:	24	Liquid Limit:	68
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial East
Project Number:	222-032
Sampling Date:	3/21/2022
Sample Number:	ST 4
Sample Depth:	39.0-40.2 ft
Boring Number:	STR #31E
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 1BW
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West line in Glendale, KY. This summary is provided for Structure 1BW, a single circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
1BW	Single Circuit	80	707.3	37°35'47.44"N	85°54'10.63"W	989	290

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 55 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of eleven inches. Beneath the surface material, lean clay was encountered to a depth of 29 feet. Fat clay was encountered from 29 feet to the boring termination depth. The lean clay was typically described as brown to reddish brown in color, wet and medium stiff to stiff in soil strength consistency. The fat clay was typically described as reddish brown, containing trace to some gravel, wet to saturated and stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1BW – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal*	
				Depth (ft.)	Elevation (ft.) MSL
STR 1BW	37°35’47.44”N	85°54’10.63”W	707.0	35.0*	672.0*

*Refusal occurred on Boulder

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1BW	CL	5.0-29.0	1.5	0.8
STR 1BW	CH	29.0-54.5	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 1BW	CL	5.0-29.0	0.025	200
STR 1BW	CH	29.0-54.5	0.010	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 1BW	CL	5.0-29.0	125.0	1.5	1.0
STR 1BW	CH	29.0-55.0	120.0	1.0	1.0

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

◎ SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 1BW GLENDALE, KY
CLIENT:	LG&E and KU
	BORING LAYOUT
	AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-12-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

REVISIONS		
NO.	DATE	DESCRIPTION

APPENDIX B

Boring Logs

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

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

STR 1BW
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/28/22 **COMPLETED** 3/29/22
GROUND ELEVATION 707 ft
DRILLING CONTRACTOR Strata Group, LLC
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Jacob Cowan **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (11 INCHES)	SPT 1	100	3-3-5 (8)	1.25	24				
		(CL) lean CLAY, brown to reddish brown, wet, medium stiff to stiff									
5			ST 1	70		3.75	23	36	13	23	Qu = 4,820 psf
10			SPT 2	100	4-5-6 (11)	2.5	24				
15			ST 2	100		3.5	26				
20			SPT 3	100	3-5-6 (11)	2.0	28				
25			ST 3	100		3.0	27	46	23	23	Qu = 1,860 psf
30		(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff	SPT 4	100	3-4-7 (11)	1.75	36				
35			ST 4	100		1.0	36				Used NQ coring steel to reach termination depth
40											Boring refused on a boulder at 35.0'
45											

(Continued Next Page)

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

STR 1BW
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
50		(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff *(continued)*									

Refusal at 35.0 feet.
Bottom of borehole at 54.5 feet.

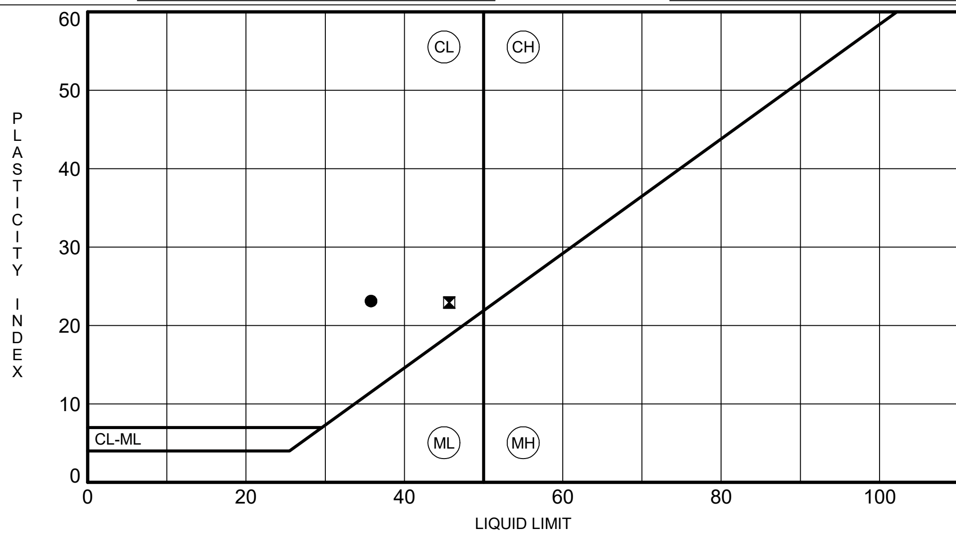
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

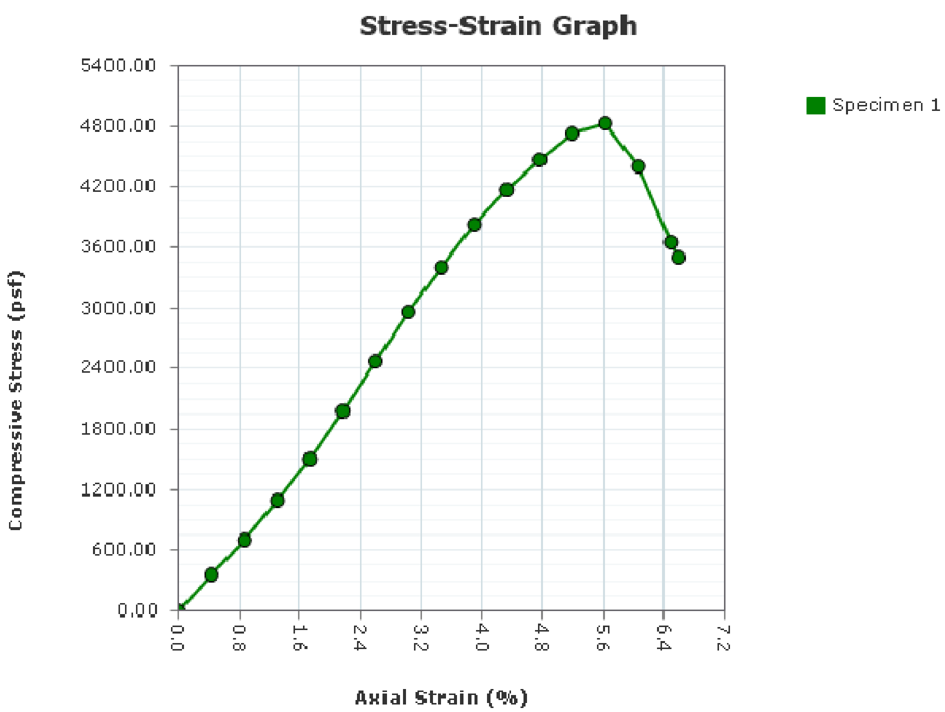


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 1BW**	**4.0**	**36**	**13**	**23**		**(CL) LEAN CLAY**
⊠	**STR 1BW**	**24.0**	**46**	**23**	**23**		**(CL) LEAN CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/15/22 11:46 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1BW
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.9							
Wet Density (pcf)	126.4							
Dry Density (pcf)	104.5							
Saturation (%):	91.2							
Void Ratio:	0.625							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4824.57							
Undrained Shear Strength (psf)	2412.29							
Strain at Failure (%):	5.62							

Specific Gravity:	2.72	Plastic Limit:	13	Liquid Limit:	36
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1BW
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

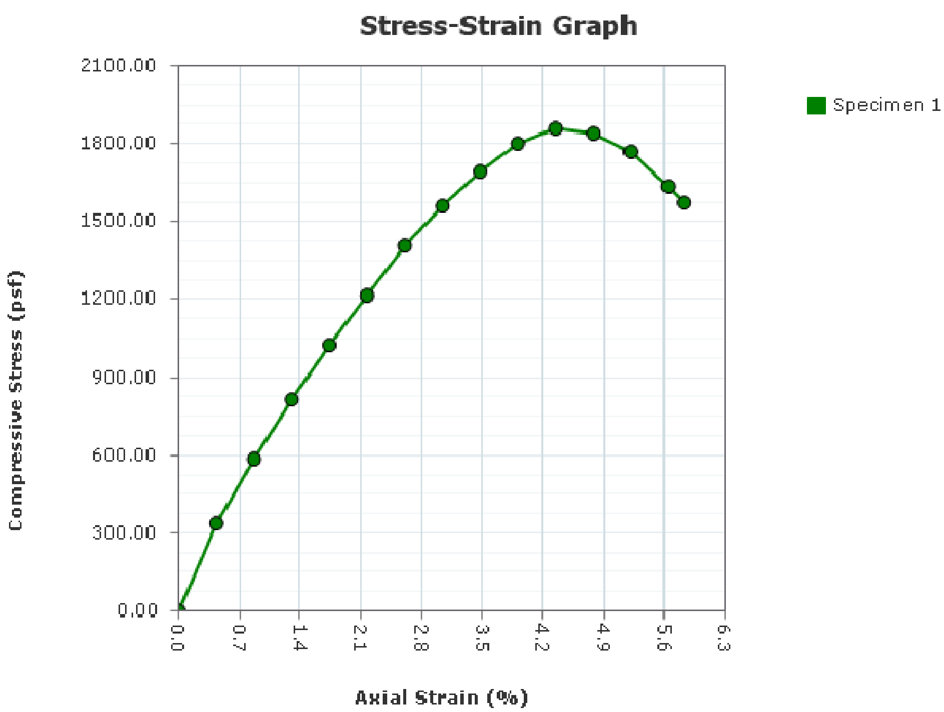
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 1BW
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	27.4							
Wet Density (pcf)	119.6							
Dry Density (pcf)	93.8							
Saturation (%):	92.2							
Void Ratio:	0.809							
Height (in)	5.7600							
Diameter (in)	2.8700							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1860.19							
Undrained Shear Strength (psf)	930.09							
Strain at Failure (%):	4.34							

Specific Gravity:	2.72	Plastic Limit:	13	Liquid Limit:	36
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 1BW
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 1W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 1W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
1W	Double Circuit	85	708.8	37°35’46.46”N	85°54’11.10”W	1,105	1,486

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 42 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of ten inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was encountered from 19 feet to the auger refusal depth. The lean clay was typically described as yellowish brown with gray mottling, moist to wet and stiff to very stiff in soil strength consistency. The fat clay was typically described as reddish brown in color, containing trace to some gravel, wet to saturated and stiff to very soft to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 1W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 1W	37°35’46.46”N	85°54’11.10”W	706.8	42.0	664.8

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1W	CL	5.0-19.0	1.6	0.9
STR 1W	CH	19.0-24.0	1.7	0.9
STR 1W	CH	24.0-42.0	0.6	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 1W	CL	5.0-19.0	0.04	200
STR 1W	CH	19.0-24.0	0.02	200
STR 1W	CH	24.0-42.0	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 1W	CL	5.0-19.0	125.0	1.6	1.0
STR 1W	CH	19.0-24.0	120.0	1.7	1.0
STR 1W	CH	24.0-42.0	57.6	0.6	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. | DATE | DESCRIPTION

BORING LAYOUT

CLIENT: LG&E and KU

PROJECT: FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 1W GLENDALE, KY

AEI
AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

SCALE: NTS

DATE: 04-12-2022

DRAWN BY: A. ANDERSON

CHECKED BY: D. BARRETT

FILE: T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV West \STR #1W\Support Information

SHEET: A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR 1W
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/29/22 **COMPLETED** 3/29/22
GROUND ELEVATION 706.8 ft
DRILLING CONTRACTOR Strata Group, LLC
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
∇ **AT TIME OF DRILLING** 24.00 ft / Elev 682.80 ft
LOGGED BY Jacob Cowan **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (10 INCHES) (CL) lean CLAY, yellowish brown with gray mottling, moist to wet, stiff to very stiff	SPT 1	93	4-5-4 (9)	3.0	24				
5		ST 1	95		4.5+	21	32	22	10	Qu = 3,620 psf
10		SPT 2	100	4-8-9 (17)	3.5	22				
15		ST 2	80		2.5	29	49	22	27	Qu = 3,270 psf
20	(CH) fat CLAY, trace to some gravel, reddish brown, wet to saturated, stiff to very soft to medium stiff	SPT 3	100	4-4-6 (10)	2.0	29				
25	∇	ST 3	75		3.5	39				Qu = 4,330 psf
30		SPT 4	33	0-0-0 (0)	0.5	37				
35		ST 4	35		-	48				Shelby Tube crushed by cobbles
40		SPT 5	100	4-3-2 (5)	<0.25	52				

Refusal at 42.0 feet.
Bottom of borehole at 42.0 feet.

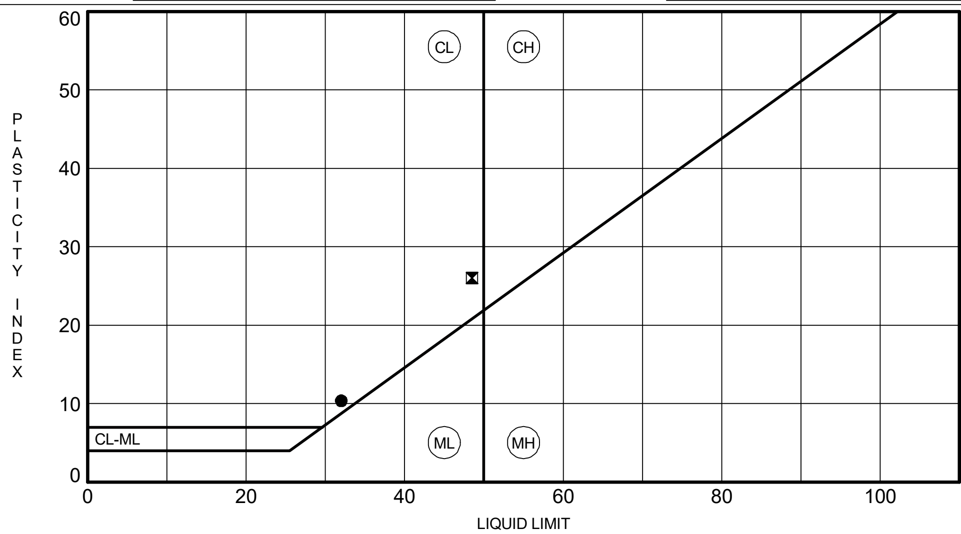
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

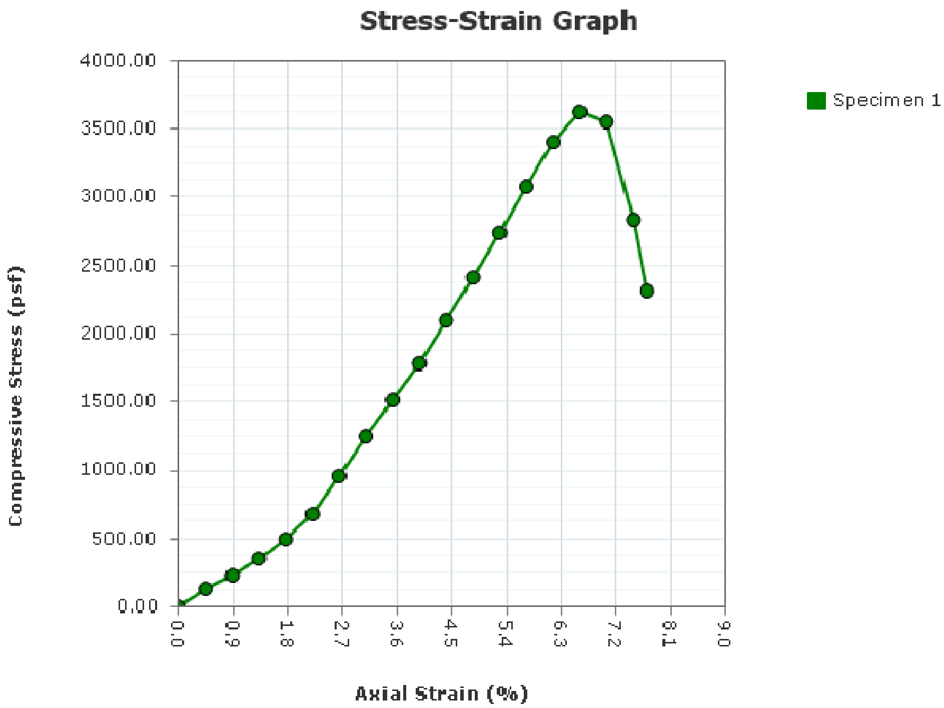


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 1W**	**4.0**	**32**	**22**	**10**		**(CL) LEAN CLAY**
⊠	**STR 1W**	**14.0**	**49**	**22**	**27**		**(CL) LEAN CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/14/22 11:03 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1W
Location:	Glendale KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.1							
Wet Density (pcf)	121.6							
Dry Density (pcf)	101.3							
Saturation (%):	80.7							
Void Ratio:	0.677							
Height (in)	5.6800							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	1.99							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.76							
Unconfined Compressive Strength (psf)	3623.97							
Undrained Shear Strength (psf)	1811.98							
Strain at Failure (%):	6.60							

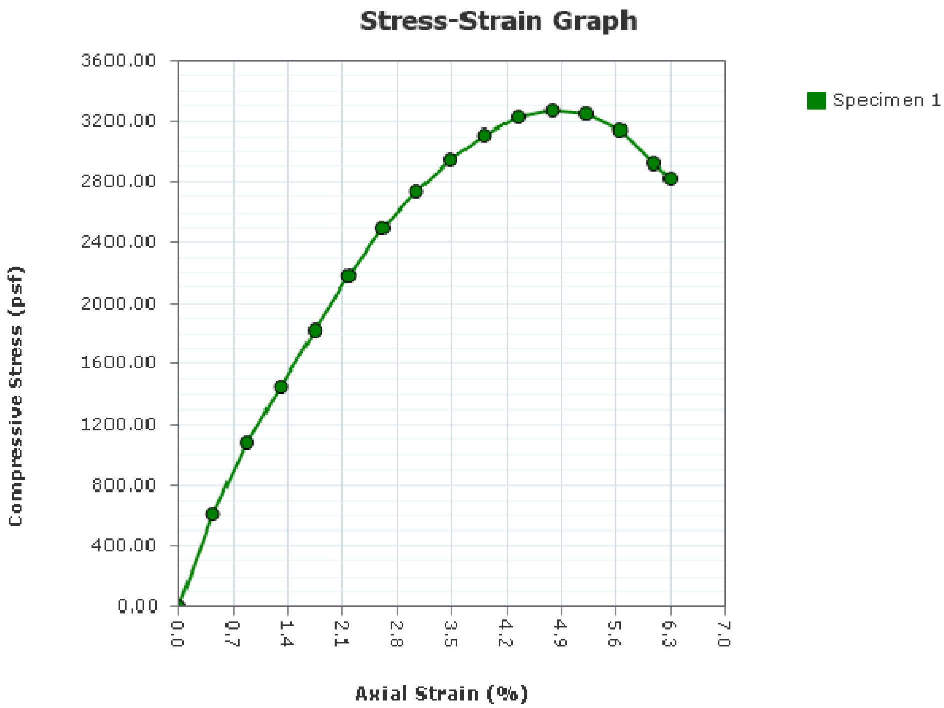
Specific Gravity:	2.72	Plastic Limit:	22	Liquid Limit:	32
Type:	UD	Soil Classification:			

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 1W
Location:	Glendale KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 1W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.4							
Wet Density (pcf)	124.8							
Dry Density (pcf)	96.4							
Saturation (%):	105.0							
Void Ratio:	0.761							
Height (in)	5.7500							
Diameter (in)	2.8100							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	3272.93							
Undrained Shear Strength (psf)	1636.47							
Strain at Failure (%):	4.78							

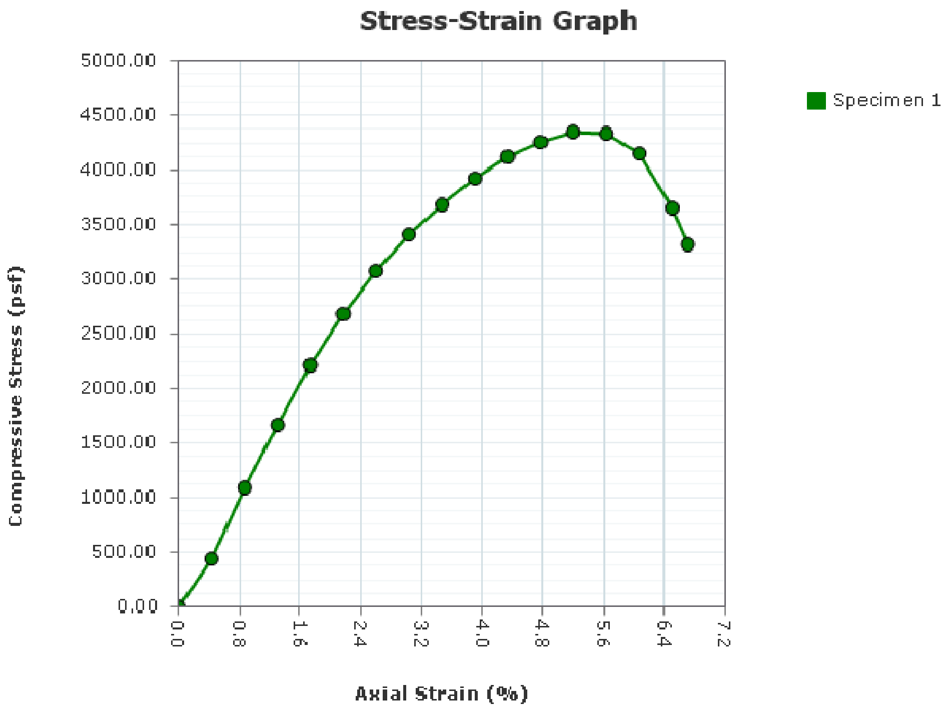
Specific Gravity:	2.72	Plastic Limit:	22	Liquid Limit:	49
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 1
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 1W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 1W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.0							
Wet Density (pcf)	123.2							
Dry Density (pcf)	95.5							
Saturation (%):	101.4							
Void Ratio:	0.778							
Height (in)	5.7700							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4334.61							
Undrained Shear Strength (psf)	2167.30							
Strain at Failure (%):	5.63							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 1W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 2W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 2W, a double circuit, tangent dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
2W	Double Circuit	105	714.3	37°35’44.24”N	85°54’12.55”W	1,055	4,790

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was encountered from 19 feet to the auger refusal depth. The lean clay was typically described as brown to reddish brown in color, wet and very stiff to stiff in soil strength consistency. The fat clay was typically described as reddish brown to brown in color, containing trace to some gravel, saturated to wet and stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 2W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 2W	37°35’44.24”N	85°54’12.55”W	711.7	49.3	662.4

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 2W	CL	5.0-19.0	1.9	1.0
STR 2W	CH	19.0-49.3	1.4	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 2W	CL	5.0-19.0	0.02	200
STR 2W	CH	19.0-49.3	0.01	200

5.2 **<u>Axial Design Parameters</u>** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 2W	CL	5.0-19.0	125.0	1.9	1.0
STR 2W	CH	19.0-49.3	120.0	1.4	1.1

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 2W GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-12-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Log

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

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

STR 2W
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/30/22 **COMPLETED** 3/30/22
GROUND ELEVATION 711.7 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
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 (5 INCHES)									
		(CL) lean CLAY, brown to reddish brown, wet, very stiff to stiff	ST 1	90		4.5+	25				
5			ST 2	85		2.0	23	36	13	23	Qu = 4,550 psf
10			SPT 1	100	5-6-7 (13)	-	23				
15											
20		(CH) fat CLAY, trace to some gravel, reddish brown to brown, saturated to wet, stiff to medium stiff	ST 3	100		3.5	27	62	28	34	Qu = 3,660 psf
25											
30			SPT 2	67	4-4-4 (8)	-	38				
35											

(Continued Next Page)

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

STR 2W
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
35		(CH) fat CLAY, trace to some gravel, reddish brown to brown, saturated to wet, stiff to medium stiff *(continued)*									
40			ST 4	65		1.0	30				
45											
			SPT 3	100	50	-	24				

Refusal at 49.3 feet.
Bottom of borehole at 49.3 feet.

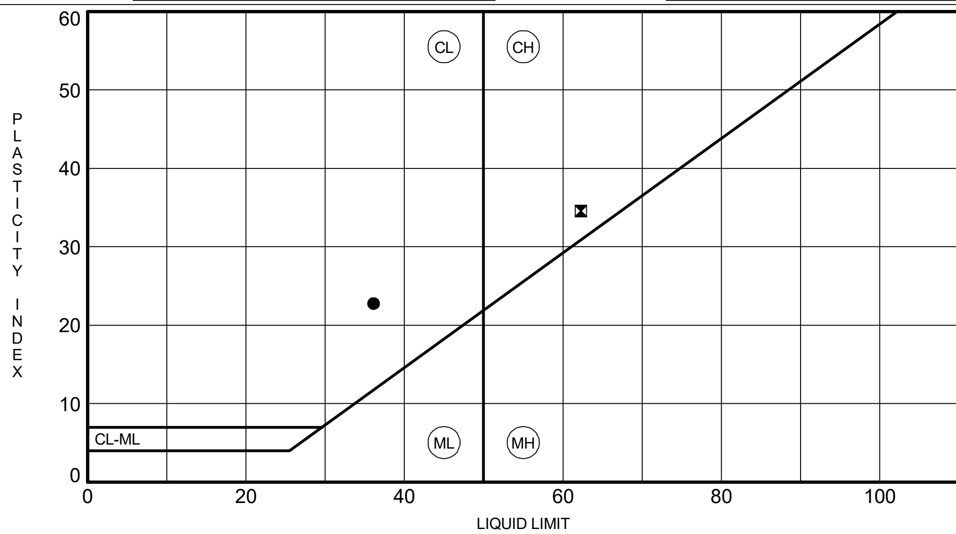
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

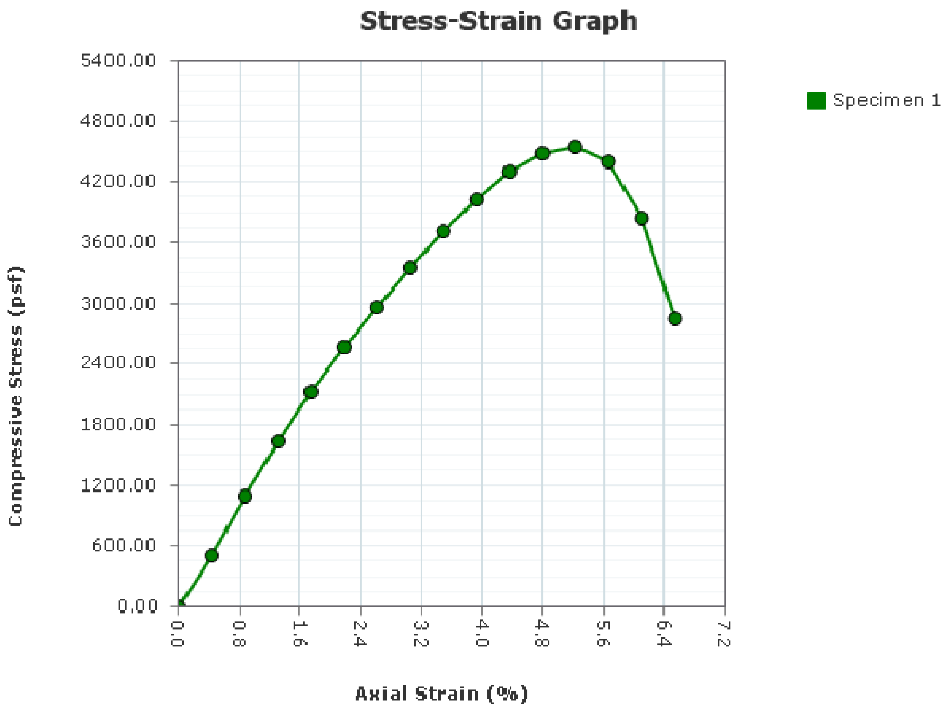


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 2W**	**4.0**	**36**	**13**	**23**		**(CL) LEAN CLAY**
⧗	**STR 2W**	**19.0**	**62**	**28**	**34**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/15/22 08:29 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 2W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.5							
Wet Density (pcf)	128.4							
Dry Density (pcf)	106.5							
Saturation (%):	94.0							
Void Ratio:	0.594							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	4556.59							
Undrained Shear Strength (psf)	2278.29							
Strain at Failure (%):	5.23							

Specific Gravity:	2.72	Plastic Limit:	13	Liquid Limit:	36
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 2W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

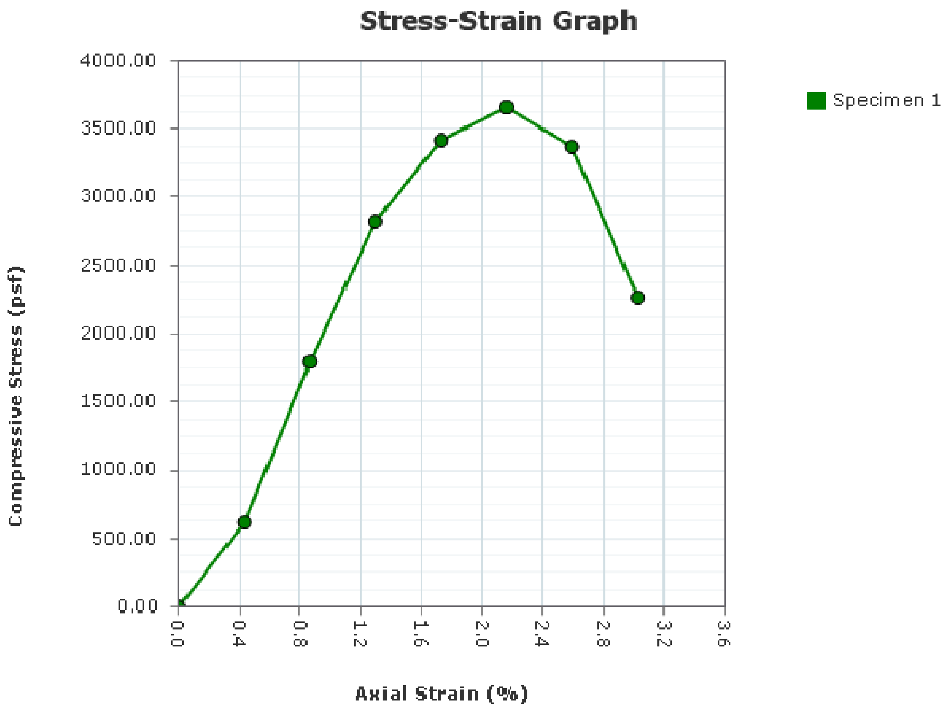
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 2W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	27.4							
Wet Density (pcf)	110.9							
Dry Density (pcf)	87.0							
Saturation (%):	78.4							
Void Ratio:	0.952							
Height (in)	5.7900							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.07							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	3665.51							
Undrained Shear Strength (psf)	1832.76							
Strain at Failure (%):	2.16							

Specific Gravity:	2.72	Plastic Limit:	28	Liquid Limit:	62
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 2W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 3W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 3W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
3W	Double Circuit	110	707.1	37°35’40.75”N	85°54’14.84”W	3,929	6,705

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 50 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 14 feet. Fat clay was encountered from 14 feet to the boring termination depth. The lean clay was typically described as reddish brown to brown in color, moist and very stiff in soil strength consistency. The fat clay was typically described as reddish brown to brown in color, containing varying amounts of gravel (gravel contents increased with depth), moist to saturated and medium stiff to very stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered at Structure 3W.

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 2: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 3W	CL	5.0-14.0	2.5	1.5
STR 3W	CH	14.0-50.5	1.4	0.8

Lateral soil parameters recommended for drilled shaft design are shown below in Table 3 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 3: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 3W	CL	5.0-14.0	0.015	400
STR 3W	CH	14.0-50.5	0.015	200

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 4. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 4: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 3W	CL	5.0-14.0	125.0	2.5	1.1
STR 3W	CH	14.0-50.5	120.0	1.4	1.1

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

AEI
AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

PROJECT: FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 3W GLENDALE, KY

CLIENT: LG&E and KU

BORING LAYOUT

REVISIONS: NO. | DATE | DESCRIPTION

SCALE: NTS
DATE: 04-13-2022
DRAWN BY: A. ANDERSON
CHECKED BY: D. BARRETT
SHEET: A-1

APPENDIX B

Boring Logs

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

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

STR 3W
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/29/22 **COMPLETED** 3/29/22
GROUND ELEVATION 704.6 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Aaron Anderson **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (6 INCHES)									
		(CL) lean CLAY, reddish brown to brown, moist, very stiff									
5			ST 1	85		2.5	22	43	20	23	Qu = 5,630 psf
10			ST 2	100		4.0	24	45	23	22	Qu = 4,350 psf
15		(CH) fat CLAY, reddish brown, moist, stiff to very stiff	SPT 1	100	3-4-6 (10)	3.25	24				
20			ST 3	65		2.0	24	63	27	36	Qu = 4,570 psf
25		(CH) fat CLAY, trace to some gravel, reddish brown with black mottle, moist to wet, medium stiff	SPT 2	100	2-4-6 (10)	2.5	21				
30			SPT 3	87	4-4-3 (7)	1.5	30				
35			ST 4	75		1.5	32				
40		(CH) gravelly fat CLAY, brown to greenish brown, wet to saturated, medium stiff to very stiff	ST 5	65		2.0	35				
45			SPT 4	100	6-5-3 (8)	1.0	43				

(Continued Next Page)

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 15:40 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LABFORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

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

STR 3W
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
50		(CH) gravelly fat CLAY, brown to greenish brown, wet to saturated, medium stiff to very stiff *(continued)*	SPT 5	100	2-10-8 (18)	1.0	32				

Bottom of borehole at 50.5 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 15:40 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

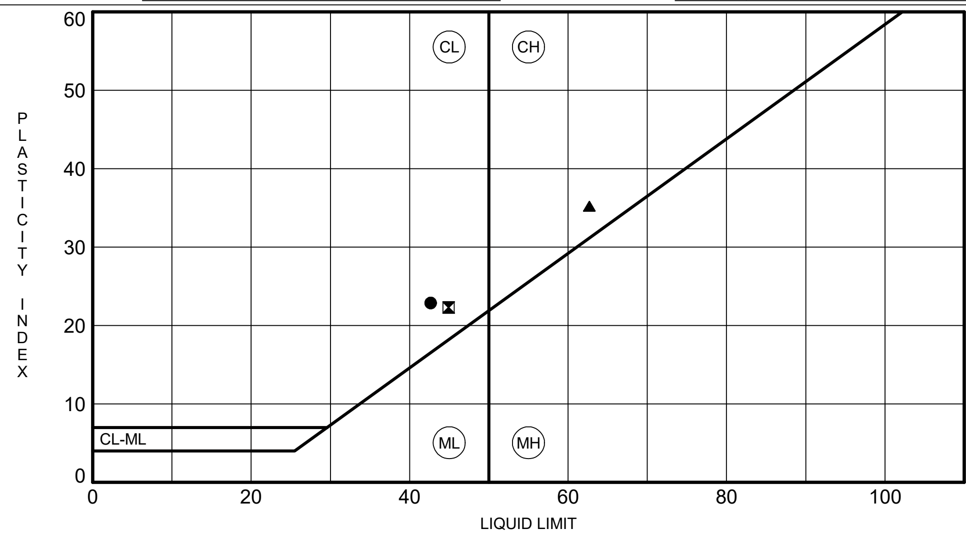
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

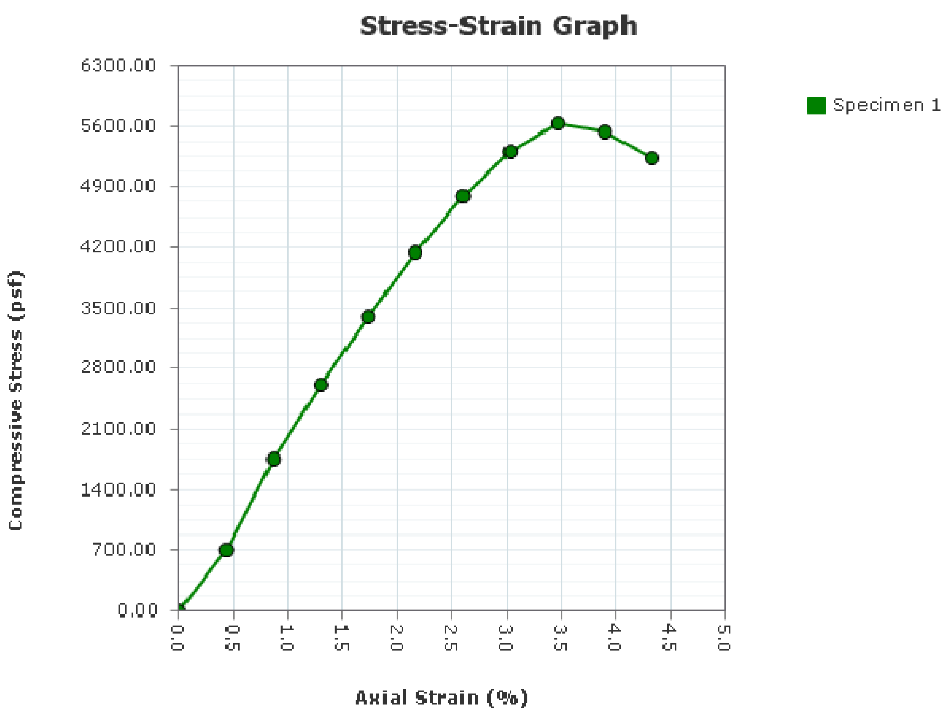


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 3W**	**4.0**	**43**	**20**	**23**		**(CL) LEAN CLAY**
⧗	**STR 3W**	**9.0**	**45**	**23**	**22**		**(CL) LEAN CLAY**
▲	**STR 3W**	**19.0**	**63**	**27**	**36**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/15/22 10:16 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.7							
Wet Density (pcf)	127.4							
Dry Density (pcf)	103.8							
Saturation (%):	97.2							
Void Ratio:	0.635							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	5635.80							
Undrained Shear Strength (psf)	2817.90							
Strain at Failure (%):	3.47							

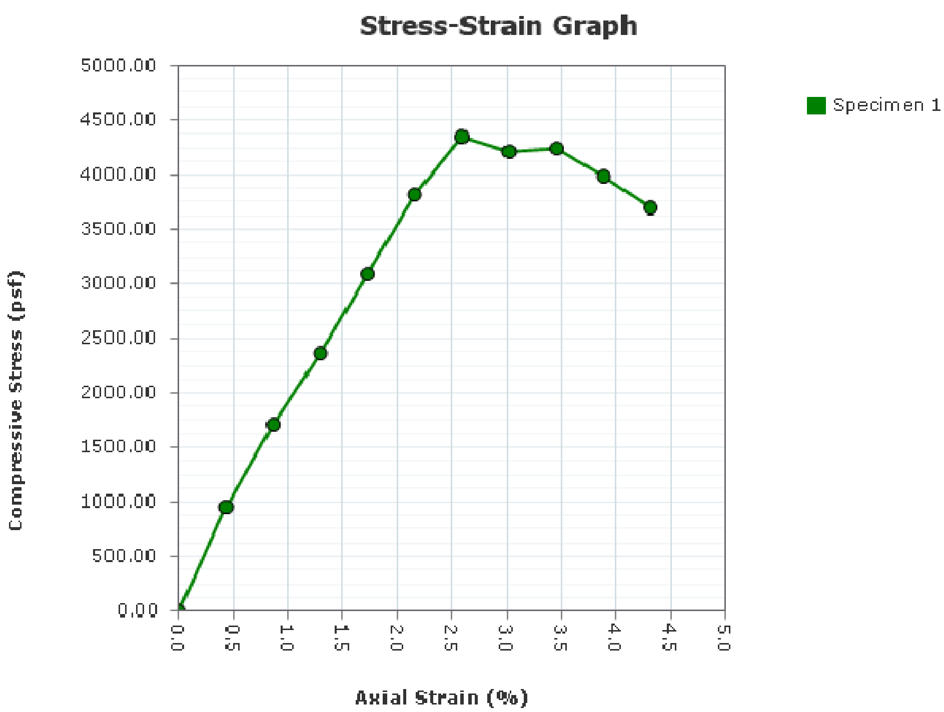
Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	43
Type:	UD	Soil Classification:			

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	9.0-11.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

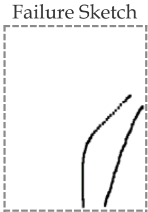
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	22.1							
Wet Density (pcf)	126.6							
Dry Density (pcf)	103.7							
Saturation (%):	94.3							
Void Ratio:	0.638							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4352.66							
Undrained Shear Strength (psf)	2176.33							
Strain at Failure (%):	2.59							

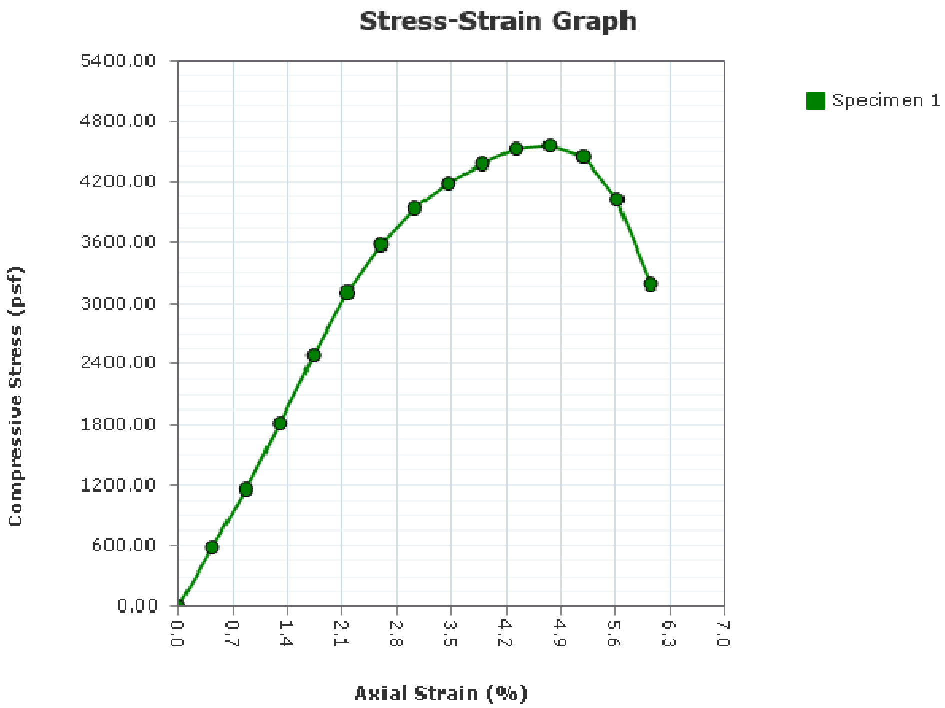
Specific Gravity:	2.72	Plastic Limit:	23	Liquid Limit:	45
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	9.0-11.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	36.2							
Wet Density (pcf)	116.4							
Dry Density (pcf)	85.5							
Saturation (%):	99.8							
Void Ratio:	0.986							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4571.11							
Undrained Shear Strength (psf)	2285.56							
Strain at Failure (%):	4.76							

Specific Gravity:	2.72	Plastic Limit:	27	Liquid Limit:	63
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 3W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 6W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 6W, a double circuit, tangent steel pole which will be supported by direct embedment.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
6W	Double Circuit	115	675.2	37°35’21.48”N	85°54’13.97”W	942	288

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 26 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown in color, moist to wet and soft in soil strength consistency. The fat clay was typically described as reddish brown to brown and gray in color, containing varying amounts of gravel, wet and medium stiff to stiff in soil strength consistency. A small layer of gravel (less than 0.5 feet in thickness) was encountered around 25 feet. The gravel layer was typically described as poorly graded, gray in color, angular to subangular and dense in relative density.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was not encountered in Boring 6W.

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 6W	CL	5.0-9.0	0.5	0.3
STR 6W	CH	9.0-26.4	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 6W	CL	5.0-9.0	0.006	-
STR 6W	CH	9.0-26.4	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 6W	CL	5.0-9.0	125.0	0.5	0.5
STR 6W	CH	9.0-26.4	120.0	1.0	0.8

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS (NO. / DATE / DESCRIPTION)	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 6W GLENDALE, KY
AEI	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Logs

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

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

STR 6W

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/28/22 **COMPLETED** 3/29/22
GROUND ELEVATION 675.5 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
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 (5 INCHES)									
		(CL) lean CLAY, brown, moist to wet, soft	ST 1	100		1.0	24				Qu = 1,045 psf
5			ST 2	90		0.5	22				
10		(CH) fat CLAY trace to some gravel, brown to reddish brown and greenish brown, wet, stiff to medium stiff	SPT 1	100	4-5-6 (11)	2.25	31				
15			ST 3	100		4.5+	30	56	24	32	Qu = 2,700 psf
20			SPT 2	93	3-2-3 (5)	2.0	29				
25			ST 4	100		1.0	30				Qu = 1,980 psf
		(GP) poorly graded GRAVEL, gray, angular to subangular, dense	SPT 3	67	36-8-4 (12)		31				
		(CH) fat CLAY, brown to gray, wet, stiff									

Bottom of borehole at 26.4 feet.

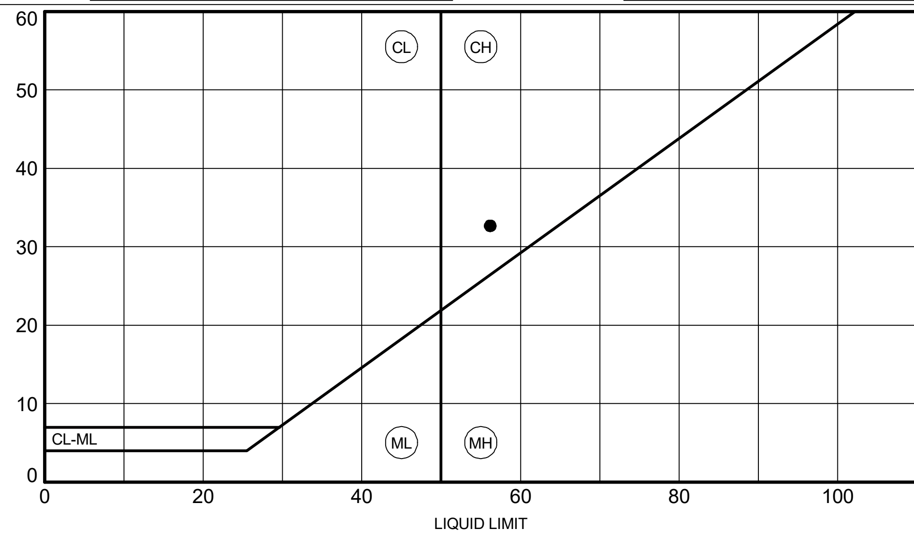
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU **PROJECT NAME** Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY

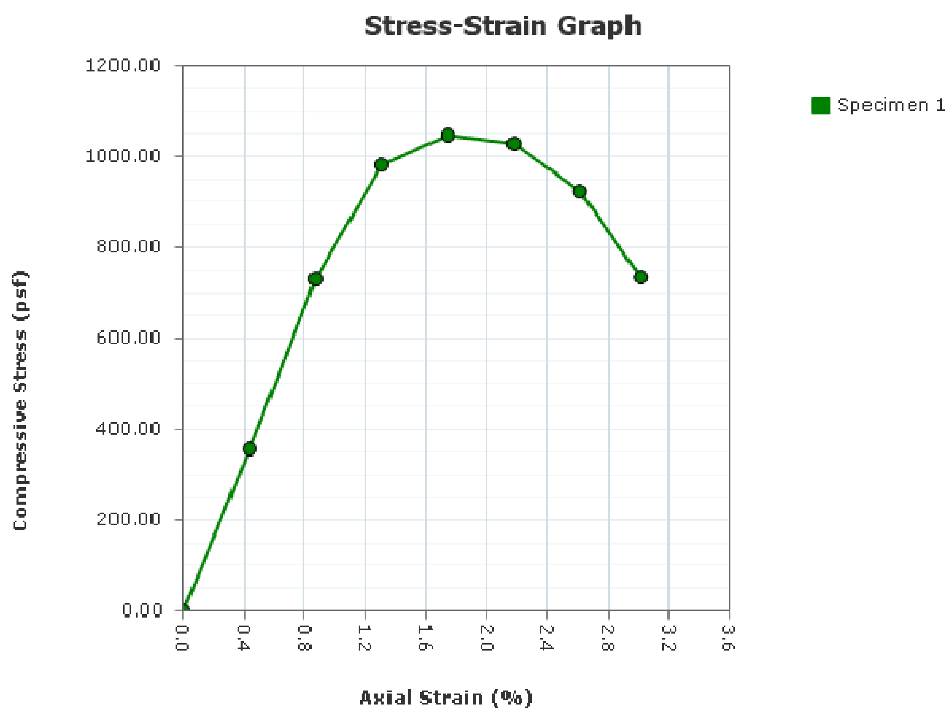


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 6W**	**14.0**	**56**	**24**	**32**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/21/22 15:12 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/15/2022
Sampling Date:	4/15/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

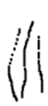
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.9							
Wet Density (pcf)	120.6							
Dry Density (pcf)	98.1							
Saturation (%):	85.4							
Void Ratio:	0.730							
Height (in)	5.7400							
Diameter (in)	2.8100							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1045.55							
Undrained Shear Strength (psf)	522.78							
Strain at Failure (%):	1.74							

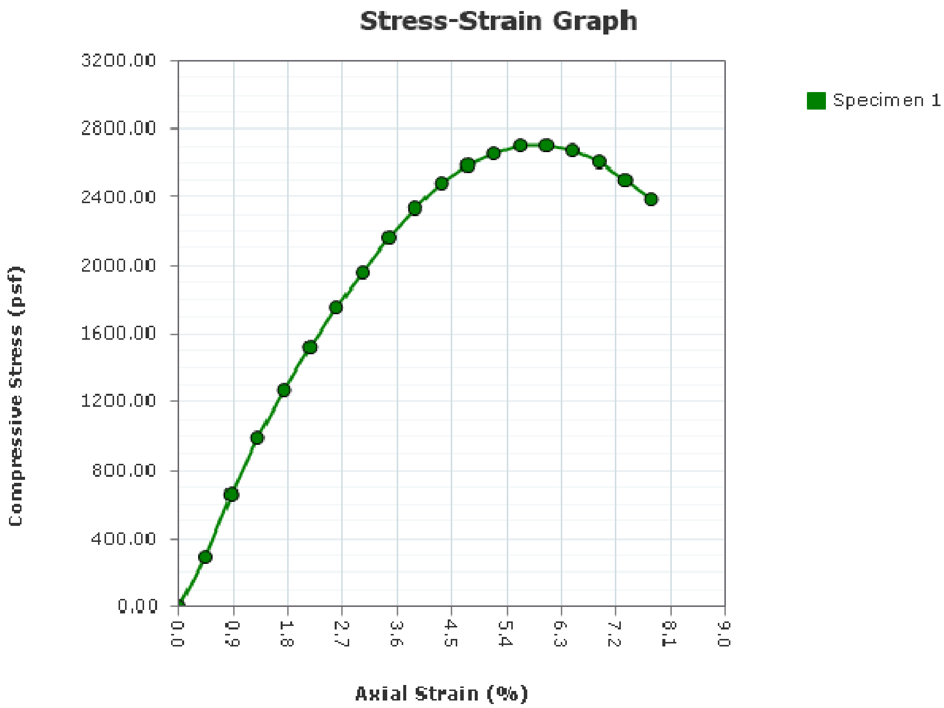
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/15/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/7/2022
Sampling Date:	4/7/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	30.2							
Wet Density (pcf)	119.7							
Dry Density (pcf)	91.9							
Saturation (%):	97.1							
Void Ratio:	0.847							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	2707.58							
Undrained Shear Strength (psf)	1353.79							
Strain at Failure (%):	6.06							

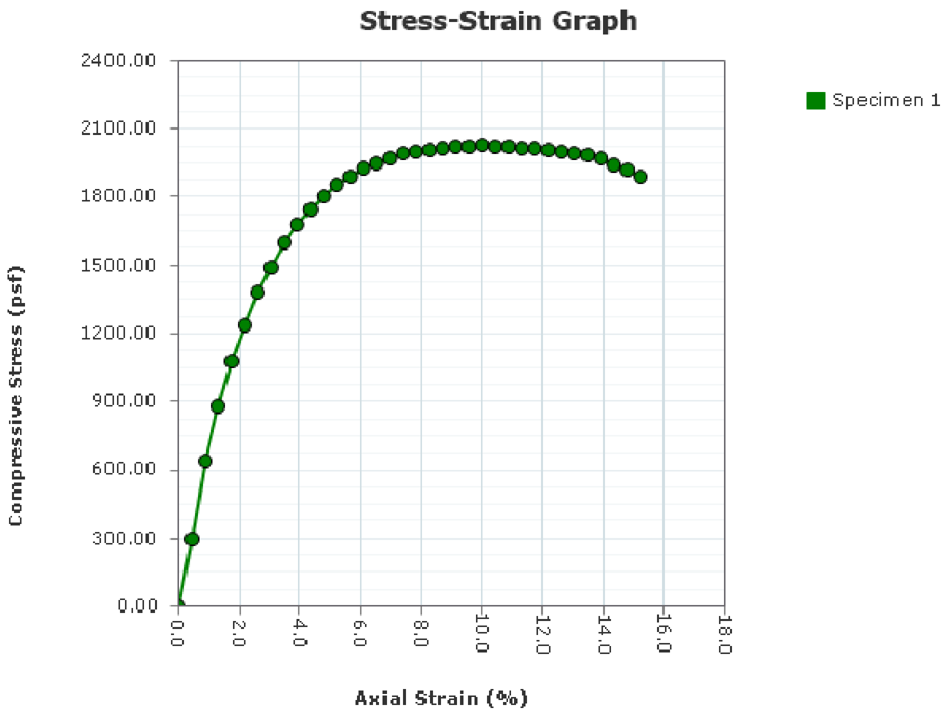
Specific Gravity:	2.72	Plastic Limit:	24	Liquid Limit:	56
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/7/2022
Sample Number:	ST 3
Sample Depth:	14.0-16.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/7/2022
Sampling Date:	4/7/2022
Sample Number:	ST 4
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	34.1							
Wet Density (pcf)	123.7							
Dry Density (pcf)	92.3							
Saturation (%):	110.3							
Void Ratio:	0.840							
Height (in)	5.7500							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1983.90							
Undrained Shear Strength (psf)	991.95							
Strain at Failure (%):	13.48							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/7/2022
Sample Number:	ST 4
Sample Depth:	24.0-26.0 ft
Boring Number:	STR 6W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 9W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West project in Glendale, KY. This summary is provided for Structure 9W, a double circuit, tangent dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
9W	Double Circuit	115	681	37°35'2.94"N	85°54'13.14"W	1,488	7,265

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 54 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of five inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown to reddish brown in color, moist to wet and medium stiff to stiff in soil strength consistency. The fat clay was typically described as reddish brown in color, containing varying amounts of gravel, wet to saturated and stiff to soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 9W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 9W	37°35’2.94”N	85°54’13.14”W	680.9	35.5	645.4

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 9W	CL	5.0-9.0	2.0	1.3
STR 9W	CH	9.0-35.5	1.0	0.6

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 9W	CL	5.0-9.0	0.024	200
STR 9W	CH	9.0-35.5	0.023	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 9W	CL	5.0-9.0	125.0	2.0	0.9
STR 9W	CH	9.0-35.5	120.0	1.0	0.9

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 9W GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Logs

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

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STR 9W
PAGE 1 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/28/22 **COMPLETED** 3/28/22
GROUND ELEVATION 680.9 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
∇ **AT TIME OF DRILLING** 29.00 ft / Elev 651.90 ft
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (5 INCHES)									
		(CL) lean CLAY, brown to reddish brown, moist, stiff	ST 1	100		2.0	25				
5			ST 2	100		1.75	24	40	23	17	Qu = 4,040 psf
10		(CH) fat CLAY with gravel, reddish brown, wet to saturated, stiff to soft	SPT 1	100	3-4-5 (9)	1.5	25				
15											
20			ST 3	95		1.5	30	56	27	29	Qu = 3,180 psf
25											
30	∇		SPT 2	100	2-2-2 (4)	0.25	41				
35											

(Continued Next Page)

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STR 9W
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
35		weathered LIMESTONE, gray, fine to medium grained, thin to thick bedded, hard, highly fractured	RC 1	47 (0)							
40			RC 2	12 (0)							
45			RC 3	34 (14)							
50		LIMESTONE with interbedded shale, gray, fine to medium grained, thin to thick bedded, hard to moderately hard	RC 4	80 (46)							

Refusal at 35.5 feet.
Bottom of borehole at 53.5 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 15:50 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

APPENDIX C

Laboratory Testing Results

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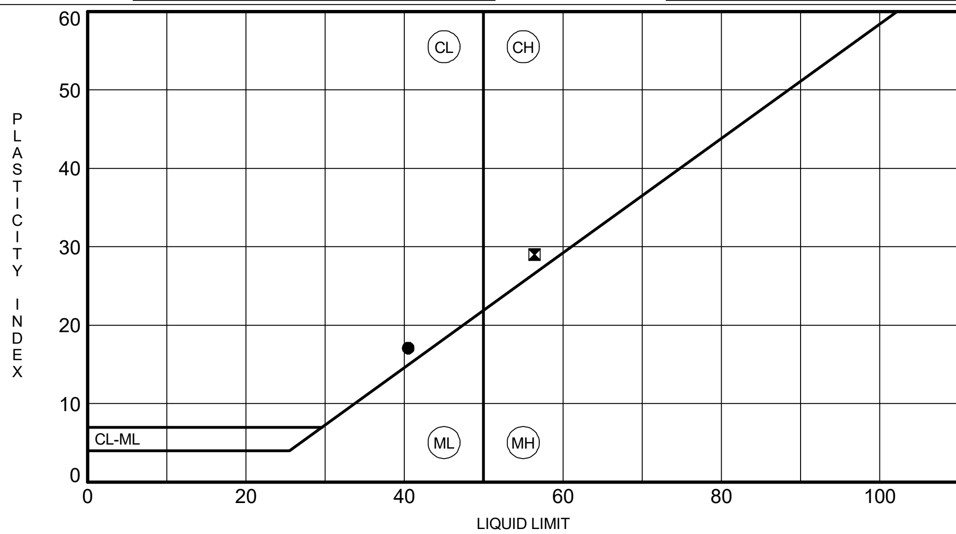
ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

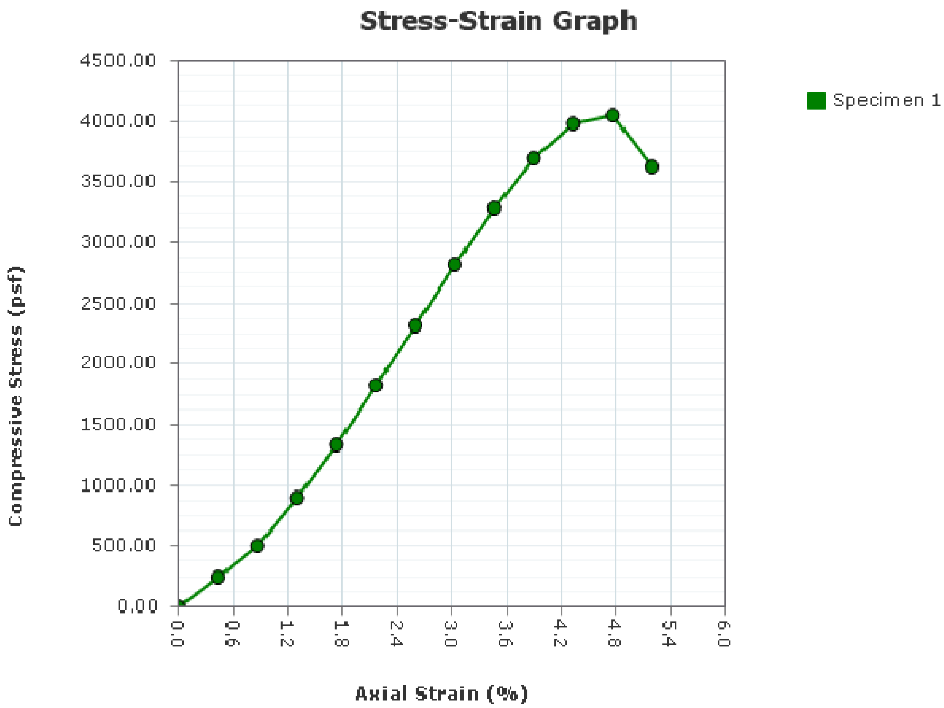


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 9W**	**4.0**	**40**	**23**	**17**		**(CL) LEAN CLAY**
⊠	**STR 9W**	**19.0**	**56**	**27**	**29**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/14/22 16:21 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/7/2022
Sampling Date:	4/7/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 9W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	23.7							
Wet Density (pcf)	130.9							
Dry Density (pcf)	105.8							
Saturation (%):	106.6							
Void Ratio:	0.604							
Height (in)	5.7700							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4045.55							
Undrained Shear Strength (psf)	2022.78							
Strain at Failure (%):	4.77							

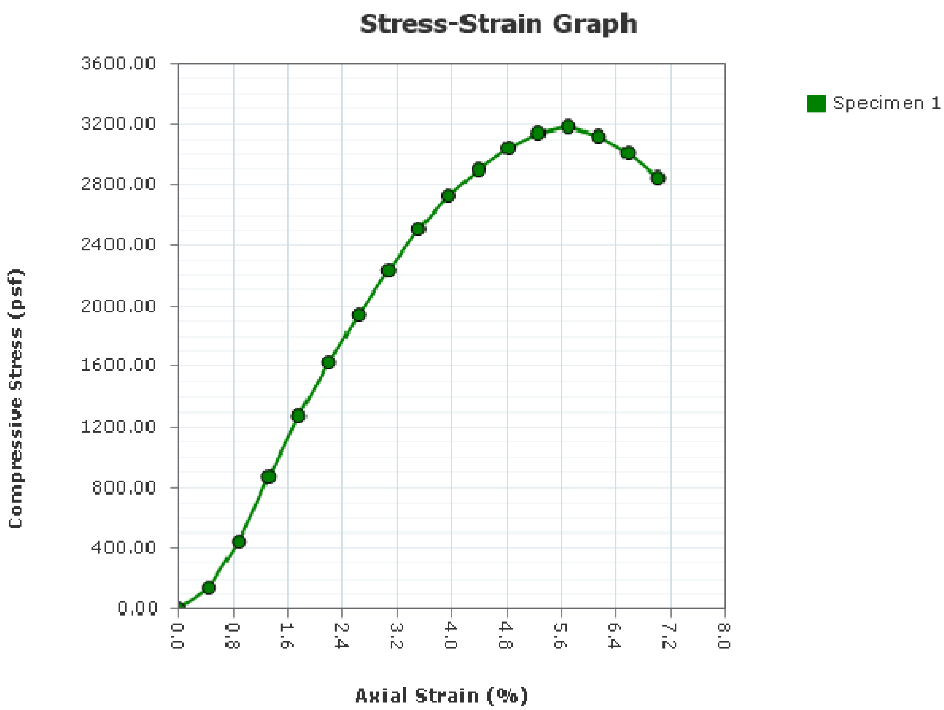
Specific Gravity:	2.72	Plastic Limit:	23	Liquid Limit:	40
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/7/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 9W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/7/2022
Sampling Date:	4/7/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 9W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Test Date: 4/7/2022 Checked By: ___________________ Date: _____________

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	37.1							
Wet Density (pcf)	120.2							
Dry Density (pcf)	87.7							
Saturation (%):	107.8							
Void Ratio:	0.937							
Height (in)	5.7000							
Diameter (in)	2.8000							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	3189.72							
Undrained Shear Strength (psf)	1594.86							
Strain at Failure (%):	5.70							

Specific Gravity:	2.72	Plastic Limit:	27	Liquid Limit:	56
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/7/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 9W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 12, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 10W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 10W, a double circuit, tangent dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
10W	Double Circuit	115	679.2	37°34'59.21"N	85°54'12.97"W	1,586	7,263

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 39 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of seven inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown to reddish brown in color, moist and very stiff in soil strength consistency. The fat clay was typically described as red to gray, containing trace to some gravel, moist and very stiff to medium stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 10W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal Depth (ft.)	Auger Refusal Elevation (ft.) MSL
STR 10W	37°34’59.21”N	85°54’12.97”W	679.8	29.8	650.0

5. FOUNDATION DESIGN PARAMETERS

5.1 __**Lateral Design Parameters**__ – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 10W	CL	5.0-9.0	2.3	1.4
STR 10W	CH	9.0-29.8	0.7	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 10W	CL	5.0-9.0	0.018	400
STR 10W	CH	9.0-29.8	0.007	-

5.2 <u>**Axial Design Parameters**</u> – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 10W	CL	5.0-9.0	125.0	2.3	1.0
STR 10W	CH	9.0-29.8	120.0	0.7	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS	NO. / DATE / DESCRIPTION
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 10W GLENDALE, KY
	AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
SHEET:	A-1

APPENDIX B

Boring Logs

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

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STR 10W
PAGE 1 OF 2

CLIENT LG&E and KU	**PROJECT NAME** Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032	**PROJECT LOCATION** Glendale, KY
DATE STARTED 3/25/22 **COMPLETED** 3/25/22	**GROUND ELEVATION** 679.828 ft
DRILLING CONTRACTOR Adam Thompson	**GROUND WATER LEVELS:**
DRILLING METHOD HSA/ Diamond impregnated coring bit	**AT TIME OF DRILLING** ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson	**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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (7 INCHES)									
		(CL) lean CLAY, brown to reddish brown, moist, very stiff	ST 1	100		1.0	24				
5			ST 2	85		2.5	23	41	20	21	Qu = 4,650 psf
10		(CH) fat CLAY, trace to some gravel, red to gray, moist, very stiff to medium stiff	SPT 1	100	4-17-10 (27)	-	26				
15											
20			ST 3	75		1.75	24	58	28	30	Qu = 1,570 psf
25											
30			SPT 2	100	2-50	-	30				
		weathered LIMESTONE with clay seams, gray, fine to medium grained, thin to thickly bedded, hard, highly fractured	RC 1	48 (19)							
35			RC	38							

(Continued Next Page)

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 15:54 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

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STR 10W
PAGE 2 OF 2

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
35		weathered LIMESTONE with clay seams, gray, fine to medium grained, thin to thickly bedded, hard, highly fractured *(continued)*	2	(12)							

Refusal at 29.8 feet.
Bottom of borehole at 39.0 feet.

APPENDIX C

Laboratory Testing Results

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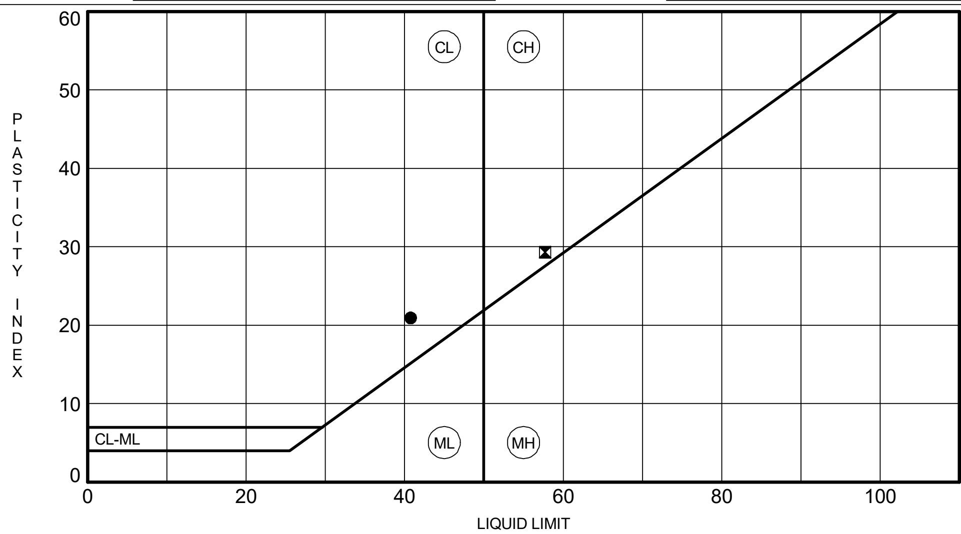
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

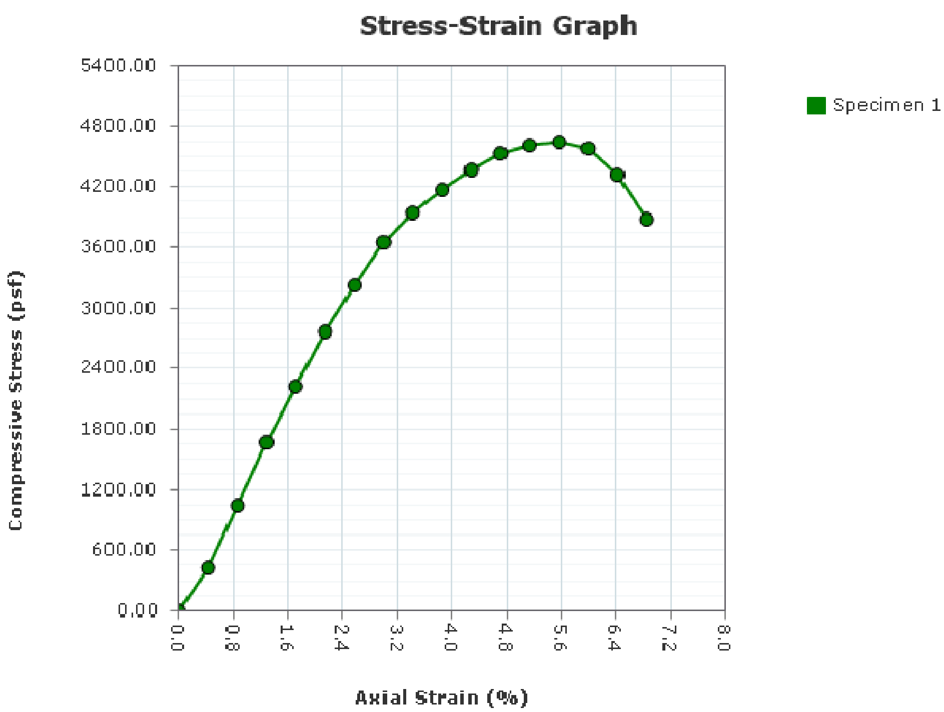


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 10W**	**4.0**	**41**	**20**	**21**		**(CL) LEAN CLAY**
⊠	**STR 10W**	**19.0**	**58**	**28**	**30**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/22/22 10:22 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 10W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

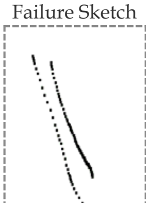
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	23.5							
Wet Density (pcf)	126.5							
Dry Density (pcf)	102.4							
Saturation (%):	97.2							
Void Ratio:	0.659							
Height (in)	5.8400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.71							
Unconfined Compressive Strength (psf)	4651.13							
Undrained Shear Strength (psf)	2325.56							
Strain at Failure (%):	5.57							

Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	41
Type:	UD	Soil Classification:	CL		

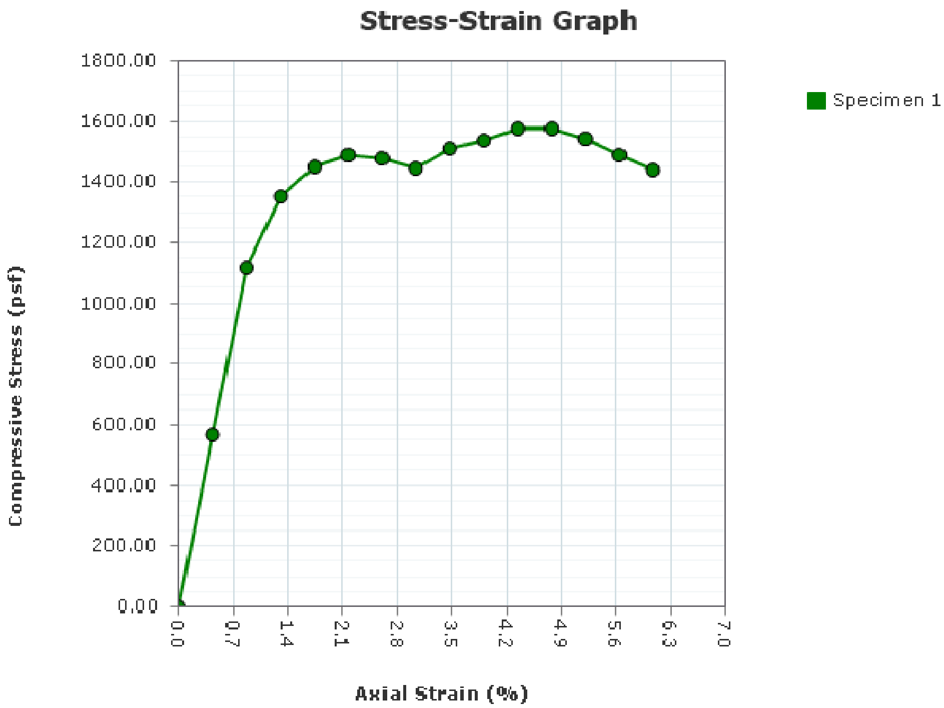
Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 10W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 10W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	39.9							
Wet Density (pcf)	112.6							
Dry Density (pcf)	80.5							
Saturation (%):	97.7							
Void Ratio:	1.110							
Height (in)	5.7600							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1574.82							
Undrained Shear Strength (psf)	787.41							
Strain at Failure (%):	4.77							

Specific Gravity:	2.72	Plastic Limit:	28	Liquid Limit:	58
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 10W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 11W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 11W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
11W	Double Circuit	110	667.0	37°34’51.56”N	85°54’12.63”W	9,855	5,467

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 44 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of seven inches. Beneath the surface material, lean clay was encountered to a depth of nine feet. Fat clay was encountered from nine feet to the auger refusal depth. The lean clay was typically described as brown to red in color, moist to wet and very stiff in soil strength consistency. The fat clay was typically described as red to brown and gray in color, containing varying amounts of gravel, moist to saturated and stiff to very soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 11W	37°34’51.56”N	85°54’12.63”W	667.0	32.8	634.2

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 11W	CL	5.0-9.0	2.1	1.3
STR 11W	CH	9.0-32.8	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 11W	CL	5.0-9.0	0.015	200
STR 11W	CH	9.0-32.8	0.020	-

5.2 **<u>Axial Design Parameters</u>** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 11W	CL	5.0-9.0	125.0	2.1	1.0
STR 11W	CH	9.0-32.8	120.0	0.5	0.7

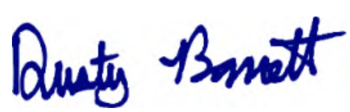
*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer



Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 11W GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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Glasgow, KY 42141
(270) 651-7220

STR 11W

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/25/22 **COMPLETED** 3/25/22
GROUND ELEVATION 667 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (7 INCHES)									
		(CL) lean CLAY, brown to red, moist to wet, very stiff	ST 1	100		1.0	22				
5			ST 2	100		2.5	26	46	21	25	Qu = 4,345 psf
10		(CH) fat CLAY with gravel, red, moist to wet, stiff to soft	SPT 1	20	5-6-7 (13)		27				
15											
20			ST 3	35		1.5	25				
			SPT 2	47	4-2-2 (4)		32				
25											
30		(CH) fat CLAY, brown and gray, saturated, very soft	SPT 3	100	2-1-0 (1)		70				
		LIMESTONE, gray, fine to medium grained, thin to thick bedded, hard	RC 1	90 (70)							
35			RC 2	100 (92)							
40			RC 3	98 (22)							
											Vertical fracture (42.3'-43.0')

Refusal at 32.8 feet.
Bottom of borehole at 43.8 feet.

APPENDIX C

Laboratory Testing Results

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Glasgow, KY 42141
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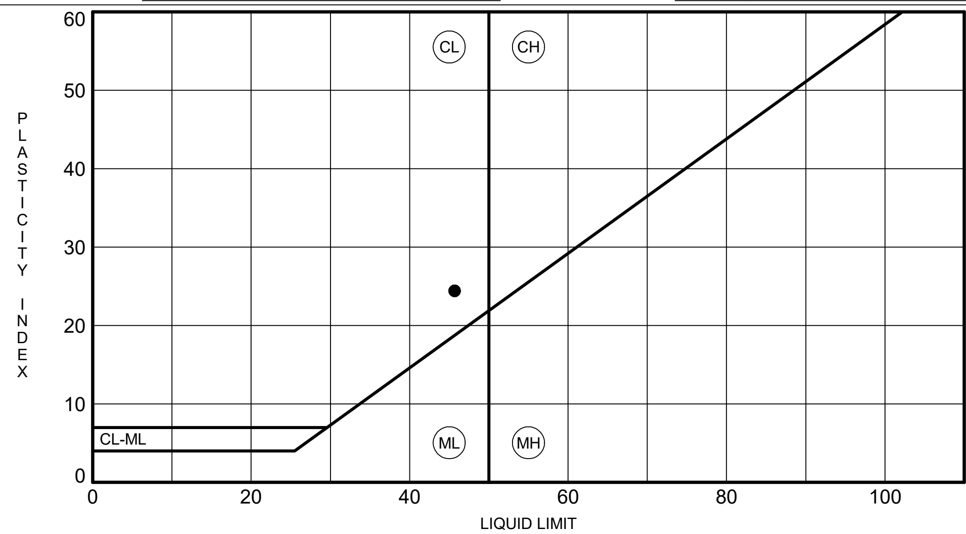
ATTERBERG LIMITS' RESULTS

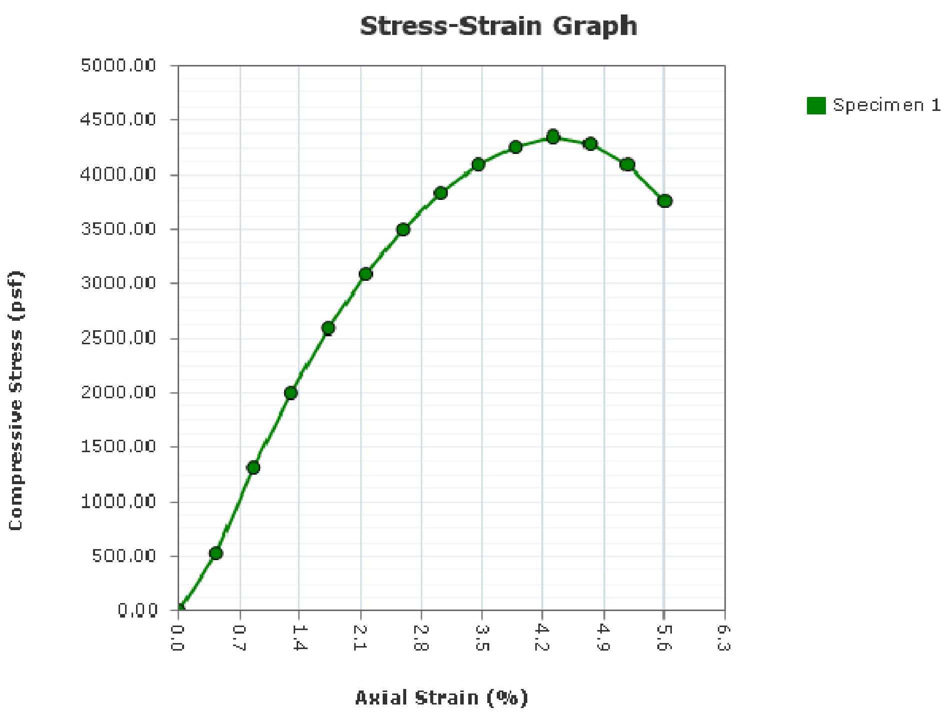
CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 11W**	**4.0**	**46**	**21**	**25**		**(CL) LEAN CLAY**

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/12/2022
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 11W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	25.9							
Wet Density (pcf)	123.3							
Dry Density (pcf)	97.9							
Saturation (%):	95.9							
Void Ratio:	0.734							
Height (in)	5.8000							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	4345.60							
Undrained Shear Strength (psf)	2172.80							
Strain at Failure (%):	4.31							

Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	46
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/12/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 11W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch | Specimen 2 Failure Sketch | Specimen 3 Failure Sketch | Specimen 4 Failure Sketch | Specimen 5 Failure Sketch | Specimen 6 Failure Sketch | Specimen 7 Failure Sketch | Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

April 14, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 14W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 14W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
14W	Double Circuit	100	671.1	37°34'49.41"N	85°53'49.42"W	8,477	4,945

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 43 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 19 feet. Fat clay was encountered from 19 feet to the auger refusal depth. The lean clay was typically described as brown to red in color, containing varying amounts of gravel, moist and medium stiff in soil strength consistency. The fat clay was typically described as red to brown in color, containing varying amounts of gravel, saturated and very soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 14W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 14W	37°34’49.41”N	85°53’49.42”W	670.5	31.3	639.2

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 14W	CL	5.0-19.0	0.7	0.4
STR 14W	CH	19.0-32.0	0.6	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 14W	CL	5.0-19.0	0.02	-
STR 14W	CH	19.0-32.0	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 14W	CL	5.0-19.0	125.0	0.7	0.7
STR 14W	CH	19.0-32.0	120.0	0.6	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE #14W GLENDALE,KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-06-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Log

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

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

STR 14W

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/23/22 **COMPLETED** 3/24/22
GROUND ELEVATION 670.5 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (6 INCHES)									
	(CL) lean CLAY, brown to red, moist, medium stiff	ST 1	100		1.25	19				Qu = 1,700 psf
5		ST 2	100		1.0	15	25	12	13	Qu = 1,160 psf
10	(CL) lean CLAY, trace to some gravel, red and brown, moist, stiff	SPT 1	60	6-5-6 (11)	1.5	18				
15										
20	(CH) fat CLAY with gravel, red to brown, saturated, very soft	ST 3	75		1.0	33	53	24	29	Qu = 2,030 psf
25										
30		SPT 2	67	12-2-0 (2)	0.25	37				
	LIMESTONE interbedded with shale, light gray to white, soft to hard, very thin to thick bedded	RC 1	44 (20)							
35		RC 2	46 (34)							
										Void (37.8'-40.5')
40		RC 3	109 (96)							

Refusal at 31.3 feet.
Bottom of borehole at 43.3 feet.

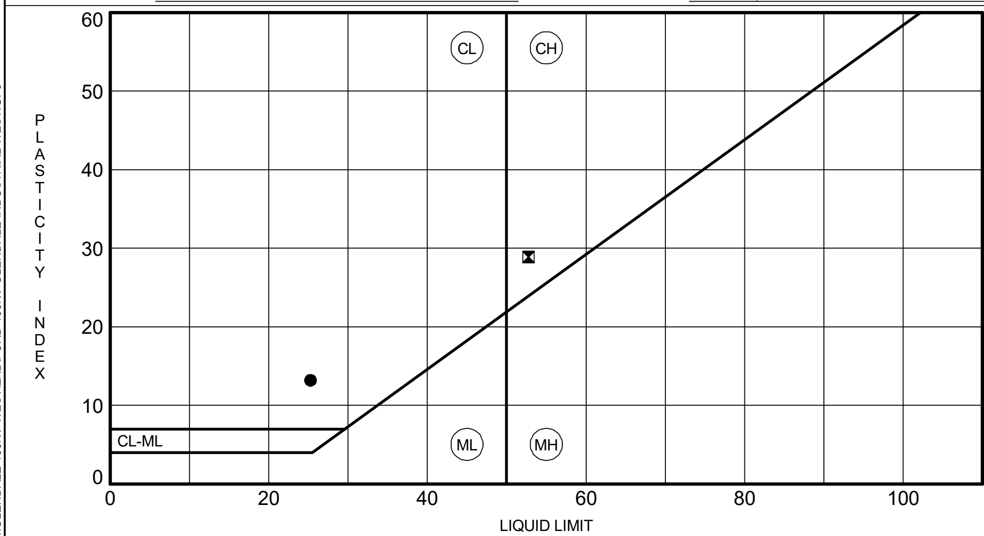
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

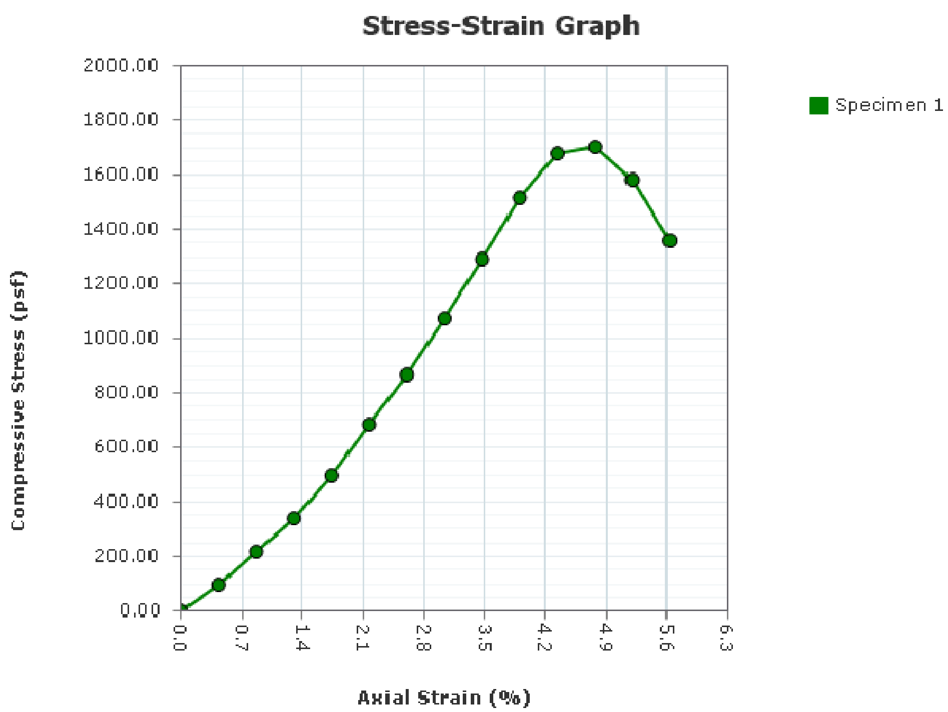


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 14W**	**4.0**	**25**	**12**	**13**		**(CL) LEAN CLAY**
⧗	**STR 14W**	**19.0**	**53**	**24**	**29**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/14/22 15:15 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/24/2022
Sampling Date:	3/24/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

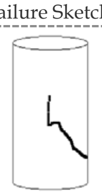
ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	19.0							
Wet Density (pcf)	128.1							
Dry Density (pcf)	107.6							
Saturation (%):	89.6							
Void Ratio:	0.577							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1702.49							
Undrained Shear Strength (psf)	851.24							
Strain at Failure (%):	4.77							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/24/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

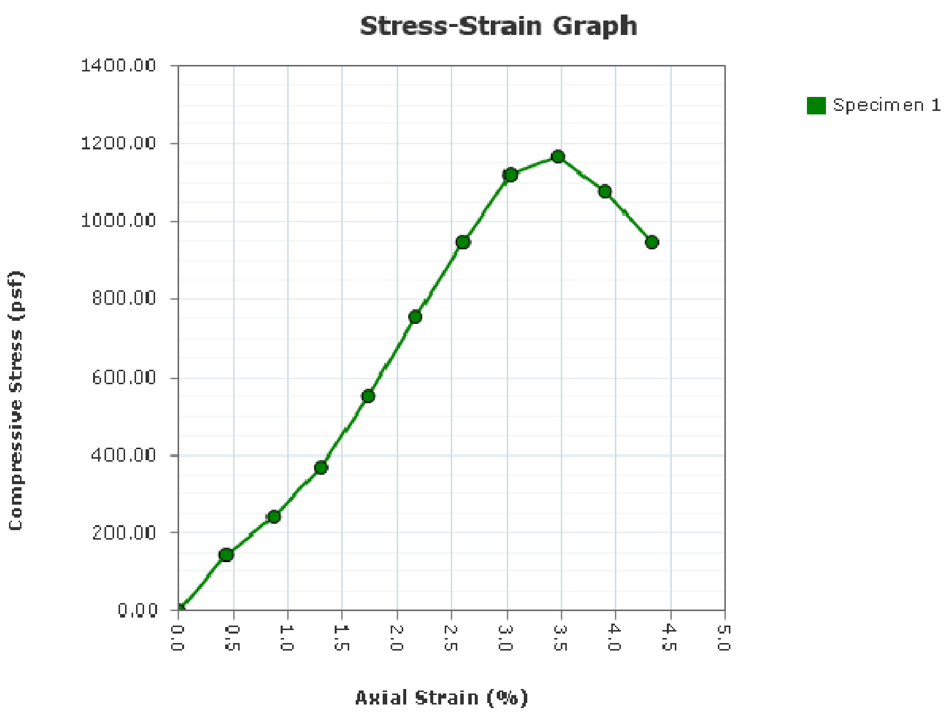
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/24/2022
Sampling Date:	3/24/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	14.5							
Wet Density (pcf)	126.8							
Dry Density (pcf)	110.7							
Saturation (%):	74.2							
Void Ratio:	0.534							
Height (in)	5.7700							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1167.75							
Undrained Shear Strength (psf)	583.88							
Strain at Failure (%):	3.47							

Specific Gravity:	2.72	Plastic Limit:	12	Liquid Limit:	25
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/24/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

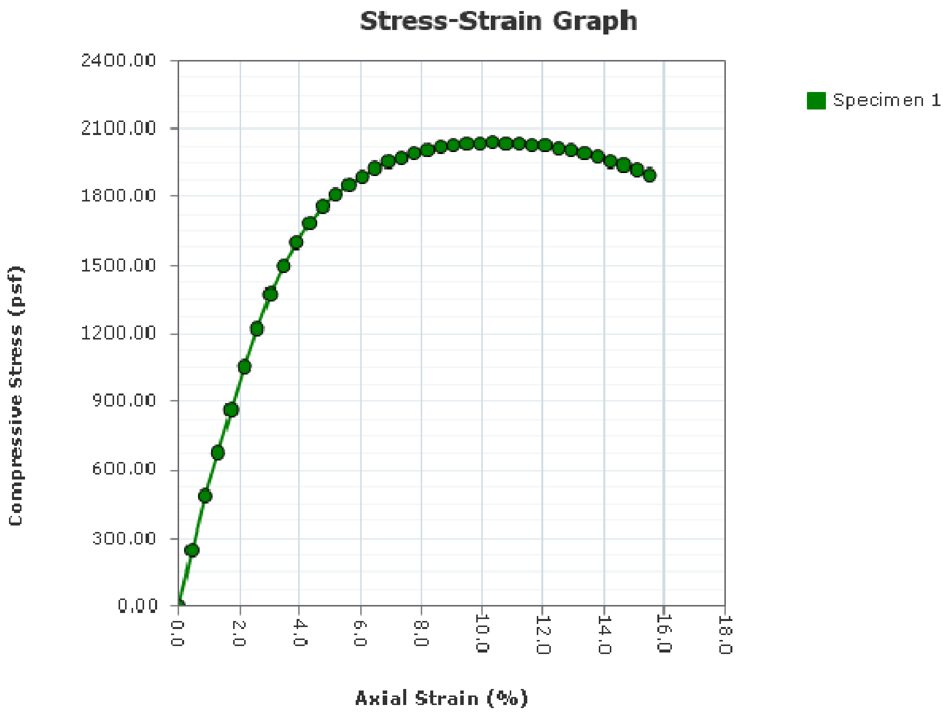
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/24/2022
Sampling Date:	3/24/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	32.7							
Wet Density (pcf)	118.1							
Dry Density (pcf)	89.0							
Saturation (%):	98.0							
Void Ratio:	0.908							
Height (in)	5.8000							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	2029.11							
Undrained Shear Strength (psf)	1014.56							
Strain at Failure (%):	12.07							

Specific Gravity:	2.72	Plastic Limit:	24	Liquid Limit:	53
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/24/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #14W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 18W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 18W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
18W	Double Circuit	110	678.7	37°35'9.19"N	85°53'41.63"W	10,410	5,214

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 53 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of six inches. Beneath the surface material, lean clay was encountered to a depth of 29 feet. Fat clay was encountered from 29 feet to the auger refusal depth. The lean clay was typically described as brown and gray to red with black mottle in color, containing trace to some gravel, moist and very stiff to medium stiff in soil strength consistency. The fat clay was typically described as brown in color, containing varying amounts of gravel, moist to saturated and medium stiff to soft in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 18W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 18W	37°35’9.19”N	85°53’41.63”W	679.0	53.0	626.0

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 18W	CL	5.0-29.0	1.6	0.8
STR 18W	CH	29.0-53.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 18W	CL	5.0-29.0	0.017	200
STR 18W	CH	29.0-53.0	0.020	-

5.2 <u>**Axial Design Parameters**</u> – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 18W	CL	5.0-29.0	125.0	1.6	1.0
STR 18W	CH	29.0-39.0	120.0	0.5	0.8
STR 18W	CH	29.0-53.0	57.6	0.5	0.8

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 18W GLENDALE, KY
CLIENT:	LG&E and KU
	BORING LAYOUT
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
SHEET:	A-1

AEI
AMERICAN ENGINEERS, INC.
DESIGNING YOUR FUTURE
65 Aberdeen Drive Glasgow KY
270.651.7220

REVISIONS		
NO.	DATE	DESCRIPTION

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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

STR 18W
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NUMBER 222-032
DATE STARTED 3/24/22 **COMPLETED** 3/24/22
DRILLING CONTRACTOR Adam Thompson
DRILLING METHOD Hollow Stem Auger
LOGGED BY Aaron Anderson **CHECKED BY** Aaron Anderson
NOTES

PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT LOCATION Glendale, KY
GROUND ELEVATION 679 ft
GROUND WATER LEVELS:
▽ **AT TIME OF DRILLING** 39.00 ft / Elev 640.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (6 INCHES)									
0.5	(CL) lean CLAY, brown and gray, moist, very stiff to stiff									
		ST 1	95		4.5+	19	31	17	14	Qu = 4,790 psf
10		ST 2	90		1.0	20				Qu = 3,000 psf
20	(CL) lean CLAY, trace to some gravel, red with black mottle, moist, medium stiff	SPT 1	67	4-3-5 (8)	1.25	22				
30	(CH) fat CLAY with gravel, brown, moist to saturated, medium stiff to soft	ST 3	100		1.0	29	57	26	31	Qu = 1,250 psf
39 ▽										
40		SPT 2	100	1-2-1 (3)	0.0	49				
50										

Refusal at 53.0 feet.
Bottom of borehole at 53.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 16:03 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

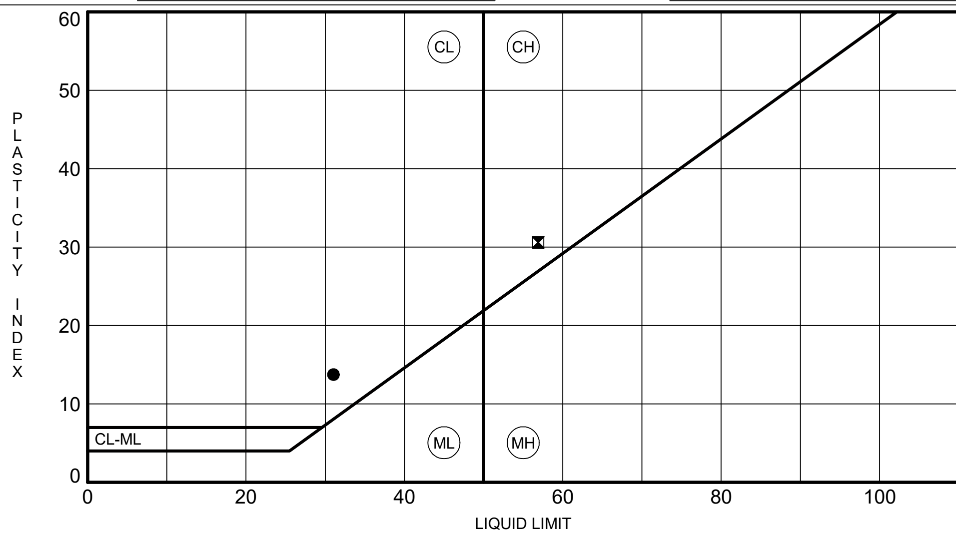
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

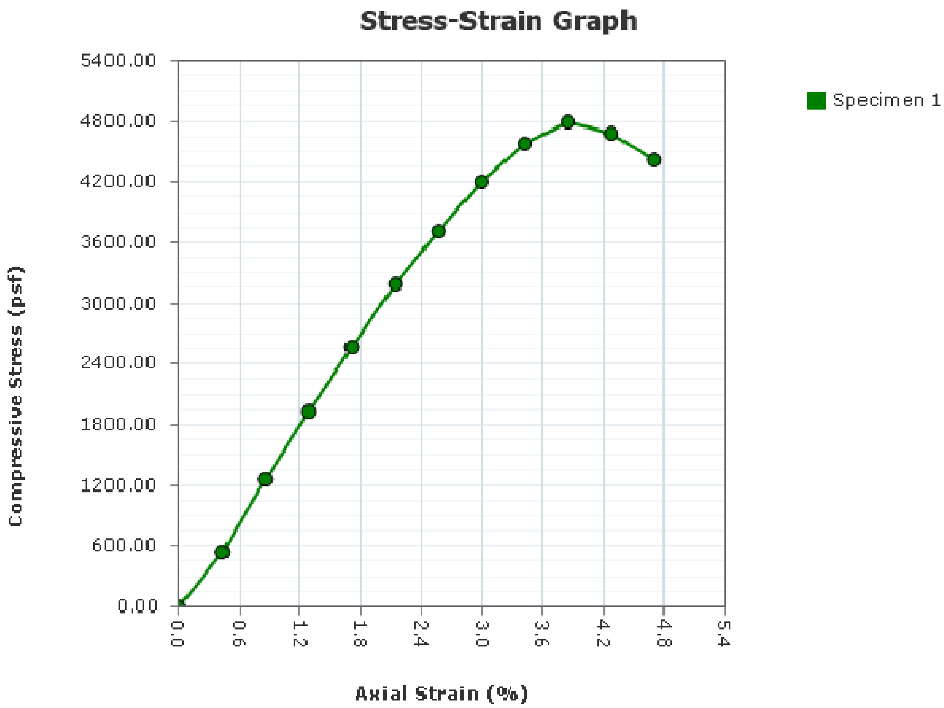


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 18W**	**4.0**	**31**	**17**	**14**		**(CL) LEAN CLAY**
⊠	**STR 18W**	**29.0**	**57**	**26**	**31**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/28/22 14:04 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	17.2							
Wet Density (pcf)	128.8							
Dry Density (pcf)	110.0							
Saturation (%):	85.8							
Void Ratio:	0.544							
Height (in)	5.8500							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.71							
Unconfined Compressive Strength (psf)	4797.71							
Undrained Shear Strength (psf)	2398.86							
Strain at Failure (%):	3.85							

Specific Gravity:	2.72	Plastic Limit:	17	Liquid Limit:	31
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 1
Sample Depth:	4.0-6.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

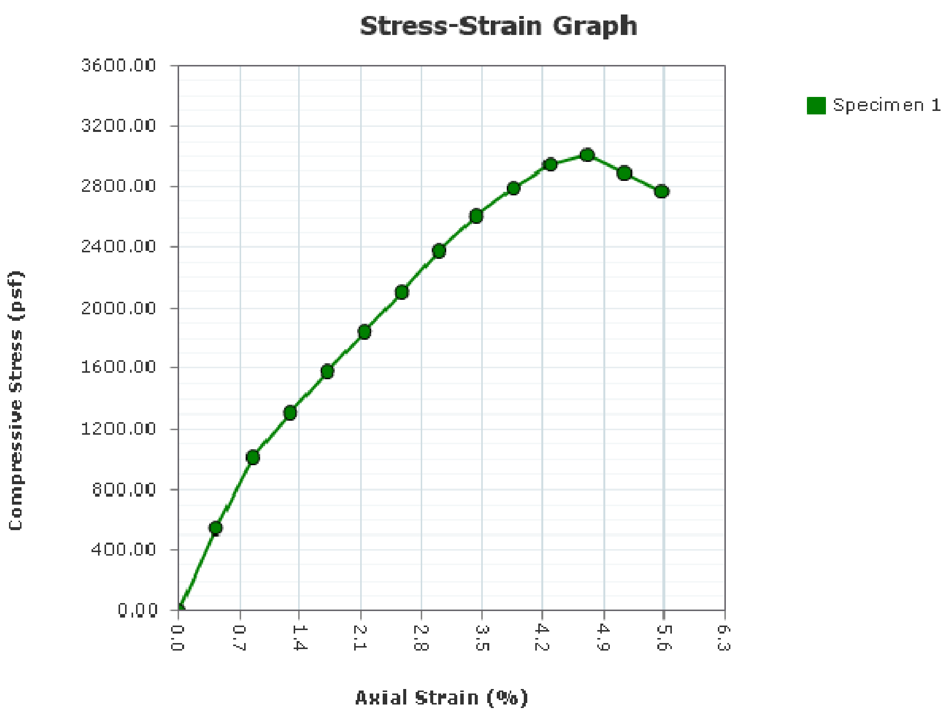
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	9.0-11.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	26.5							
Wet Density (pcf)	123.4							
Dry Density (pcf)	97.5							
Saturation (%):	97.3							
Void Ratio:	0.742							
Height (in)	5.8400							
Diameter (in)	2.8300							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.71							
Unconfined Compressive Strength (psf)	3006.15							
Undrained Shear Strength (psf)	1503.07							
Strain at Failure (%):	4.71							

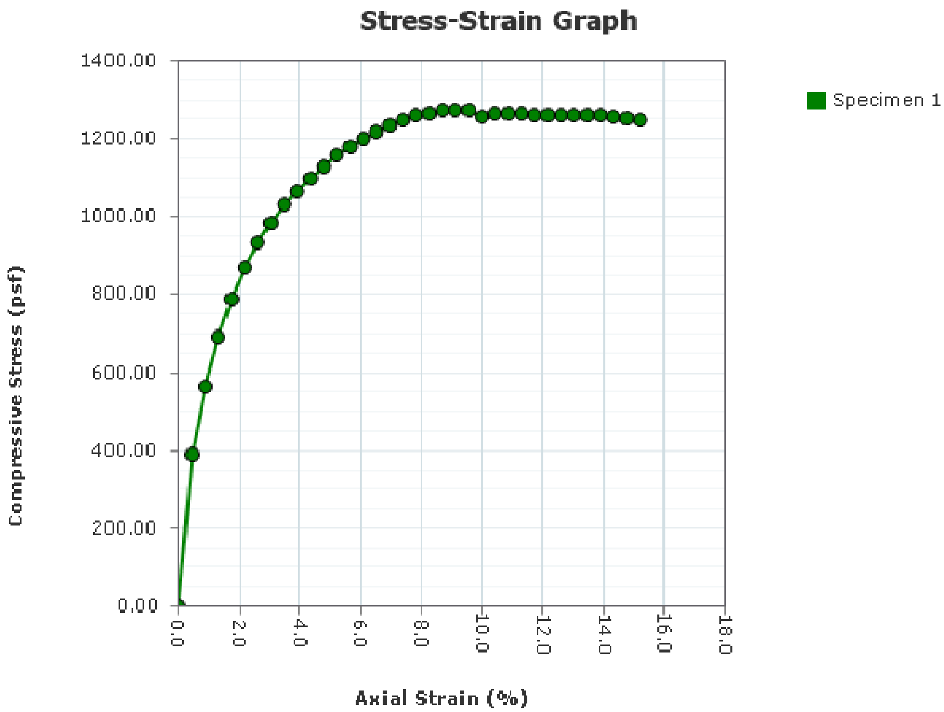
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 2
Sample Depth:	9.0-11.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	4/11/2022
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	29.0-31.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	32.7							
Wet Density (pcf)	123.0							
Dry Density (pcf)	92.7							
Saturation (%):	106.9							
Void Ratio:	0.832							
Height (in)	5.7600							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	1252.89							
Undrained Shear Strength (psf)	626.45							
Strain at Failure (%):	14.76							

Specific Gravity:	2.72	Plastic Limit:	26	Liquid Limit:	57
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	4/11/2022
Sample Number:	ST 3
Sample Depth:	29.0-31.0 ft
Boring Number:	STR 18W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 21W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 21W, a double circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
21W	Double Circuit	100	703.9	37°35’3.583”N	85°53’17.327”W	8,918	4,818

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 46 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered to a depth of about eight inches. Beneath the surface material, lean clay and fat clay were encountered to the auger refusal depth. The lean clay was typically described as light brown to reddish brown in color, containing trace amounts of gravel, wet and very stiff to stiff. The fat clay was typically described as reddish brown, containing varying amounts of gravel (gravel contents increased with depth), wet to saturated, and medium stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 21W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 21W	37°35'3.583"N	85°53'17.327"W	703.6	46.4	657.2

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 21W	CL	5.0-19.0	1.8	1.0
STR 21W	CH	19.0-28.0	1.5	0.8
STR 21W	CH	28.0-46.4	0.8	0.4

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 21W	CL	5.0-19.0	0.02	200
STR 21W	CH	19.0-28.0	0.015	200
STR 21W	CH	28.0-46.4	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 21W	CL	5.0-19.0	125.0	1.8	1.0
STR 21W	CH	19.0-28.0	120.0	1.5	1.0
STR 21W	CH	28.0-46.4	57.6	0.8	0.8

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

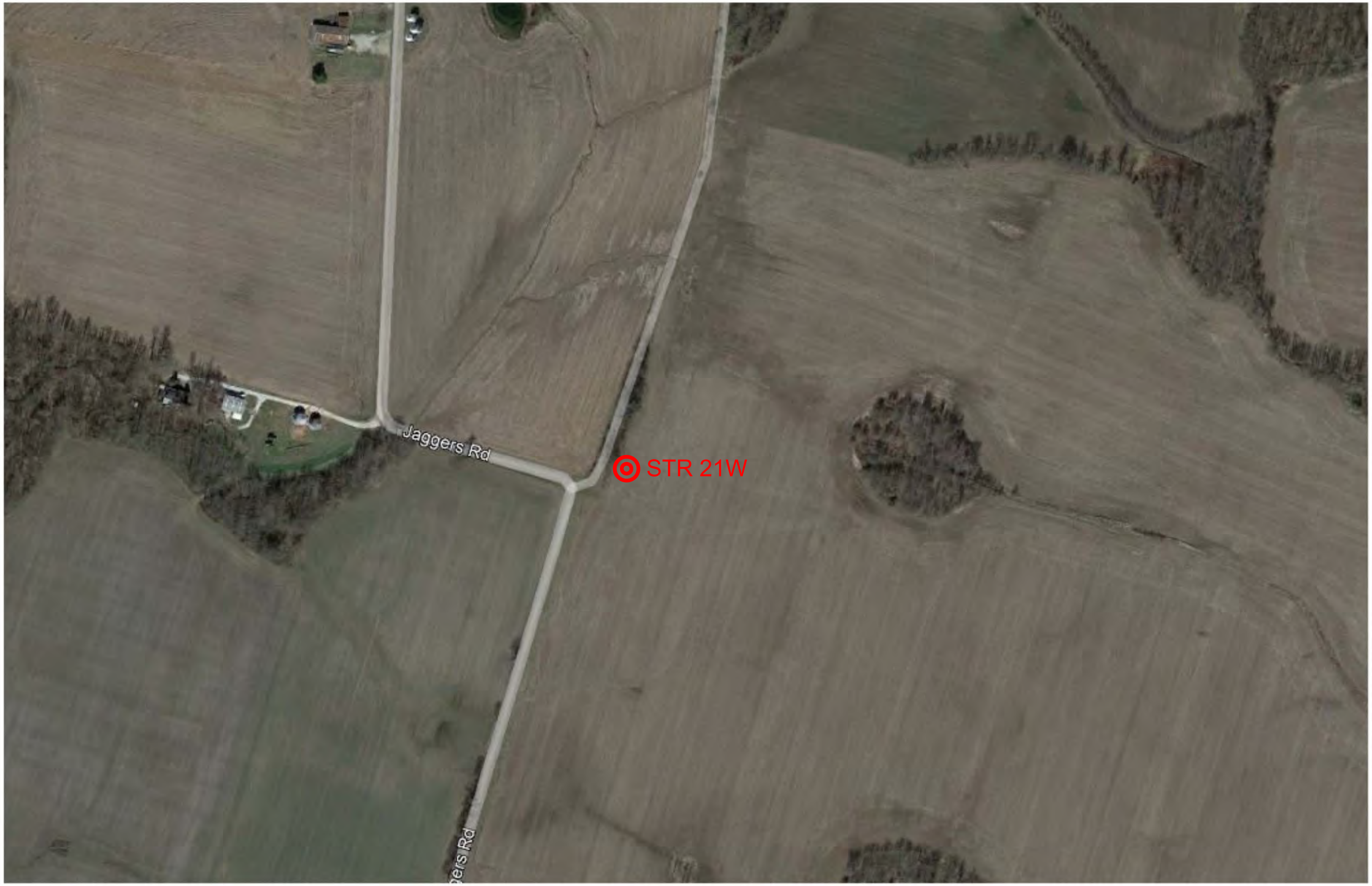
Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout



LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 21W
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-08-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 138kV West \STR #21W\Support Information
SHEET:	A-1

APPENDIX B

Boring Log

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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Glasgow, KY 42141
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STR 21W
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/15/22 **COMPLETED** 3/16/22
GROUND ELEVATION 703.6 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers
▽ **AT TIME OF DRILLING** 27.60 ft / Elev 676.00 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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 (8 INCHES)									
		(CL) lean CLAY, trace gravel, light brown to reddish brown, wet, very stiff to stiff	ST 1	90		4.5+	25				Qu = 2,920 psf
5			ST 2	100		3.75	19	32	19	13	Qu = 5,430 psf
10			SPT 1	100	4-5-6 (11)	3.0	23				
15											
20		(CH) fat CLAY, trace to some gravel, reddish brown, wet, stiff	ST 3	100		3.25	36	58	25	33	3,080 psf
25		▽									
		(CH) fat CLAY with gravel, reddish brown, saturated to wet, medium stiff									
30			SPT 2	87	5-4-3 (7)	2.75	40				
35											
40			ST 4	100		1.25	35	53	21	32	Qu = 1,620 psf
45											

Refusal at 46.4 feet.
Bottom of borehole at 46.4 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 5/5/22 16:09 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

APPENDIX C

Laboratory Testing Results

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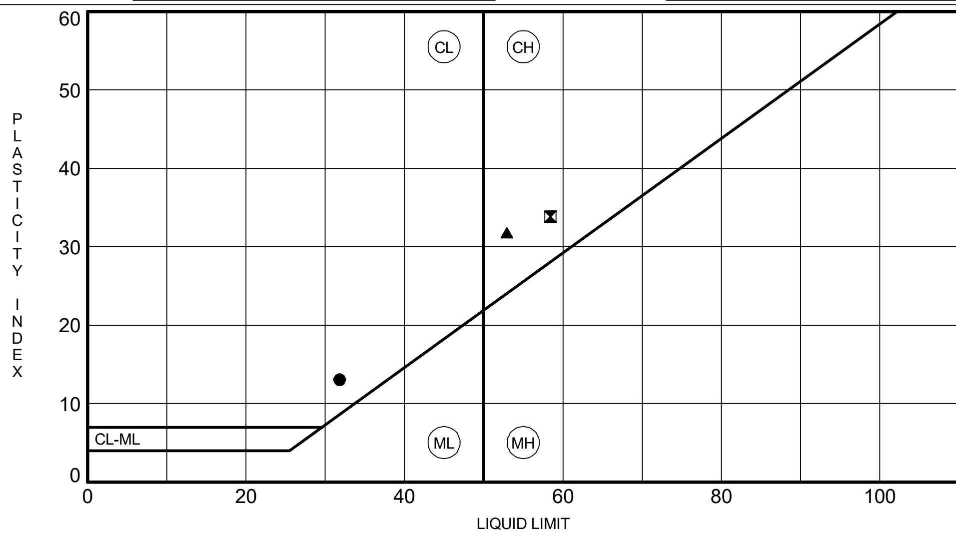
65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

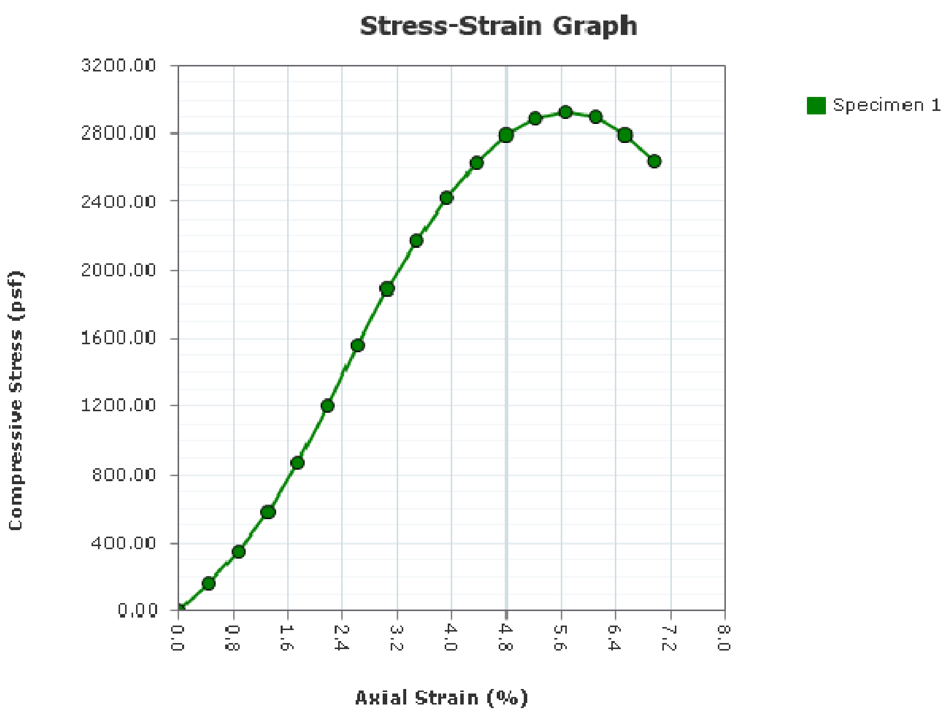


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #21W**	**4.0**	**32**	**19**	**13**		**(CL) LEAN CLAY**
⊠	**STR #21W**	**19.0**	**58**	**25**	**33**		**(CH) FAT CLAY**
▲	**STR #21W**	**39.0**	**53**	**21**	**32**		**(CH) FAT CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/8/22 09:24 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/17/2022
Sampling Date:	3/17/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	21.2							
Wet Density (pcf)	128.4							
Dry Density (pcf)	105.9							
Saturation (%):	95.6							
Void Ratio:	0.603							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2928.07							
Undrained Shear Strength (psf)	1464.04							
Strain at Failure (%):	5.66							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/17/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

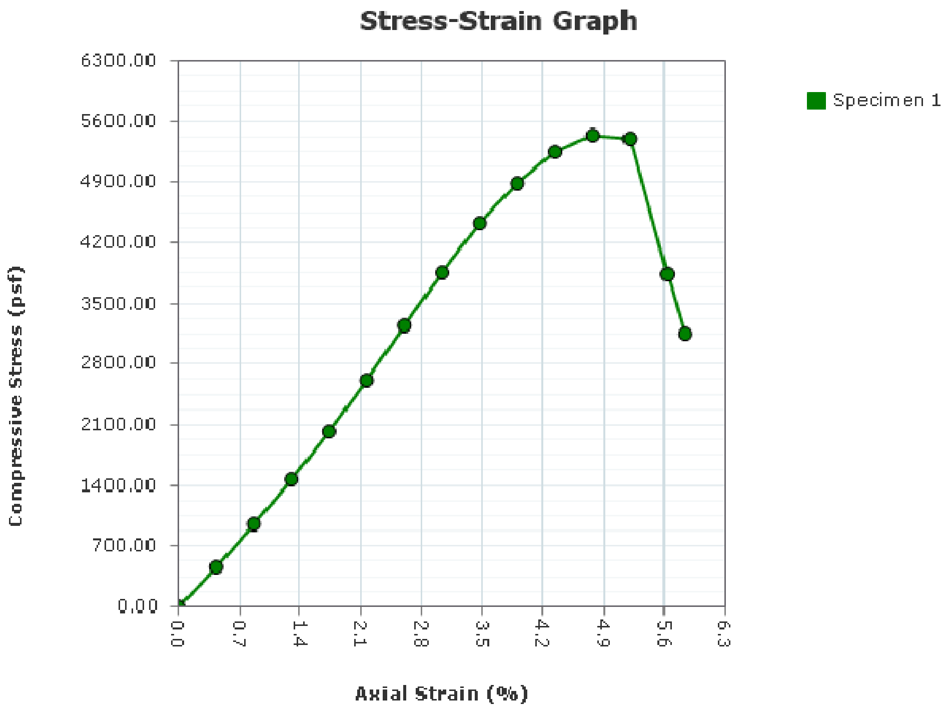
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/17/2022
Sampling Date:	3/17/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

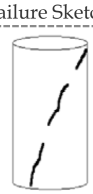
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	19.6							
Wet Density (pcf)	130.7							
Dry Density (pcf)	109.3							
Saturation (%):	96.1							
Void Ratio:	0.553							
Height (in)	5.7700							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	5434.77							
Undrained Shear Strength (psf)	2717.39							
Strain at Failure (%):	4.77							

Specific Gravity:	2.72	Plastic Limit:	19	Liquid Limit:	32
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/17/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

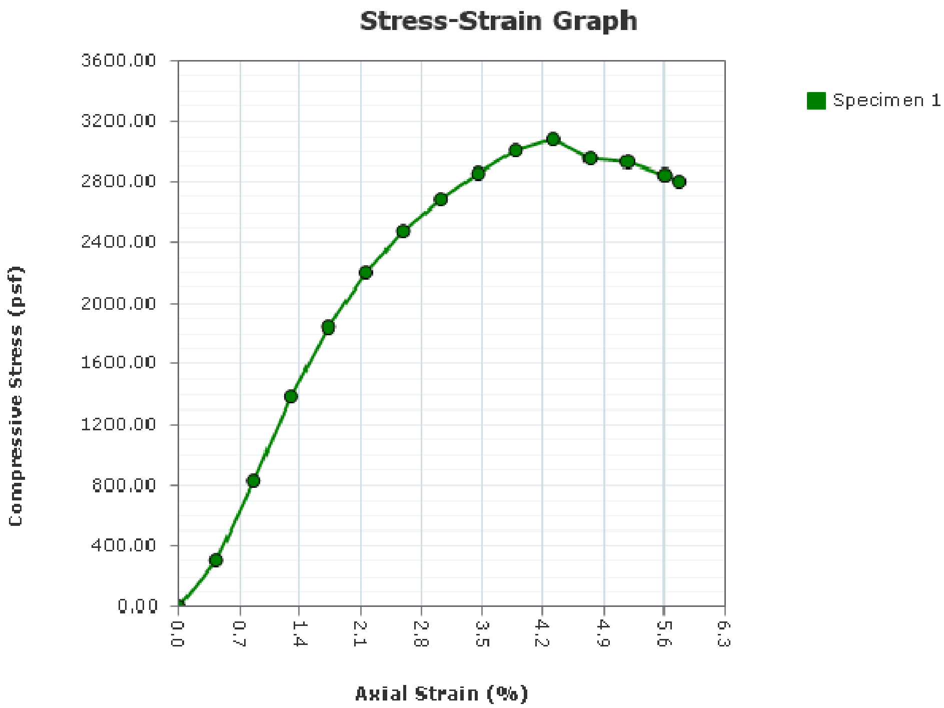
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/17/2022
Sampling Date:	3/17/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

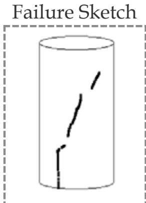
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	32.7							
Wet Density (pcf)	117.4							
Dry Density (pcf)	88.4							
Saturation (%):	96.7							
Void Ratio:	0.920							
Height (in)	5.8000							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	3084.42							
Undrained Shear Strength (psf)	1542.21							
Strain at Failure (%):	4.31							

Specific Gravity:	2.72	Plastic Limit:	25	Liquid Limit:	58
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/17/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

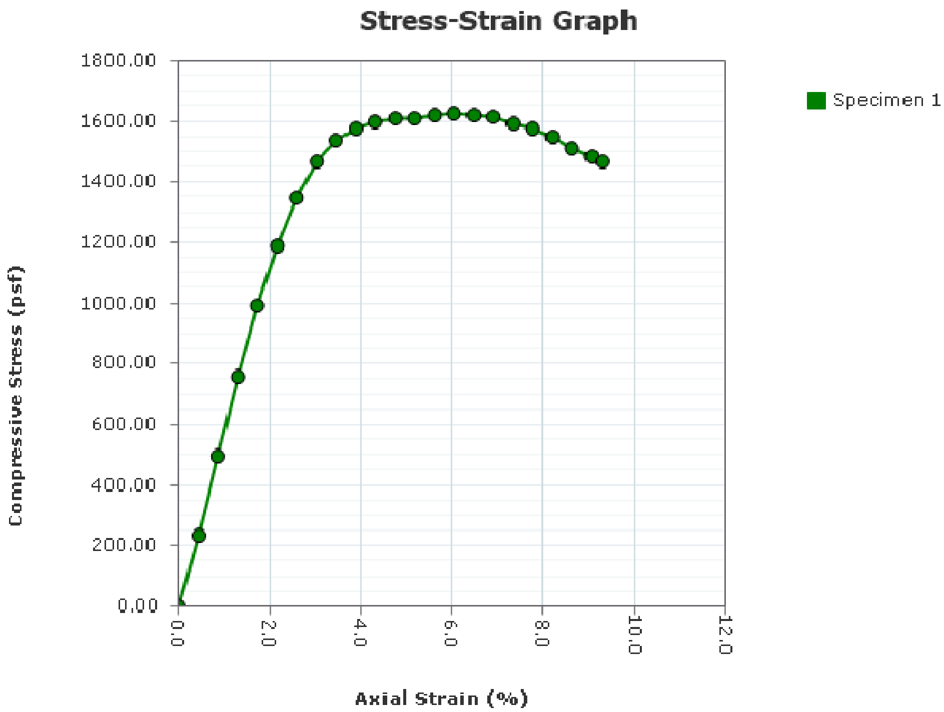
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/17/2022
Sampling Date:	3/17/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR 21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

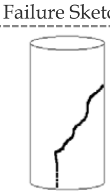
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	34.8							
Wet Density (pcf)	117.9							
Dry Density (pcf)	87.4							
Saturation (%):	100.6							
Void Ratio:	0.942							
Height (in)	5.7900							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1622.47							
Undrained Shear Strength (psf)	811.24							
Strain at Failure (%):	6.48							

Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	53
Type:	UD	Soil Classification:	CH		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/17/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR 21W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

May 5, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford 138kV Glendale Industrial West
Structure 24W
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford 138kV Glendale Industrial West in Glendale, KY. This summary is provided for Structure 24W, a double circuit, angle dead end which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
24W	Double Circuit	110	691.7	37°34’42.58”N	85°53’21.88”W	10,578	5,178

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of 34 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of nine inches. Beneath the surface material, lean clay was encountered to the auger refusal depth. The lean clay was typically described as reddish brown in color, containing varying amounts of gravel, wet and soft to stiff in soil strength consistency.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 24W – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 24W	37°34’42.58”N	85°53’21.88”W	691.6	34.0	657.6

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Soil Type	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 24W	CL	5.0-9.0	0.4	0.3
STR 24W	CL	9.0-34.0	1.2	0.7

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 24W	CL	5.0-9.0	0.007	-
STR 24W	CL	9.0-34.0	0.021	200

5.2 **<u>Axial Design Parameters</u>** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 24W	CL	5.0-9.0	125.0	0.4	0.5
STR 24W	CL	9.0-34.0	125.0	1.2	0.9

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
	BORING LAYOUT
CLIENT:	LG&E and KU
PROJECT:	FORD 138kV GLENDALE INDUSTRIAL WEST STRUCTURE 24W GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	04-13-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Log

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

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

STR 24W
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/18/22 **COMPLETED** 3/18/22
GROUND ELEVATION 691.6 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (9 INCHES)									
		(CL) lean CLAY, reddish brown, wet, soft to stiff	ST 1	100		2.75	23				Qu = 740 psf
5			ST 2	100		3.25	26	44	21	23	Qu = 840 psf
10			SPT 1	100	5-5-6 (11)	3.75	26				
15											
20		(CL) lean CLAY, trace to some gravel, reddish brown, wet, stiff	ST 3	90		4.5+	29	47	22	25	Qu = 2,210 psf
25											
30			SPT 2	20	4-7-5 (12)	<0.25	27				

Refusal at 34.0 feet.
Bottom of borehole at 34.0 feet.

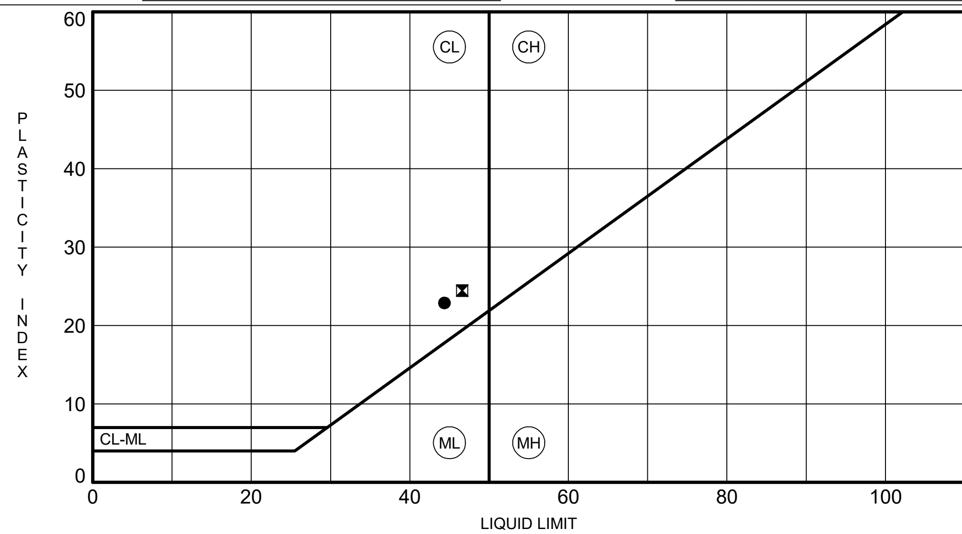
APPENDIX C

Laboratory Testing Results

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

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford 138kV Glendale Industrial West
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

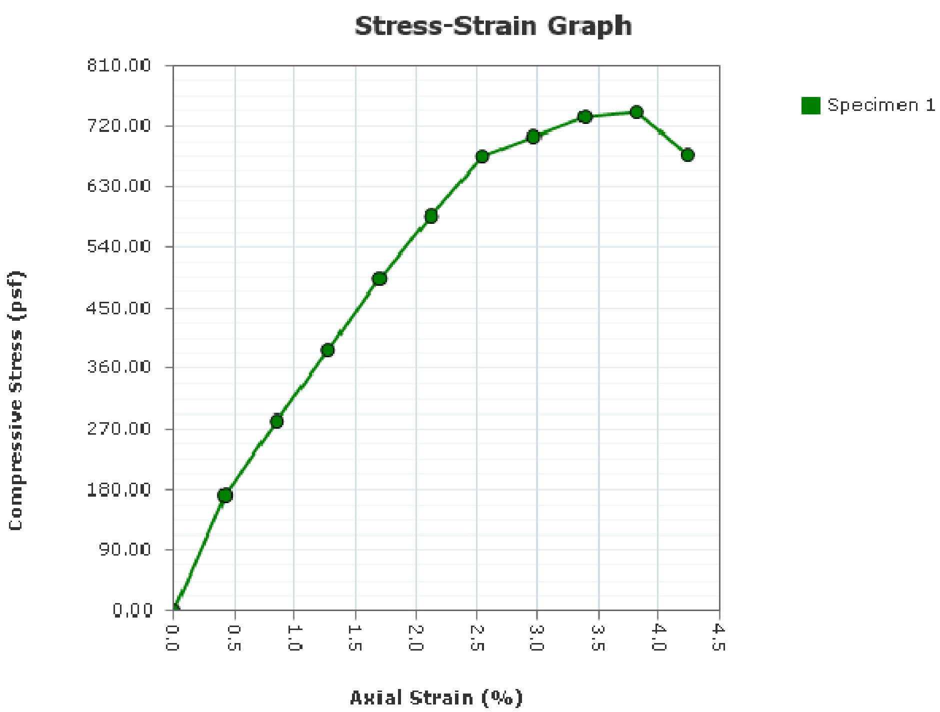


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 24W**	**4.0**	**44**	**21**	**23**		**(CL) LEAN CLAY**
⊠	**STR 24W**	**19.0**	**47**	**22**	**25**		**(CL) LEAN CLAY**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/28/22 15:56 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 138KV WEST\LAB\FORD 138KV GLENDALE INDUSTRIAL WEST.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.0							
Wet Density (pcf)	123.3							
Dry Density (pcf)	101.0							
Saturation (%):	87.9							
Void Ratio:	0.680							
Height (in)	5.9000							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.69							
Unconfined Compressive Strength (psf)	741.33							
Undrained Shear Strength (psf)	370.67							
Strain at Failure (%):	3.81							

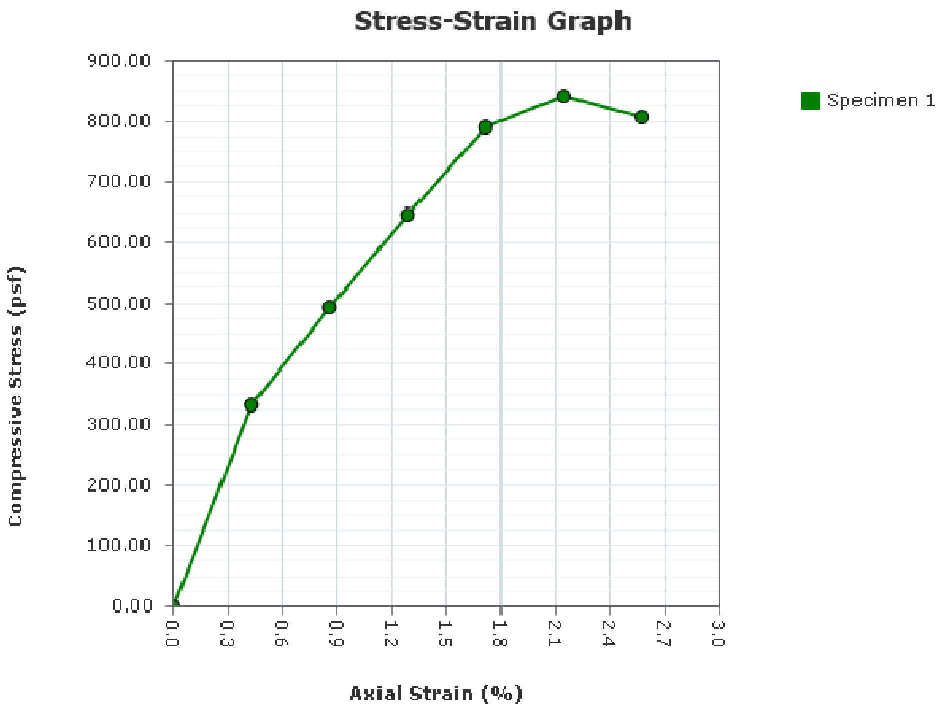
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/18/2022
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	24.9							
Wet Density (pcf)	122.2							
Dry Density (pcf)	97.8							
Saturation (%):	92.2							
Void Ratio:	0.736							
Height (in)	5.8300							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.07							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	843.23							
Undrained Shear Strength (psf)	421.62							
Strain at Failure (%):	2.14							

Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	44
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/18/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

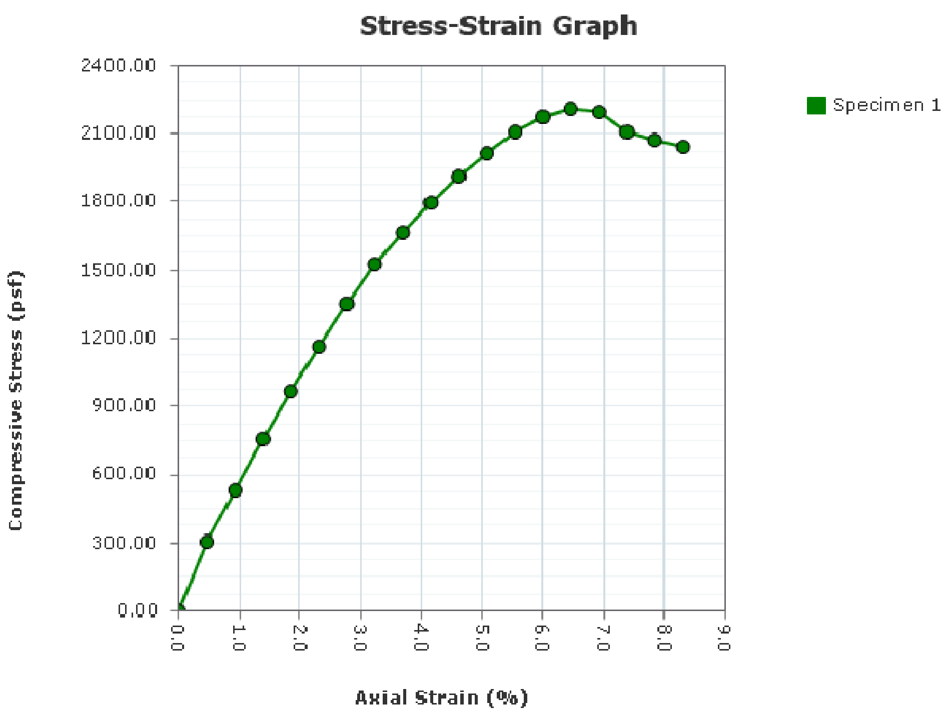
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Received Date:	3/21/2022
Sampling Date:	3/21/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

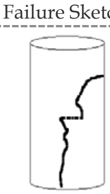
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.3							
Wet Density (pcf)	118.1							
Dry Density (pcf)	91.4							
Saturation (%):	92.8							
Void Ratio:	0.858							
Height (in)	5.4200							
Diameter (in)	2.8500							
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	1.90							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.85							
Unconfined Compressive Strength (psf)	2213.75							
Undrained Shear Strength (psf)	1106.87							
Strain at Failure (%):	6.46							

Specific Gravity:	2.72	Plastic Limit:	22	Liquid Limit:	47
Type:	UD	Soil Classification:	CL		

Project:	Ford 138kV Glendale Industrial West
Project Number:	222-032
Sampling Date:	3/21/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR 24W
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

March 16, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford Property 345kV Glendale South – Brown North
Structure 1A
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 1A, a 3DS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
1A	3DS Tower	105	705.40	37°35’45.769”N	85°53’50.216”W	4,196	4,453
-	Leg 1	-	705.35	37°35’45.57”N	85°53’50.35”W	-	-
-	Leg 2	-	705.35	37°35’45.65”N	85°53’49.96”W	-	-
-	Leg 3	-	705.35	37°35’45.98”N	85°53’50.07”W	-	-
-	Leg 4	-	705.35	37°35’45.90”N	85°53’50.47”W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 48 feet beneath the surface. The rockline soundings were advanced to a depth of about 42 feet to 54 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

3. 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 surface with thicknesses of approximately nine inches. Beneath the surface materials, lean clay was encountered to refusal depths in each of the borings. The lean clay was typically described as reddish-brown to red in color, moist to saturated and soft to very stiff.

Detailed laboratory results are included in Appendix C of this report.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal was encountered in the soil test borings at the depths shown in the table below.

Table 2: Structure 1A – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 1A L1	37°35’45.57”N	85°53’50.35”W	703.5	48.8	654.7
STR 1A L2	37°35’45.65”N	85°53’49.96”W	702.7	42.3	660.4
STR 1A L3	37°35’45.98”N	85°53’50.07”W	703.0	54.1	648.9
STR 1A L4	37°35’45.90”N	85°53’50.47”W	703.9	48.7	655.2

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 1A	CL	5.0-12.0	2.3	0.7
STR 1A	CL	12.0-28.0	2.0	0.6
STR 1A	CL	28.0-48.8	0.5	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 1A	CL	5.0-12.0	0.03	400
STR 1A	CL	12.0-28.0	0.03	200
STR 1A	CL	28.0-48.8	0.02	-

5.2 **<u>Axial Design Parameters</u>** – Due to the karst conditions at the site, it is recommended to design the drilled shaft as soil bearing. Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 1A	CL	5.0-12.0	125	2.3	1.0
STR 1A	CL	12.0-28.0	62.6	2.0	1.0
STR 1A	CL	28.0-48.8	62.6	0.5	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

- SOIL TEST BORING WITH ROCK CORE
- SOIL TEST BORING
- ROCKLINE SOUNDING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS	NO. / DATE / DESCRIPTION
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD PROPERTY 345kV GLENDALE SOUTH - BROWN NORTH GLENDALE, KY
AEI	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	03-10-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:\PROJECTS222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 345kV\STR 1A\Reports \Support Information
SHEET:	A-1

APPENDIX B

Boring Logs

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

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STR 1A L1

PAGE 1 OF 2

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 2/16/22 **COMPLETED** 2/23/22
GROUND ELEVATION 703.5 ft
DRILLING CONTRACTOR Aaron Anderson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
▽ **AT TIME OF DRILLING** 30.00 ft / Elev 673.50 ft
LOGGED BY Clint Ervin **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES Leg 1
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (9 INCHES)									
		(CL) lean CLAY, trace sand, light brown to reddish brown with black mottle, moist to wet, stiff to very stiff	ST 1	85		4.5+	22	30	19	11	Qu = 4,172 psf
5			ST 2	100		4.25	20				Qu = 4,039 psf
10											
15		(CL) lean CLAY, trace sand, red with gray mottle, moist to wet, very stiff	ST 3	95		2.5	21	42	15	27	Qu = 4,419 psf
20		(CL) lean CLAY with gravel, red, moist to wet, very stiff to medium stiff	ST 4	100		3.5	27				Qu = 4,819 psf
25			ST 5	40		4.0					
30			ST 6	80		0.5	37	46	23	23	Qu = 1,704 psf
	▽	(CL) lean CLAY with gravel, red, wet to saturated, soft to stiff									
35			ST 7	70		0.25					
40			ST 8	100		1.25	50	38	16	22	Qu = 1,195 psf

(Continued Next Page)

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PAGE 2 OF 2

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
	(CL) lean CLAY with gravel, red, wet to saturated, soft to stiff *(continued)*	ST 9	100		0.25	32				Qu = 954 psf
45										
50	LIMESTONE, white to light gray, fine to medium crystalline, moderately hard to hard, thin bedded, highly weathered, highly fractured, vuggy	RC 1	83 (22)							
	VOID 51.2 ft to 52.8 ft	RC 2	20 (6)							
	LIMESTONE, white to light gray, fine to medium crystalline, moderately hard to hard, thin bedded, highly weathered, highly fractured, vuggy									
55	VOID 53.5 ft to 53.9 ft									
	LIMESTONE, white to light gray, fine to medium crystalline, moderately hard to hard, thin bedded, highly weathered, highly fractured, vuggy	RC 3	20 (0)							
	VOID 56.8 ft to 62.3 ft									
60		RC 4	66 (54)							
	LIMESTONE, white to light gray, fine to medium crystalline, moderately hard to hard, thin bedded, highly weathered, highly fractured, vuggy									
65		RC 5	72 (28)							Clay Seam 66.7 ft to 66.9 ft
	VOID 68.6 ft to 69.3 ft									
70	LIMESTONE, white to light gray, fine to medium crystalline, moderately hard to hard, thin bedded, highly weathered to decomposed, highly fractured, vuggy	RC 6	76 (0)							
75										Clay Seam 75.0 ft o 75.1 ft; Vertical Fracture 75.1 ft to 75.6 ft

Refusal at 48.8 feet.
Bottom of borehole at 75.6 feet.

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PAGE 1 OF 1

CLIENT LG&E KU
PROJECT NUMBER 222-032
DATE STARTED 2/16/22 **COMPLETED** 2/16/22
DRILLING CONTRACTOR Aaron Anderson
DRILLING METHOD Hollow Stem Auger
LOGGED BY Clint Ervin **CHECKED BY** Jacob Cowan
NOTES Leg 2

PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT LOCATION Glendale, KY
GROUND ELEVATION 702.7 ft
GROUND WATER LEVELS:
∇ **AT TIME OF DRILLING** 32.00 ft / Elev 670.70 ft
AT END OF DRILLING ---
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 (42.3 FEET)									
10											
20											
30		∇									
40											

Refusal at 42.3 feet.
Bottom of borehole at 42.3 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/11/22 14:14 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

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STR 1A L3
PAGE 1 OF 1

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 2/23/22 **COMPLETED** 2/23/22
GROUND ELEVATION 702.98 ft
DRILLING CONTRACTOR Aaron Anderson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 12.00 ft / Elev 690.98 ft
LOGGED BY Aaron Anderson **CHECKED BY** Jacob Cowan
AT END OF DRILLING ---
NOTES Leg 3
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 (54.1 FEET)									
10		▽ (12.00 ft)									
20											
30											
40											
50											

Refusal at 54.1 feet.
Bottom of borehole at 54.1 feet.

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PAGE 1 OF 2

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 2/25/22 **COMPLETED** 2/28/22
GROUND ELEVATION 703.926 ft
DRILLING CONTRACTOR Aaron Anderson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 25.20 ft / Elev 678.73 ft
LOGGED BY Peyton Linder **CHECKED BY** Katy Bridges
AT END OF DRILLING ---
NOTES Leg 4
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	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0		TOPSOIL (9 INCHES)									
		(CL) sandy lean CLAY, trace gravel, brown with gray and black mottle, wet to saturated	ST 1	65		2.5	40	33	18	15	Qu = 1,471
5			ST 2	100		4.5+	21				Qu = 5,423
10		(CL) lean CLAY with sand, red with tan mottle, moist to wet, stiff	SPT 1	100	3-4-6 (10)	1.5	24				
15											
20		(CL) lean CLAY with sand, trace gravel, red with black mottle, wet to saturated, soft to medium stiff	ST 3	100		1.25	35				Qu = 3,093
25	∇										
30			SPT 2	100	2-2-2 (4)	0.5	39				
35											
40			ST 4	75		0	50	41	20	21	Qu = 383

(Continued Next Page)

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PAGE 2 OF 2

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

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
45		(CL) lean CLAY with sand, trace gravel, red with black mottle, wet to saturated, soft to medium stiff *(continued)*									

Refusal at 48.7 feet.
Bottom of borehole at 48.7 feet.

APPENDIX C

Laboratory Testing Results

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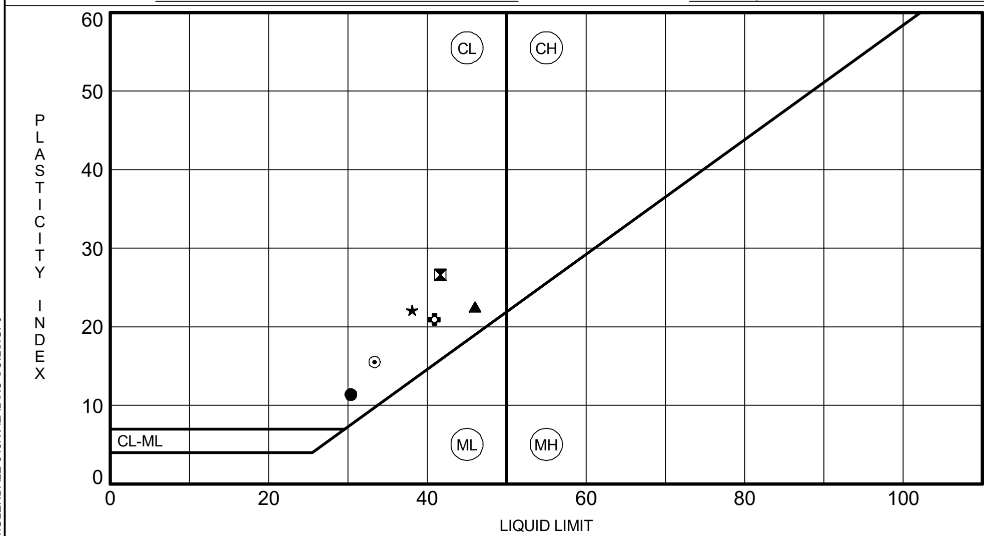
ATTERBERG LIMITS' RESULTS

CLIENT LG&E KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

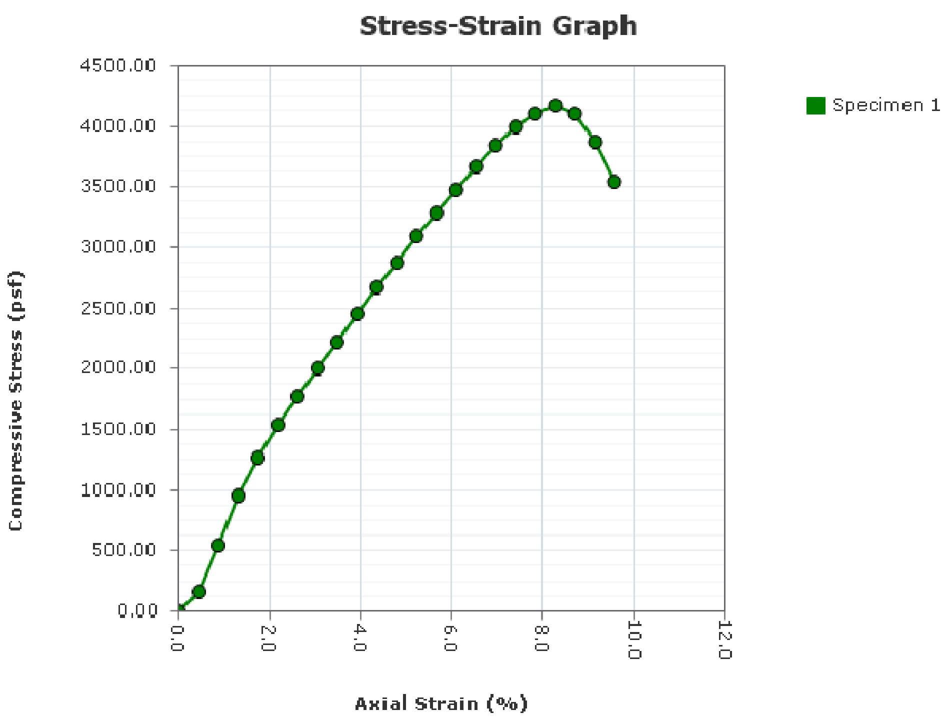


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 1A L1**	**1.0**	**30**	**19**	**11**		**LEAN CLAY (CL)**
⧗	**STR 1A L1**	**13.0**	**42**	**15**	**27**		**LEAN CLAY (CL)**
▲	**STR 1A L1**	**28.0**	**46**	**23**	**23**		**LEAN CLAY (CL)**
★	**STR 1A L1**	**38.0**	**38**	**16**	**22**		**LEAN CLAY (CL)**
⊙	**STR 1A L4**	**1.0**	**33**	**18**	**15**		**SANDY LEAN CLAY (CL)**
✿	**STR 1A L4**	**39.0**	**41**	**20**	**21**		**LEAN CLAY (CL)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/11/22 14:02 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.2							
Wet Density (pcf)	130.6							
Dry Density (pcf)	106.9							
Saturation (%):	102.5							
Void Ratio:	0.589							
Height (in)	5.7420							
Diameter (in)	2.7750							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.07							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	4171.83							
Undrained Shear Strength (psf)	2085.91							
Strain at Failure (%):	8.27							

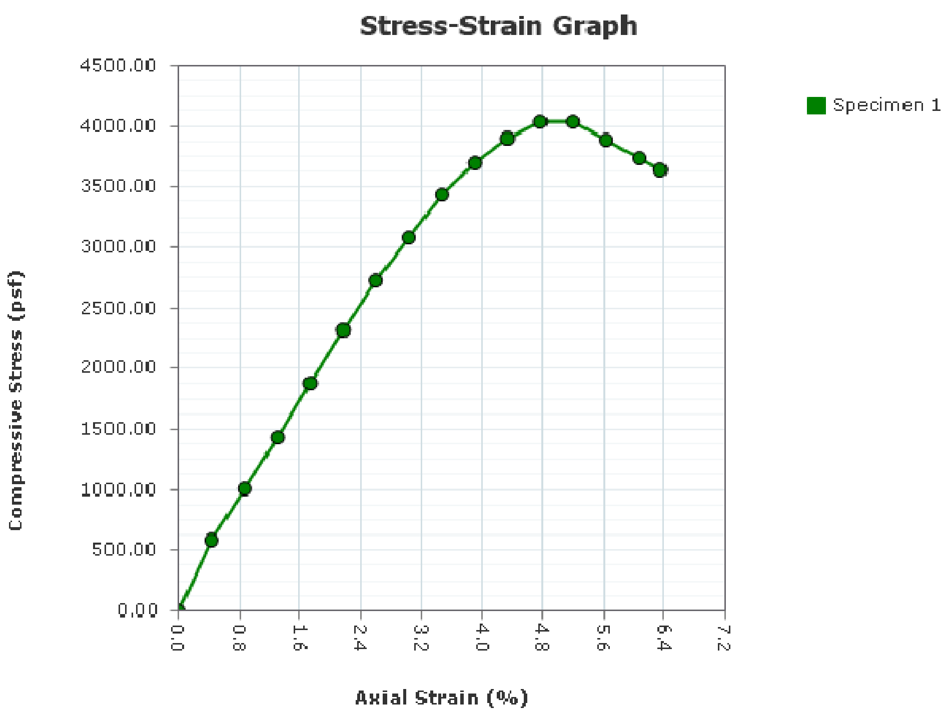
Specific Gravity:	2.72	Plastic Limit:	19	Liquid Limit:	30
Type:	Undisturbed	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 2
Sample Depth:	6.0-8.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.1							
Wet Density (pcf)	132.1							
Dry Density (pcf)	110.0							
Saturation (%):	100.6							
Void Ratio:	0.544							
Height (in)	5.7730							
Diameter (in)	2.8350							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4038.64							
Undrained Shear Strength (psf)	2019.32							
Strain at Failure (%):	5.20							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 2
Sample Depth:	6.0-8.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

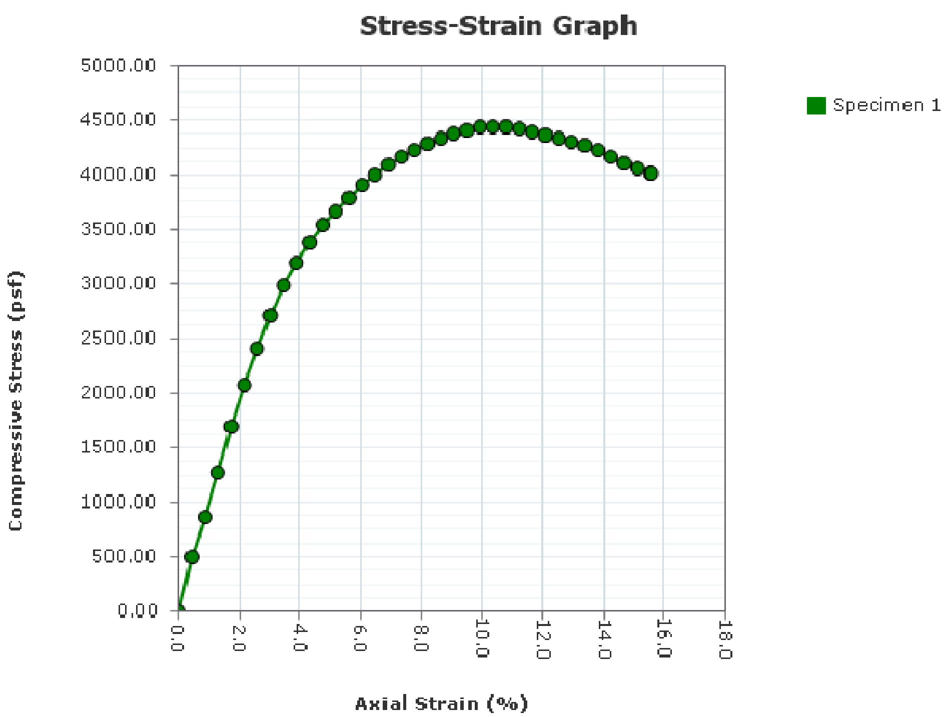
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 3
Sample Depth:	13.0-15.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	21.5							
Wet Density (pcf)	132.8							
Dry Density (pcf)	109.3							
Saturation (%):	105.5							
Void Ratio:	0.553							
Height (in)	5.7970							
Diameter (in)	2.7950							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.07							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4418.79							
Undrained Shear Strength (psf)	2209.39							
Strain at Failure (%):	11.21							

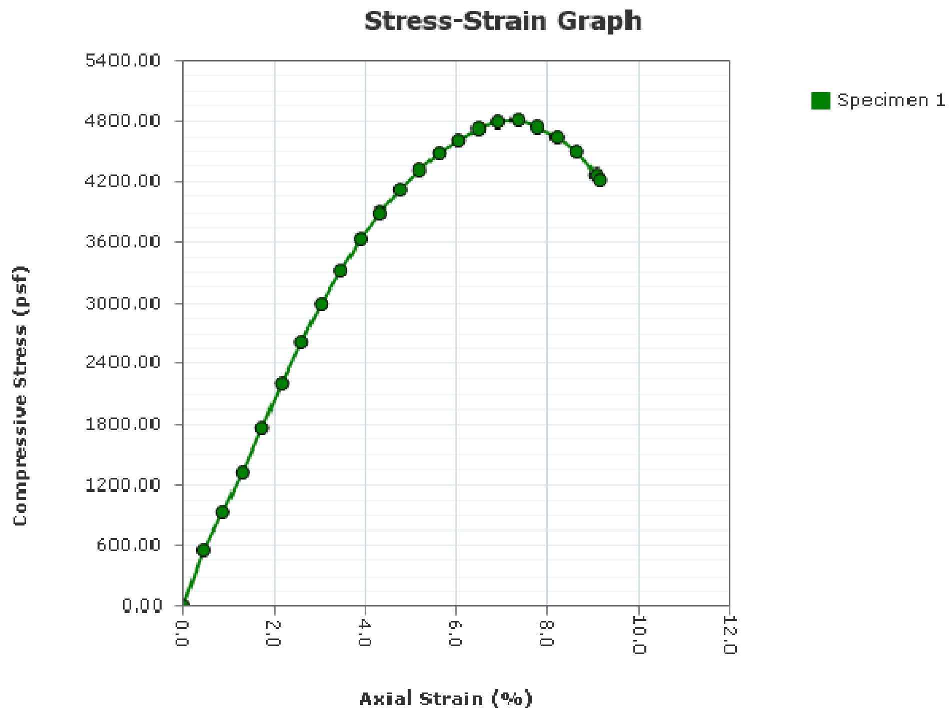
Specific Gravity:	2.72	Plastic Limit:	15	Liquid Limit:	42
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 3
Sample Depth:	13.0-15.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 4
Sample Depth:	18.0-20.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

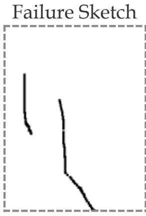
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	37.5							
Wet Density (pcf)	114.1							
Dry Density (pcf)	83.0							
Saturation (%):	97.5							
Void Ratio:	1.046							
Height (in)	5.7860							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	4819.01							
Undrained Shear Strength (psf)	2409.50							
Strain at Failure (%):	7.35							

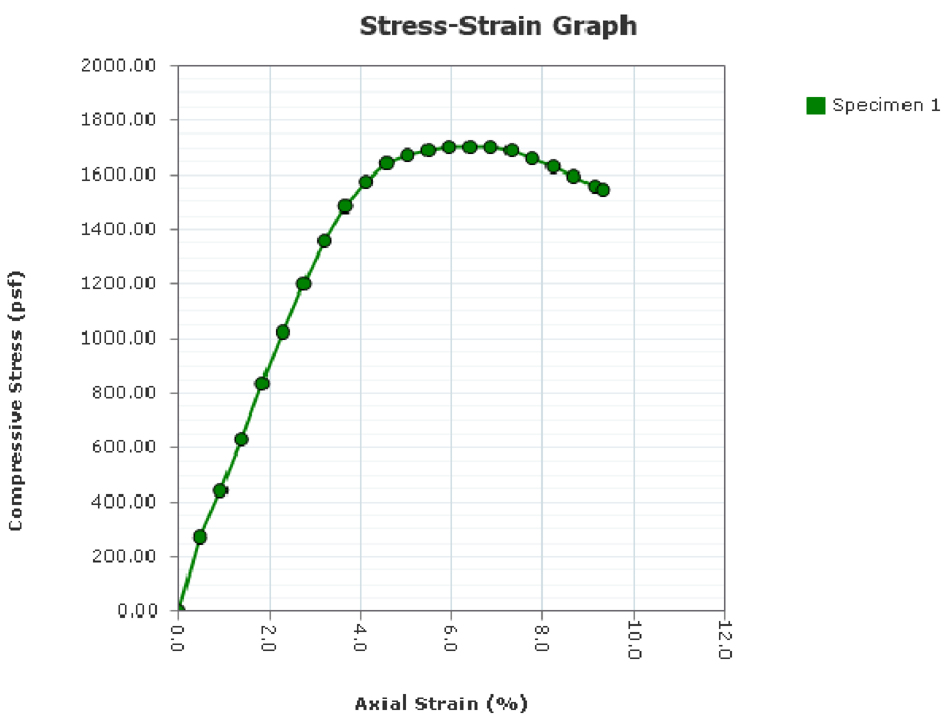
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 4
Sample Depth:	18.0-20.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 6
Sample Depth:	28.0-30.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	37.4							
Wet Density (pcf)	118.5							
Dry Density (pcf)	86.3							
Saturation (%):	104.9							
Void Ratio:	0.968							
Height (in)	5.4710							
Diameter (in)	2.7790							
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	1.97							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.094							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	1704.24							
Undrained Shear Strength (psf)	852.12							
Strain at Failure (%):	6.85							

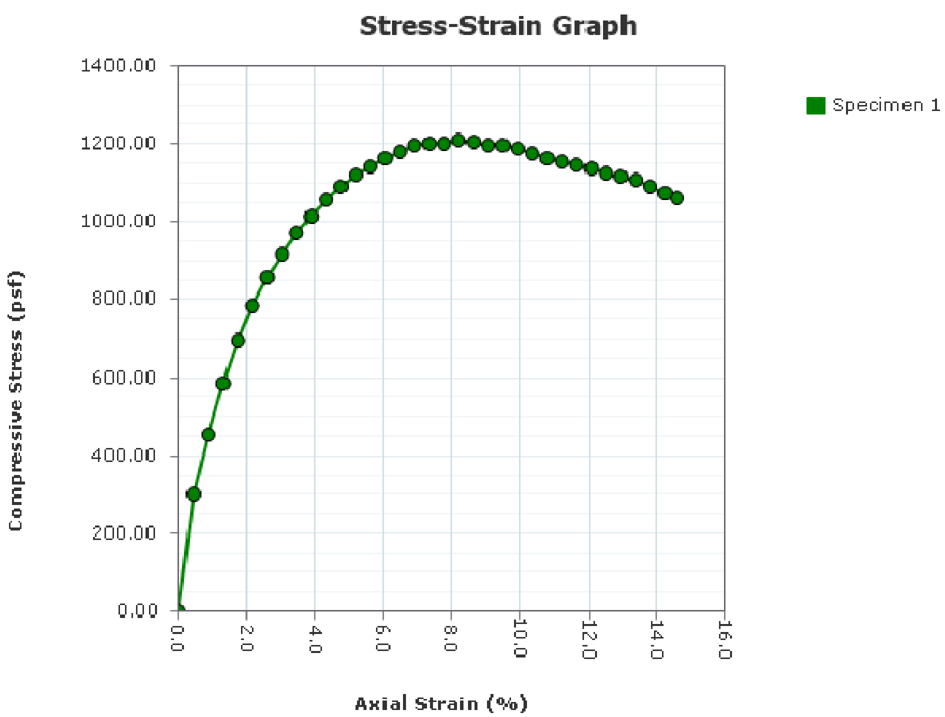
Specific Gravity:	2.72	Plastic Limit:	23	Liquid Limit:	46
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 6
Sample Depth:	28.0-30.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 8
Sample Depth:	38.0-40.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	29.2							
Wet Density (pcf)	123.5							
Dry Density (pcf)	95.6							
Saturation (%):	102.2							
Void Ratio:	0.776							
Height (in)	5.7900							
Diameter (in)	2.8170							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1195.22							
Undrained Shear Strength (psf)	597.61							
Strain at Failure (%):	9.50							

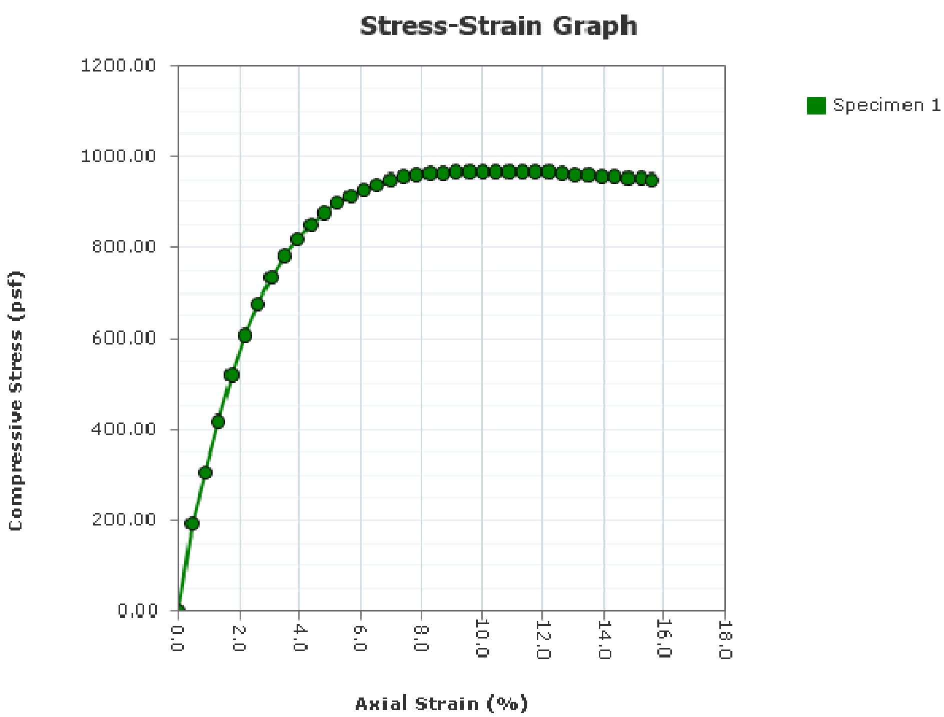
Specific Gravity:	2.72	Plastic Limit:	16	Liquid Limit:	38
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 8
Sample Depth:	38.0-40.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	2/22/2022
Sampling Date:	2/22/2022
Sample Number:	ST 9
Sample Depth:	43.0-45.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	32.0							
Wet Density (pcf)	123.9							
Dry Density (pcf)	93.9							
Saturation (%):	107.5							
Void Ratio:	0.809							
Height (in)	5.7430							
Diameter (in)	2.8010							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	953.85							
Undrained Shear Strength (psf)	476.93							
Strain at Failure (%):	14.80							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	2/22/2022
Sample Number:	ST 9
Sample Depth:	43.0-45.0 ft
Boring Number:	STR #1A L1
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 1

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

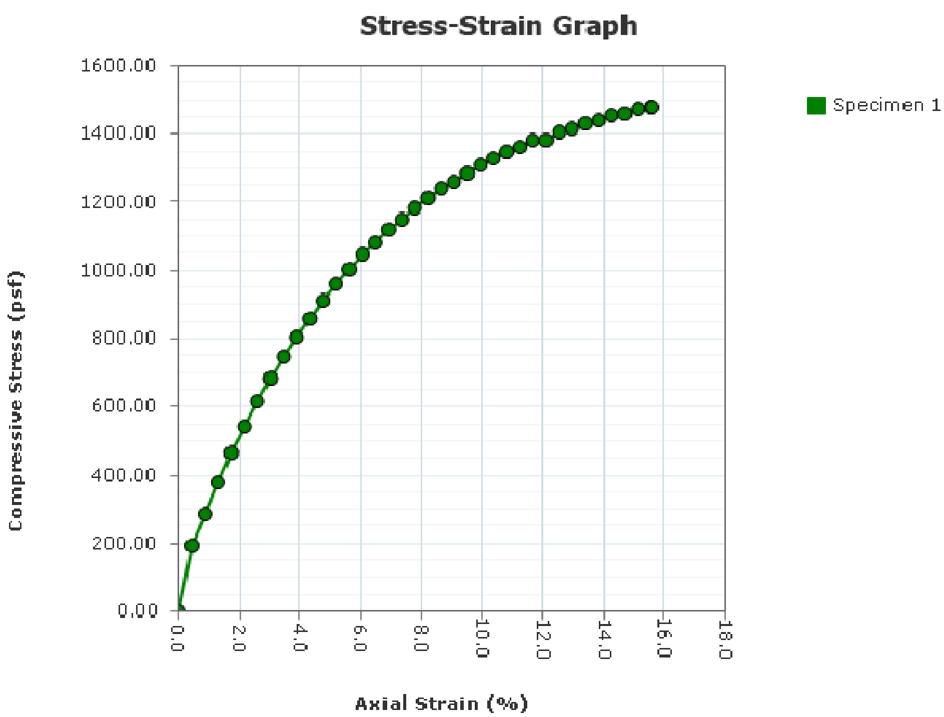
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/2/2022
Sampling Date:	3/2/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	56.2							
Wet Density (pcf)	126.5							
Dry Density (pcf)	81.0							
Saturation (%):	139.4							
Void Ratio:	1.096							
Height (in)	5.7870							
Diameter (in)	2.8750							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1471.58							
Undrained Shear Strength (psf)	735.79							
Strain at Failure (%):	15.12							

Specific Gravity:	2.72	Plastic Limit:	18	Liquid Limit:	33
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/2/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

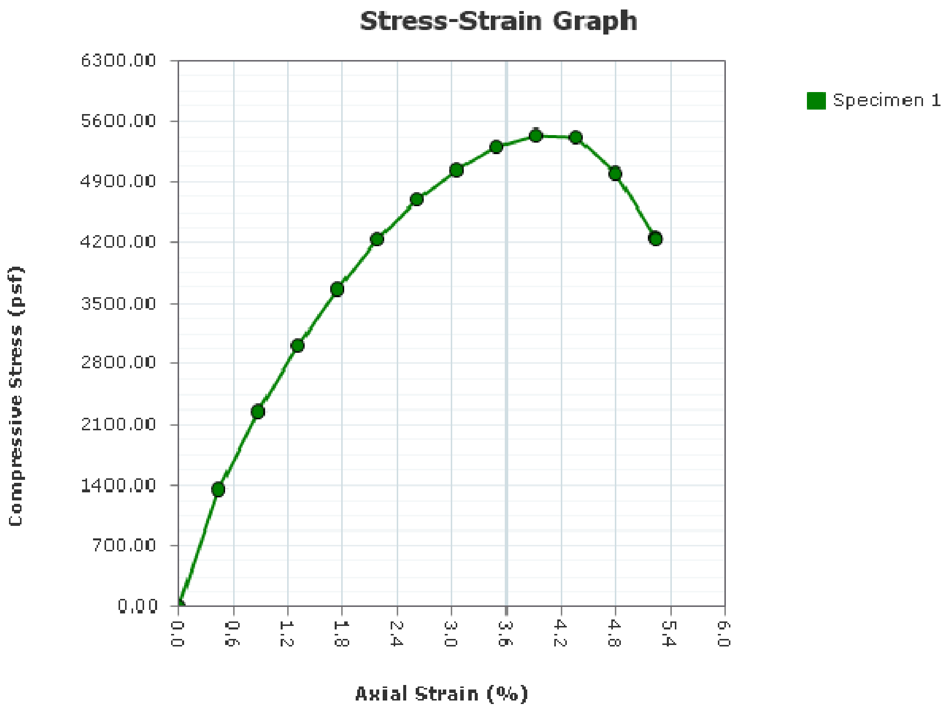
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/2/2022
Sampling Date:	3/2/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	18.4							
Wet Density (pcf)	133.7							
Dry Density (pcf)	112.9							
Saturation (%):	99.2							
Void Ratio:	0.504							
Height (in)	5.7310							
Diameter (in)	2.7820							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.06							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	5423.97							
Undrained Shear Strength (psf)	2711.99							
Strain at Failure (%):	4.36							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/2/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

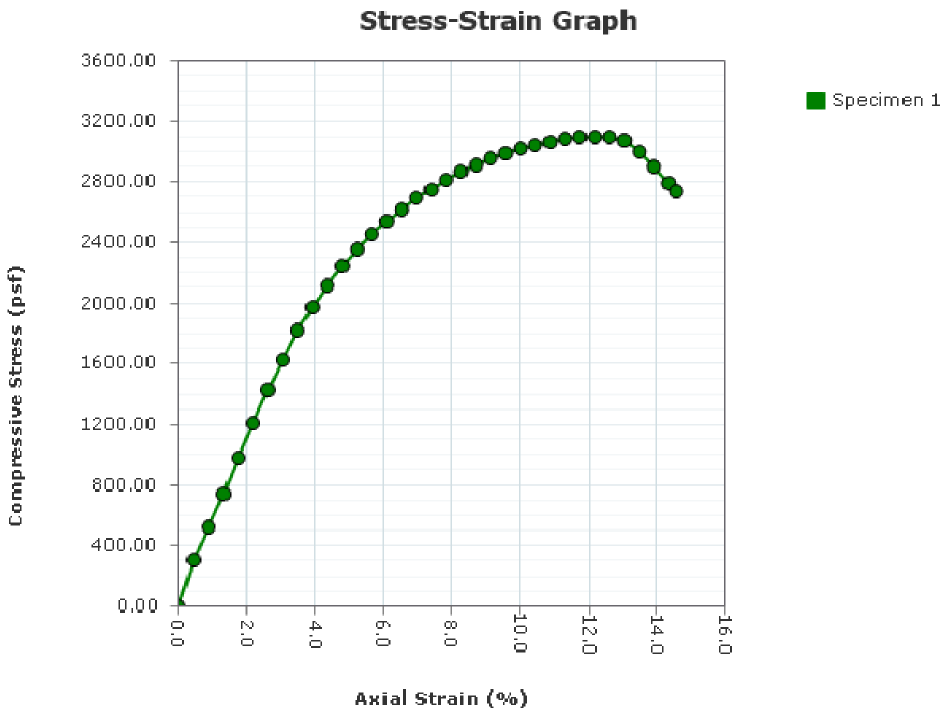
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/2/2022
Sampling Date:	3/2/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.9							
Wet Density (pcf)	134.4							
Dry Density (pcf)	111.1							
Saturation (%):	107.8							
Void Ratio:	0.528							
Height (in)	5.7440							
Diameter (in)	2.8230							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	3093.71							
Undrained Shear Strength (psf)	1546.86							
Strain at Failure (%):	12.62							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/2/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

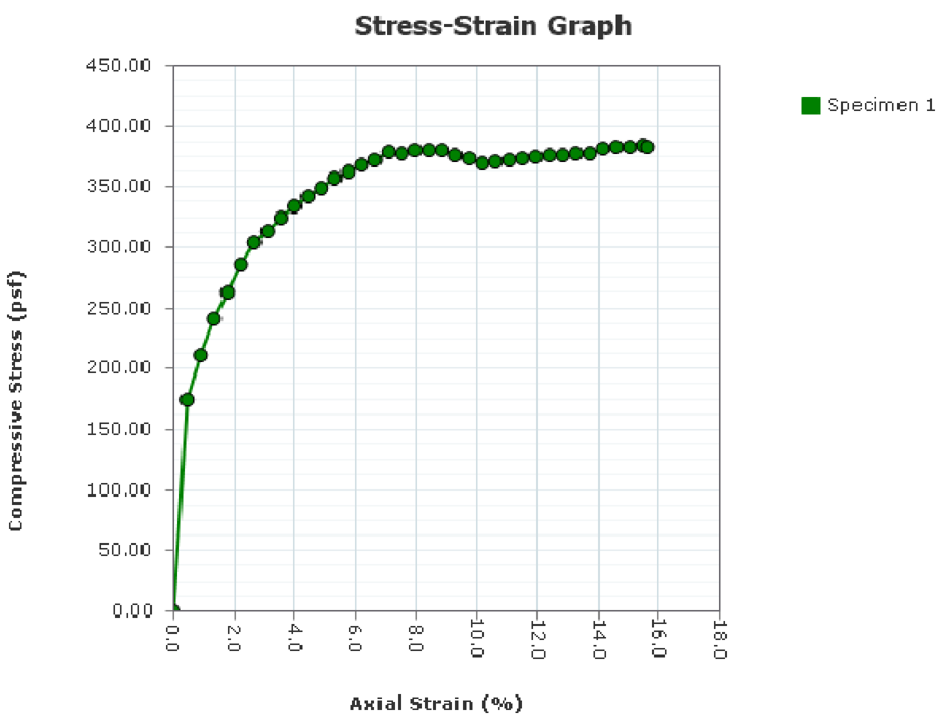
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/2/2022
Sampling Date:	3/2/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	30.3							
Wet Density (pcf)	125.5							
Dry Density (pcf)	96.3							
Saturation (%):	107.9							
Void Ratio:	0.763							
Height (in)	5.6550							
Diameter (in)	2.8270							
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	2.00							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.77							
Unconfined Compressive Strength (psf)	383.28							
Undrained Shear Strength (psf)	191.64							
Strain at Failure (%):	15.03							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/2/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #1A L4
Location:	Glendale, KY
Client Name:	LG&E KU
Remarks:	Leg 4

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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.

AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING

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

AEI
AMERICAN ENGINEERS, INC.

March 21, 2022

[redacted]

LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford Property 345kV Glendale South – Brown North
Structure 2A
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 2A, a 3CS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
2A	3CS Tower	90	729.4	37°35’50.552”N	85°53’39.827”W	2,817	15
-	Leg 1	-	729.4	37°35’50.38”N	85°53’39.91”W	-	-
-	Leg 2	-	729.4	37°35’50.51”N	85°53’39.62”W	-	-
-	Leg 3	-	729.4	37°35’50.71”N	85°53’39.74”W	-	-
-	Leg 4	-	729.4	37°35’50.62”N	85°53’40.02”W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 55 to 67 feet beneath the surface. The rockline soundings were advanced to a depth of about 58 feet to 59 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

3. 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 surface with thicknesses of approximately eight to nine inches. Beneath the surface materials, lean clay was encountered to refusal depths in each of the borings. The lean clay was typically described as reddish-brown to red in color, containing varying amounts of gravel, moist to saturated and soft to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. Auger refusal depths are provided in the table below.

Table 2: Structure 1A – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 2A L1	37°35’50.38”N	85°53’39.91”W	726.4	46.9	679.5
STR 2A L2	37°35’50.51”N	85°53’39.62”W	727.2	59.3	667.9
STR 2A L3	37°35’50.71”N	85°53’39.74”W	727.3	55.1	672.2
STR 2A L4	37°35’50.62”N	85°53’40.02”W	726.7	58.2	668.5

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 2A	CL	5.0-37.0	1.4	0.4
STR 2A	CL	37.0-60.0	0.5	0.2

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 2A	CL	5.0-37.0	0.03	200
STR 2A	CL	37.0-60.0	0.03	-

5.2 <u>**Axial Design Parameters**</u> – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 2A	CL	5.0-37.0	125.0	1.4	1.0
STR 2A	CL	37.0-60.0	62.6	0.5	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND
- SOIL TEST BORING WITH ROCK CORE
- SOIL TEST BORING
- ROCKLINE SOUNDING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

BORING LAYOUT

CLIENT: LG&E and KU

PROJECT: FORD PROPERTY 345KV GLENDALE SOUTH - BROWN NORTH STRUCTURE 2A GLENDALE, KY

AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220

SCALE: NTS
DATE: 03-16-2022
DRAWN BY: A. ANDERSON
CHECKED BY: D. BARRETT
FILE: T:22PROJECTS222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 345kV\STR 2A\Reports \Support Information
SHEET: A-1

APPENDIX B

Boring Logs

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

T:\10 PROJECTS\210-000 Folder Template\Geotech\REPORTS\Class System.doc

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Glasgow, KY 42141
(270) 651-7220

STR 2A L1

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/3/22 **COMPLETED** 3/4/22
GROUND ELEVATION 726.4 ft
DRILLING CONTRACTOR Wayne Tucker
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING 37.40 ft / Elev 689.00 ft
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 1
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (8 Inches)									
	(CL) lean CLAY, brown to reddish brown, moist to wet, stiff	ST 1	100		4.5+	21				Qu = 2,423 psf
		ST 2	90		4.5+	18				Qu = 3,118 psf
10	(CL) lean CLAY, trace chert, reddish brown and gray, moist to saturated, stiff	SPT 3	100	3-5-8 (13)	4.25	23				
20		ST 4	100		3.5	22	41	21	20	Qu = 2,361 psf
30		SPT 5	40	5-8-7 (15)	2.5	22				
40	(CL) lean CLAY with chert, reddish brown to brown, wet to saturated, medium stiff to stiff	ST 6	30		4.5+	34	44	19	25	Water Level ATD
50	LIMESTONE, white to light gray, iron stained, fine to medium grained, moderately hard to hard, thin bedded, highly weathered, vuggy, highly fractured	RC 7	68 (0)							
		RC 8	54 (18)							
		RC 9	54 (8)							
60		RC 10	68 (8)							
		RC 11	86 (19)							

Refusal at 46.9 feet.
Bottom of borehole at 67.1 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/21/22 10:17 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

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STR 2A L2
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/9/22 **COMPLETED** 3/9/22
GROUND ELEVATION 727.2 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 2
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 (59.3 FEET)									
10											
20											
30											
40											
50											

Refusal at 59.3 feet.
Bottom of borehole at 59.3 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/21/22 10:17 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LABKU SOILS.GPJ

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STR 2A L3

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/4/22 **COMPLETED** 3/4/22
GROUND ELEVATION 727.3 ft
DRILLING CONTRACTOR Aaron Anderson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Katy Bridges **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 3
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 (9 Inches)									
		(CL) lean CLAY, with sand, tan to red, moist to wet	ST 1	95		4.25	20				Qu = 4,269 psf
		(CL) sandy lean CLAY, red with tan and gray mottle, moist to wet, very stiff	ST 2	100		3.5	18	39	20	19	
10			SPT 3	100	4-7-9 (16)	3.75	22				
20		(CL) lean CLAY with chert, red, moist to wet	ST 4	60		4.25	26	37	15	22	
30		(CL) lean CLAY with sand, red, moist to wet, medium stiff to soft	SPT 5	73	0-2-3 (5)	1.0	30				
40			ST 6	100		4.25	31	34	20	14	Qu = 1,669 psf
50			SPT 7	93	0-1-2 (3)	0.5	37				

Refusal at 55.1 feet.
Bottom of borehole at 55.1 feet.

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Glasgow, KY 42141
(270) 651-7220

STR 2A L4
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/8/22 **COMPLETED** 3/8/22
GROUND ELEVATION 726.7 ft
DRILLING CONTRACTOR Wayne Tucker
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 4
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 (58.2 FEET)									
10											
20											
30											
40											
50											

Refusal at 58.2 feet.
Bottom of borehole at 58.2 feet.

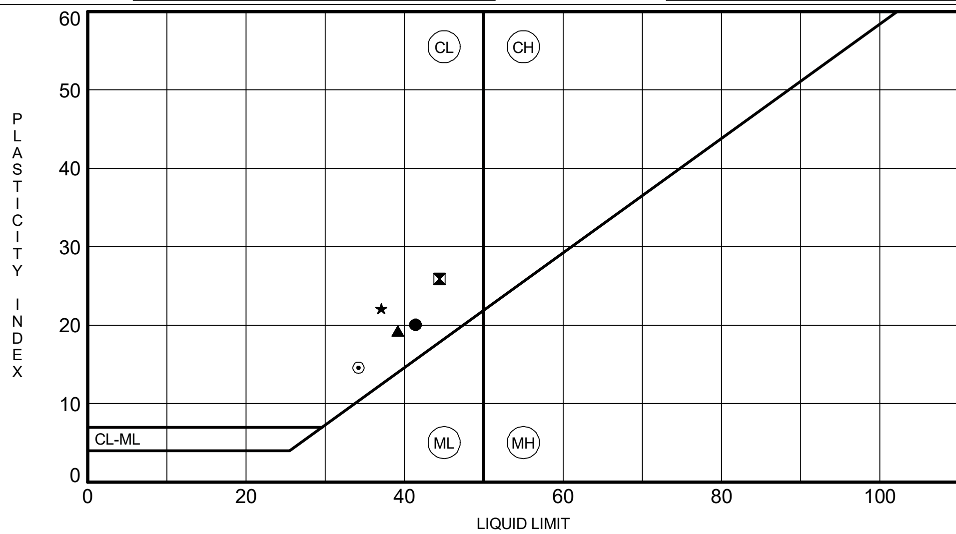
APPENDIX C

Laboratory Testing Results

AEI AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR 2A L1**	**19.0**	**41**	**21**	**20**		**LEAN CLAY (CL)**
⊠	**STR 2A L1**	**39.0**	**44**	**19**	**25**	**57**	**LEAN CLAY (CL)**
▲	**STR 2A L3**	**4.0**	**39**	**20**	**19**	**67**	**LEAN CLAY (CL)**
★	**STR 2A L3**	**19.0**	**37**	**15**	**22**	**63**	**LEAN CLAY (CL)**
⊙	**STR 2A L3**	**39.0**	**34**	**20**	**14**		**LEAN CLAY (CL)**

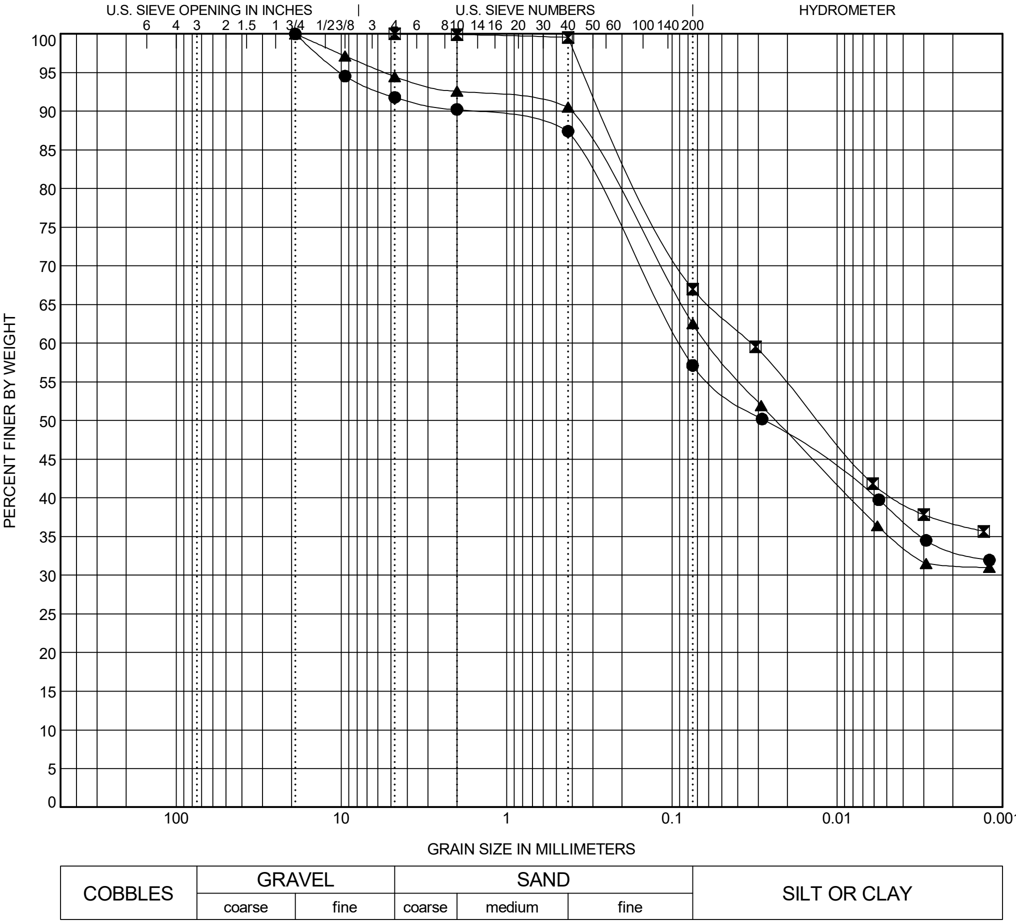
ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/21/22 10:21 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

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

GRAIN SIZE DISTRIBUTION

CLIENT LG&E and KU **PROJECT NAME** Ford Property 345kV Glendale South - Brown North

PROJECT NUMBER 222-032 **PROJECT LOCATION** Glendale, KY



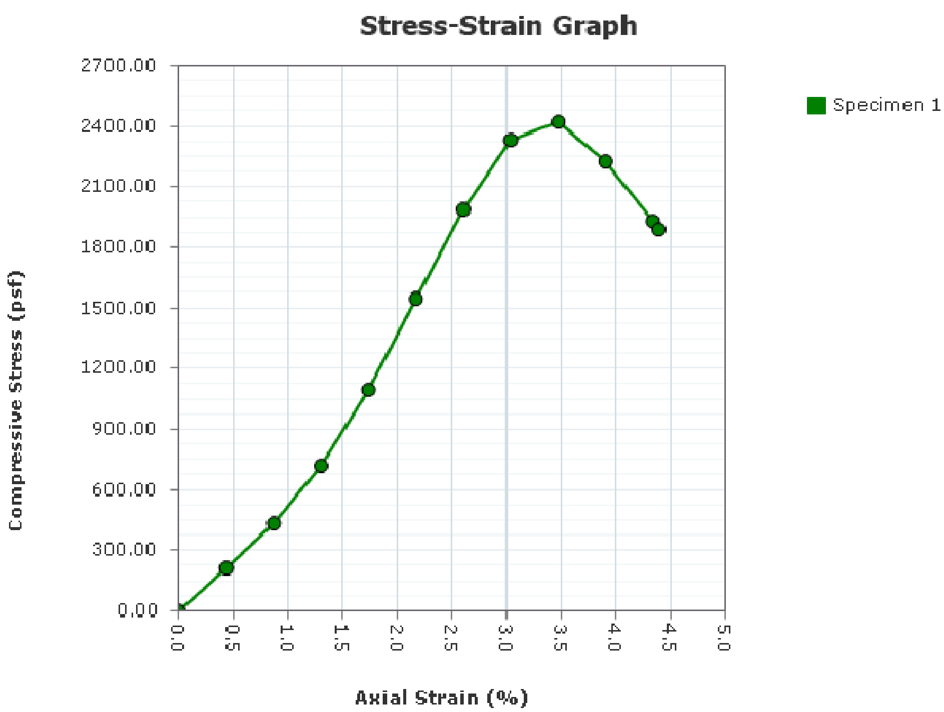
	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**STR 2A L1**	**39.0**	**LEAN CLAY (CL)**	**44**	**19**	**25**		
⊠	**STR 2A L3**	**4.0**	**LEAN CLAY (CL)**	**39**	**20**	**19**		
▲	**STR 2A L3**	**19.0**	**LEAN CLAY (CL)**	**37**	**15**	**22**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**STR 2A L1**	**39.0**	**19**	**0.088**			**8.2**	**34.7**	**18.3**	**38.9**
⊠	**STR 2A L3**	**4.0**	**4.75**	**0.033**			**0.0**	**33.0**	**26.3**	**40.7**
▲	**STR 2A L3**	**19.0**	**19**	**0.06**			**5.5**	**32.0**	**27.1**	**35.5**

GRAIN SIZE - GINT STD US LAB.GDT - 3/21/22 10:21 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/7/2022
Sampling Date:	3/7/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	16.5							
Wet Density (pcf)	131.3							
Dry Density (pcf)	112.7							
Saturation (%):	88.7							
Void Ratio:	0.507							
Height (in)	5.7620							
Diameter (in)	2.8650							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.01							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2423.55							
Undrained Shear Strength (psf)	1211.78							
Strain at Failure (%):	3.47							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/7/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

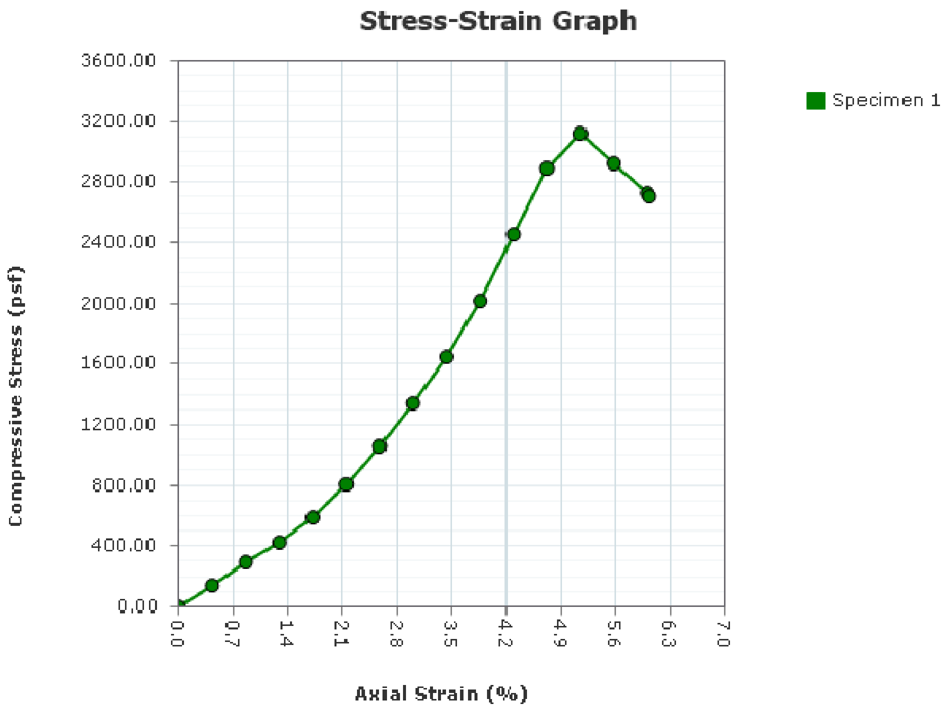
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/7/2022
Sampling Date:	3/7/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	18.2							
Wet Density (pcf)	130.3							
Dry Density (pcf)	110.3							
Saturation (%):	91.5							
Void Ratio:	0.540							
Height (in)	5.8260							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.05							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	3118.48							
Undrained Shear Strength (psf)	1559.24							
Strain at Failure (%):	5.15							

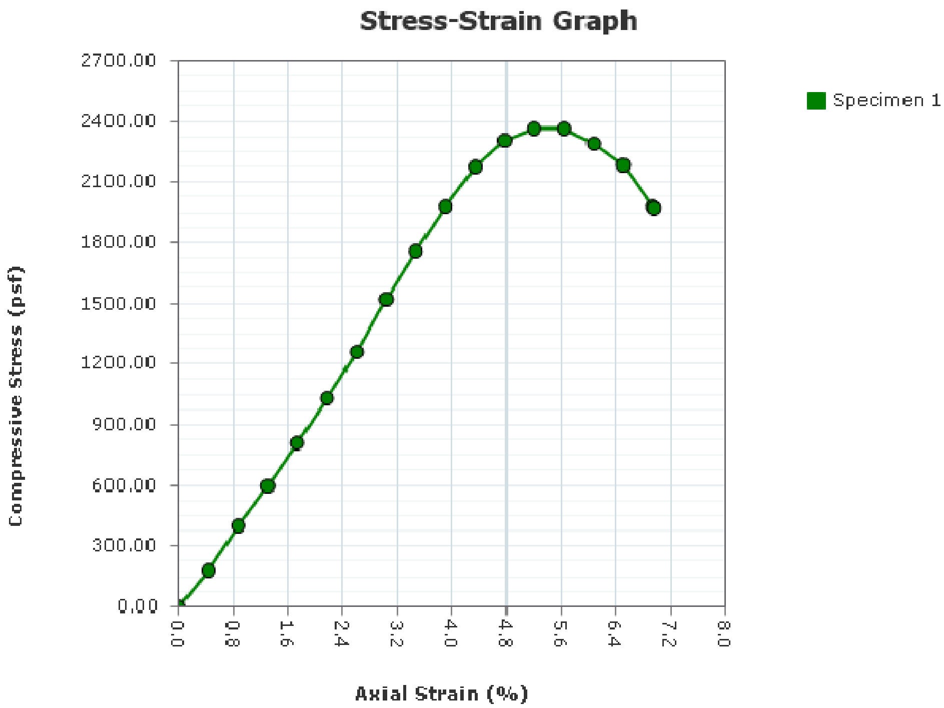
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/7/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/7/2022
Sampling Date:	3/7/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	19.5							
Wet Density (pcf)	129.4							
Dry Density (pcf)	108.3							
Saturation (%):	93.4							
Void Ratio:	0.569							
Height (in)	5.7630							
Diameter (in)	2.8510							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2361.79							
Undrained Shear Strength (psf)	1180.90							
Strain at Failure (%):	5.64							

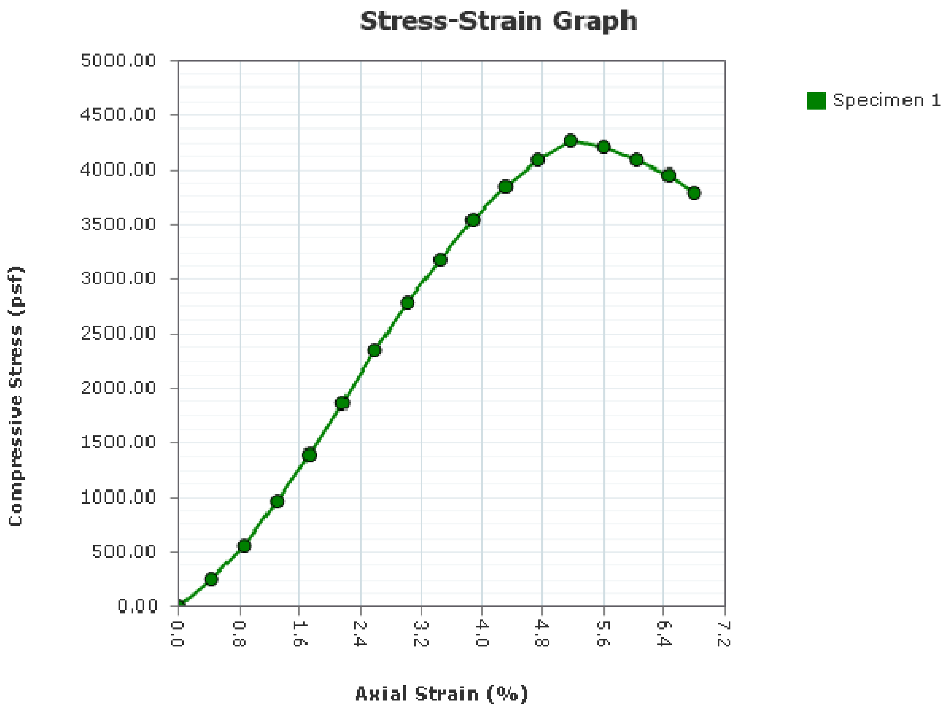
Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	41
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/7/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #2A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/8/2022
Sampling Date:	3/8/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #2A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Unconfined Compression Test

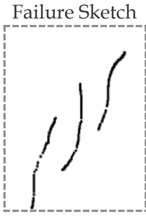
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	17.1							
Wet Density (pcf)	132.0							
Dry Density (pcf)	112.8							
Saturation (%):	91.7							
Void Ratio:	0.506							
Height (in)	5.8070							
Diameter (in)	2.8410							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	4269.81							
Undrained Shear Strength (psf)	2134.91							
Strain at Failure (%):	5.17							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/8/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #2A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

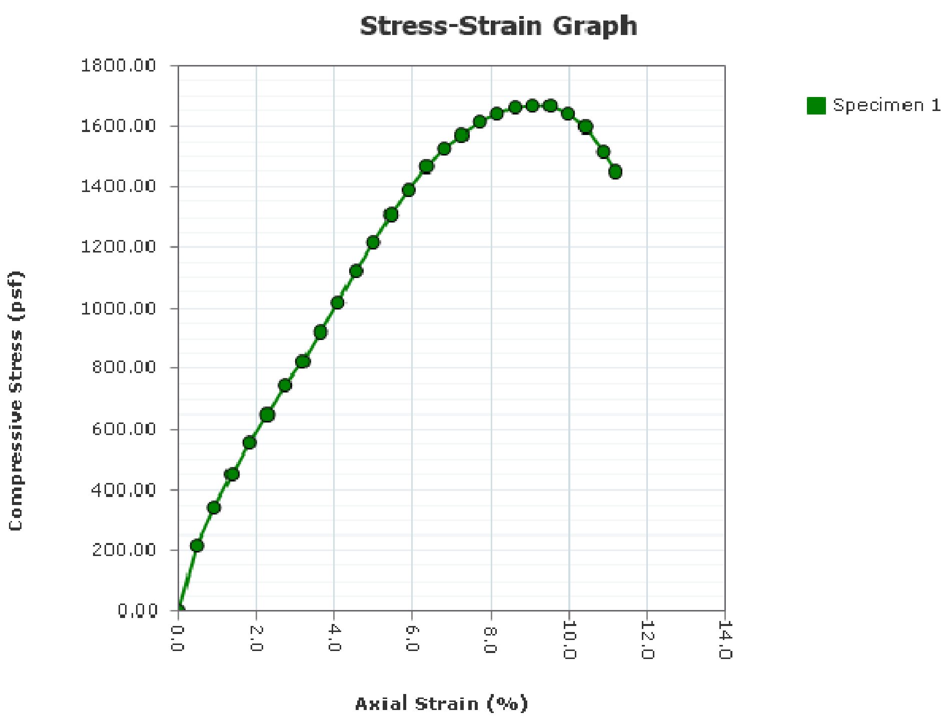
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/8/2022
Sampling Date:	3/8/2022
Sample Number:	ST 4
Sample Depth:	39'-41' ft
Boring Number:	STR #2A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	27.2							
Wet Density (pcf)	120.7							
Dry Density (pcf)	94.9							
Saturation (%):	93.6							
Void Ratio:	0.789							
Height (in)	5.5160							
Diameter (in)	2.8560							
Strain Limit @ 15% (in)	0.8							
Height To Diameter Ratio:	1.93							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.095							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	1669.10							
Undrained Shear Strength (psf)	834.55							
Strain at Failure (%):	9.52							

Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	34
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/8/2022
Sample Number:	ST 4
Sample Depth:	39'-41' ft
Boring Number:	STR #2A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

March 22, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford Property 345kV Glendale South – Brown North
Structure 5A
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 5A, a 3DS Tower.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Latitude (DMS)	Longitude (DMS)	Trans. Moment (ft-k)	Long. Moment (ft-k)
5A	3DS Tower	110	720.40	37°35'57.32"N	85°53'12.08"W	8,206	3,254
-	Leg 1	-	720.32	37°35'57.16"N	85°53'12.33"W	-	-
-	Leg 2	-	720.32	37°35'57.13"N	85°53'11.88"W	-	-
-	Leg 3	-	720.32	37°35'57.47"N	85°53'11.82"W	-	-
-	Leg 4	-	720.32	37°35'57.52"N	85°53'12.27"W	-	-

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of two soil test borings and two rockline soundings. The soil test borings were advanced to a depth of about 43 feet to 61 feet beneath the surface. The rockline soundings were advanced to a depth of about 41 feet to 45 feet beneath the surface. The boring locations were staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately eight to nine inches. Beneath the surface material, lean clay and fat clay were encountered to refusal depth in the boring. The lean clay was typically described as brown to red in color, moist to wet and stiff. The fat clay was described as reddish brown to brown in color, containing varying amounts of gravel, moist to wet and medium stiff to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 5A – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 5A L1	37°35’57.16”N	85°53’12.33”W	720.8	N/A	N/A
STR 5A L2	37°35’57.13”N	85°53’11.88”W	720.4	41.3	679.1
STR 5A L3	37°35’57.47”N	85°53’11.82”W	718.5	43.2	675.3
STR 5A L4	37°35’57.52”N	85°53’12.27”W	718.2	45.3	672.9

5. FOUNDATION DESIGN PARAMETERS

5.1 **Lateral Design Parameters** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 5A	CL	5.0-40.0	1.5	0.8
STR 5A	CH	40.0-61.0	0.5	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Estimated Strain at 50% Stress (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 5A	CL	5.0-40.0	0.02	200
STR 5A	CH	40.0-61.0	0.03	-

5.2 **<u>Axial Design Parameters</u>** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 5A	CL	5.0-40.0	125.0	1.5	1.0
STR 5A	CH	40.0-61.0	120.0	0.5	0.7

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS. INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:

- Boring Layout
- Typed Boring Logs
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

- SOIL TEST BORING WITH ROCK CORE
- SOIL TEST BORING
- ROCKLINE SOUNDING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS	NO. / DATE / DESCRIPTION
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD PROPERTY 345KV GLENDALE SOUTH - BROWN NORTH STRUCTURE 5A GLENDALE, KY
AEI	AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220
SCALE:	NTS
DATE:	03-18-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	T:/22 PROJECTS/222-032 LG&E KU Glendale Ford Plant\Geotech\Glendale 345kV\STR 5A\Reports\Support Information
SHEET:	A-1

APPENDIX B

Boring Logs

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

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Glasgow, KY 42141
(270) 651-7220

STR #5A L1

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/9/22 COMPLETED 3/10/22
GROUND ELEVATION 720.8 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder CHECKED BY Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 1
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (9 INCHES)									
	(CL) lean CLAY, light brown to reddish brown, gray mottle, moist, medium stiff to stiff	ST 1	100		4.5+	18				Qu = 1,786 psf
		ST 2	100		1.5	19	33	13	20	Qu = 4,536 psf
10	(CL) lean CLAY, trace gravel, red to brown, wet to saturated, stiff to very soft	SPT 1	100	4-4-5 (9)	2.75	22				
20		ST 3	95		2.0	24	38	20	18	Qu = 3,952 psf
30		SPT 2	100	3-2-3 (5)	0.75	27				
40		ST 4	100		0.0	44				Qu = 653 psf
50		SPT 3	60	1-1-0 (1)	0.0	36				
60		ST 5	75		0.0	41	40	15	25	

Bottom of borehole at 61.0 feet.

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STR #5A L2
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/11/22 **COMPLETED** 3/11/22
GROUND ELEVATION 720.4 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 2
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 (41.3 FEET)									
5											
10											
15											
20											
25											
30											
35											
40											

Refusal at 41.3 feet.
Bottom of borehole at 41.3 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/22/22 13:19 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LABKU SOILS.GPJ

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STR #5A L3

PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/11/22 **COMPLETED** 3/11/22
GROUND ELEVATION 718.5 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit
AT TIME OF DRILLING ---
LOGGED BY Adam Cash **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 3
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (8 INCHES)									
	(CL) lean CLAY, trace gravel, light to reddish brown, stiff, wet to saturated	ST 1	100		4.5+	18				Qu = 1,931 psf
		ST 2	100		3.0	22	39	20	19	Qu = 2,488 psf
10		SPT 1	80	4-5-6 (11)	3.0	22				
20	(CH) fat CLAY, trace gravel, brown to red, wet to saturated, very stiff	ST 3	100		3.0	38	58	27	31	Qu = 1,499 psf
30		SPT 2	67	5-9-9 (18)	2.5	34				
40		ST 4	100		3.0	23				Qu = 2,235 psf
	LIMESTONE, gray, moderately hard to hard, thin to thick bedded	RC 1	100 (0)							
		RC 2	38 (20)							
50		RC 3	92 (78)							
		RC 4	88 (0)							
60										

Refusal at 43.2 feet.
Bottom of borehole at 60.0 feet.

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STR #5A L4
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY
DATE STARTED 3/10/22 **COMPLETED** 3/10/22
GROUND ELEVATION 718.2 ft
DRILLING CONTRACTOR Adam Thompson
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
AT END OF DRILLING ---
NOTES Leg 4
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 (45.3 FEET)									
10											
20											
30											
40											

Refusal at 45.3 feet.
Bottom of borehole at 45.3 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/22/22 13:19 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

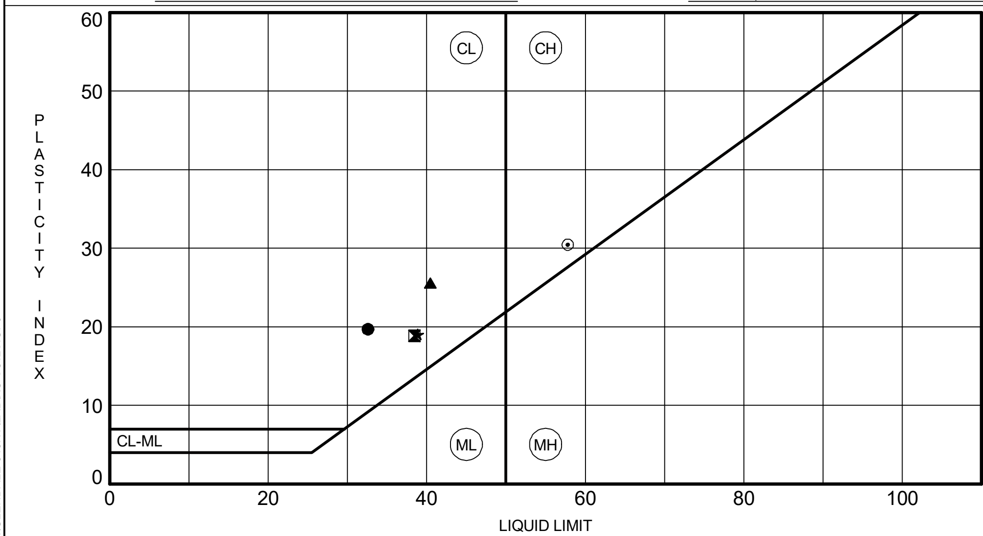
APPENDIX C

Laboratory Testing Results

AEI AMERICAN ENGINEERS, INC. PROFESSIONAL ENGINEERING

ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

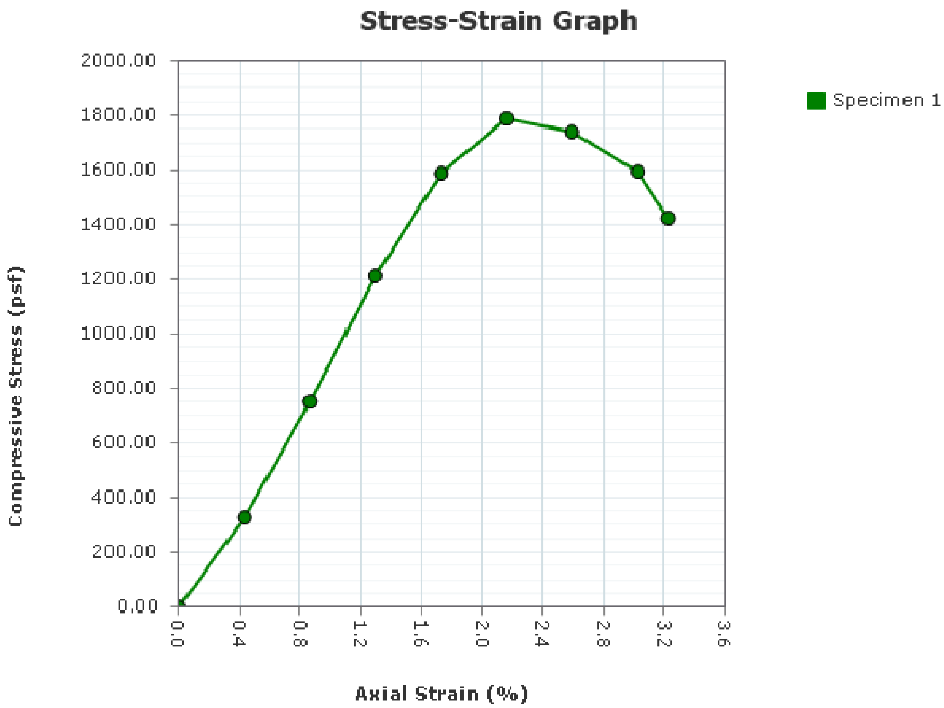


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #5A L1**	**4.0**	**33**	**13**	**20**		**LEAN CLAY (CL)**
⊠	**STR #5A L1**	**19.0**	**38**	**20**	**18**		**LEAN CLAY (CL)**
▲	**STR #5A L1**	**59.0**	**40**	**15**	**25**		**LEAN CLAY (CL)**
★	**STR #5A L3**	**4.0**	**39**	**20**	**19**		**LEAN CLAY (CL)**
⊙	**STR #5A L3**	**19.0**	**58**	**27**	**31**		**FAT CLAY (CH)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/22/22 13:22 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

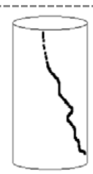
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	17.8							
Wet Density (pcf)	132.1							
Dry Density (pcf)	112.1							
Saturation (%):	94.3							
Void Ratio:	0.515							
Height (in)	5.7900							
Diameter (in)	2.8350							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1786.32							
Undrained Shear Strength (psf)	893.16							
Strain at Failure (%):	2.16							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

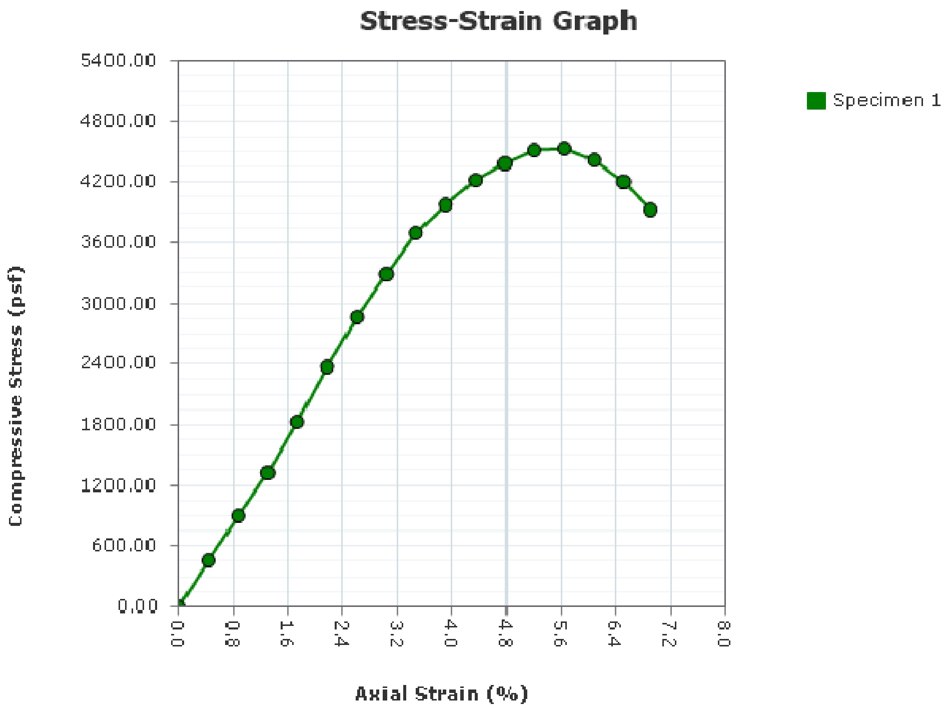
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	19.2							
Wet Density (pcf)	132.2							
Dry Density (pcf)	110.9							
Saturation (%):	98.2							
Void Ratio:	0.531							
Height (in)	5.7600							
Diameter (in)	2.8350							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.03							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	4536.55							
Undrained Shear Strength (psf)	2268.27							
Strain at Failure (%):	5.64							

Specific Gravity:	2.72	Plastic Limit:	13	Liquid Limit:	33
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

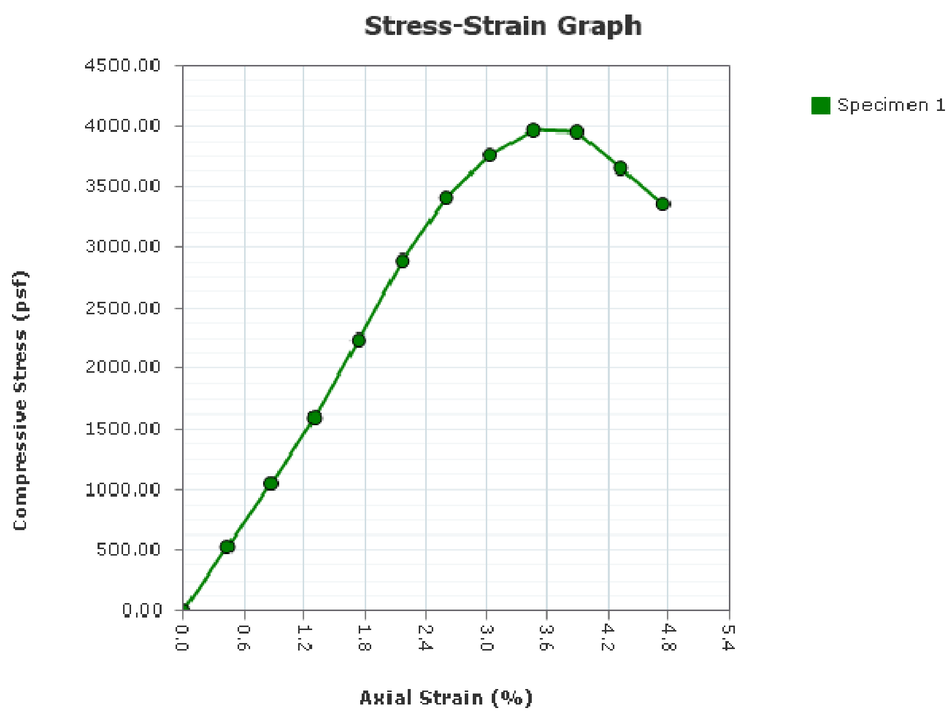
Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	24.1							
Wet Density (pcf)	126.5							
Dry Density (pcf)	102.0							
Saturation (%):	98.5							
Void Ratio:	0.665							
Height (in)	5.7800							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	3952.45							
Undrained Shear Strength (psf)	1976.23							
Strain at Failure (%):	3.89							

Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	38
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

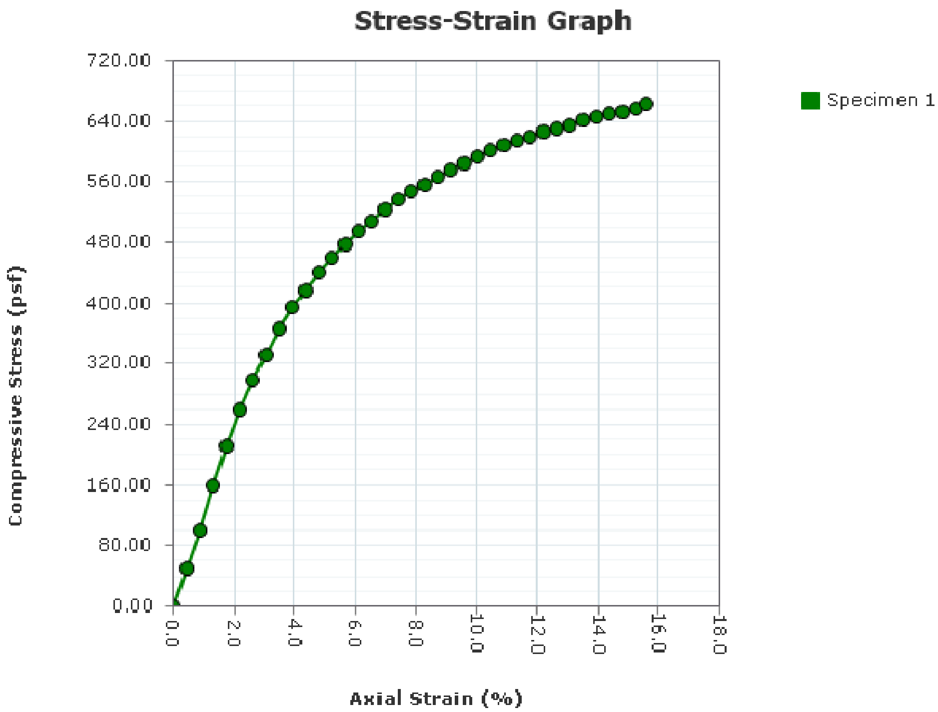
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/11/2022
Sampling Date:	3/11/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Unconfined Compression Test

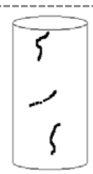
ASTM D2166

	Specimen Number							
Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	43.8							
Wet Density (pcf)	115.7							
Dry Density (pcf)	80.5							
Saturation (%):	107.3							
Void Ratio:	1.111							
Height (in)	5.7400							
Diameter (in)	2.8200							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	653.33							
Undrained Shear Strength (psf)	326.66							
Strain at Failure (%):	14.81							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/11/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5A L1
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 1

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

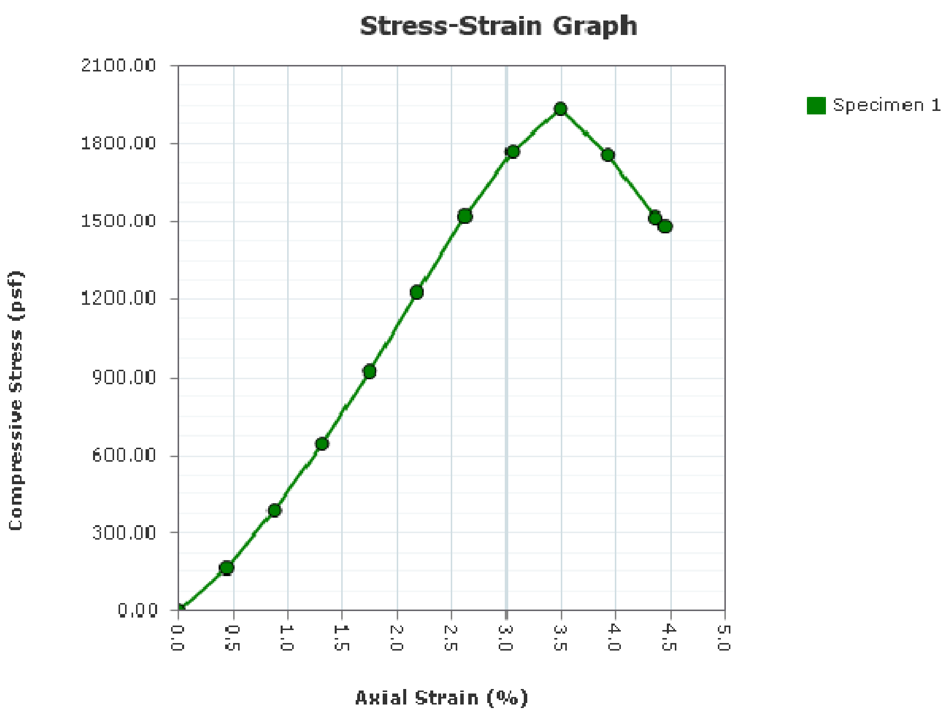
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	220-032
Received Date:	3/14/2022
Sampling Date:	3/14/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	17.9							
Wet Density (pcf)	133.1							
Dry Density (pcf)	112.9							
Saturation (%):	96.4							
Void Ratio:	0.504							
Height (in)	5.7300							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.75							
Unconfined Compressive Strength (psf)	1931.57							
Undrained Shear Strength (psf)	965.79							
Strain at Failure (%):	3.49							

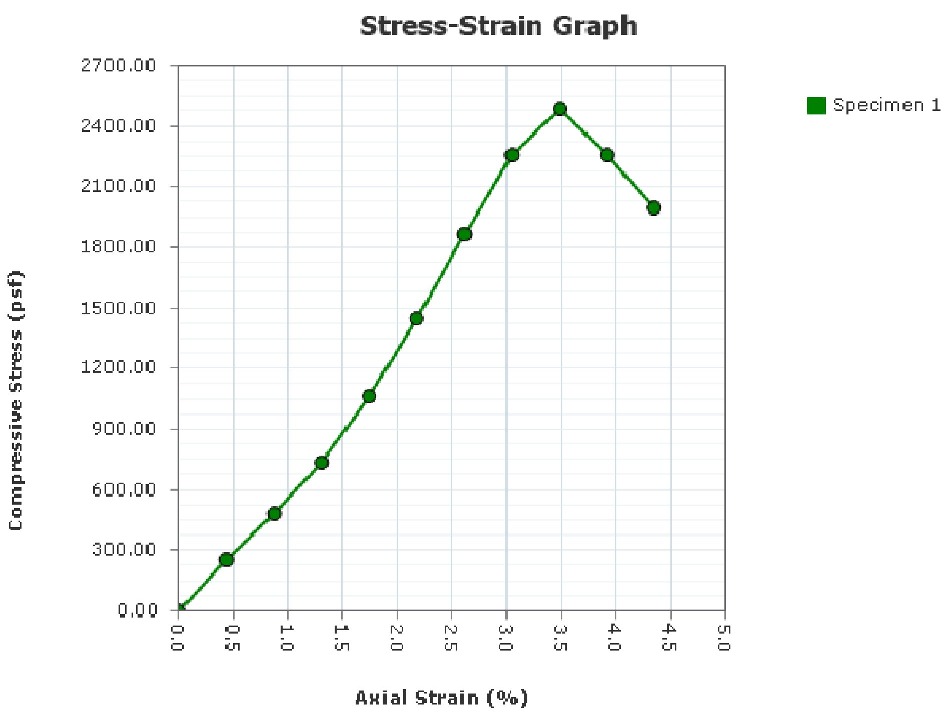
Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	220-032
Sampling Date:	3/14/2022
Sample Number:	ST 1
Sample Depth:	1.0-3.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/14/2022
Sampling Date:	3/14/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

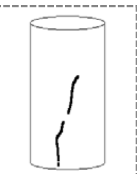
Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	22.0							
Wet Density (pcf)	125.9							
Dry Density (pcf)	103.2							
Saturation (%):	92.8							
Void Ratio:	0.645							
Height (in)	5.7400							
Diameter (in)	2.8700							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.00							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2488.16							
Undrained Shear Strength (psf)	1244.08							
Strain at Failure (%):	3.48							

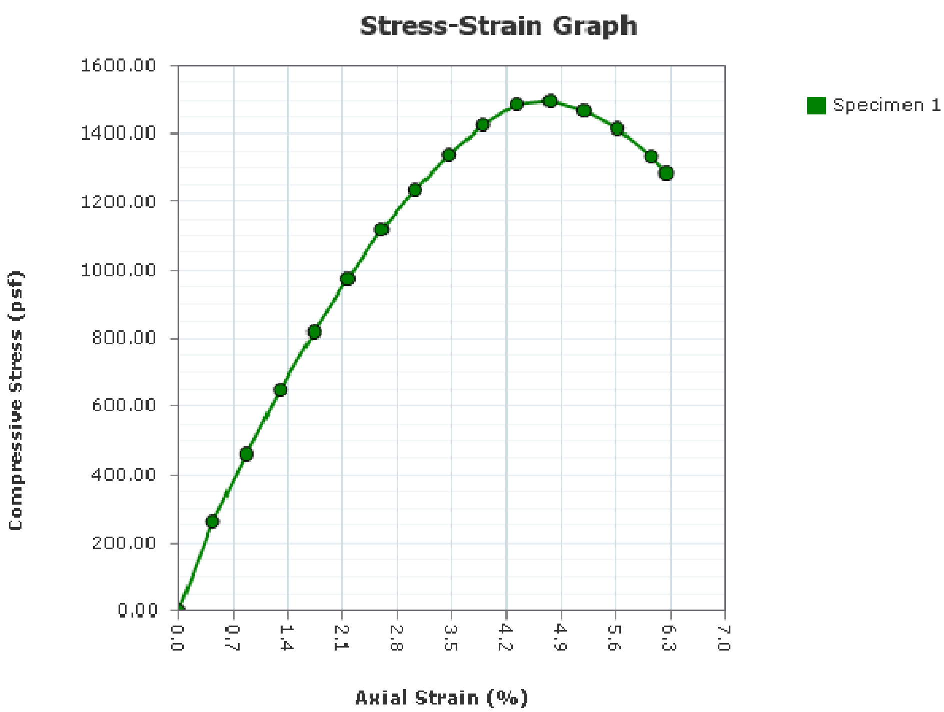
Specific Gravity:	2.72	Plastic Limit:	20	Liquid Limit:	39
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/14/2022
Sample Number:	ST 2
Sample Depth:	4.0-6.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/14/2022
Sampling Date:	3/14/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	38.1							
Wet Density (pcf)	113.6							
Dry Density (pcf)	82.3							
Saturation (%):	97.4							
Void Ratio:	1.063							
Height (in)	5.7800							
Diameter (in)	2.8600							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	1499.34							
Undrained Shear Strength (psf)	749.67							
Strain at Failure (%):	4.76							

Specific Gravity:	2.72	Plastic Limit:	27	Liquid Limit:	58
Type:	UD	Soil Classification:	CH		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/14/2022
Sample Number:	ST 3
Sample Depth:	19.0-21.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

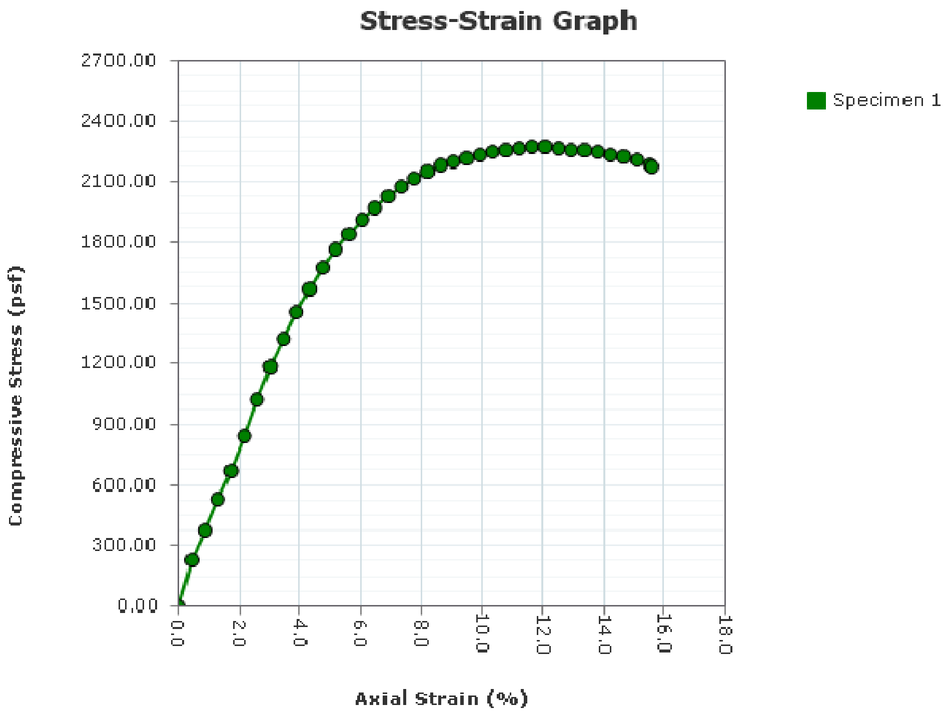
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/14/2022
Sampling Date:	3/14/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Unconfined Compression Test

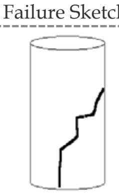
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	23.1							
Wet Density (pcf)	128.4							
Dry Density (pcf)	104.3							
Saturation (%):	100.1							
Void Ratio:	0.628							
Height (in)	5.8000							
Diameter (in)	2.8450							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.72							
Unconfined Compressive Strength (psf)	2235.14							
Undrained Shear Strength (psf)	1117.57							
Strain at Failure (%):	14.22							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CH		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/14/2022
Sample Number:	ST 4
Sample Depth:	39.0-41.0 ft
Boring Number:	STR #5A L3
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	Leg 3

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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

AMERICAN ENGINEERS, INC.

April 6, 2022

[redacted]
LG&E and KU
One Quality Street
Lexington, KY 40507

RE: Report of Geotechnical Exploration
Ford Property 345kV Glendale South – Brown North
Structure 7A
Glendale, KY
AEI Project No. 222-032

[redacted]

1. INTRODUCTION

A summary of the geotechnical parameters necessary to facilitate foundation design has been prepared for the immediate use of the design team. The project is a part of the Ford Property 345kV Glendale South – Brown North in Glendale, KY. This summary is provided for Structure 7A, a single circuit, angle dead end steel pole which will be supported by a drilled shaft foundation.

Table 1: Tower Details

Structure Number	Structure Description	Height (ft)	Centerline Elevation (ft)	Structure Coordinates		Trans. Moment (ft-k)	Long. Moment (ft-k)
				Latitude (DMS)	Longitude (DMS)		
7A	Single Circuit	120	721.2	37°35'51.225"N	85°52'58.831"W	10,622	2,528

2. DRILLING AND SAMPLING

The geotechnical exploration consisted of one soil test boring. The soil test boring was advanced to a depth of about 58 feet beneath the surface. The boring location was staked by KU personnel. A boring layout is included in Appendix A of this report.

3. SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring location, including descriptions of the various strata and their depths and thicknesses are presented on the typed boring log in Appendix B.

Topsoil was encountered at the surface with a thickness of approximately nine inches. Beneath the surface material, lean and fat clays were encountered to refusal depth in the boring. The lean clay was typically described as brown to gray in color, containing varying amounts of sand, moist to saturated and very stiff to soft. The fat clay was described as reddish brown to brown in color, containing varying amounts of gravel and sand, wet to saturated and medium stiff to very stiff.

4. BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring log, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. The auger refusal depth is provided in the table below.

Table 2: Structure 7A – Summary of Boring

Hole No.	Latitude	Longitude	Surface Elevation (ft.) MSL	Auger Refusal	
				Depth (ft.)	Elevation (ft.) MSL
STR 7A	37°35’51.225”N	85°52’58.831”W	719.8	58.5	661.3

5. FOUNDATION DESIGN PARAMETERS

5.1 **<u>Lateral Design Parameters</u>** – MFAD soil parameters are provided in the table below. These values are derived from the laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The soil deformation moduli provided below were derived from Figure 3-2 and Figure 3-4 of the User Guide for MFAD 5.0 (Moment Foundation Analysis and Design).

Table 3: MFAD Geotechnical Design Parameters

Structure Number	Lithology	Depth (feet)	Soil Undrained Shear Strength (ksf)	Modulus of Deformation (ksi)
STR 7A	CL	5.0-24.5	1.5	0.8
STR 7A	CH	24.5-58.5	0.75	0.3

Lateral soil parameters recommended for drilled shaft design are shown below in Table 4 using estimations by Matlock (1970) for soft clays with free water and by Reese, et. al (1975) for stiff clay with free water. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (feet)	Estimated Strain at 50% Shear Strength (ε_{50})	Initial Soil Stiffness (k_{py}) (pci)
STR 7A	CL	5.0-24.5	0.02	200
STR 7A	CH	24.5-58.5	0.02	-

5.2 **Axial Design Parameters** – Axial soil parameters recommended for drilled shaft design are shown below in Table 5. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. An ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (φ) of 0.45 in accordance with the Brown et al. (2010) method. Utilize an uplift resistance factor of 0.35 for cohesive soils in accordance with the Brown et al. (2018) method. Due to karst features present at the proposed tower location, it is recommended that base resistance be neglected for design purposes.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Soil Type	Depth (feet)	Effective Unit Weight* (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Side Resistance (q_s) (ksf)
STR 7A	CL	5.0-24.5	125.0	1.5	1.0
STR 7A	CH	24.5-58.5	57.6	0.75	0.7

*Effective Unit Weight accounts for Buoyancy

The designer should feel free to contact AEI at 270-651-7220 for further recommendations or if any questions arise pertaining to this project.

Sincerely,

AMERICAN ENGINEERS, INC.

Aaron Anderson, EIT
Geotechnical Engineer

Dusty Barrett, PE, PMP
Director of Geotechnical Services

Attachments:
- Boring Layout
- Typed Boring Log
- Laboratory Data

APPENDIX A

Boring Layout

LEGEND

SOIL TEST BORING

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISIONS: NO. / DATE / DESCRIPTION	
BORING LAYOUT	
CLIENT:	LG&E and KU
PROJECT:	FORD PROPERTY 345kV GLENDALE SOUTH - BROWN NORTH STRUCTURE 7A GLENDALE, KY
AEI AMERICAN ENGINEERS, INC. DESIGNING YOUR FUTURE 65 Aberdeen Drive Glasgow KY 270.651.7220	
SCALE:	NTS
DATE:	03-18-2022
DRAWN BY:	A. ANDERSON
CHECKED BY:	D. BARRETT
FILE:	
SHEET:	A-1

APPENDIX B

Boring Logs

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

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(270) 651-7220

STR #7A
PAGE 1 OF 1

CLIENT LG&E and KU
PROJECT NUMBER 222-032
DATE STARTED 3/14/22 **COMPLETED** 3/14/22
DRILLING CONTRACTOR Adam Thompson
DRILLING METHOD Hollow Stem Auger
LOGGED BY Peyton Linder **CHECKED BY** Aaron Anderson
NOTES

PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT LOCATION Glendale, KY
GROUND ELEVATION 719.8 ft
GROUND WATER LEVELS:
▽ **AT TIME OF DRILLING** 20.50 ft / Elev 699.32 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
0	TOPSOIL (9 INCHES)									
	(CL) lean CLAY, brown to gray, moist, very stiff	ST 1	85		3.25	23				Qu = 4,361 psf
		ST 2	85		3.75	21	34	13	21	Qu = 5,067 psf
10	(CL) lean CLAY, some sand, brown to gray, moist to saturated, stiff to soft	SPT 1	100	5-5-6 (11)	2.75	22				
20	▽	ST 3	100		1.75	19	33	14	19	Qu = 2,381 psf
	(CH) fat CLAY, trace sand, red to brown, saturated, medium stiff									
30		SPT 2	93	3-3-3 (6)	1.25	24	51	22	29	
40		ST 4	75		0.25	34				
	(CH) gravelly fat CLAY, brown, saturated, very stiff									
50		SPT 3	53	19-8-17 (25)	1.0	32				

Refusal at 58.5 feet.
Bottom of borehole at 58.5 feet.

APPENDIX C

Laboratory Testing Results

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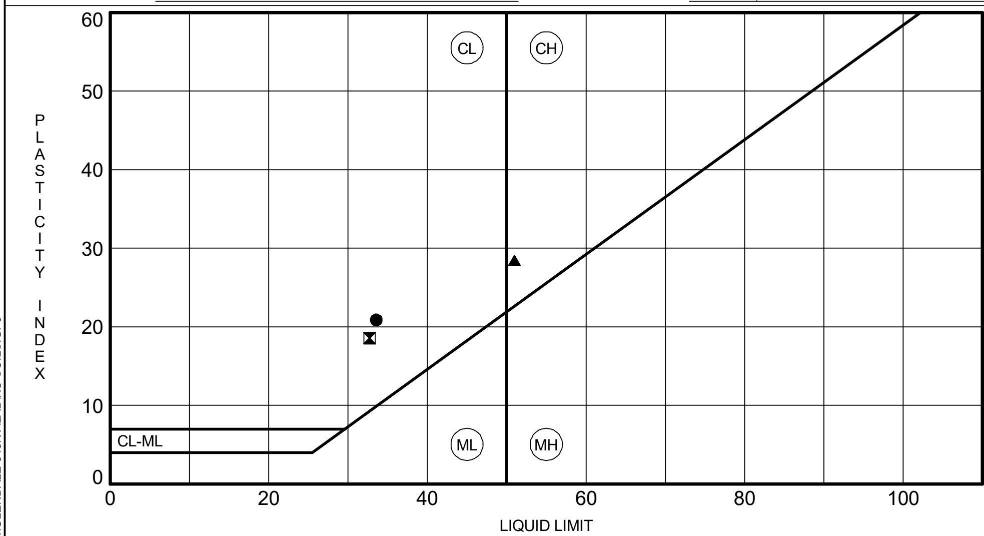
ATTERBERG LIMITS' RESULTS

CLIENT LG&E and KU
PROJECT NAME Ford Property 345kV Glendale South - Brown North
PROJECT NUMBER 222-032
PROJECT LOCATION Glendale, KY

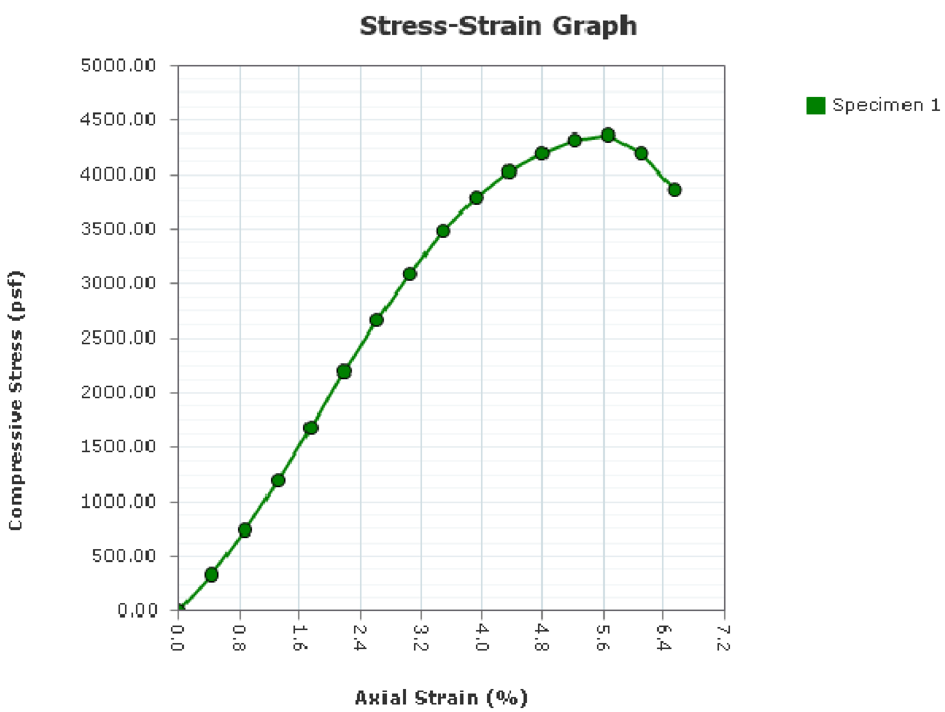


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STR #7A**	**4.0**	**34**	**13**	**21**		**LEAN CLAY (CL)**
⧗	**STR #7A**	**19.0**	**33**	**14**	**19**		**LEAN CLAY (CL)**
▲	**STR #7A**	**29.0**	**51**	**22**	**29**		**FAT CLAY (CH)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 3/18/22 08:39 - T:\22 PROJECTS\222-032 LG&E KU GLENDALE FORD PLANT\GEOTECH\GLENDALE 345KV\LAB\KU SOILS.GPJ

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 1
Sample Depth:	1-3 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

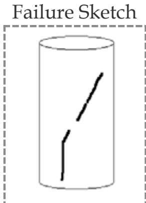
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	23.5							
Wet Density (pcf)	127.0							
Dry Density (pcf)	102.9							
Saturation (%):	98.1							
Void Ratio:	0.651							
Height (in)	5.7400							
Diameter (in)	2.8350							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	4361.38							
Undrained Shear Strength (psf)	2180.69							
Strain at Failure (%):	5.66							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 1
Sample Depth:	1-3 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

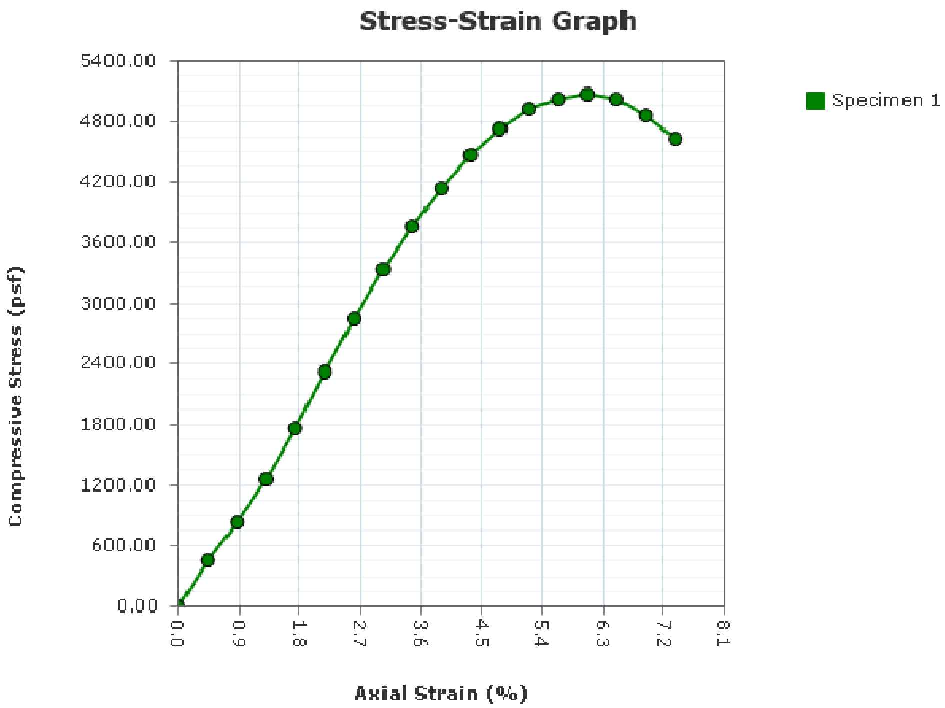
Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 2
Sample Depth:	4-6 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	20.7							
Wet Density (pcf)	130.7							
Dry Density (pcf)	108.3							
Saturation (%):	99.2							
Void Ratio:	0.568							
Height (in)	5.7700							
Diameter (in)	2.8250							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.04							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.73							
Unconfined Compressive Strength (psf)	5067.91							
Undrained Shear Strength (psf)	2533.96							
Strain at Failure (%):	6.07							

Specific Gravity:	2.72	Plastic Limit:	13	Liquid Limit:	34
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 2
Sample Depth:	4-6 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch

Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

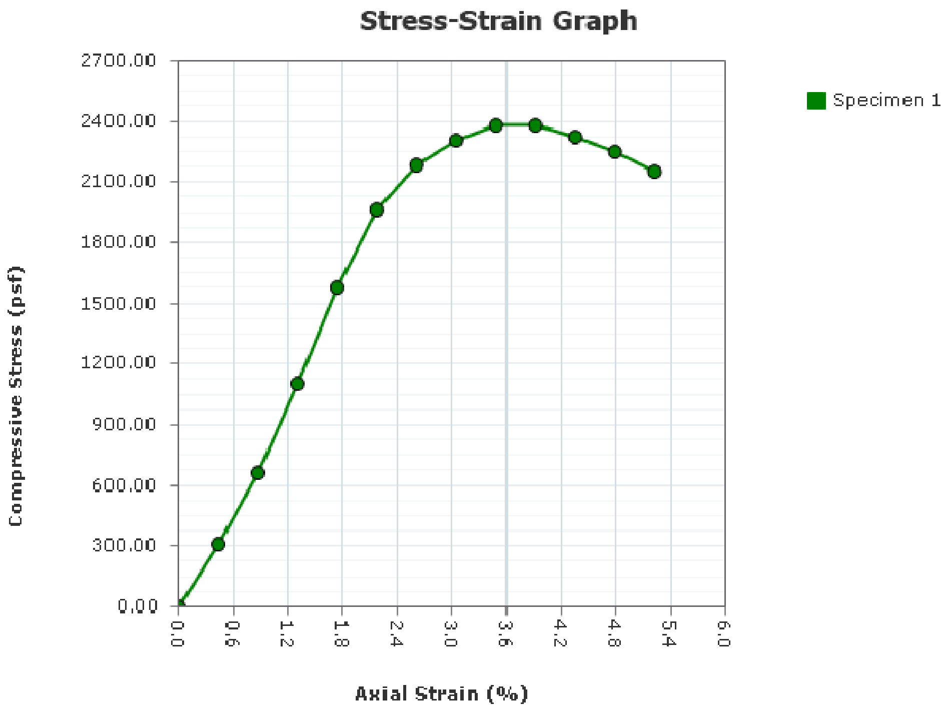
Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

Unconfined Compression Test - Results

Unconfined Compression Test

ASTM D2166



Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Received Date:	3/15/2022
Sampling Date:	3/15/2022
Sample Number:	ST 3
Sample Depth:	19-21 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Unconfined Compression Test

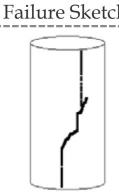
ASTM D2166

	Specimen Number							
Before Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Moisture Content (%):	19.2							
Wet Density (pcf)	133.0							
Dry Density (pcf)	111.6							
Saturation (%):	99.9							
Void Ratio:	0.522							
Height (in)	5.7400							
Diameter (in)	2.8400							
Strain Limit @ 15% (in)	0.9							
Height To Diameter Ratio:	2.02							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Failure Angle (°):	0							
Strain Rate (in/min)	0.1							
Strain Rate (%/min):	1.74							
Unconfined Compressive Strength (psf)	2381.92							
Undrained Shear Strength (psf)	1190.96							
Strain at Failure (%):	3.92							

Specific Gravity:	2.72	Plastic Limit:	14	Liquid Limit:	33
Type:	UD	Soil Classification:	CL		

Project:	Ford Property 345kV Glendale South - Brown North
Project Number:	222-032
Sampling Date:	3/15/2022
Sample Number:	ST 3
Sample Depth:	19-21 ft
Boring Number:	STR #7A
Location:	Glendale, KY
Client Name:	LG&E and KU
Remarks:	

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

Specimen 8 Failure Sketch

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
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PROFESSIONAL ENGINEERING

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Glasgow, KY 42141
270-651-7220

Wetland Delineation Report for the Glendale 345kV Transmission Lines Project

LG&E-KU Energy Services Company

Glendale 345kV Transmission Lines
Project No. 144025

5/4/2022

Wetland Delineation Report for the Glendale 345kV Transmission Lines Project

prepared for

LG&E-KU Energy Services Company
Glendale 345kV Transmission Lines Project
Lexington, KY

Project No. 144025

5/4/2022

prepared by

Burns & McDonnell Engineering Company, Inc.
Chicago, Illinois

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LIST OF TABLES

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
APT	Antecedent Precipitation Tool
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
CWA	Clean Water Act
E	Ephemeral
EPA	Environmental Protection Agency
FAC	Facultative plants
FACU	Facultative upland plants
FACW	Facultative wetland plants
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GPS	Global Positioning System
I	Intermittent
kV	Kilovolt
LRR	Land Resource Regions
LG&E-KU	LG&E-KU Energy Services Company
NFHL	National Flood Hazard Layer
NHD	National Hydrography Dataset
NRCS	Natural Resources Conservation Service
NRPW	Non-Relatively Permanent Water
NTCHS	National Technical Committee for Hydric Soils
NWI	National Wetlands Inventory

Abbreviation	**Term/Phrase/Name**
OBL	Obligate wetland plants
OHWM	Ordinary High Water Mark
P	Perennial
PEM	Palustrine Emergent wetland
PFO	Palustrine Forested wetland
Project Area	Glendale 345kV transmission lines (LI-167000 and LI-167444) right-of-way and proposed access routes
Project	Glendale 345kV Transmission Lines Project
PUB	Palustrine Unconsolidated Bottom wetland
Regional Supplement	Regional supplements to the 1987 Wetlands Delineation Manual
RPW	Relatively Permanent Water
S	Stream
SDA	Soil Data Access
SP	Sample Plot
SSURGO	Soil Survey Geographic
SWANCC	Solid Waste Agency of Northern Cook County
Survey Area	216 acres including transmission lines right-of-way and proposed access routes
TNW	Traditional Navigable Waterway
UPL	Upland plants
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Abbreviation	Term/Phrase/Name
WOTUS	Waters of the U.S.

1.0 INTRODUCTION

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was retained by LG&E-KU Energy Services Company (LG&E-KU) to provide wetland delineation and permitting services for the proposed Glendale 345kV Transmission Lines Project (Project) that is located in Hardin County, Kentucky (Figure 1, Appendix A). The Project consists of two new 345kV transmission lines (LI-167000 and LI-167444) totaling approximately 8.2 miles as well as the use of access routes totaling approximately 12 miles. LI-167000 is approximately 4.8 miles totaling 35 structures. LI-167444 is approximately 3.4 miles totaling 27 structures. The Project will be located with a new 200-foot right-of-way (ROW). The Project Area encompasses a total of 216 acres, which includes the 200-foot ROW, 5-foot-wide access roads and potential pull pad locations that extend outside of the ROW, and approximately 0.5 acre access and work area for stringing new OPGW wires from the existing Hardin County Substation to Structure 4 of LI-167000. The Survey Area for the wetland delineation consists of the entire 216 acre Project Area, with approximately 26 acres of the Survey Area being previously delineated by Third Rock Consultants LLC in November and December 2021. The results of the delineation conducted by Third Rock Consultants LLC is not included in this Wetland Delineation Report.

The purpose of this assessment was to identify wetlands and surface waters present within the Survey Area that may be considered “Waters of the United States” (WOTUS, 40 CFR 230.3[s]) and subject to regulation under the federal Clean Water Act (CWA) by the U.S. Army Corps of Engineers (USACE). The USACE and the U.S. Environmental Protection Agency (EPA) jointly define wetlands as: “Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (42 Fed. Reg. 37128-29). According to 40 CFR 230.3(s), WOTUS include all waters that may be used for interstate or foreign commerce, all interstate wetlands and waterways, intrastate wetlands and waterways of which the use, degradation, or destruction could affect interstate or foreign commerce, impoundments of waters, territorial seas, and wetlands adjacent to waters not including waste treatment systems, including their treatment ponds or lagoons designed to meet the requirements of the CWA.

Burns & McDonnell conducted a wetland and surface water delineation on March 8 through 10, 2022 to identify the location and extent of wetlands and surface waters present within the Survey Area. This report documents the methods and results of the desktop and field investigations conducted to identify wetlands and surface waters for the Project.

2.0 METHODS

The following sections summarize the methods used to complete the desktop review of existing data and to conduct the field investigations within the Project Area.

2.1 Existing Data Review

Burns & McDonnell reviewed available background information for the Survey Area prior to conducting the site visit. Available background information included the following:

- U.S. Geological Survey (USGS) 7.5-minute topographic map (Elizabethtown 2019, Cecilia 2019, Sonora 2019, Tonieville 2019 quadrangles);
- U.S. Fish & Wildlife Service (USFWS) National Wetlands Inventory (NWI) map (USFWS 2022);
- USGS National Hydrography Dataset (NHD);
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), National Flood Hazard Layer (NFHL 2007); and
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO 2021) digital data for Hardin County.

Background data helps in identifying locations of potential wetland and surface waters. However, as these features may not have been field verified or modified since the data was published, the field analyses supersedes the mapped data.

2.2 Wetland Delineation

Identification of wetlands is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology, originally set forth by the USACE in the 1987 Environmental Laboratory publication entitled "*Corps of Engineers Wetlands Delineation Manual: Technical Report Y-87-1*", commonly referred to as the 1987 Wetlands Delineation Manual (Environmental Laboratory 1987).

The USACE released regional supplements to the 1987 Wetlands Delineation Manual outlining updated technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the CWA or Section 10 of the Rivers and

Harbors Act. The Survey Area is located within the following regional supplement(s) (Regional Supplements):

- 2010 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0)*

This wetland delineation used the hydrophytic vegetation, hydric soil, and wetland hydrology indicators as outlined in the applicable Regional Supplement for each sample point. A general overview of hydrophytic vegetation, hydric soil, and wetland hydrology indicators are provided below. Detailed information for each indicator can be found in the applicable Regional Supplement. In addition, methodology for determining wetland quality (where applicable), surface water boundaries, and farmed wetland determinations are provided below.

2.2.1 Hydrophytic Vegetation

To evaluate the presence of hydrophytic vegetation, data are gathered using a graduated series of plots, one for each vegetation stratum. Plot shape and size are dictated by vegetation type, as well as the shape and size of the plant community being evaluated.

The indicator status and percent absolute cover for plants within plots for all vegetation strata are recorded. The indicator status for plant species are based on an estimated probability of occurring in wetlands. This rating system, published by the USACE in 2020 under the title "The National Wetland Plant List, version 3.5" (USACE 2020), consists of obligate wetland plants (OBL), facultative-wet plants (FACW), facultative plants (FAC), facultative upland plants (FACU), and upland plants (UPL). Obligate plant species generally grow in water. Facultative plant species can exist in saturated or dry soil conditions, and upland plants typically require dry soil conditions to exist.

2.2.2 Hydric Soil

A description of the soil profile is used to evaluate the presence of hydric soil. The USDA recognizes 28 Land Resource Regions (LRRs) based on soil, climate, and land use. Hydric soil indicators for LRRs presented in the Regional Supplements are a subset of the National Technical Committee for Hydric Soils (NTCHS) Field Indicators of Hydric Soils in the United States and are regularly modified. The most recent version of Field Indicators of Hydric Soils is Version 8.2 (USDA NRCS 2018) and was used for this delineation.

2.2.3 Wetland Hydrology

Wetland hydrology indicators are separated into four groups and divided into a primary or secondary category based on their estimated reliability in the applicable region. Primary indicators provide stand-alone evidence of a current or recent hydrological event. Secondary indicators provide evidence of recent inundation or saturation when supported by one or more other primary indicators or secondary wetland hydrology indicators but should not be used alone.

2.2.4 Surface Water Assessment

Surface waters may only have one or two of the wetland criteria listed above. The USACE defines the ordinary high water mark (OHWM) as the boundary of surface waters (33 CFR 328.3[F]). The USACE issued an OHWM Identification regulatory guidance letter (USACE, 2005) which defines "the OHWM [as] the line on the shore established by fluctuations of water and is indicated by physical characteristics such as:

- A clear, natural line impressed on the bank;
- Shelving;
- Changes in the character of soil;
- Destruction of terrestrial vegetation;
- The presence of litter and debris; or
- Other appropriate means that consider the characteristics of the surrounding areas."

During low streamflow or drought conditions, the OHWM is used to determine the boundary of a surface water. During extremely high streamflow conditions or flood conditions the boundaries of surface waters cannot accurately be determined. Therefore, surface water boundaries should be delineated when normal streamflow conditions are present.

To differentiate boundaries between surface waters and adjacent wetlands, evidence of the OHWM is utilized. Changes in vegetation can also be evaluated to determine where true hydrophytic (FAC and FACW) plant species are present versus aquatic or OBL species; however, it should be noted that in many cases vegetation is not present within the channels of surface waters. Vegetation adjacent to surface waters may be limited to species overhanging the banks and channel.

If the presence of a surface water is questionable, the USACE will typically conduct a review of historic aerial photographs and historic USGS topographic maps to confirm the current or historic presence of a surface water. This can include segments of streams that are entirely enclosed.

3.0 RESULTS

The following sections summarize the desktop evaluation and field investigations.

3.1 Existing Data Review

Burns & McDonnell reviewed available background information for the Survey Area prior to conducting the site visit. These sources provide an indication of areas where wetlands and surface waters potentially occur and certain characteristics. A summary of the available background information is presented below and mapped on Figures in Appendix A.

3.1.1 USGS 7.5-minute Topographic Maps

The USGS topographic map indicates the Survey Area crosses generally flat areas (≤ 5%) consisting of agricultural and pastureland with some gently rolling hills of 15-20% slopes (Figure 2 in Appendix A).

3.1.2 FEMA FIRM

The FEMA FIRM (Figure 2 in Appendix A) depicts the Survey Area crossing six floodplains associated with Valley Creek, East Rhudes Creek, and Rose Run as well as multiple tributaries (Figure 2 in Appendix A).

3.1.3 USFWS NWI

The digital format NWI maps were developed by USFWS in collaboration with the USGS, Water Resource Division using data from 1987 and are periodically updated. The maps are prepared primarily by stereoscopic analysis of high-altitude aerial photographs to produce reconnaissance level information on the location, type and size of wetlands and deepwater habitats. All wetlands are identified based on vegetation, visible hydrology, and geography in accordance with the Cowardin System (Cowardin 1979). According to the USFWS, the aerial photographs reflect conditions during the year and season they were taken; however, there is a margin of error inherent in the use of aerial photographs to delineate wetlands. Therefore, wetland boundaries established through interpretation of aerial photographs may be revised based upon detailed ground survey and historical analysis of an individual site.

The NWI map (Figure 3 in Appendix A) indicates two palustrine forested broad-leaved deciduous temporary flooded (PFO1A) wetlands, three palustrine unconsolidated bottom permanently flooded (PUBH) wetlands, one palustrine unconsolidated shore seasonally flooded (PUSC) wetland, one riverine lower perennial unconsolidated bottom permanently flooded (R2UBH) wetland, 14 riverine intermittent streambed seasonally flooded (R4SBC) wetlands, and three riverine unknown perennial unconsolidated bottom permanently flooded (R5UBH) wetlands are located within the Survey Area.

3.1.4 USGS NHD

The NHD represents the water drainage network of the United States with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and streamgages. NHD is updated and maintained through partnerships with states and other collaborative bodies. The NHD dataset (Figure 3 in Appendix A) shows that fifteen unnamed streams and three named streams cross the Survey Area. Named waterbodies include East Rhudes Creek, Valley Creek, and Rose Run.

3.1.5 USDA NRCS SSURGO

The NRCS Web Soil Survey (USDA NRCS 2022a) is generated from the USDA-NRCS certified data (Figure 4 in Appendix A). The NRCS Soil Data Access (SDA) Hydric Soils List (USDA NRCS 2022b) contains a compilation of all map units with either a major or minor component that is at least in part hydric. As the list includes both major and minor (small) percentages for map units, in some cases most of the map unit may not be hydric. The list is useful in identifying map units that may contain hydric soils.

The NRCS SSURGO digital data indicates that portions of 22 soil map units are located in the Survey Area. One soil map unit, Melvin silt loam (Mv), is included on local and national hydric soil lists.

3.2 Site Investigation Results

A total of eight wetlands and 26 surface waters were delineated. The Antecedent Precipitation Tool (APT) results indicated the Survey Area was experiencing wetter than normal conditions at the time of the survey (Appendix B). The wetlands and surface waters are summarized in Tables 1 and 3, respectively, and are mapped on Figure 5 in Appendix A. Wetland Determination Data Forms from the applicable Regional Supplement were completed for each wetland and are included in Appendix B. Natural color photographs of sample plots, wetland and surface waters, and other identified features are included in Appendix C. Locations of sample plots, wetland and surface water boundaries, and other identified features were surveyed using a sub-meter accurate Global Positioning System (GPS) unit.

Approximately 0.5 acre of the approximate 216 acre Survey Area was added after the site investigations were completed. A desktop determination was conducted to identify wetlands and other water bodies within this area. Both the information gathered in the existing data review and knowledge from the previous site investigations were utilized to identify potential wetlands and waterbodies. These features were not field verified.

3.2.1 Wetlands

A total of eight wetlands were delineated within the Survey Area. Refer to Table 1 below for details for each wetland.

Table 1: Summary of Wetlands within the Survey Area

Wetland Number	Wetland Type[a]	Dominant Vegetation[b]	Hydric Soil Indicator(s)[c]	Wetland Hydrology Indicator(s)[d]	Area of Wetland Delineated in Survey Area (acre)	Figure 5 Page Number	WOTUS (Y/N)[e]
W-1	PEMf	Wing-pod purslane, common panic grass, Kentucky blue grass	F3	A1, A2, A3, C9, D1, D2	0.25	21	N
W-2	PFO	Green ash, American elm, river birch, black elder	F6	A2, A3, B3, B9, B10, D2, D5	0.18	46	Y
W-3	PEM	Deer-tongue rosette grass, lamp rush	F3	A2, A3, B10, D2, D5	1.10	44	Y
W-4	PEM	Silver maple, Dudley's rush, sedge species	F3	A2, A3, B9, C3, D2, D5	0.11	43	Y
W-5	PEM	Creeping buttercup, lamp rush	F3	A2, A3, D2, D5	0.25	42	N
W-6	PEMf	Common panic grass, Kentucky blue grass	F3	A3, C9, D2	0.44	39	Y
W-7	PUB	--	--	--	--	36	N
W-8	PEM	Sedge species, wand panic grass, dark-green bulrush	F3	A2, A3, C3, C9, D2, D5	0.72	35	Y
Total					**3.05**	--	--

(a) Symbols for wetland type: PEMf = farmed wetland, PEM = palustrine emergent, PFO = palustrine forested, PUB = palustrine unconsolidated bottom
(b) Winged-pod purslane (*Portulaca umbraticola*), common panic grass (*Panicum capillare*), Kentucky blue grass (*Poa pratensis*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), river birch (*Betula nigra*), black elder (*Sambucus nigra*), deer-tongues rosette grass (*Dichanthelium clandestinum*), lamp rush (*Juncus effusus*), Silver maple (*Acer saccharinum*), Dudley's rush (*Juncus dudleyi*), sedge species (*Carex sp.*), creeping buttercup (*Ranunculus repens*), wand panic grass (*Panicum virgatum*), and dark-green bulrush (*Scirpus atrovirens*).
(c) Indicator code for hydric soil: F3 = Depleted Matrix, F6 = Redox Dark Surface
(d) Indicator code for wetland hydrology: A1 = Surface Water, A2 = High Water Table, A3 = Saturation, B3 = Drift Deposits, B9 = Water-Stained Leaves, B10 = Drainage Patterns, C3 = Oxidized Rhizospheres on Living Roots, C9 = Saturation Visible on Aerial Imagery, D1 = Stunted or Stressed Plants, D2 = Geomorphic Position, D5 = FAC-Neutral Test
(e) Jurisdiction is based on professional judgement using the using the definition of WOTUS under Solid Waste Agency of Northern Cook County (SWANNCC) v. U.S. Army Corps of Engineers, and Rapanos v. United States. The USACE makes the final determination of jurisdictional status.

Areas Determined to not Meet Wetland Criteria

Table 2: Sample Plots Not Determined to Meet Wetland Criteria

Sample Plot (SP)	Dominant Vegetation[a]	Hydric Soil Indicator(s)	Wetland Hydrology Indicator(s)[b]	Figure 5 Page Number
SP-1	Kentucky blue grass	None	A1, C9	9
SP-2	Common panic grass, Kentucky blue grass	None	A2, A3	25
SP-5	Sycamore, black cherry, giant cane	None	D5	18
SP-16	Common panic grass, Kentucky blue grass	None	None	38

(a) Kentucky blue grass (*Poa pratensis*), common panic grass (*Panicum capillare*), sycamore (*Platanus occidentalis*), black cherry (*Prunus serotina*) giant cane (*Arundinaria gigantea*)
(b) Indicator code for wetland hydrology: A1 = Surface Water, A2 = High Water Table, A3 = Saturation, C9 = Saturation Visible on Aerial Imagery, D5 = FAC-Neutral Test

3.2.2 Streams

A total of 26 surface waters were delineated within the Survey Area. Refer to Table 3 below for details for each stream.

Table 3: Type and Length of Streams Delineated

Stream Number[a]	Flow Regime/ Stream Type[b]	WOTUS (Y/N)[c]	Stream Name[d]	Substrate	OHWM Width (feet)	OHWM Bank Height (feet)	Surface Water Depth (feet)	Length of Delineated Stream in Survey Area (feet)	Figure 5 Page
S-1	E/NRPW	Y	UNT to Valley Creek	Silt	3	4	0	73	3
S-2	P/RPW	Y	UNT to Valley Creek	Gravel, silt	8	8	1	498	3
S-3A	P/RPW	Y	Valley Creek	Cobble, gravel, silt	70	15	5	254	3
S-3B	P/RPW	Y	Valley Creek	Cobble, gravel, silt	70	20	8	218	15
S-4	I/RPW	Y	UNT to Valley Creek	Cobble, silt	5	6	0.5	350	3
S-5	I/RPW	Y	UNT to Valley Creek	Silt	8	1	0.5	205	5
S-6	P/RPW	Y	UNT to Valley Creek	Gravel, Silt	4	1	0.75	211	6
S-7	P/RPW	Y	UNT to Valley Creek	Silt, detritus	25	4	3	259	15
S-8	E/NRPW	Y	UNT to East Rhodes Creek	Silt	2.5	2	0.1	331	18
S-9	E/NRPW	Y	UNT to Rose Run	Silt	7	0.25	0.5	166	23
S-10	P/RPW	Y	Rose Run	Cobble, gravel, sand, silt	10	4	1	201	23
S-11	P/RPW	Y	UNT to Rose Run	Cobble, gravel, silt	8	0.25	0.5	884	24, 25
S-12	I/RPW	Y	UNT to Rose Run	Gravel, silt	2	1	0.2	421	24, 25
S-13	E/NRPW	Y	UNT to Rose Run	Gravel, silt	1	2.5	0.1	37	24
S-14A	P/RPW	Y	East Rhodes Creek	Cobble, gravel, sand, silt	35	6	5	215	18
S-14B	P/RPW	Y	East Rhodes Creek	Cobble, gravel, sand, silt	25	10	4	220	46
S-15	I/RPW	Y	UNT to East Rhodes Creek	Gravel, sand, detritus	4	4	2	578	19
S-16	I/RPW	Y	UNT to Nolin River	Silt	3	0.5	0.3	271	34
S-17	E/NRPW	Y	UNT to East Rhodes Creek	Silt, detritus	2.5	6	0.1	67	46
S-18	I/RPW	Y	UNT to East Rhodes Creek	Silt, detritus	3	4	0.4	296	44
S-19	E/NRPW	Y	UNT to East Rhodes Creek	Silt, detritus	4	0.25	0.1	87	43

Stream Number[a]	Flow Regime/ Stream Type[b]	WOTUS (Y/N)[c]	Stream Name[d]	Substrate	OHWM Width (feet)	OHWM Bank Height (feet)	Surface Water Depth (feet)	Length of Delineated Stream in Survey Area (feet)	Figure 5 Page
S-20	I/RPW	Y	UNT to East Rhodes Creek	Gravel, sand, silt	3	7	0.75	239	42
S-21	E/NRPW	Y	UNT to Rose Run	Silt	2	0.5	0.2	71	39
S-22	E/NRPW	Y	UNT to Rose Run	Silt	1.5	1.5	0	50	39
S-23	I/RPW	Y	UNT to Nolin River	Detritus, silt	2	3	0.3	257	38
S-24	I/RPW	Y	UNT to Nolin River	Gravel, silt	1.5	0.5	0.2	37	35
S-25	I/RPW	Y	UNT to Nolin River	Silt	1.5	0.5	0.5	238	35
S-AA*	E/NRP	Y	UNT to Valley Creek	UNK	9**	UNK	UNK	15**	
S-AB*	E/NRP	Y	UNT to Valley Creek	UNK	9**	UNK	UNK	16**	
							Total:	**6,765**	

(a) Assigned by Burns & McDonnell staff during the site investigation; S = stream
(b) Stream name follows USGS topographic map, NHD, or state/local data source; P = Perennial, I = Intermittent, E = Ephemeral; TNW = Traditional Navigable Waterway; RPW= Relatively Permanent Water, NRPW= Non-Relatively Permanent Water
(c) Jurisdiction is based on professional judgement using the using the definition of WOTUS under Solid Waste Agency of Northern Cook County (SWANNCC) v. U.S. Army Corps of Engineers, and Rapanos v. United States. The USACE makes the final determination of jurisdictional status.
(d) UNT = Unnamed Tributary
* Stream identified based on desktop review and not verified with a field survey.
** Value based on desktop review.

4.0 SUMMARY

Burns & McDonnell conducted a wetland delineation of the Survey Area to identify wetlands and other waterbodies. A total of eight wetlands and 26 surface waters were identified. Avoidance of wetlands and surface waters should be considered in Project planning. If avoidance is not possible, permits for impacts and alterations may be required. Permits for impacts to jurisdictional waterways and wetlands within Kentucky are regulated by the USACE in compliance with Section 404 of the CWA. Jurisdictional surface waters and wetlands are defined by the pre-2015 regulatory definition using guidance from Rapanos and SWANCC.

In addition, the Survey Area crossed floodplains associated with Valley Creek, East Rudes Creek, Rose Run, and several of their unnamed tributaries. Floodplains in Kentucky are regulated by Kentucky Department of Environmental Protection and the counties. The Project may be covered under the General Permit KY FPGP, but consultation with the state and counties is recommended.

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APPENDIX A – FIGURES

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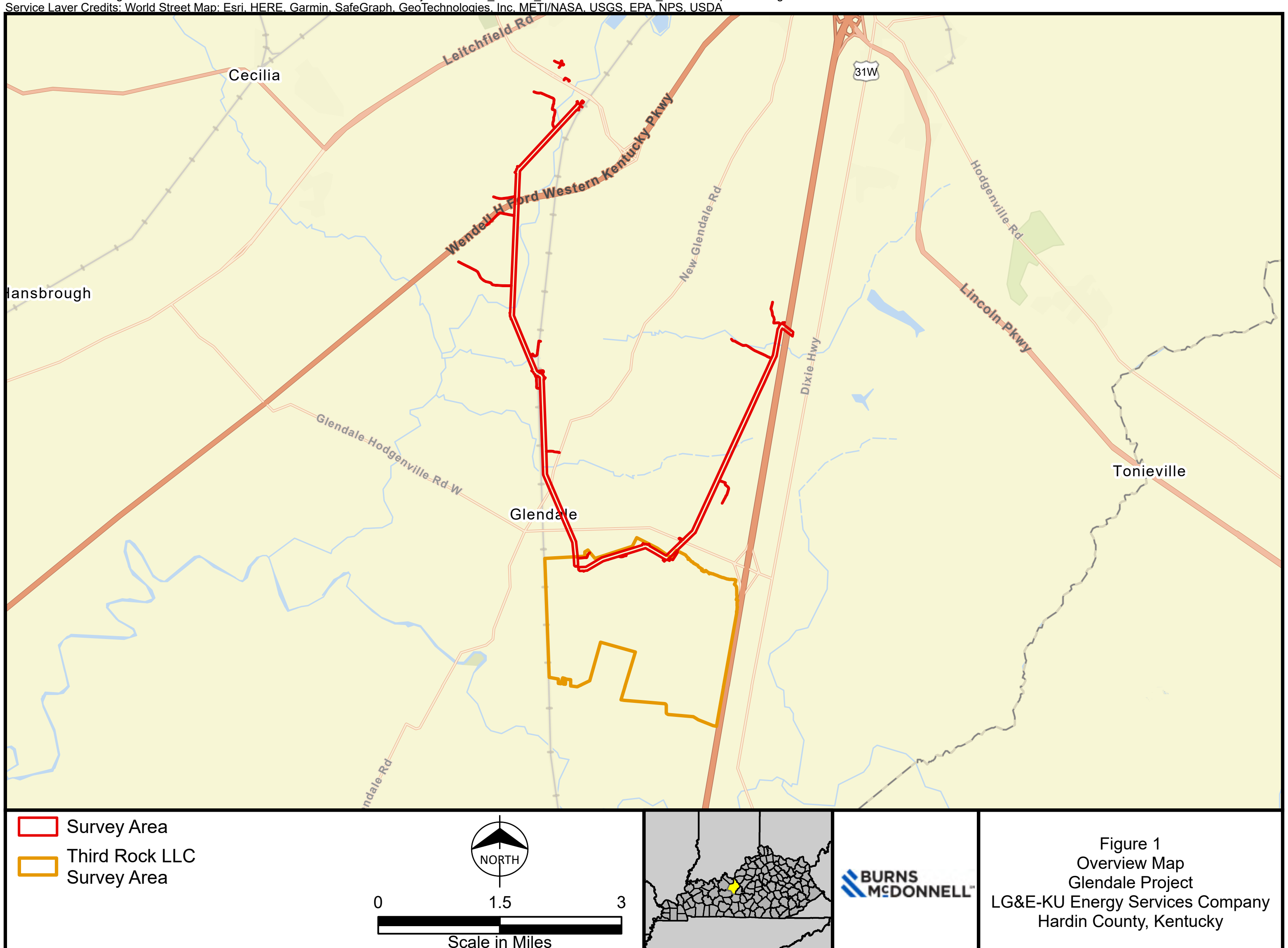

BURNS McDONNELL

Figure 1
Overview Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky

Source: Esri and Burns & McDonnell Engineering Company

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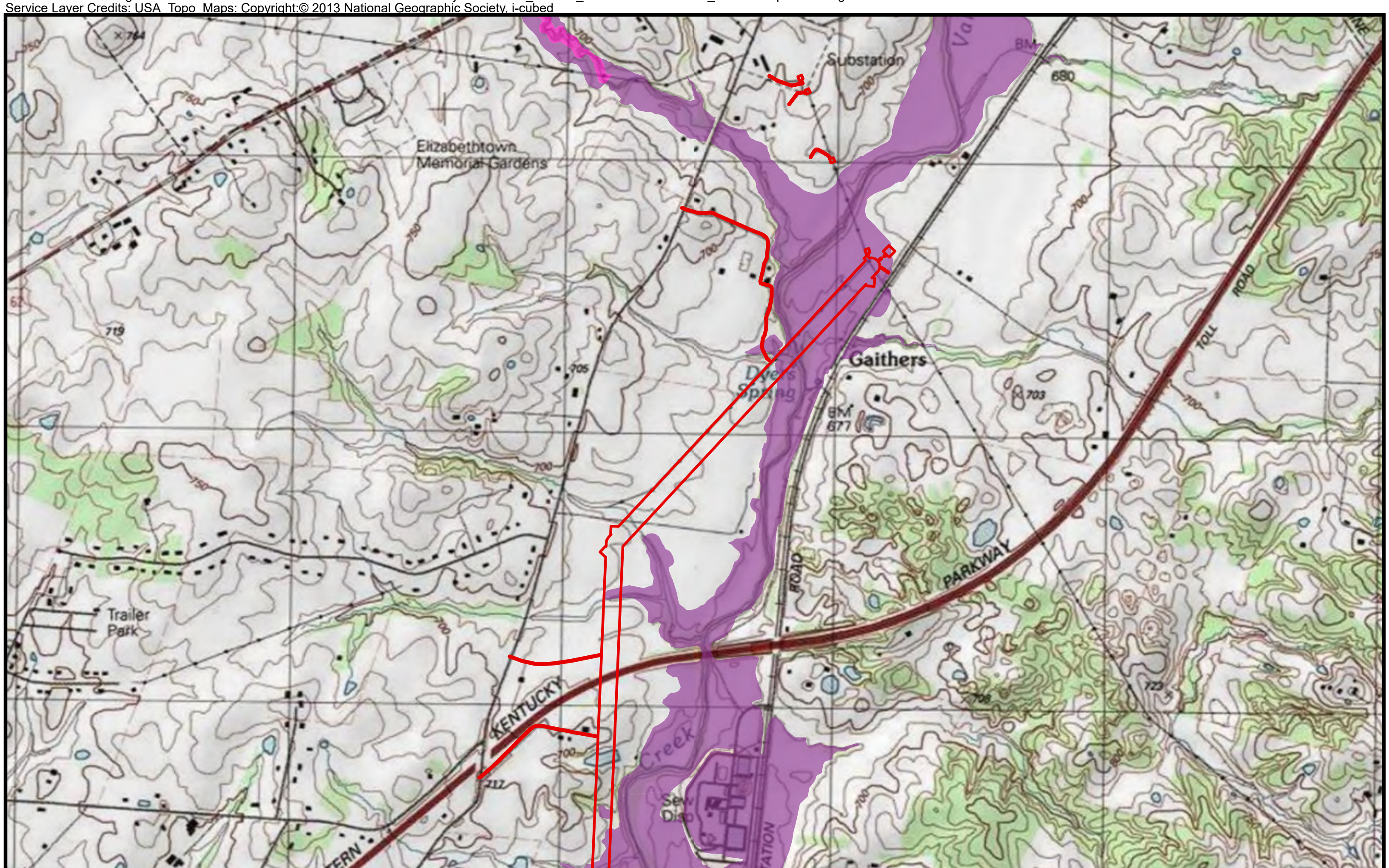

Survey Area
Third Rock LLC Survey Area
FEMA Floodplain
FEMA Floodway

NORTH

0 1,000 2,000
Scale in Feet

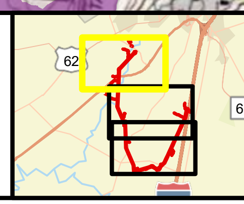

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Figure 2
Topographic and FEMA FIRM Map
Glendale Project
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Hardin County, Kentucky
Page 1 of 3

Source: Esri, FEMA FIRM and Burns & McDonnell Engineering Company

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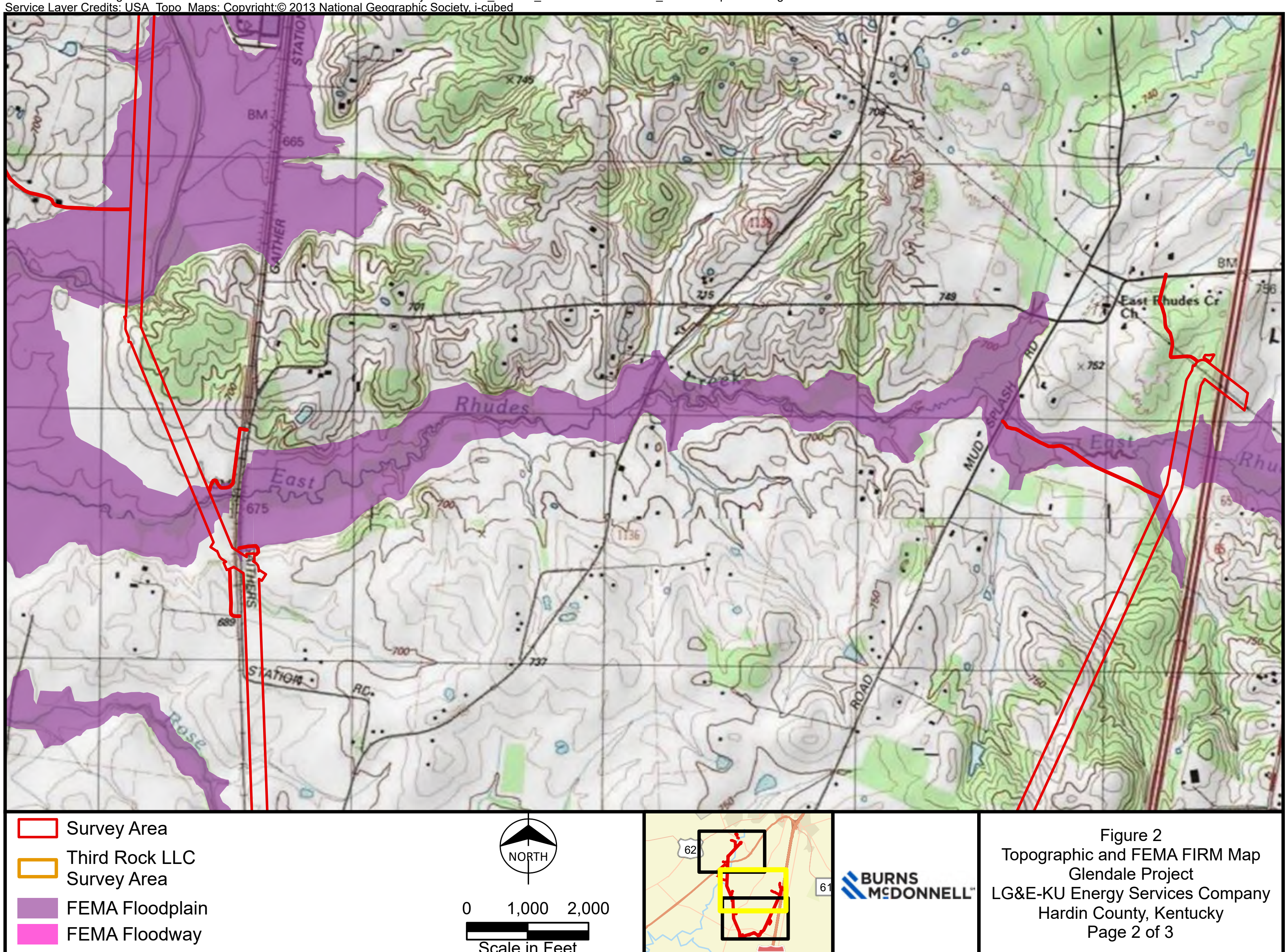

BURNS McDONNELL

Figure 2
Topographic and FEMA FIRM Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 2 of 3

Source: Esri, FEMA FIRM and Burns & McDonnell Engineering Company

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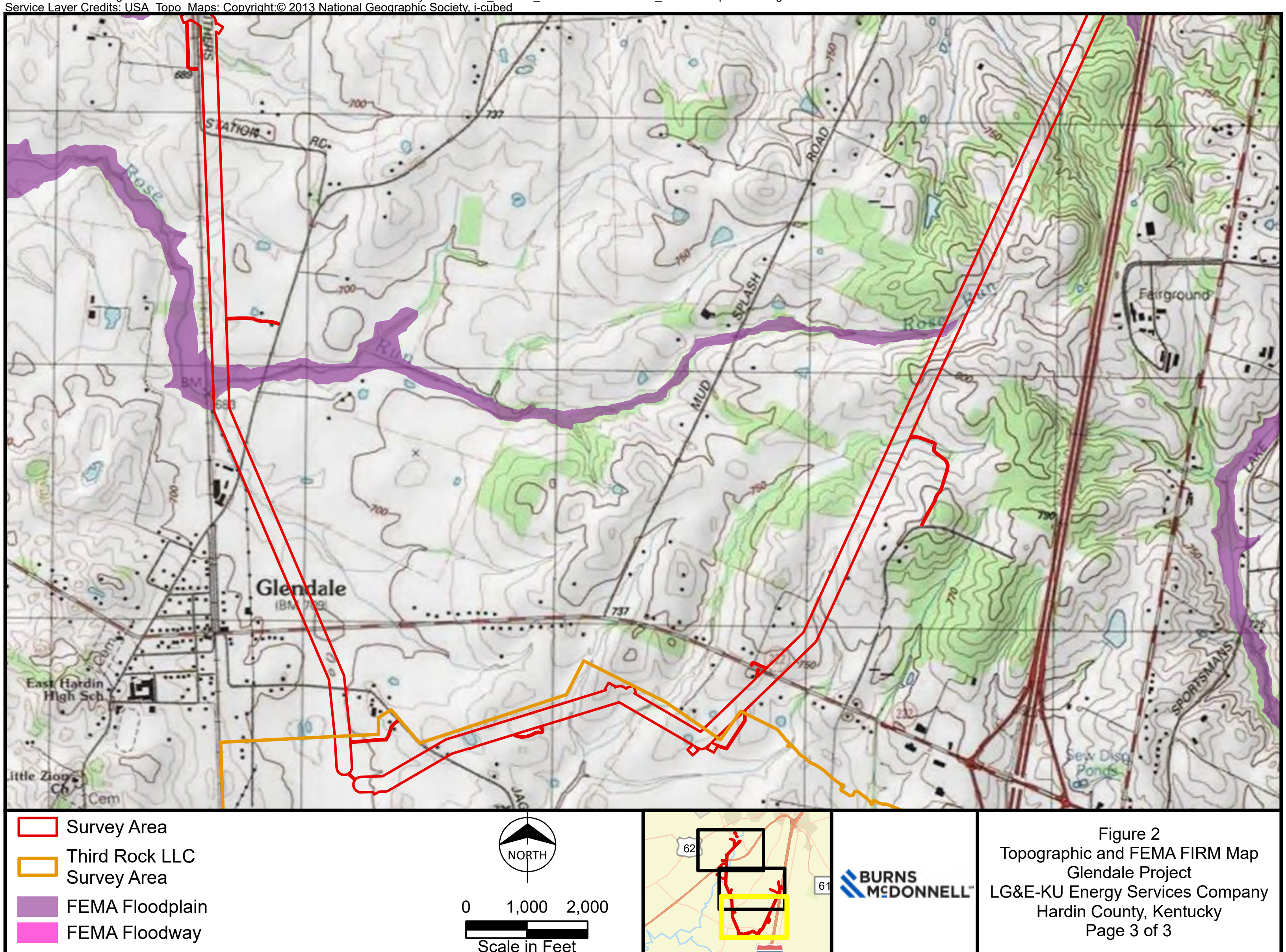

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Figure 2
Topographic and FEMA FIRM Map
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Hardin County, Kentucky
Page 3 of 3

Source: Esri, FEMA FIRM and Burns & McDonnell Engineering Company

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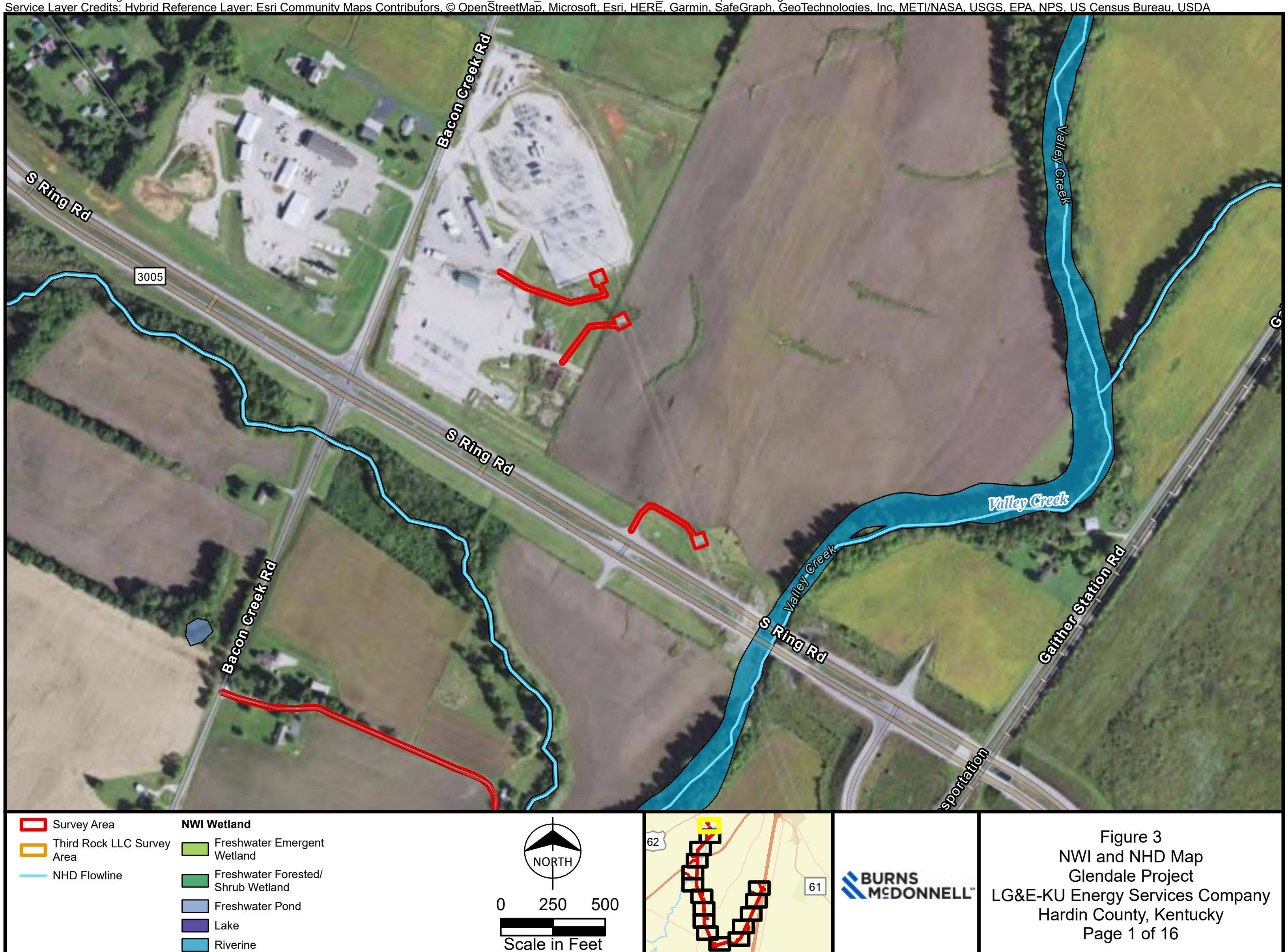

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 1 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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Figure 3
NWI and NHD Map
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Hardin County, Kentucky
Page 2 of 16

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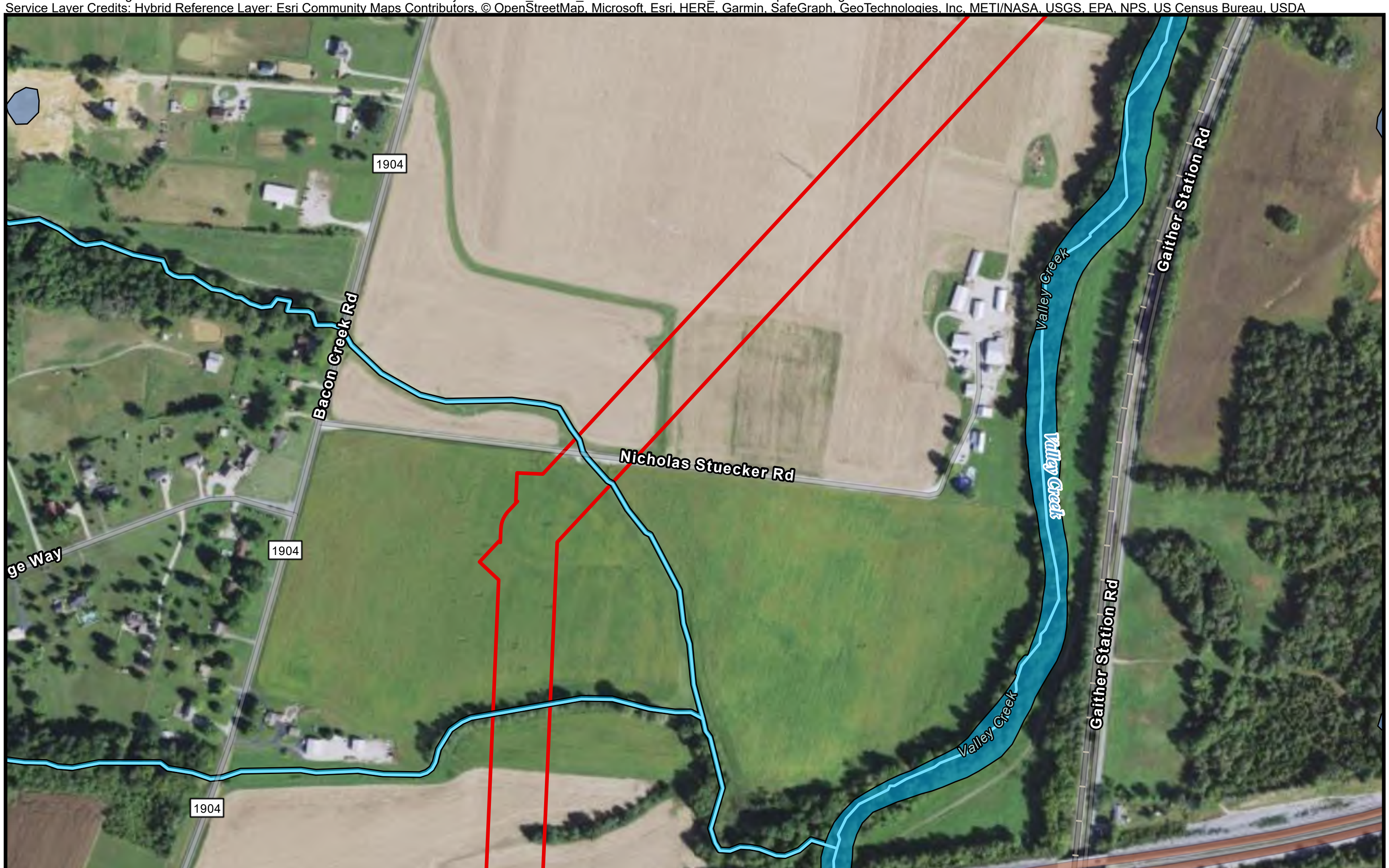

Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH
0 250 500
Scale in Feet

BURNS McDONNELL

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 3 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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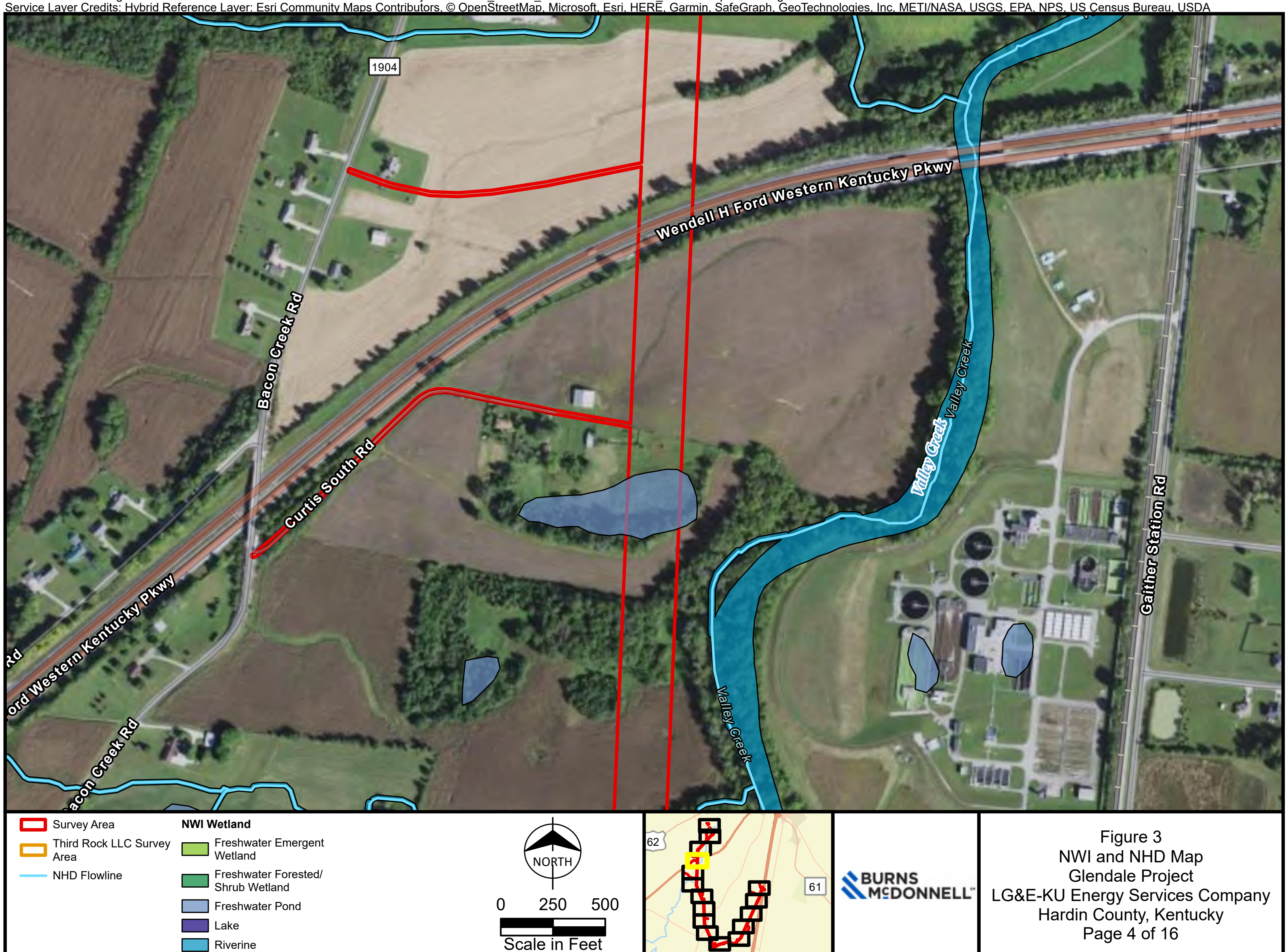

BURNS McDONNELL

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 4 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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- Survey Area
- Third Rock LLC Survey Area
- NHD Flowline

NWI Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/ Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

NORTH

0 250 500
Scale in Feet

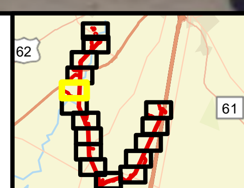

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Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 5 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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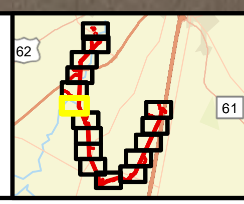
Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH
0 250 500
Scale in Feet



BURNS McDONNELL

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 6 of 16

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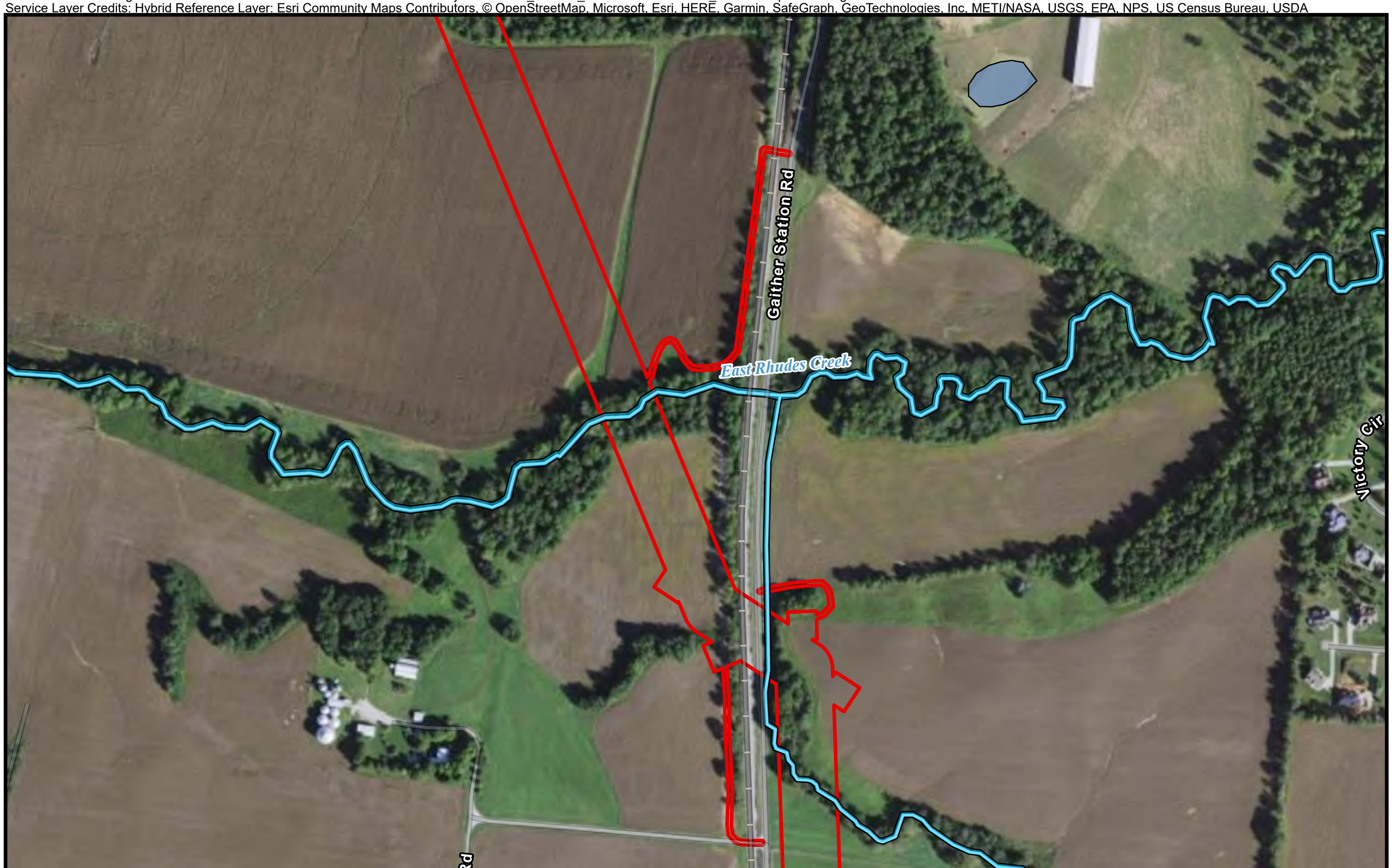

Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH
0 250 500
Scale in Feet

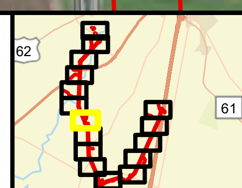

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Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 7 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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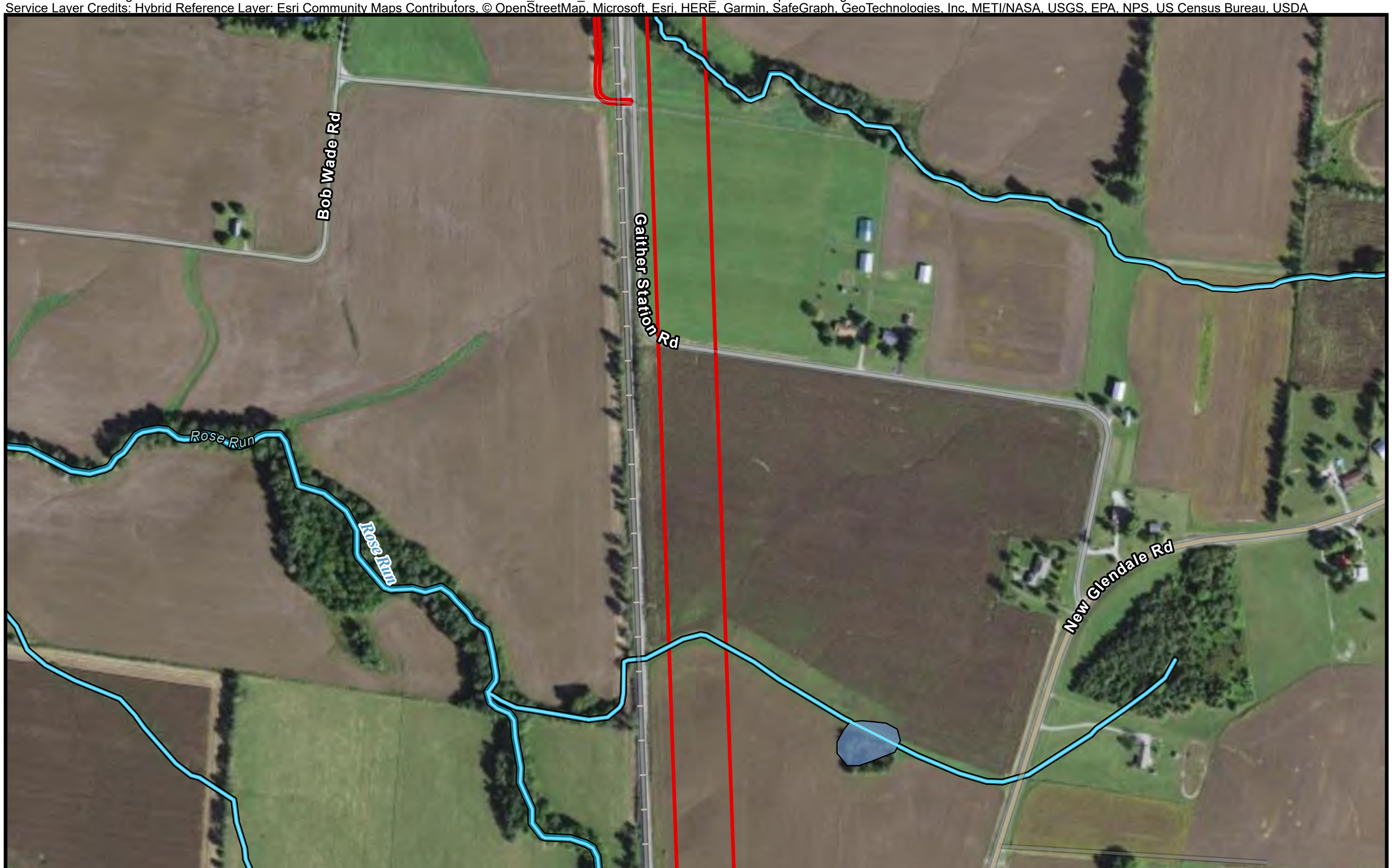

Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH

0 250 500
Scale in Feet

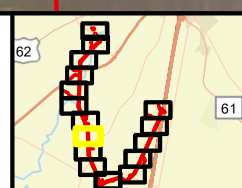

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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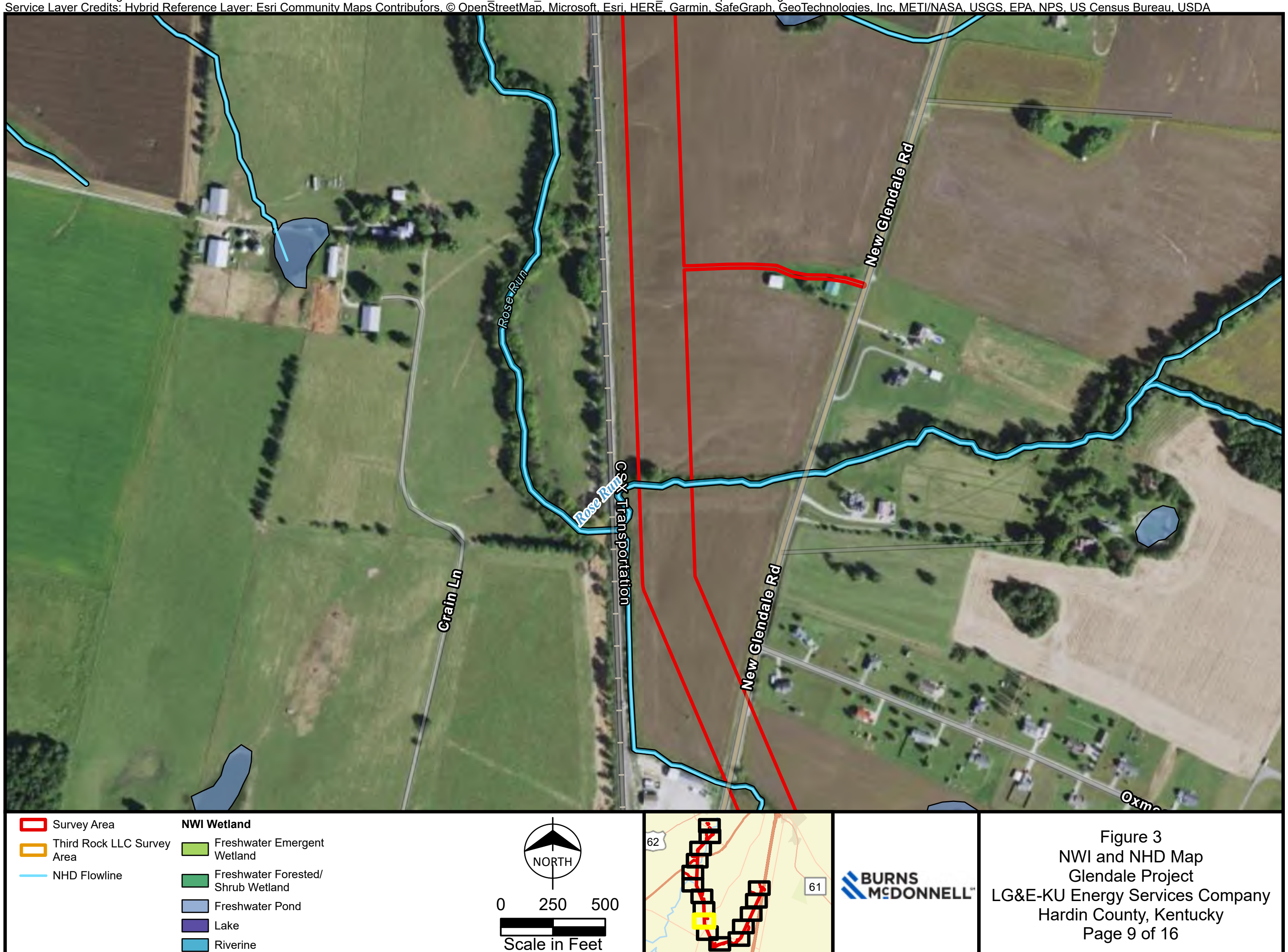

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH
0 250 500
Scale in Feet

BURNS McDONNELL

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 10 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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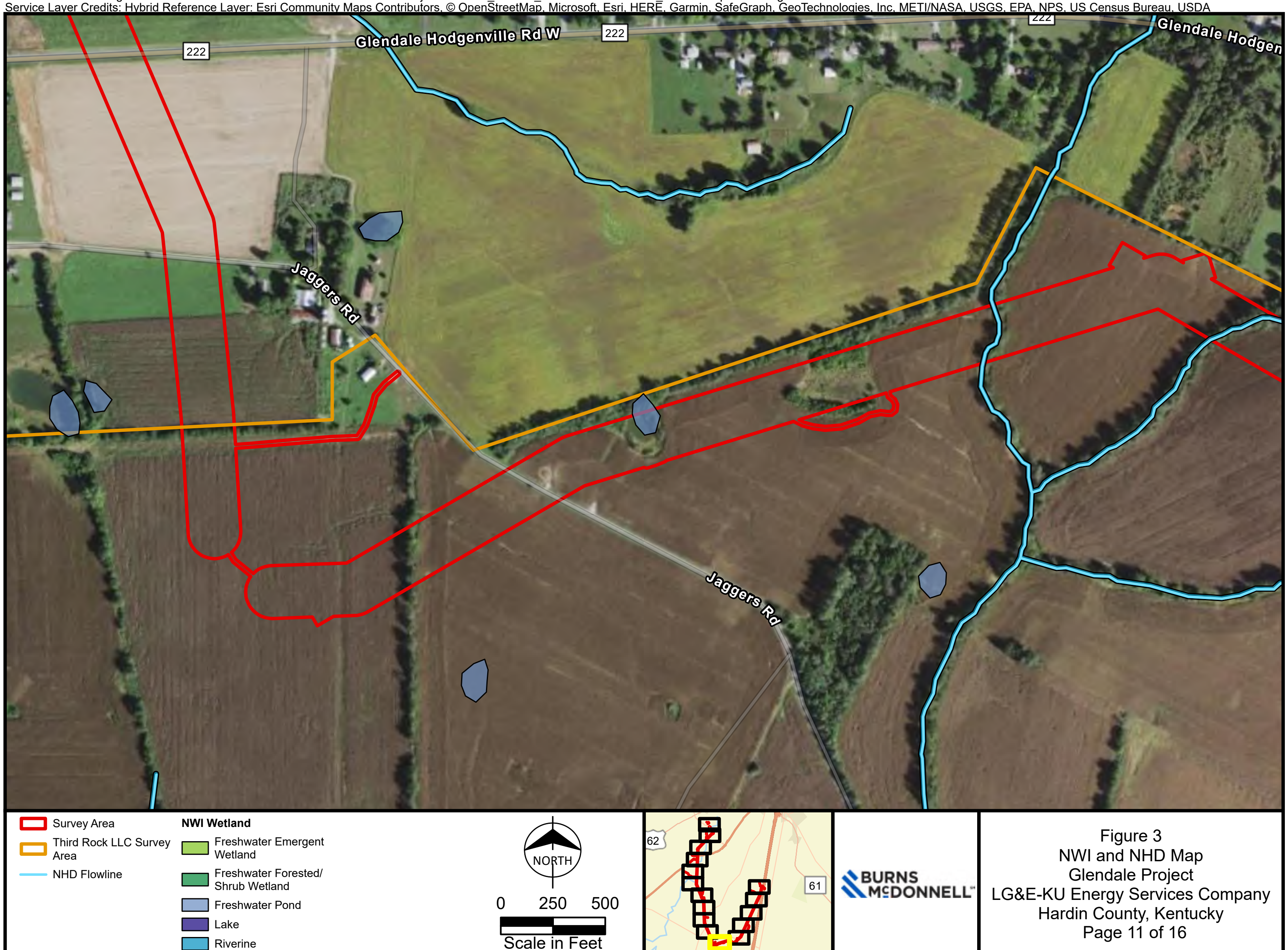

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Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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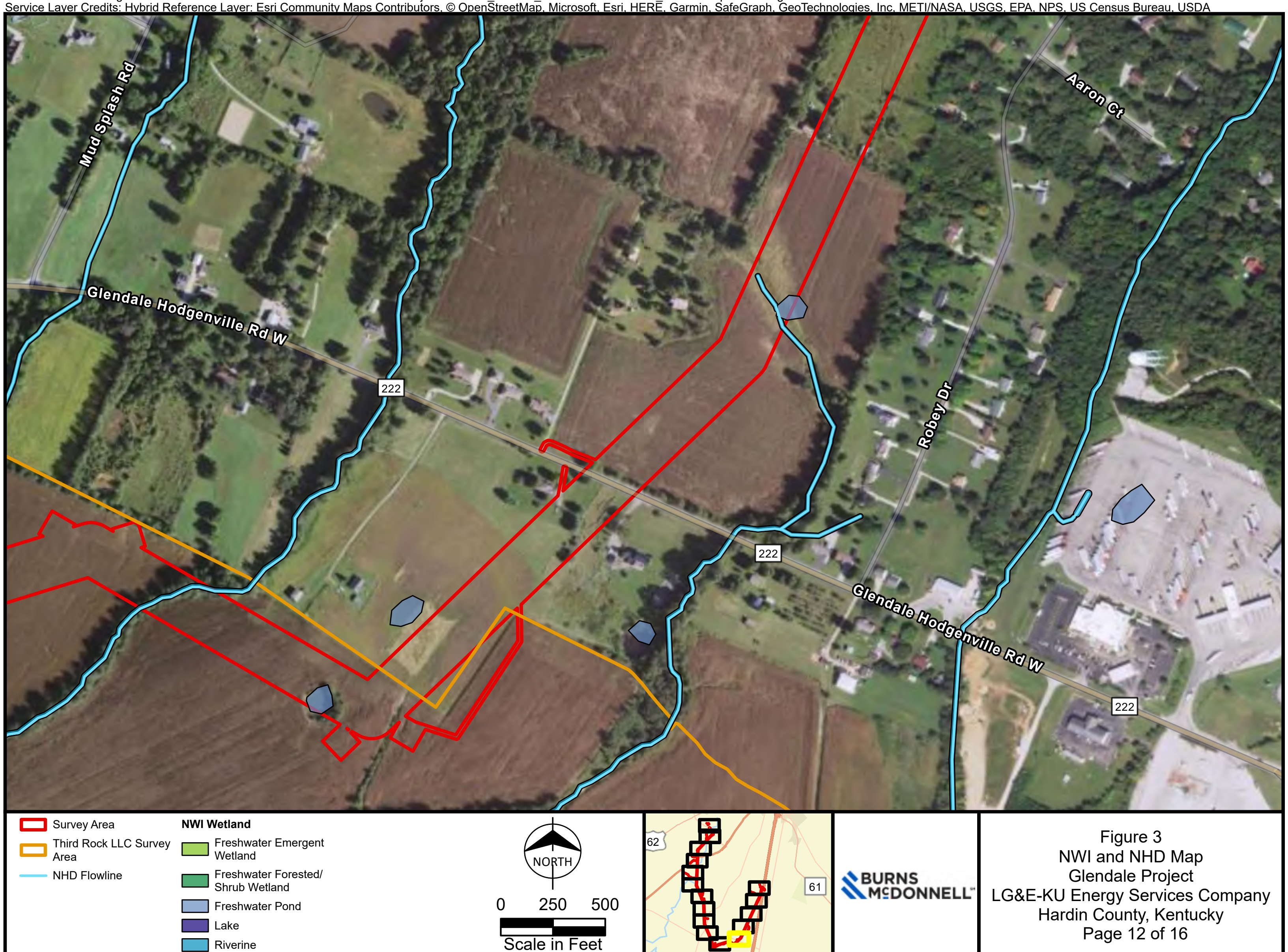

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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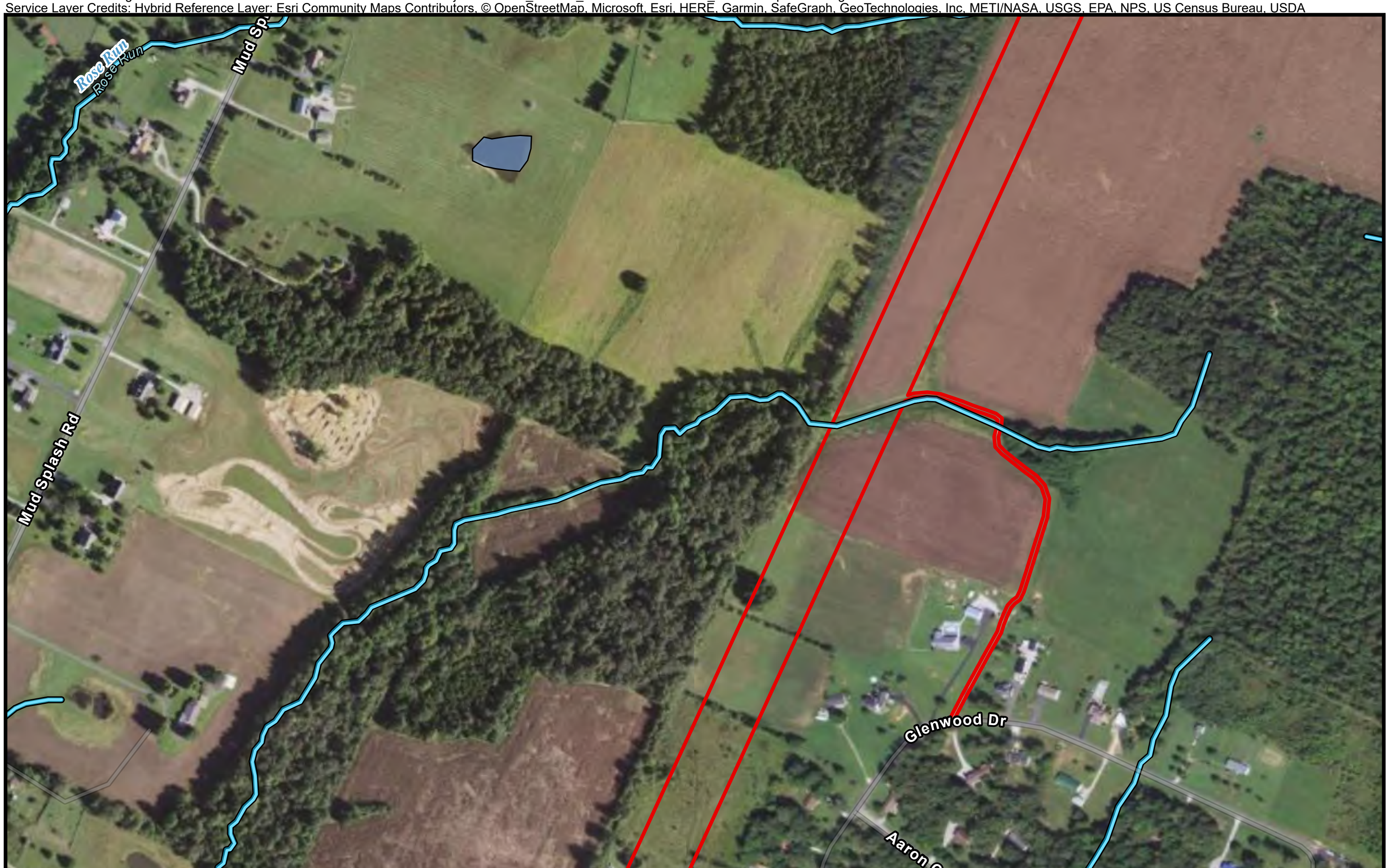

Survey Area
Third Rock LLC Survey Area
NHD Flowline

NWI Wetland
Freshwater Emergent Wetland
Freshwater Forested/ Shrub Wetland
Freshwater Pond
Lake
Riverine

NORTH
0 250 500
Scale in Feet

BURNS McDONNELL

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 13 of 16

Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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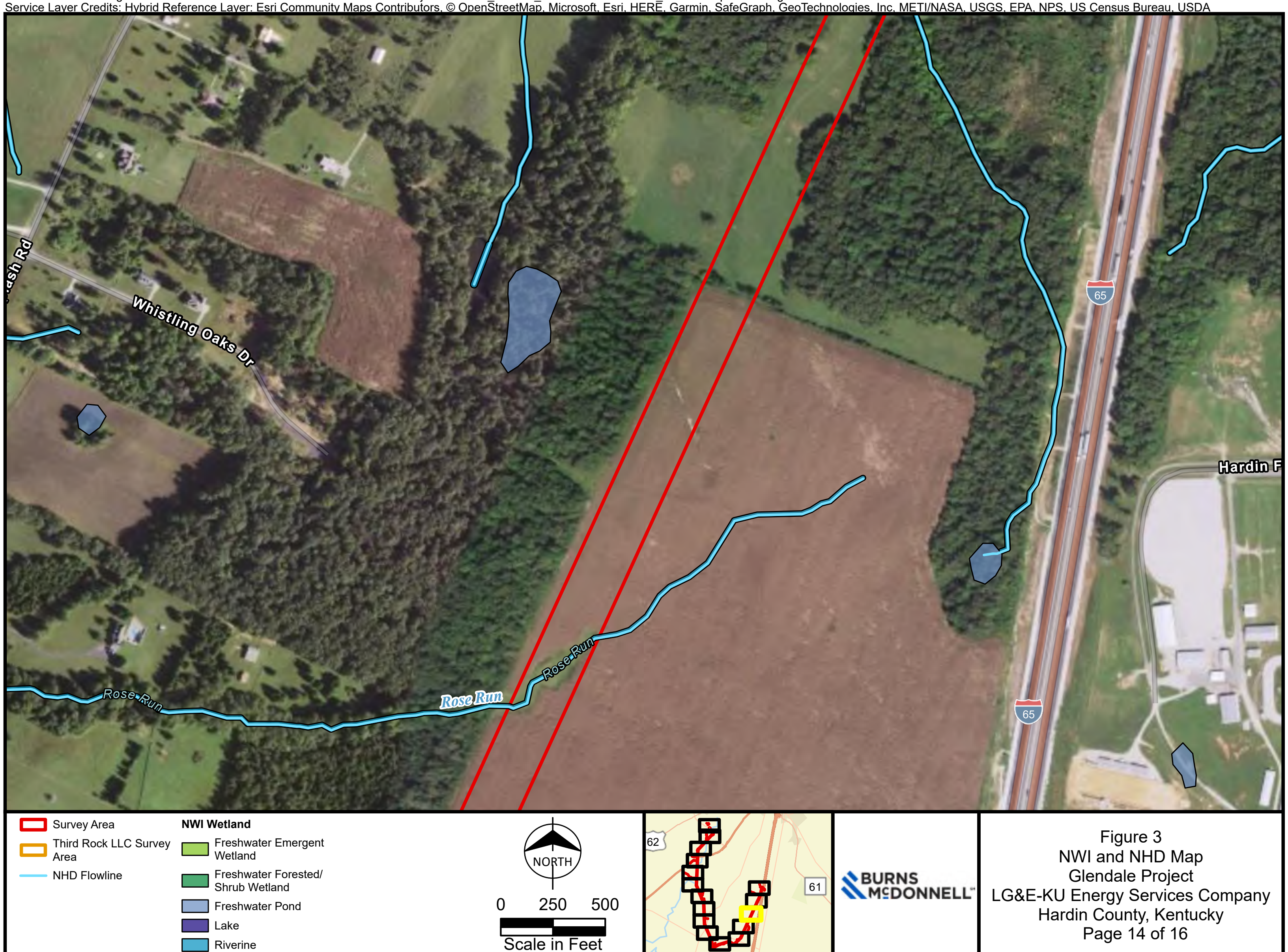

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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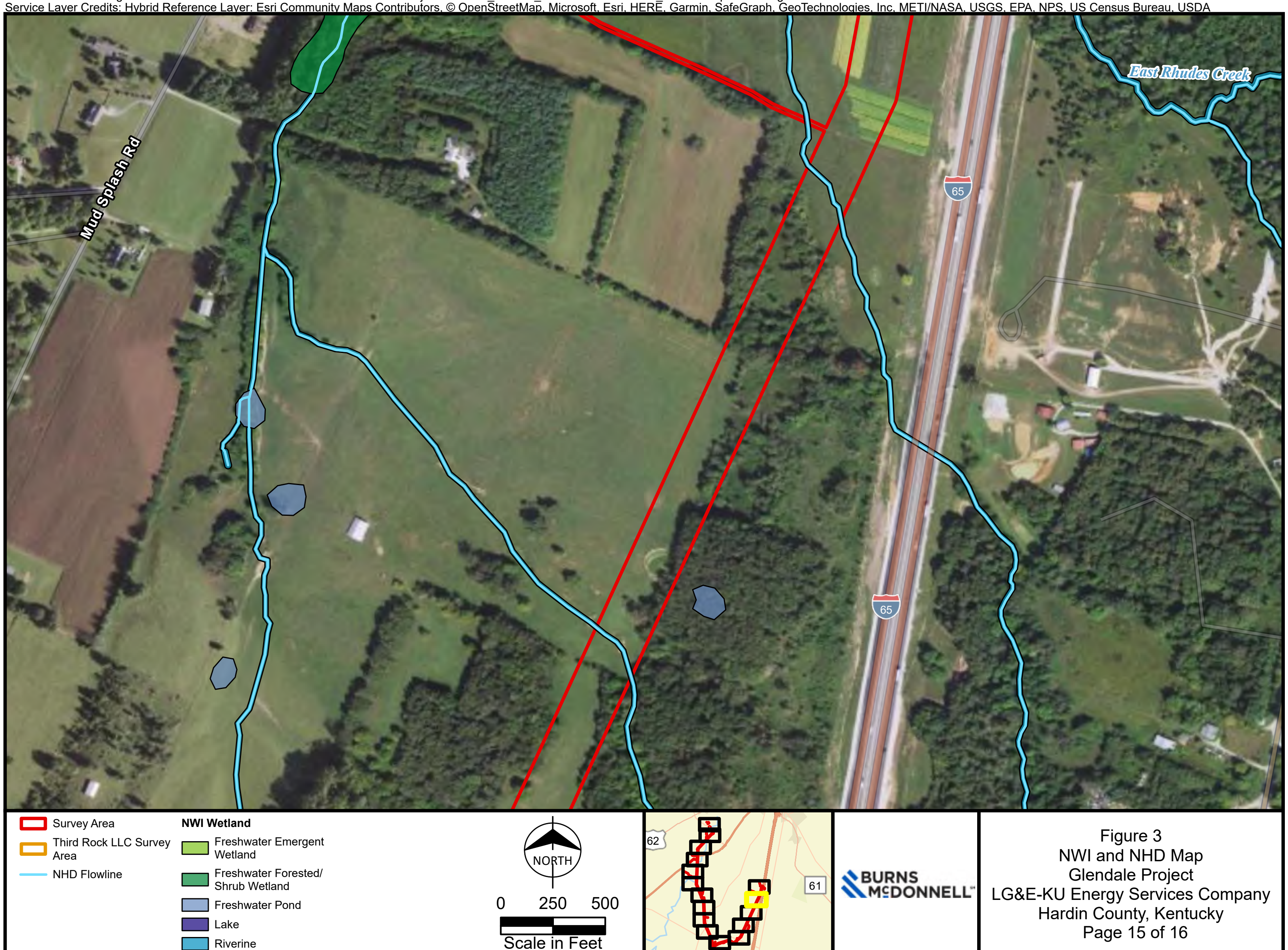

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Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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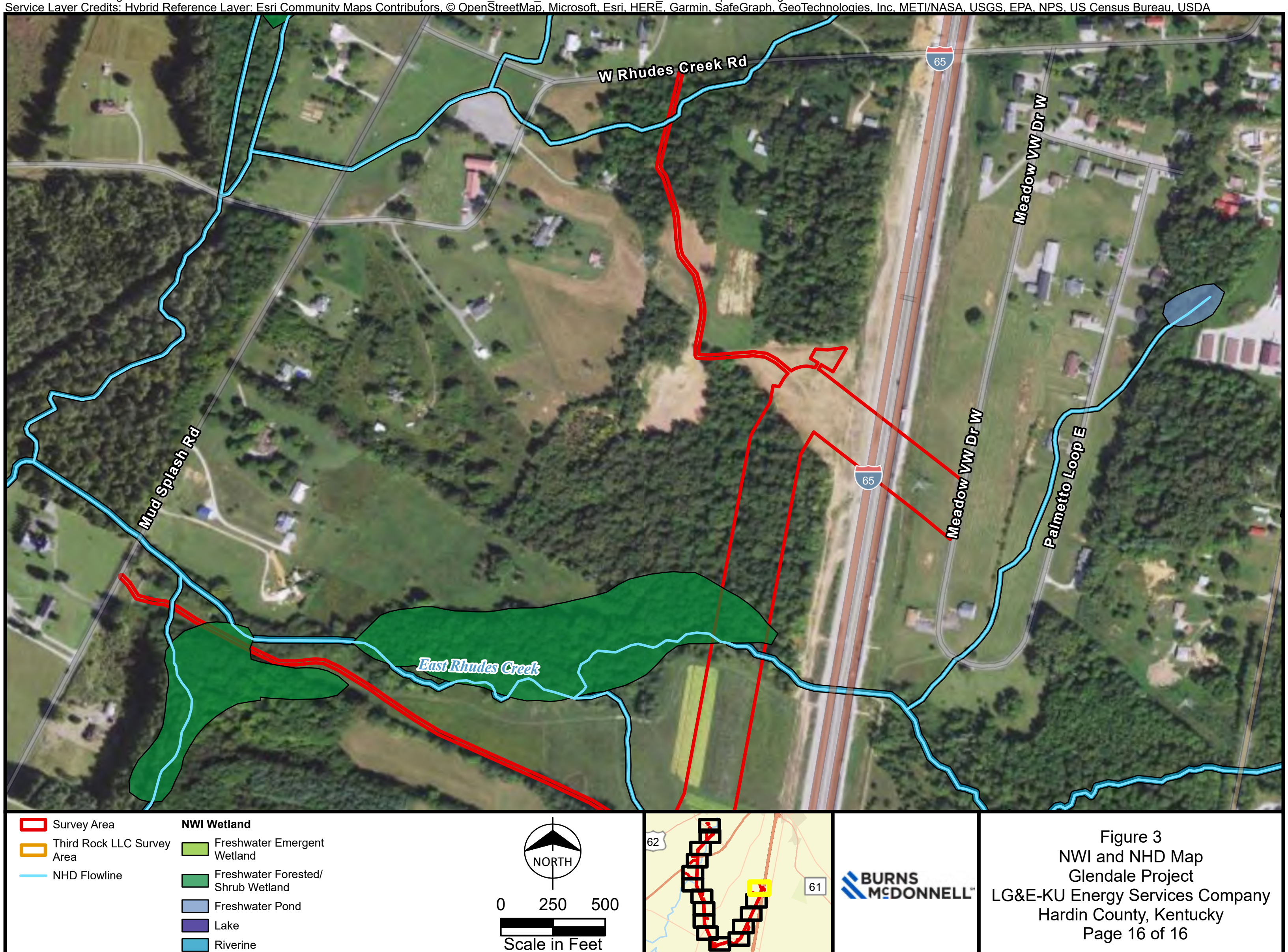

Figure 3
NWI and NHD Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, NHD, NWI and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)
Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

BURNS McDONNELL

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 1 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

BURNS McDONNELL

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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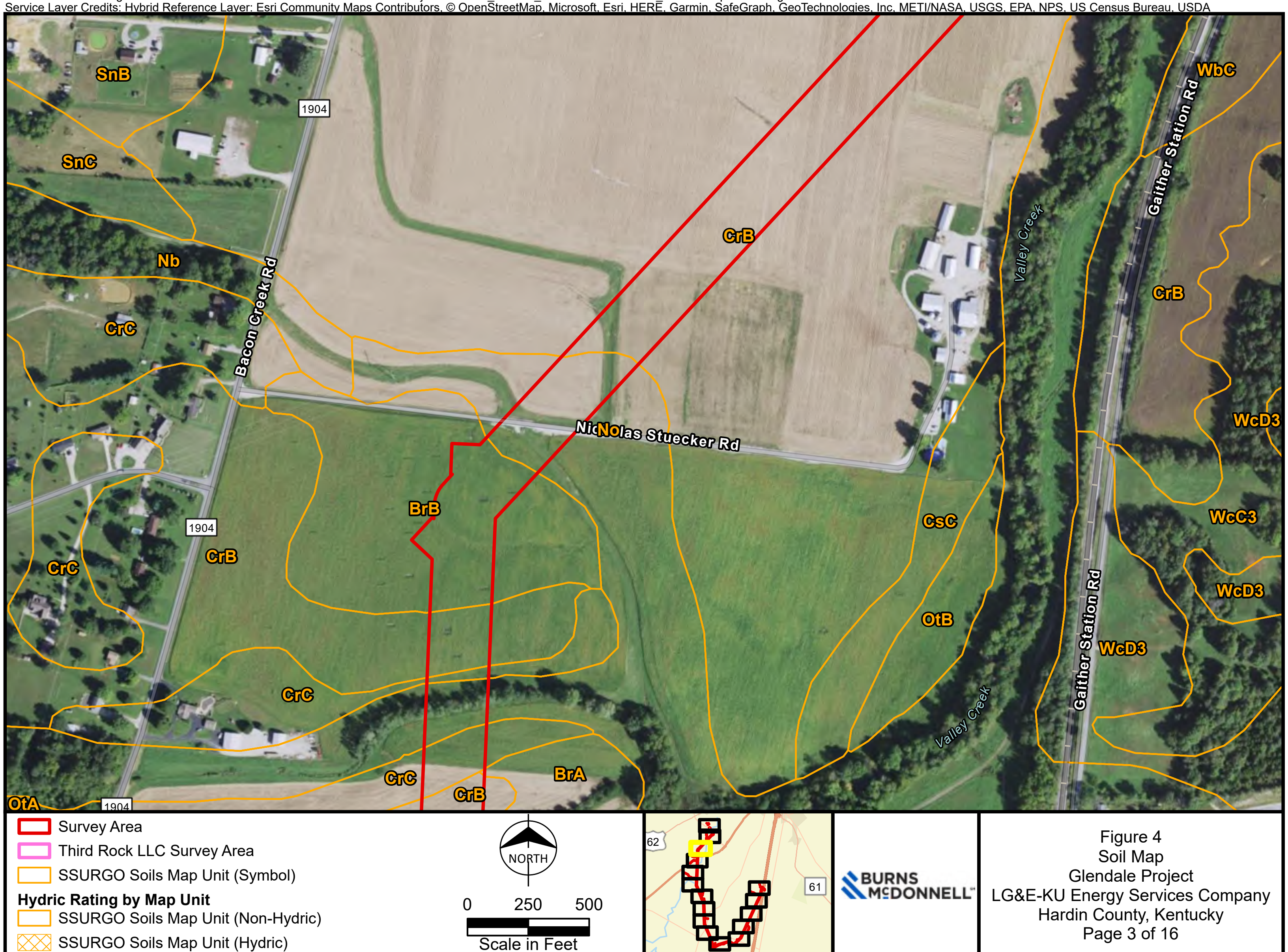

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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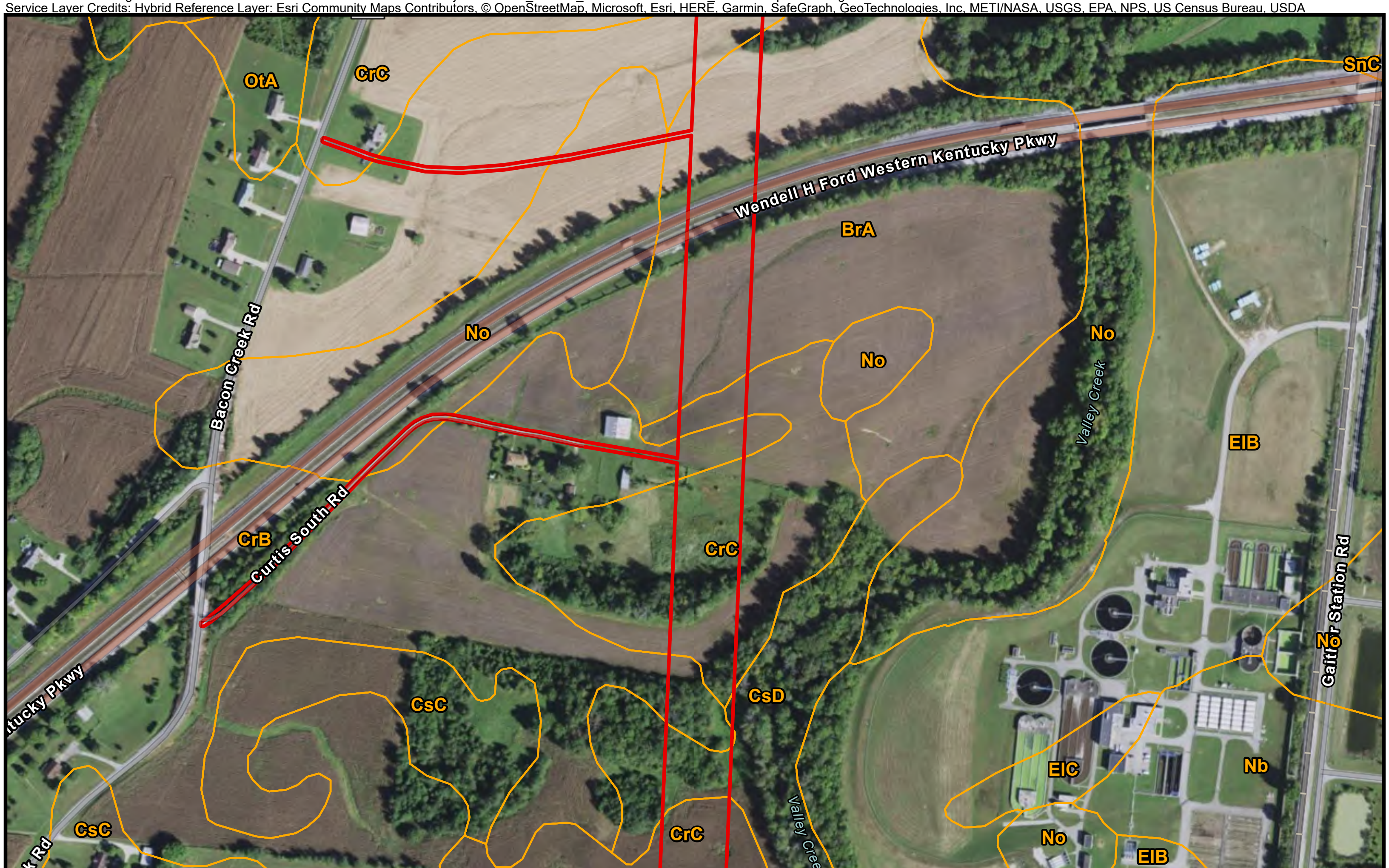

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

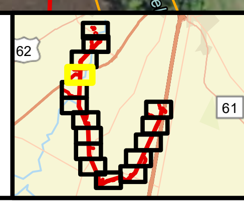

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 4 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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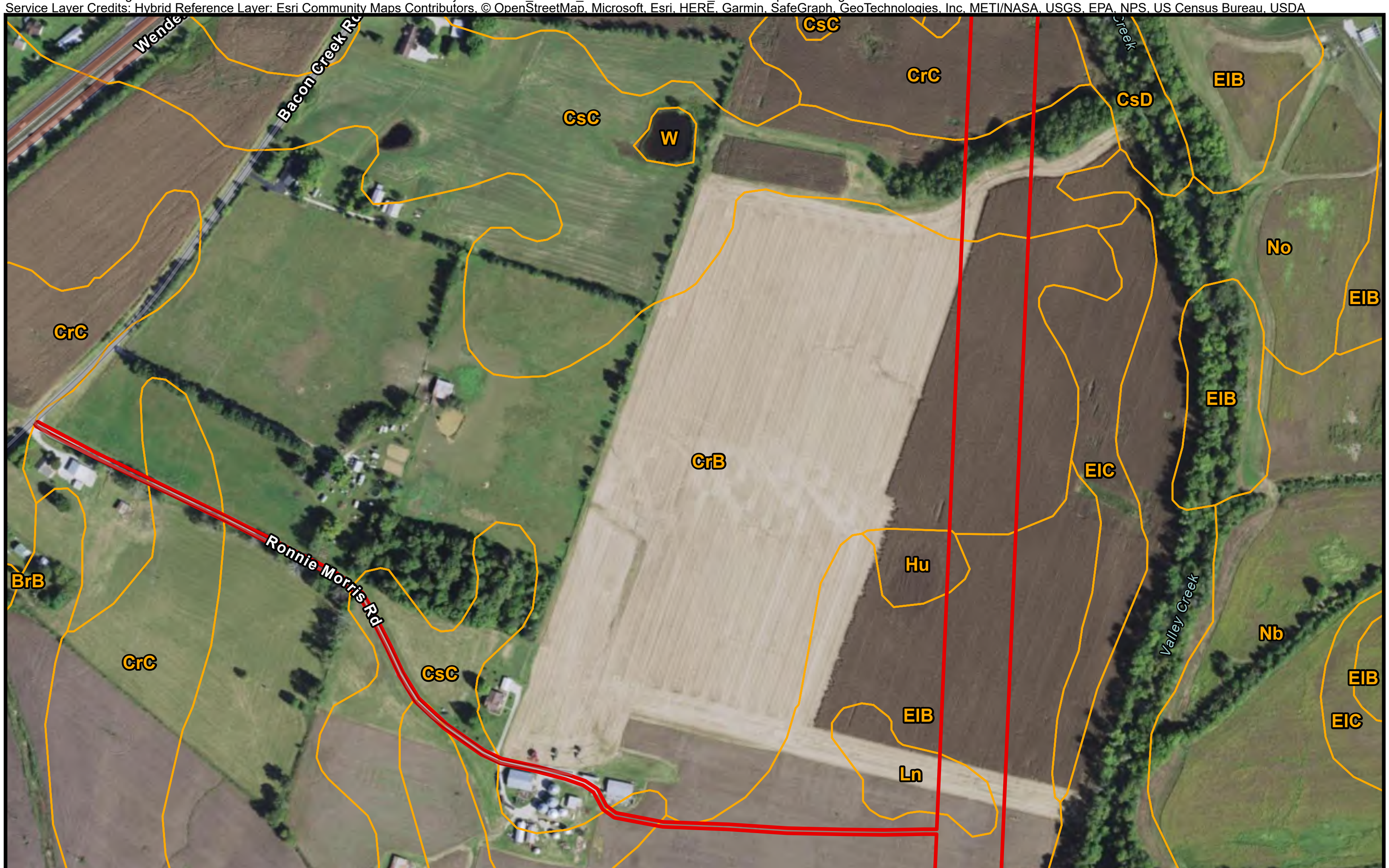

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)
Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

BURNS McDONNELL

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 5 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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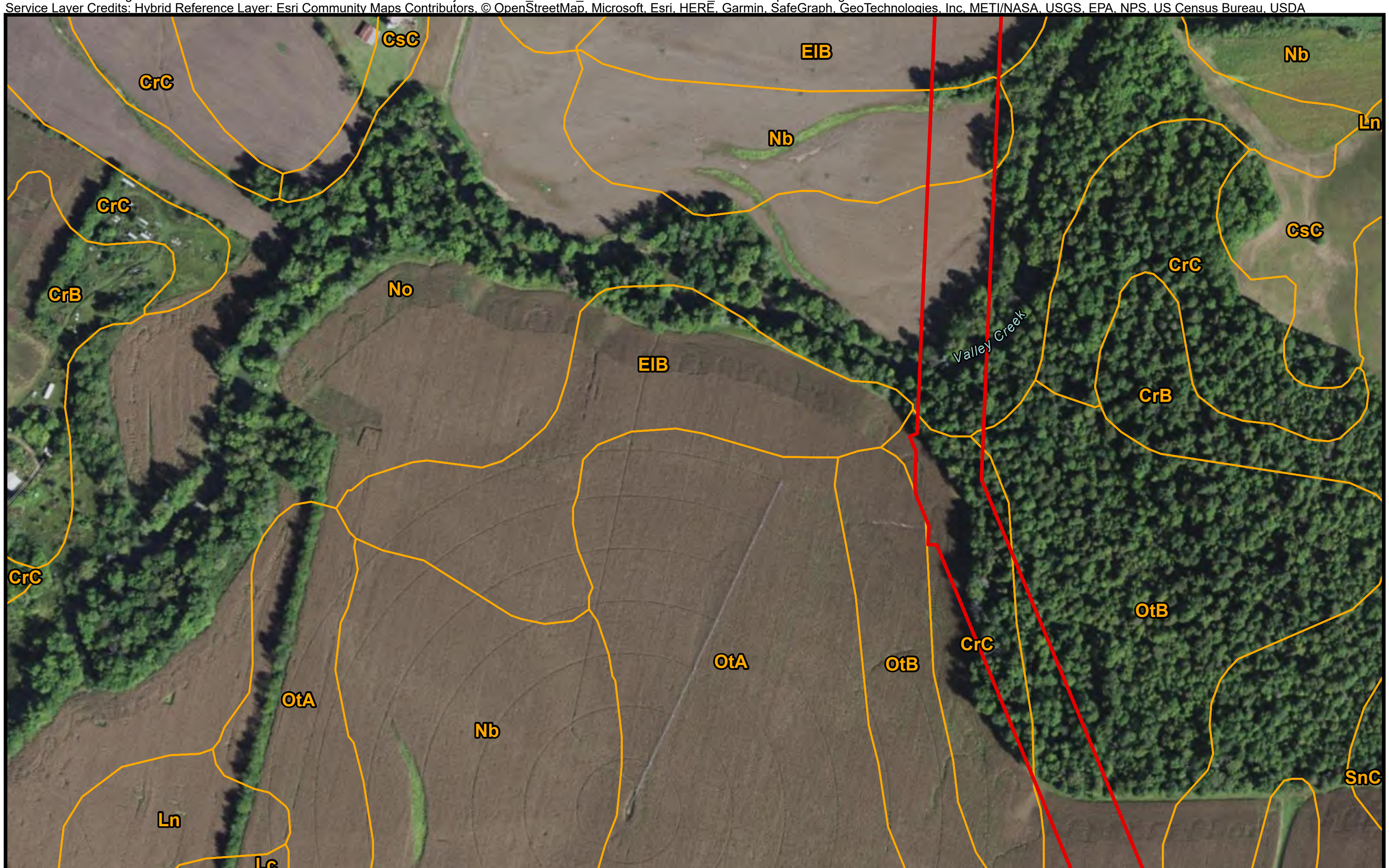

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit

SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

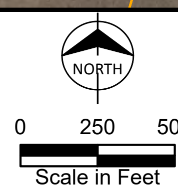

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)
Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

BURNS McDONNELL

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 7 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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- Survey Area
- Third Rock LLC Survey Area
- SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit

- SSURGO Soils Map Unit (Non-Hydric)
- SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

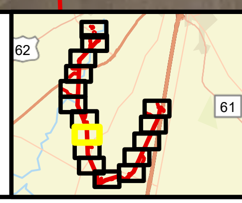

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 8 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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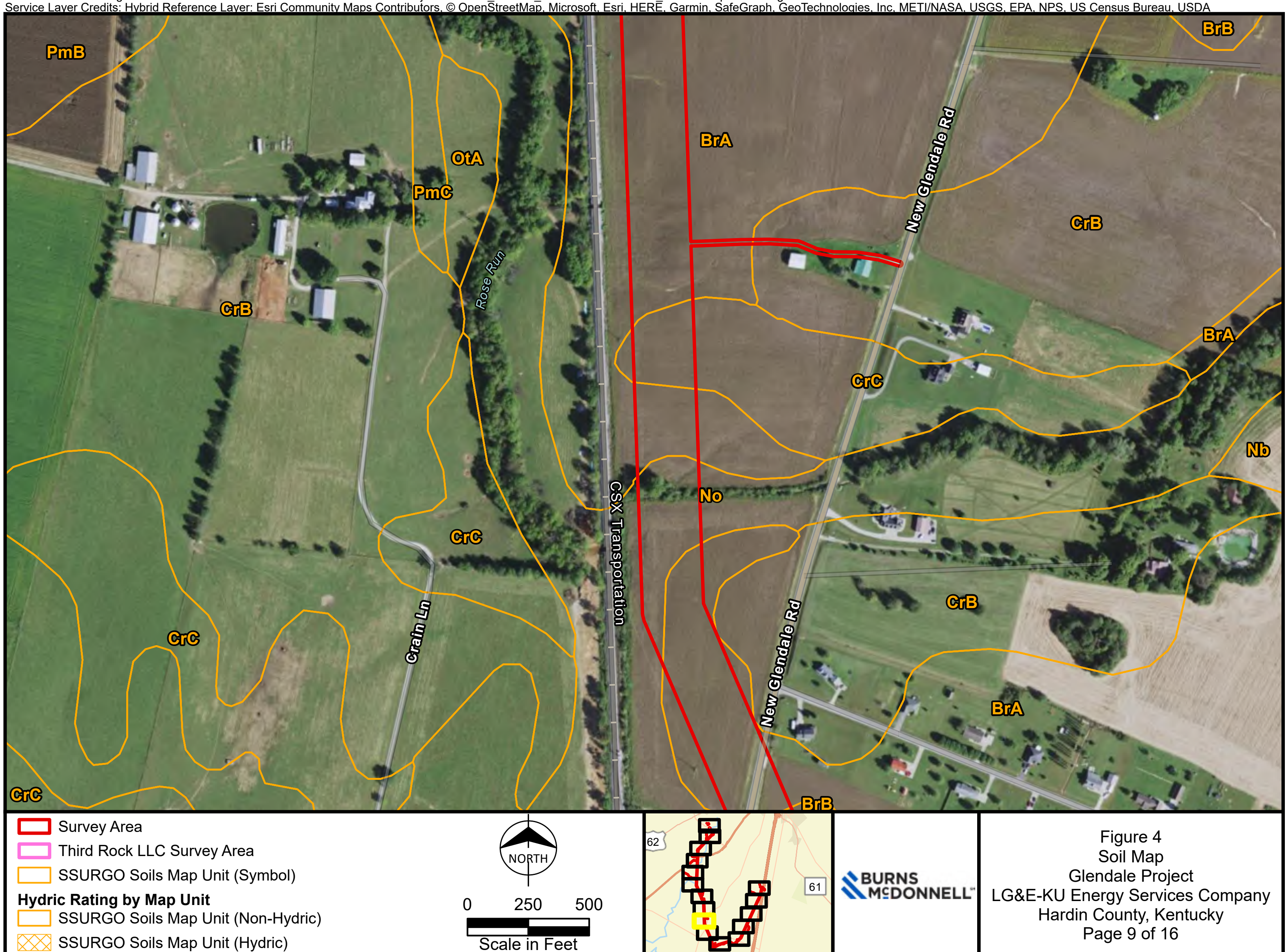

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

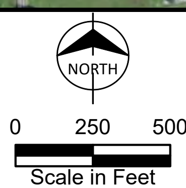

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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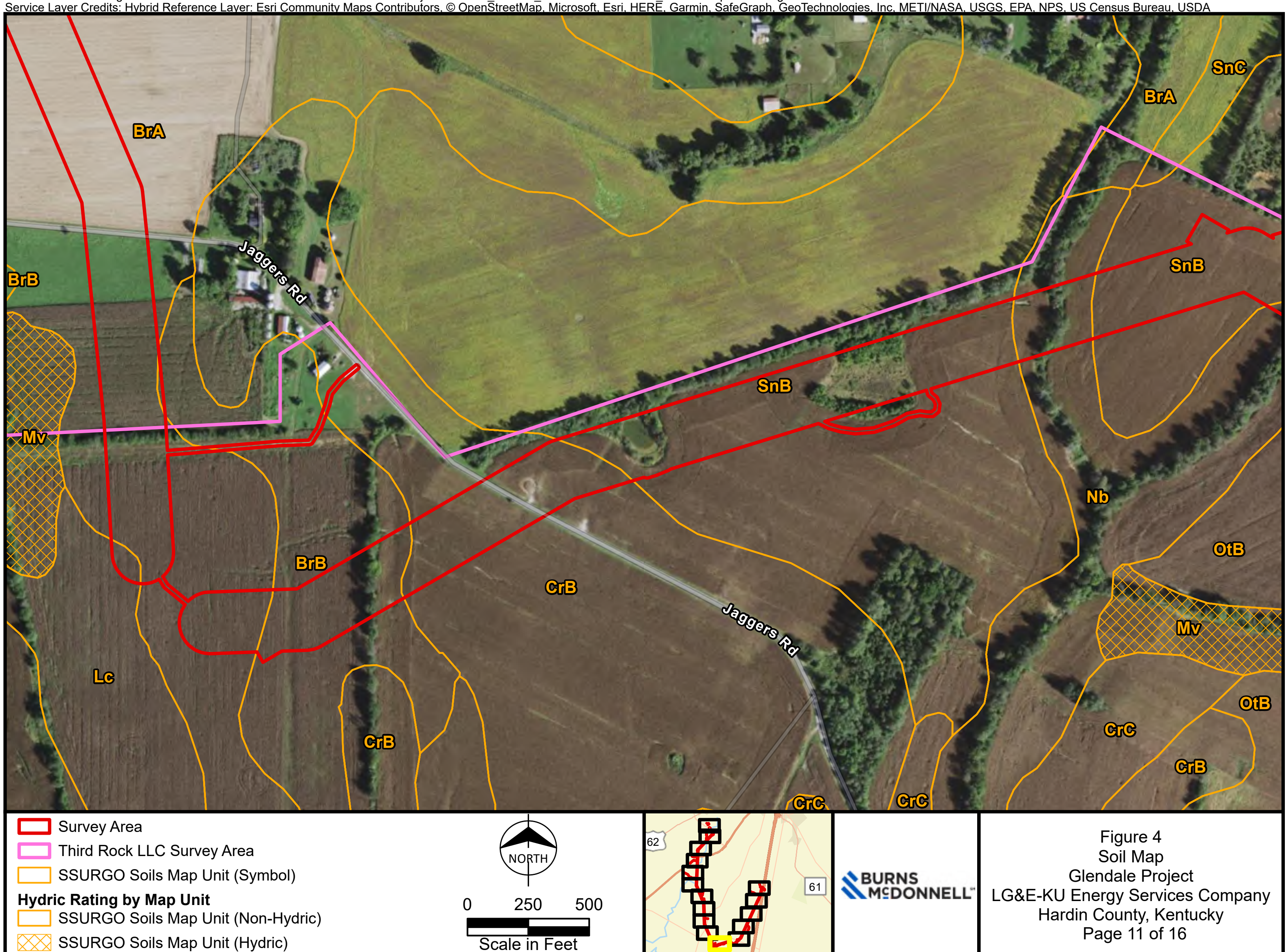

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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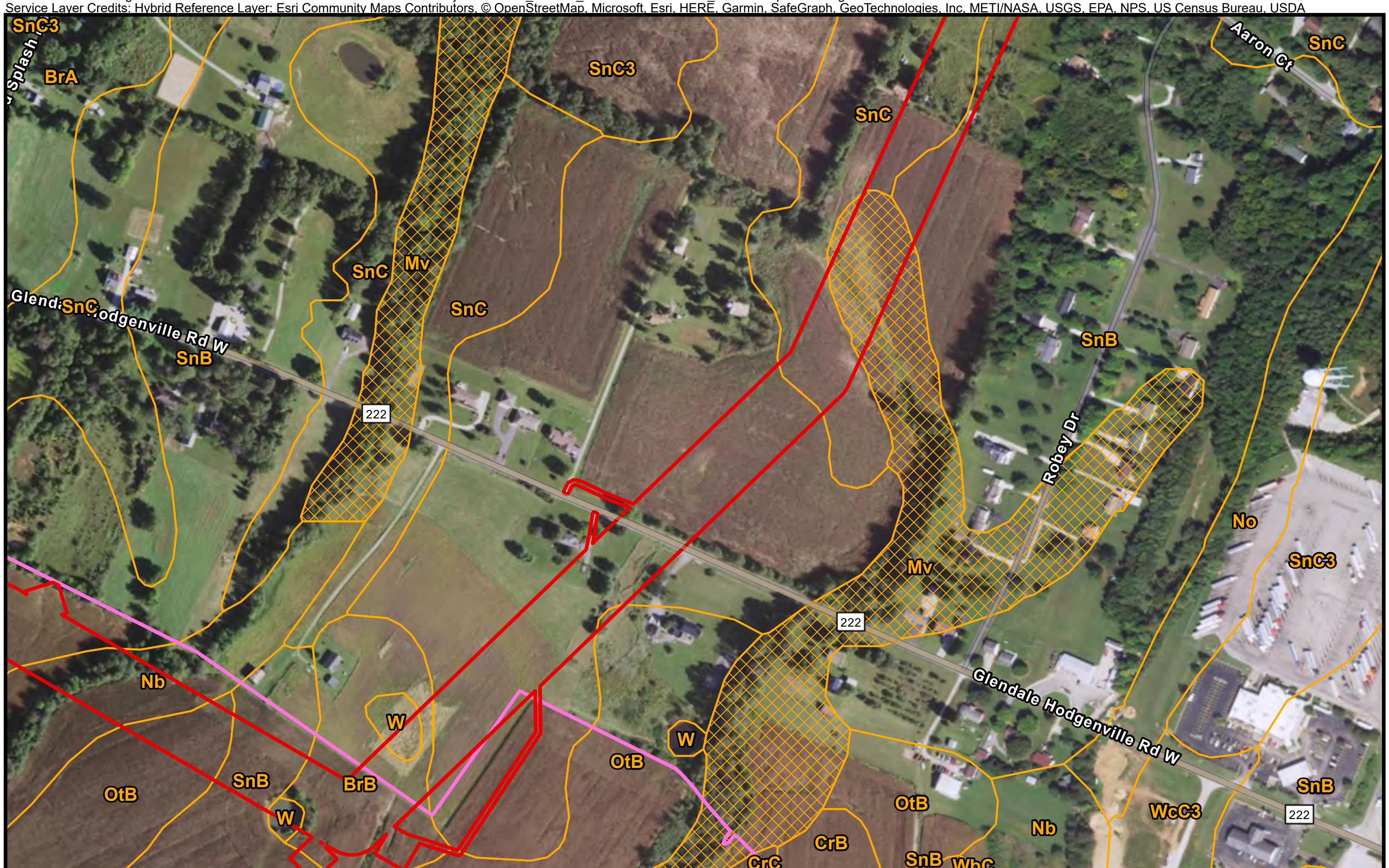

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit

SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

BURNS McDONNELL

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 12 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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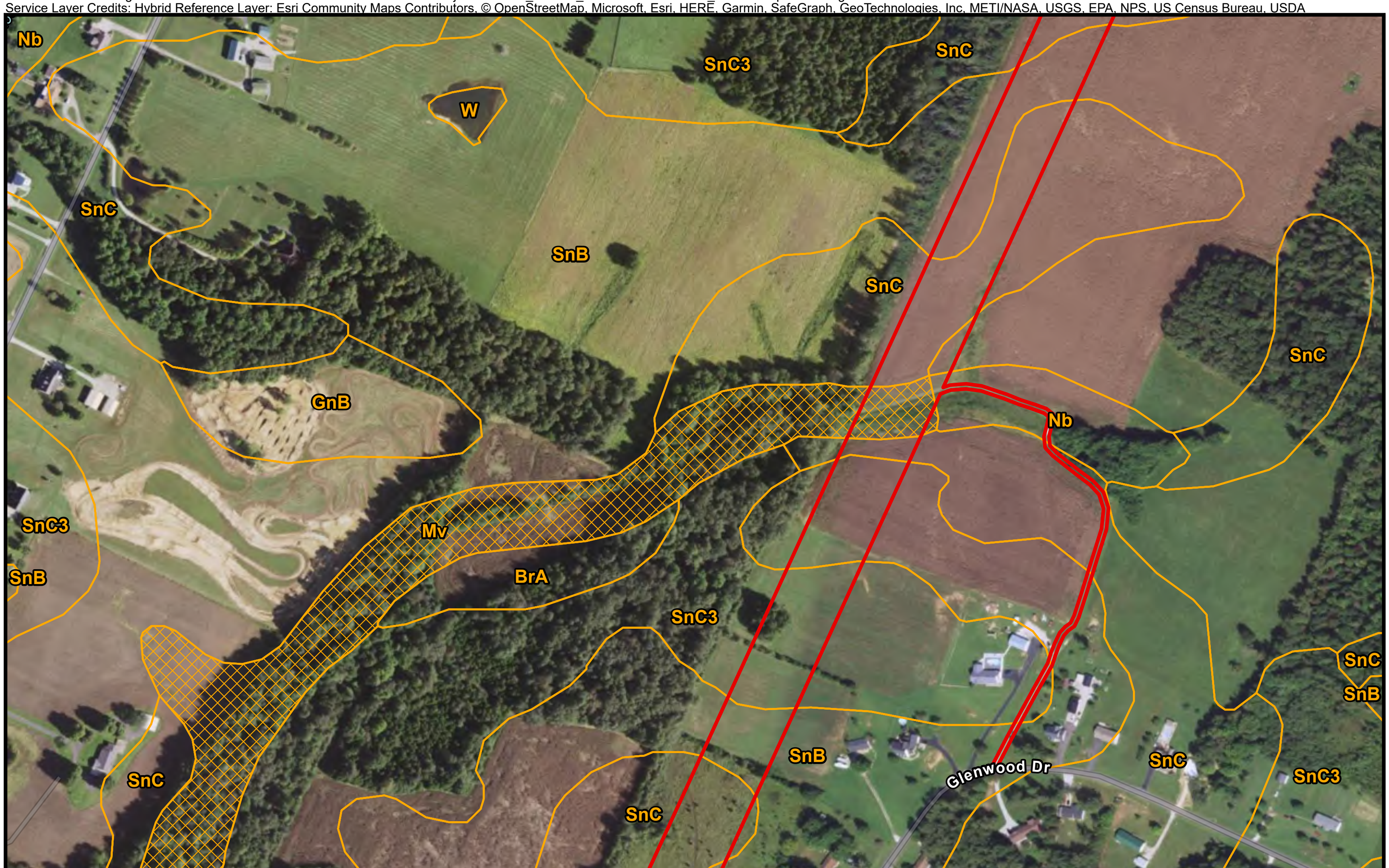

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)
Hydric Rating by Map Unit
SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH
0 250 500
Scale in Feet

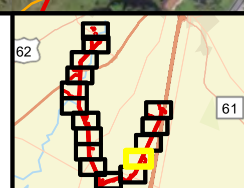

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 13 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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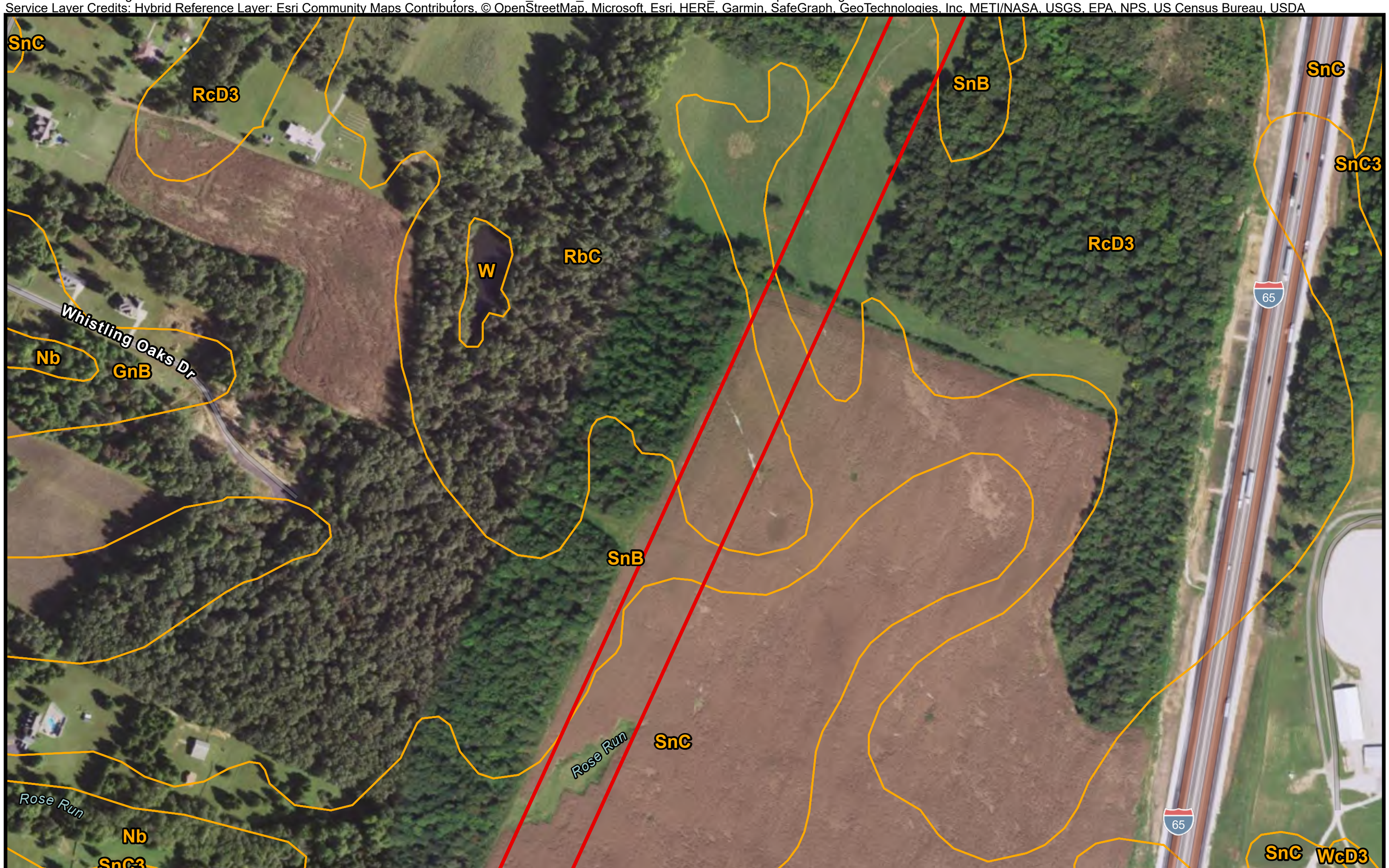

Survey Area
Third Rock LLC Survey Area
SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit

SSURGO Soils Map Unit (Non-Hydric)
SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

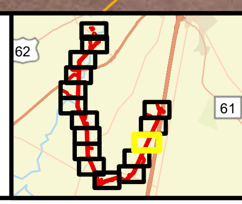

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 14 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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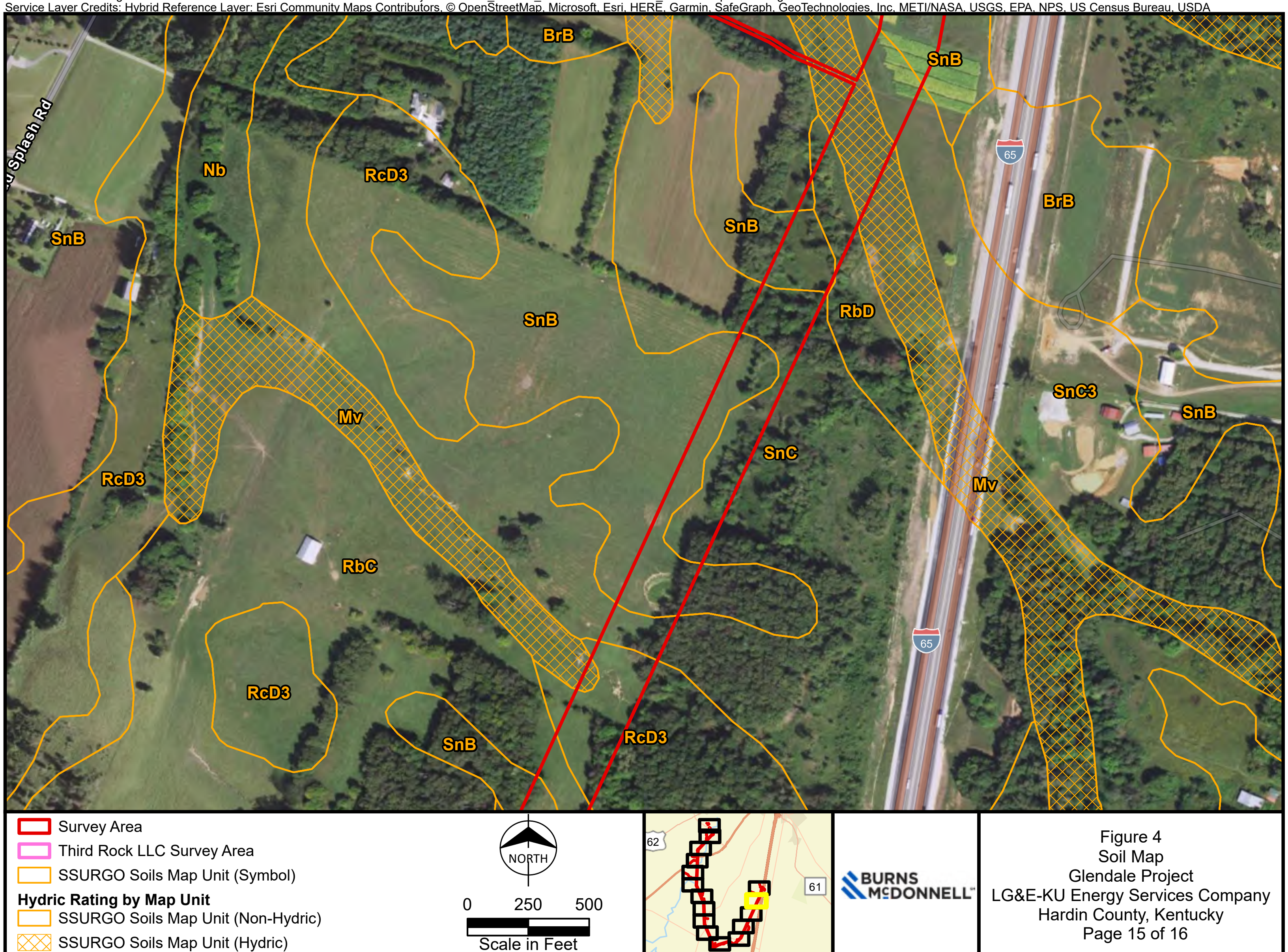

Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 15 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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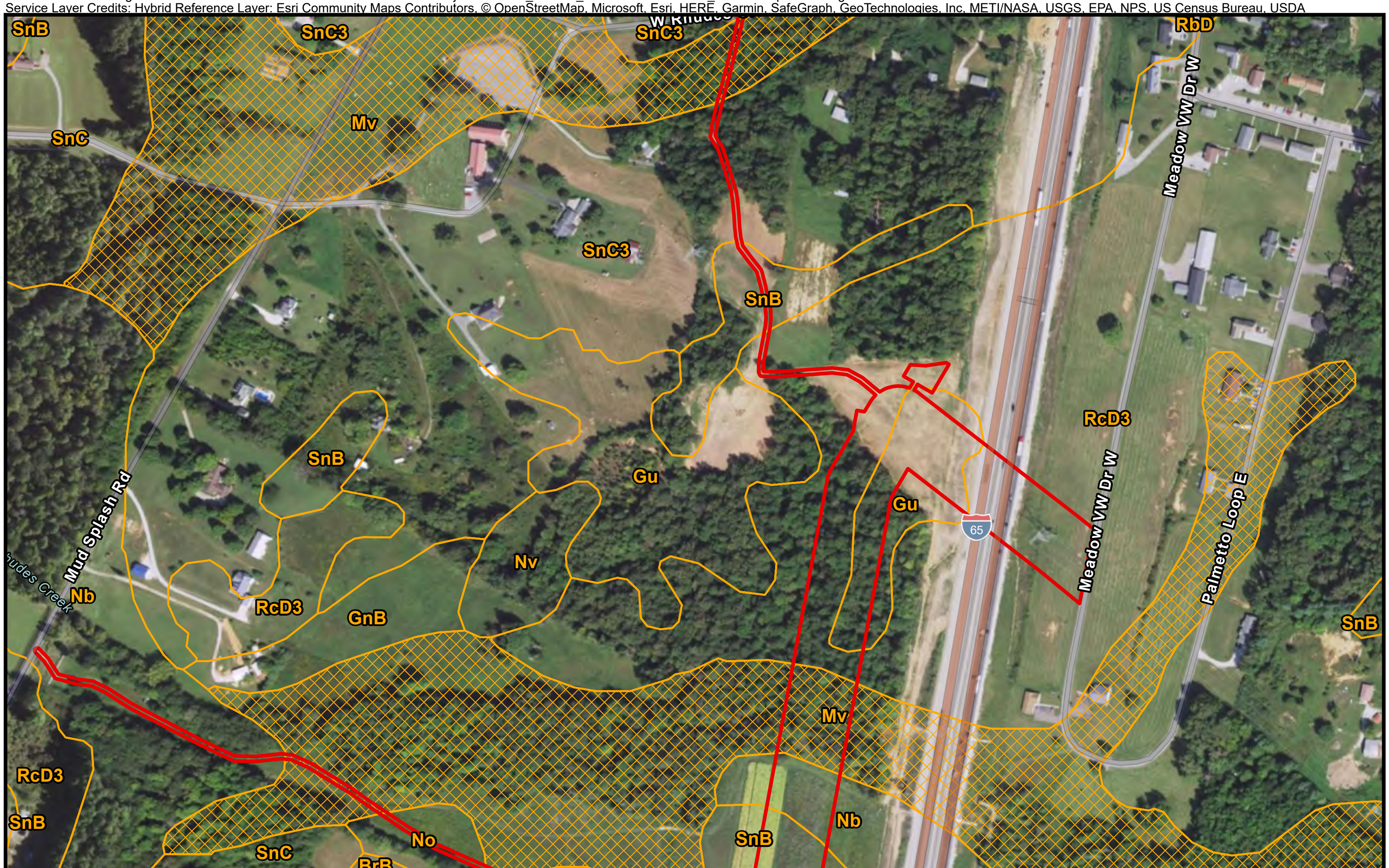

- Survey Area
- Third Rock LLC Survey Area
- SSURGO Soils Map Unit (Symbol)

Hydric Rating by Map Unit

- SSURGO Soils Map Unit (Non-Hydric)
- SSURGO Soils Map Unit (Hydric)

NORTH

0 250 500
Scale in Feet

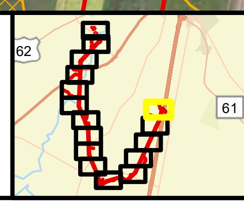

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Figure 4
Soil Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 16 of 16

Source: Esri, SSURGO, and Burns & McDonnell Engineering Company

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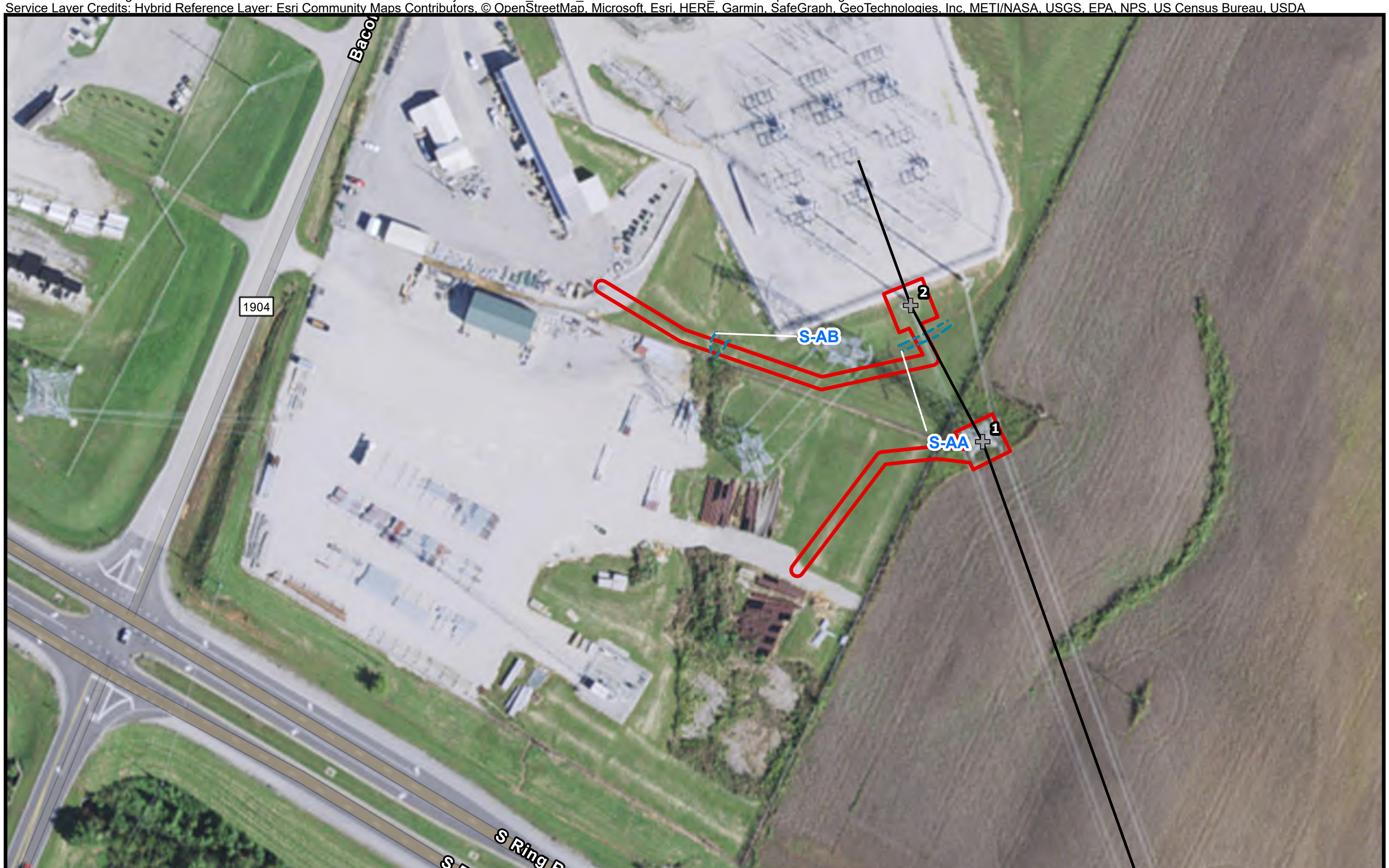

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

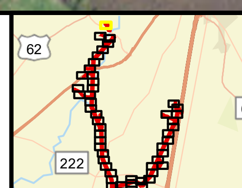

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 1 of 49

Source: Esri and Burns & McDonnell Engineering Company

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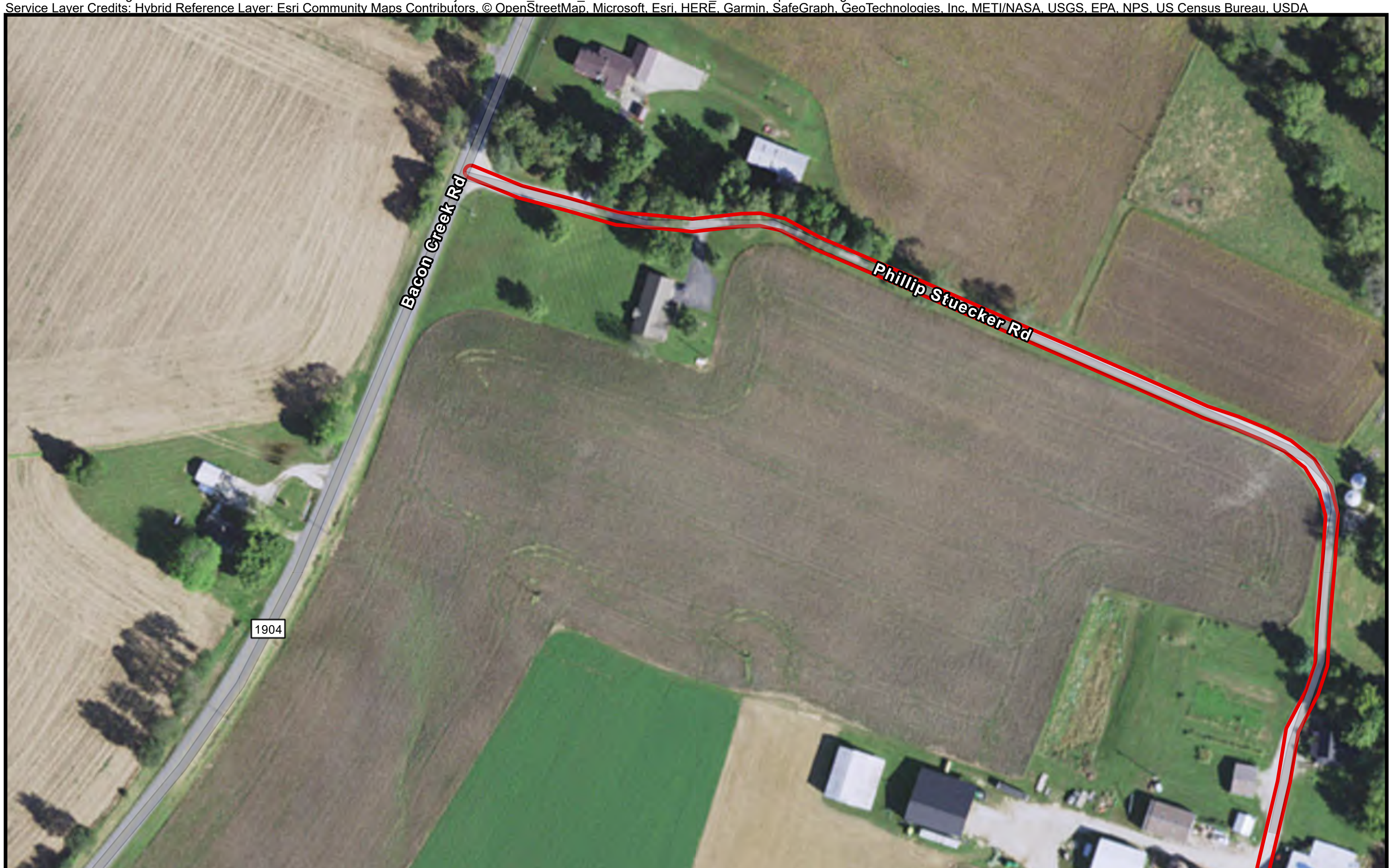

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

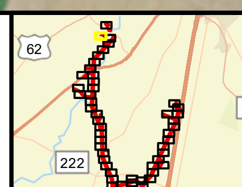

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 2 of 49

Source: Esri and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

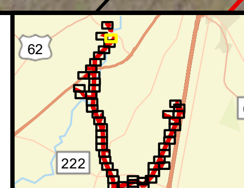

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 3 of 49

Source: Esri and Burns & McDonnell Engineering Company

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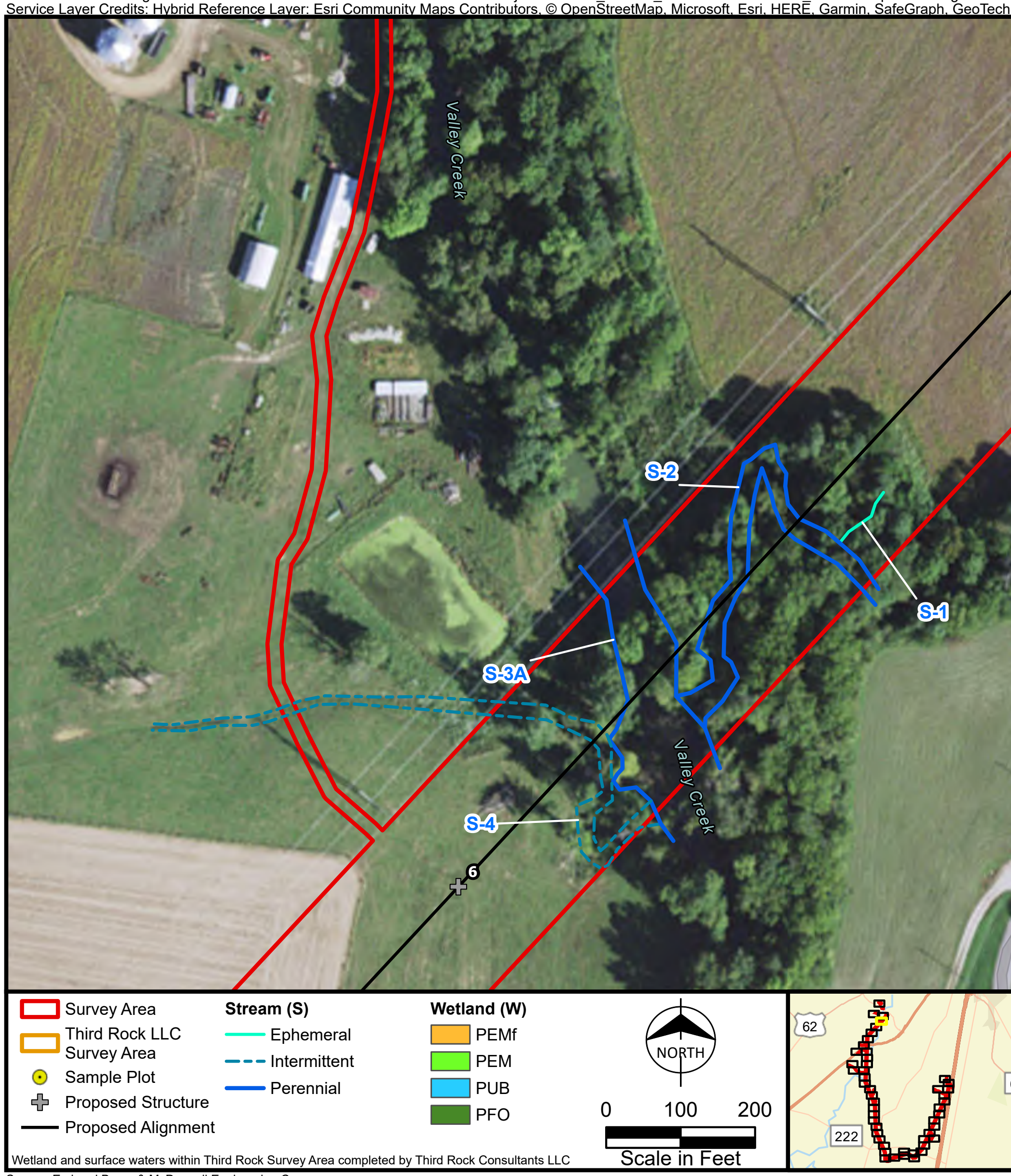

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 4 of 49

Source: Esri and Burns & McDonnell Engineering Company

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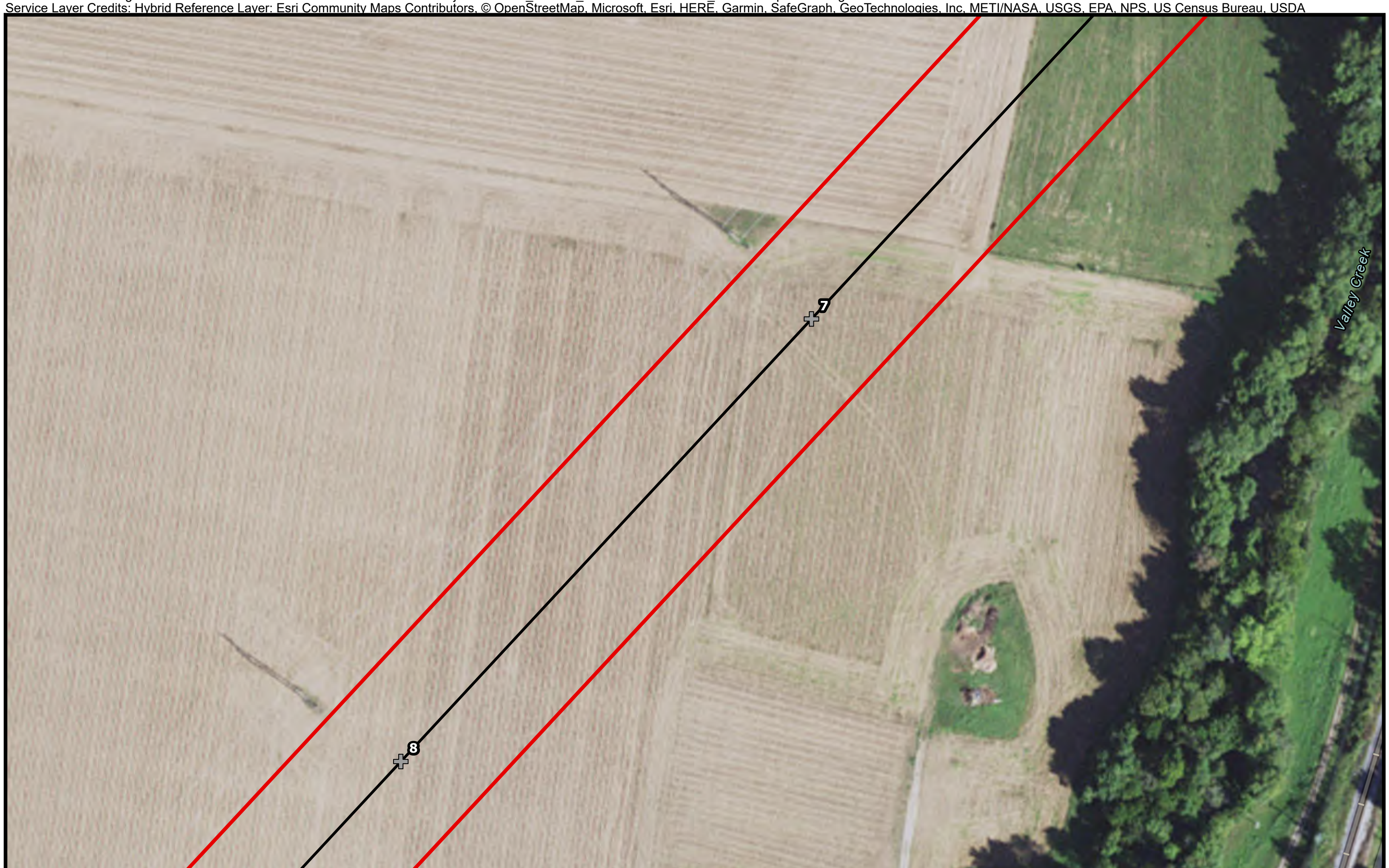

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

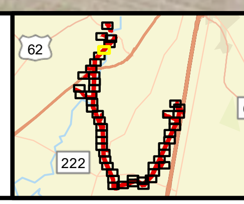

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 5 of 49

Source: Esri and Burns & McDonnell Engineering Company

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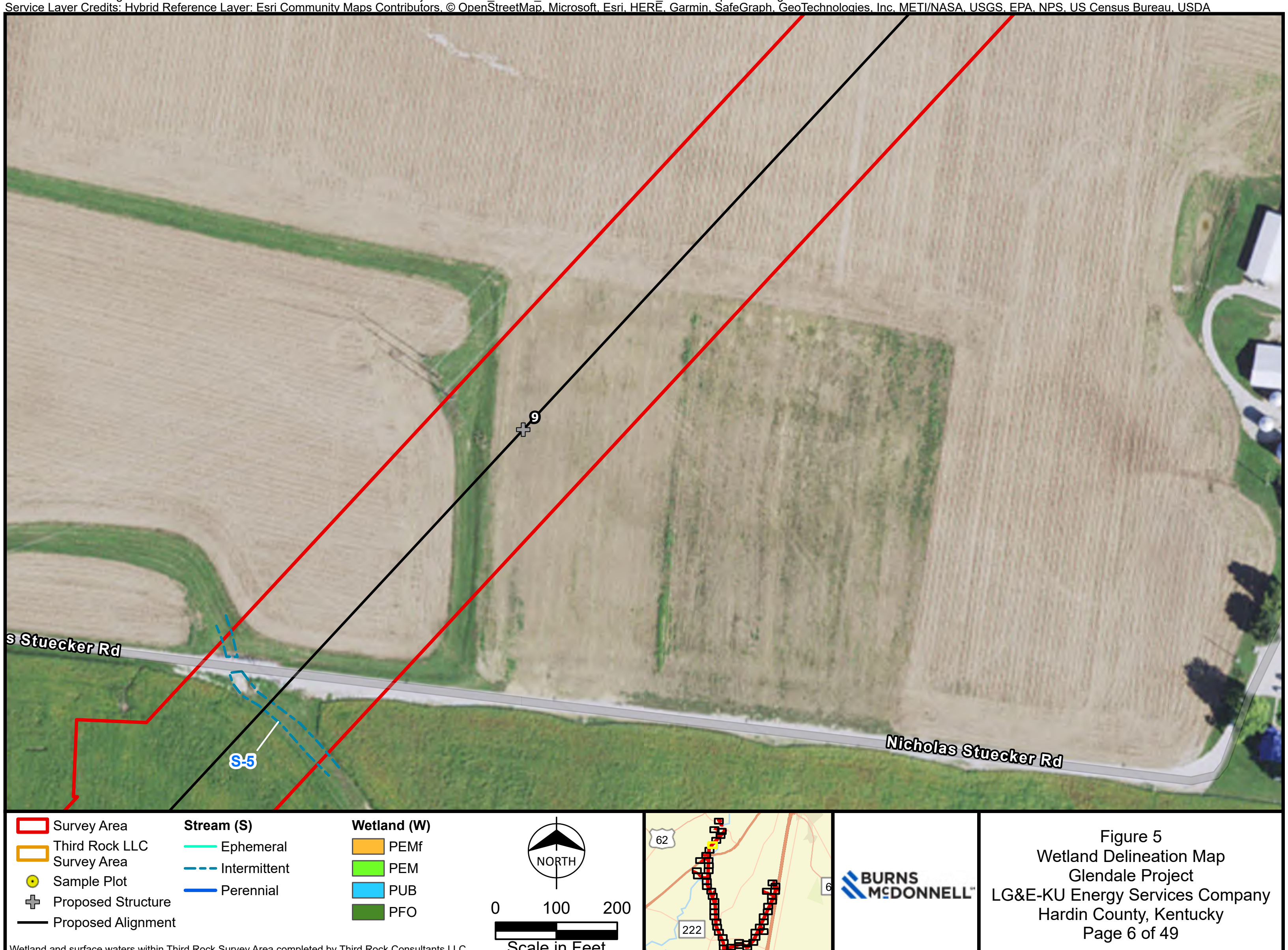

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 6 of 49

Source: Esri and Burns & McDonnell Engineering Company

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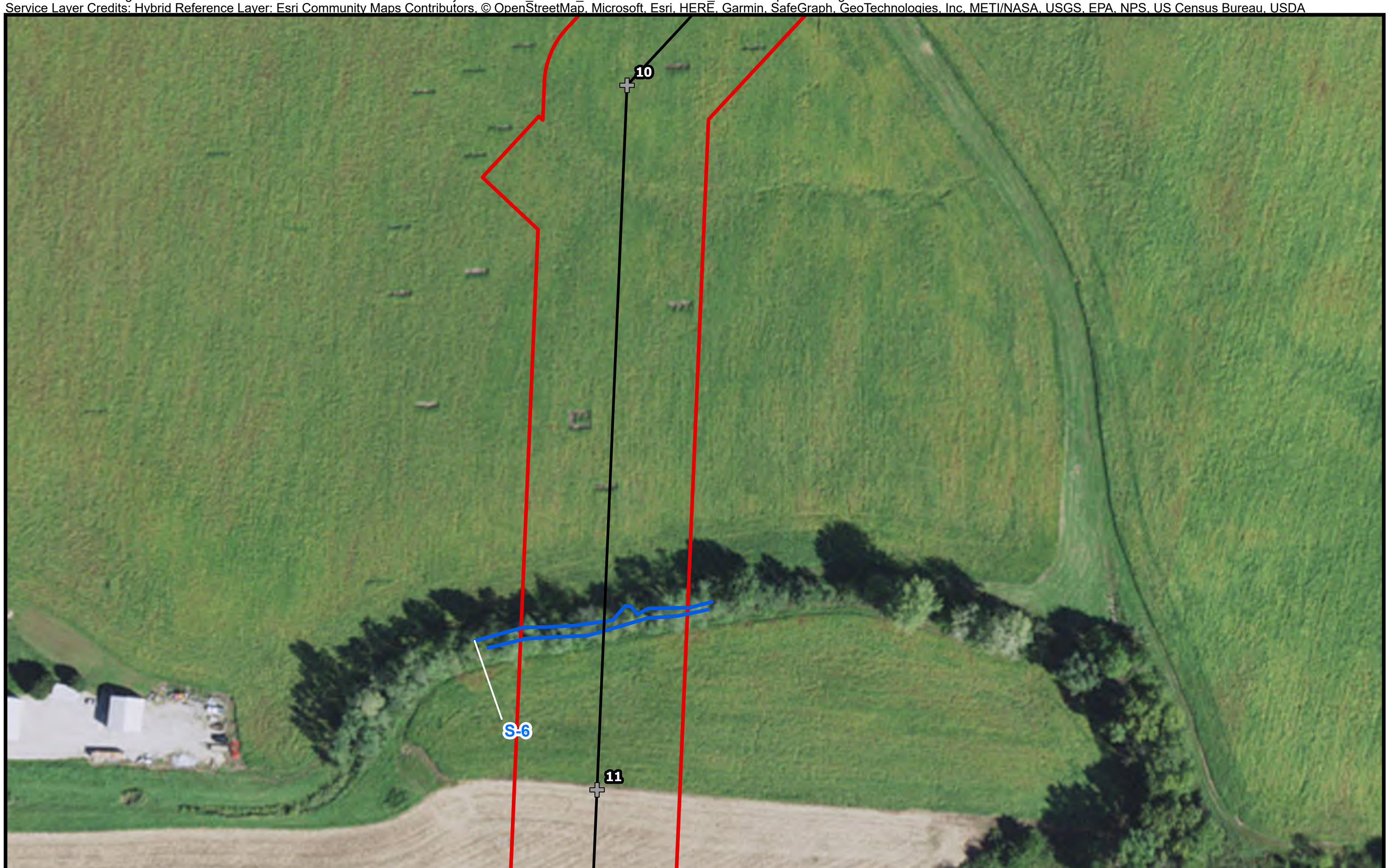

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

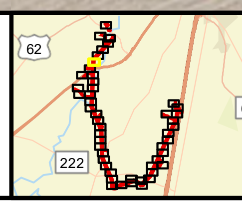

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 7 of 49

Source: Esri and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

BURNS McDONNELL

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 8 of 49

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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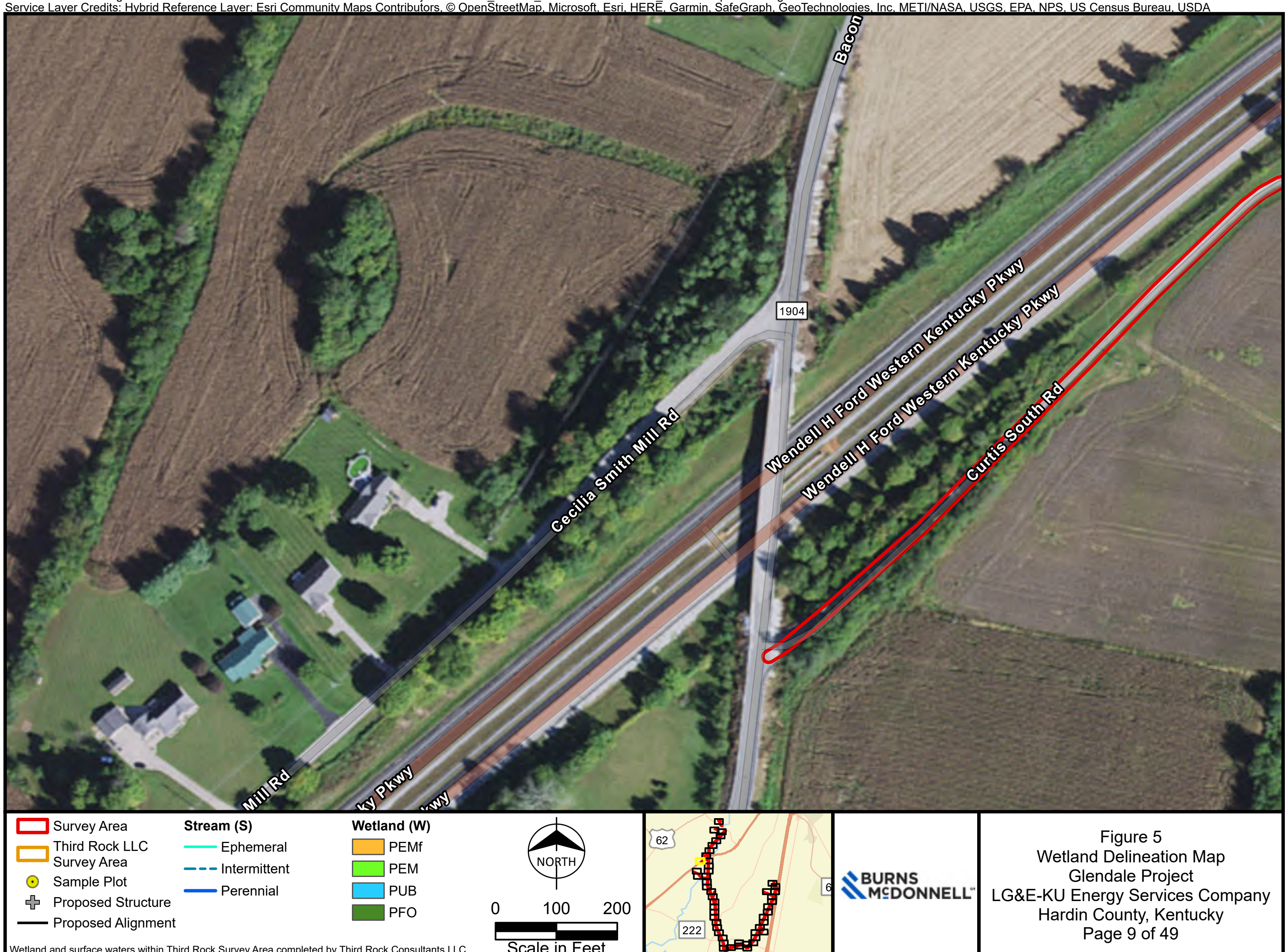

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 9 of 49

Source: Esri and Burns & McDonnell Engineering Company

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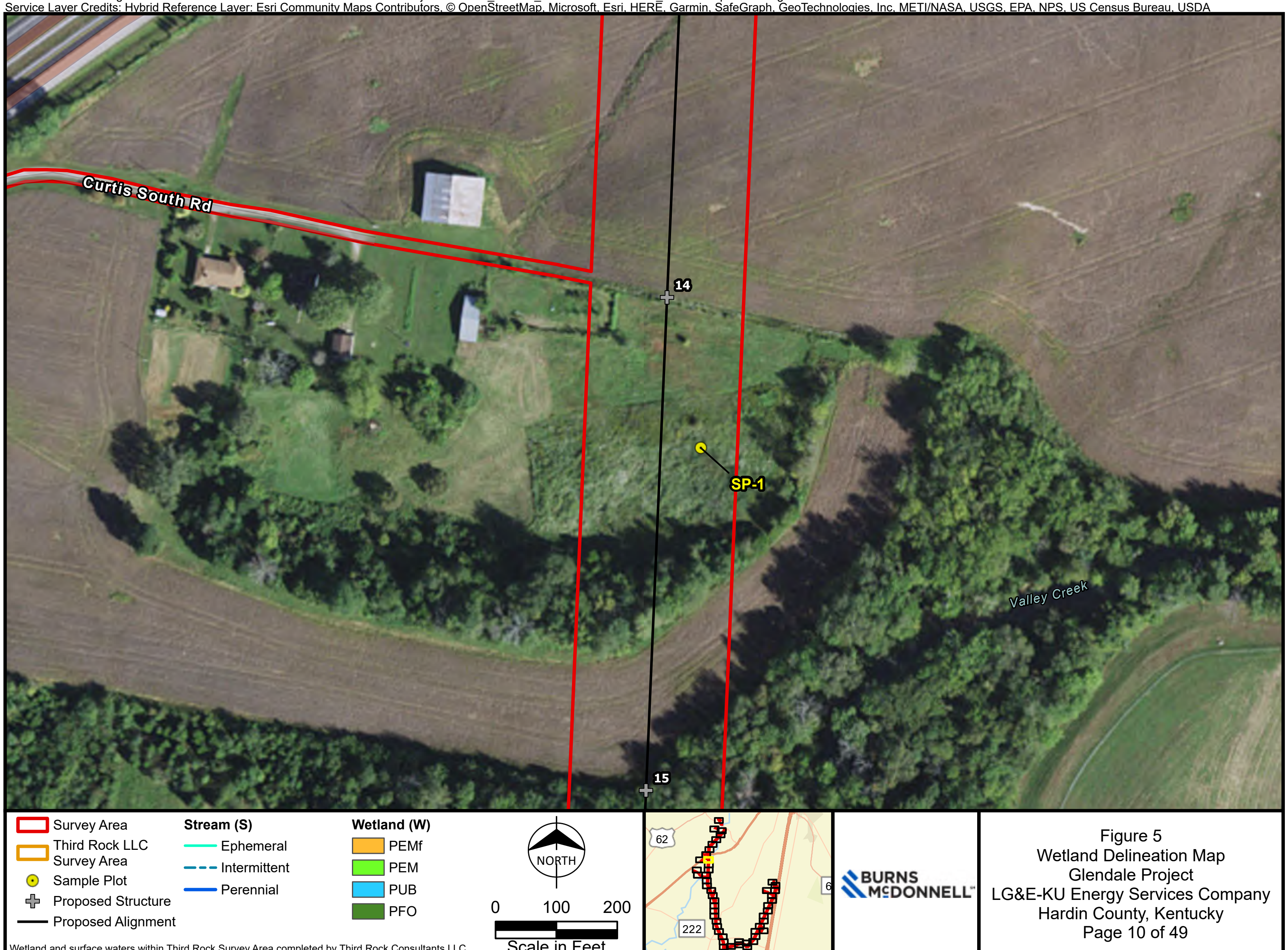

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 10 of 49

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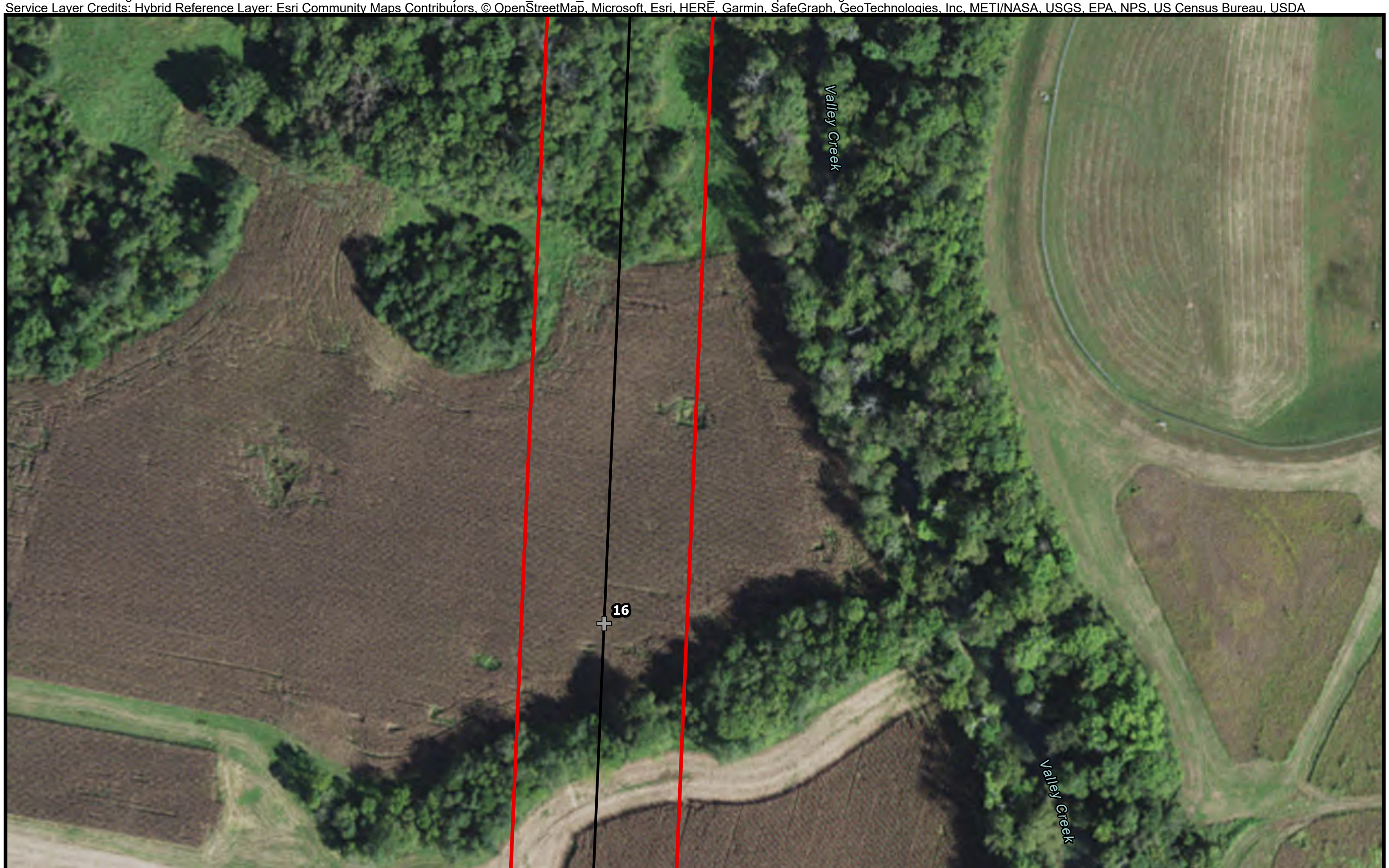

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 11 of 49

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

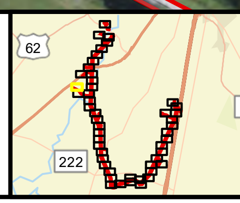

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 12 of 49

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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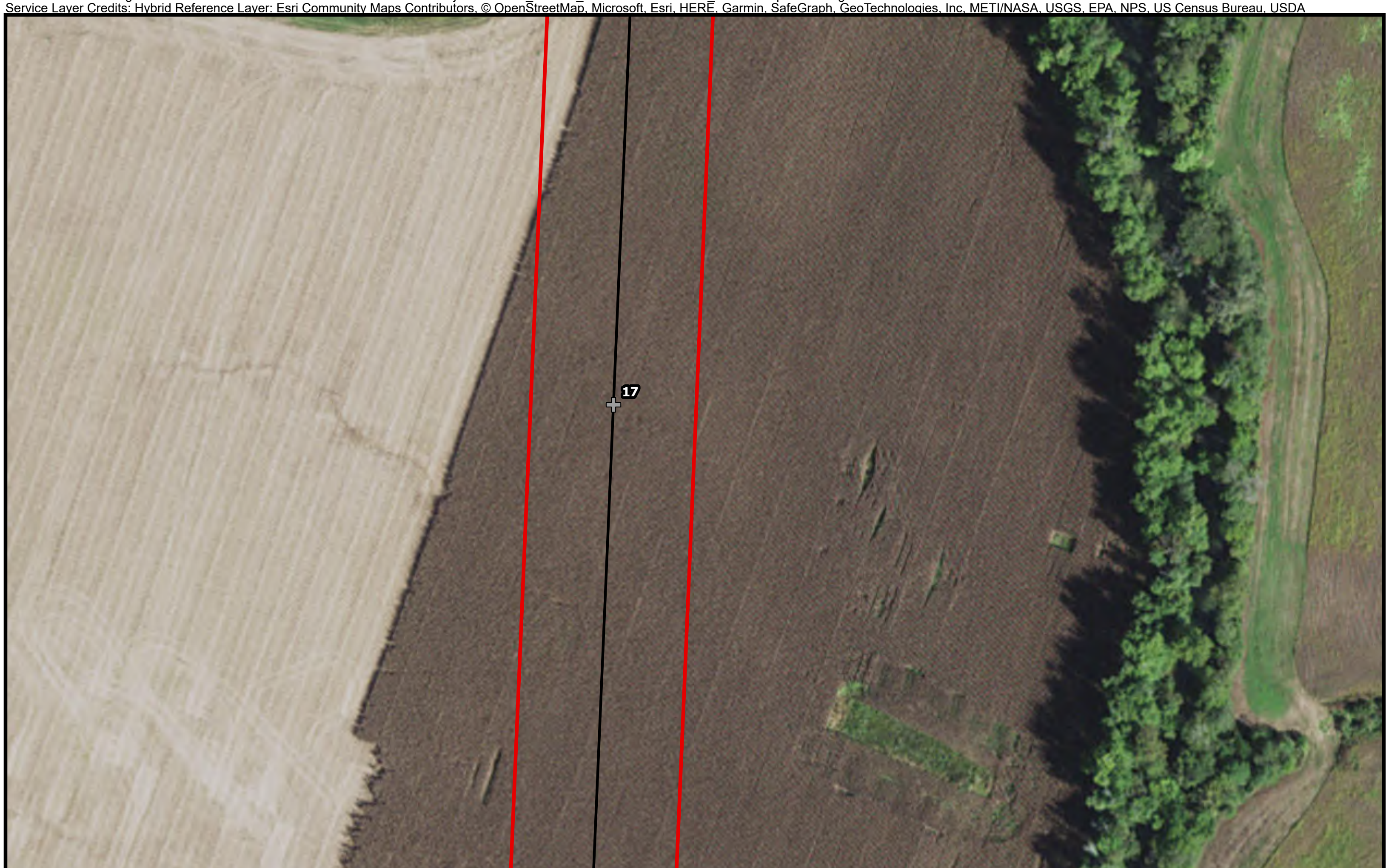

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

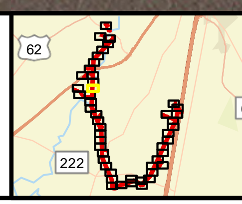

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 13 of 49

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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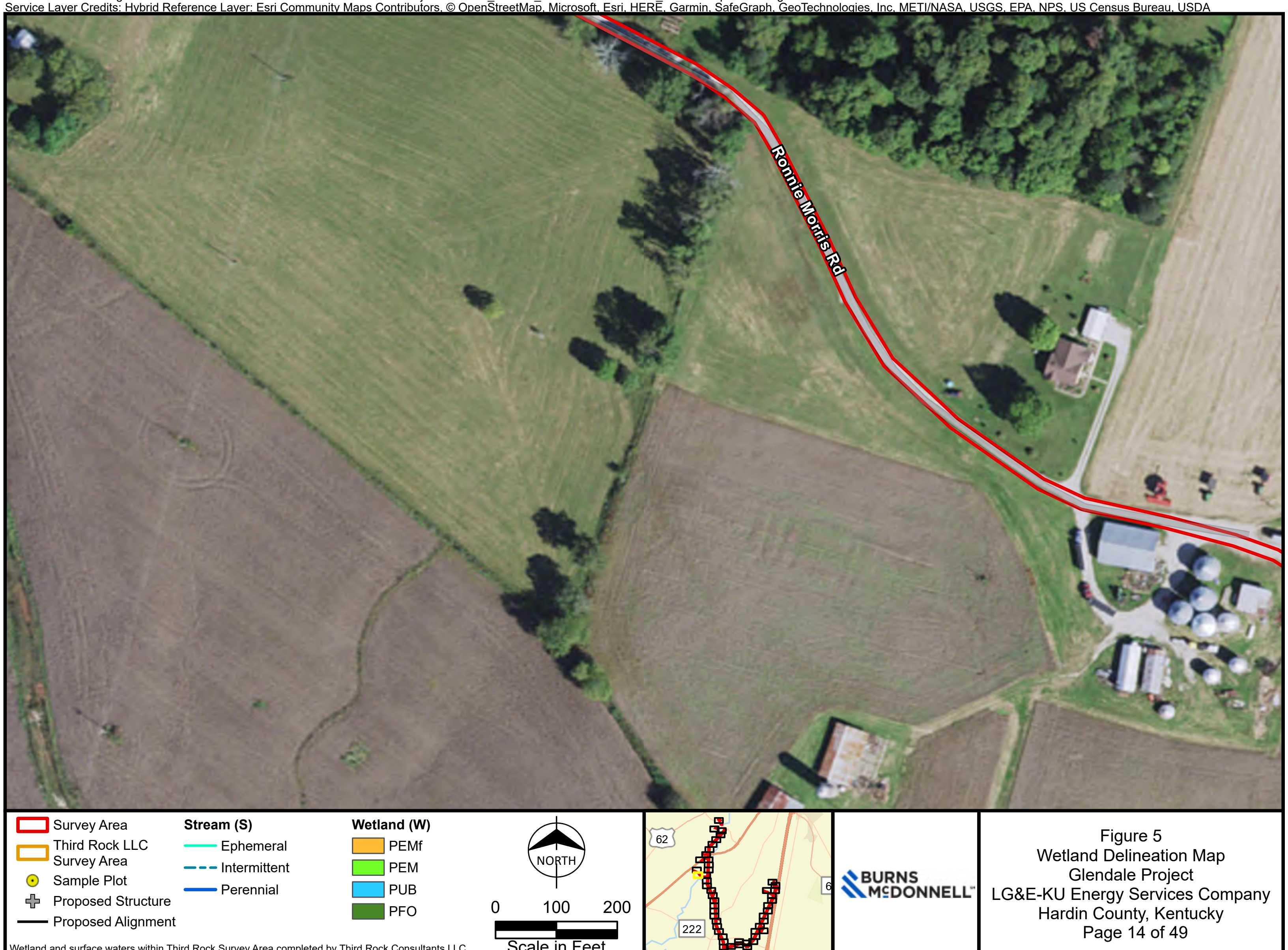

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

BURNS McDONNELL

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 14 of 49

Source: Esri and Burns & McDonnell Engineering Company

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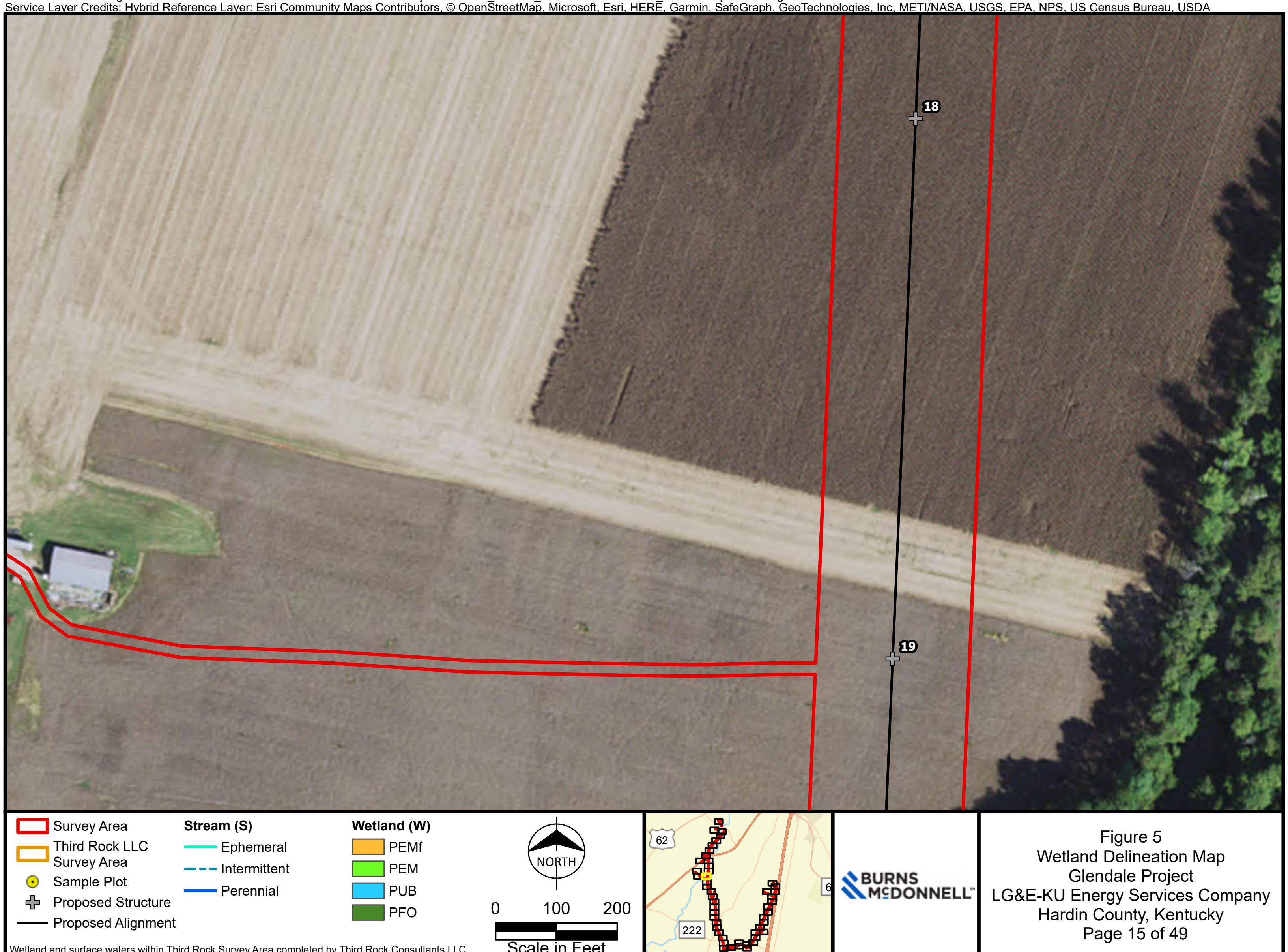

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 15 of 49

Source: Esri and Burns & McDonnell Engineering Company

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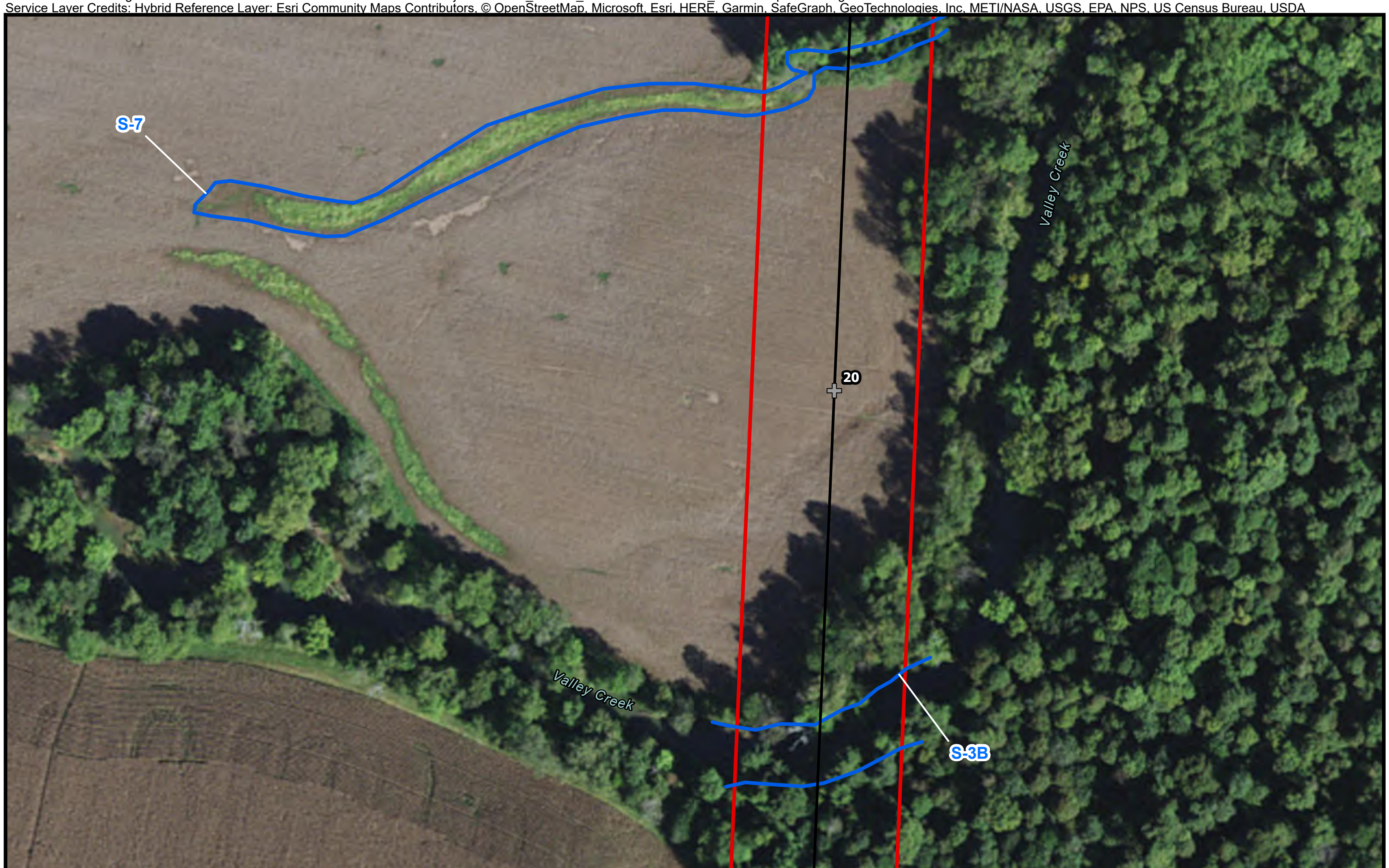

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

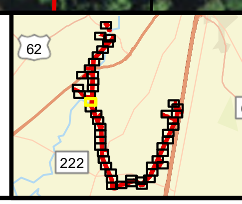

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 16 of 49

Source: Esri and Burns & McDonnell Engineering Company

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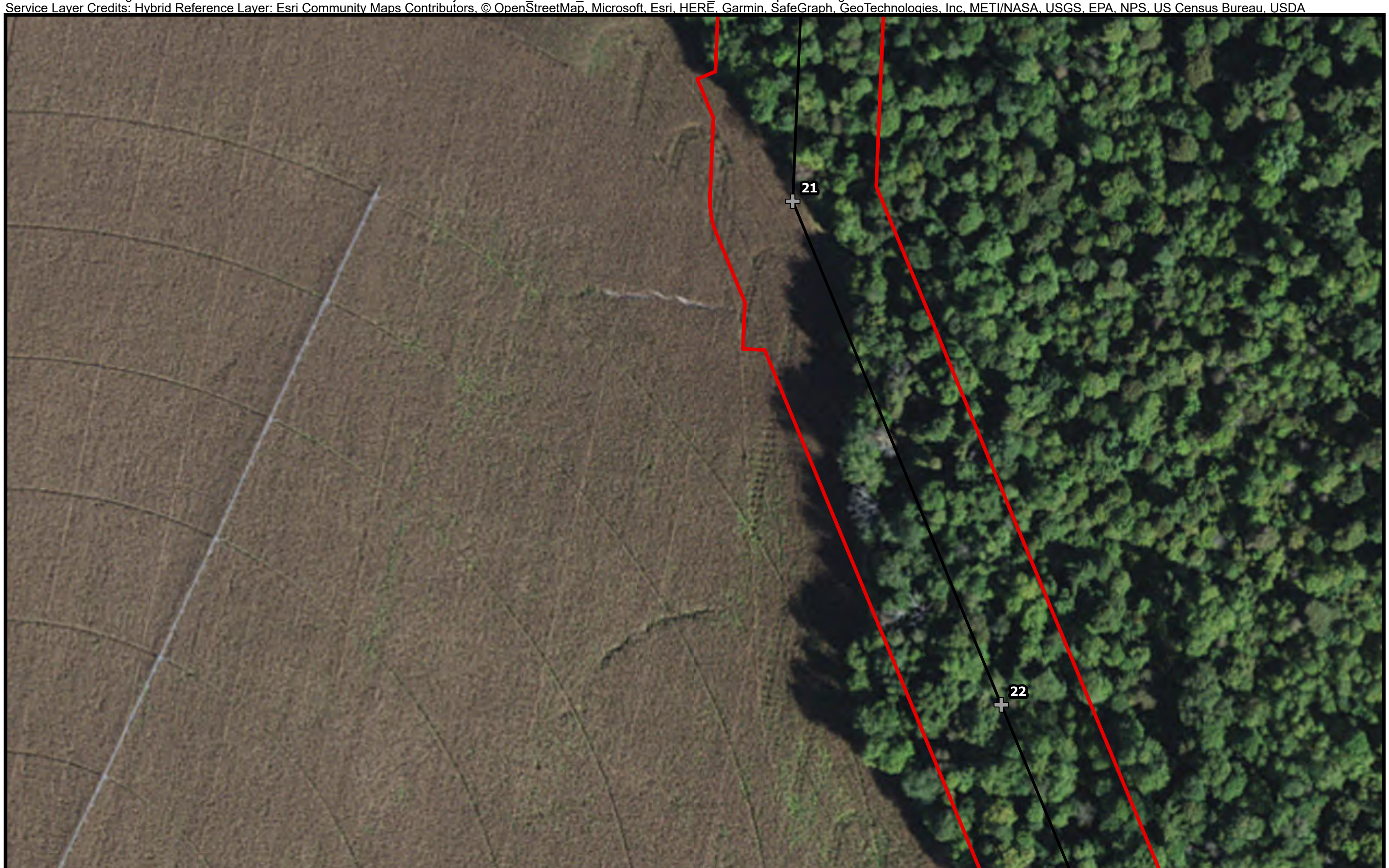

Survey Area
Third Rock LLC Survey Area
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Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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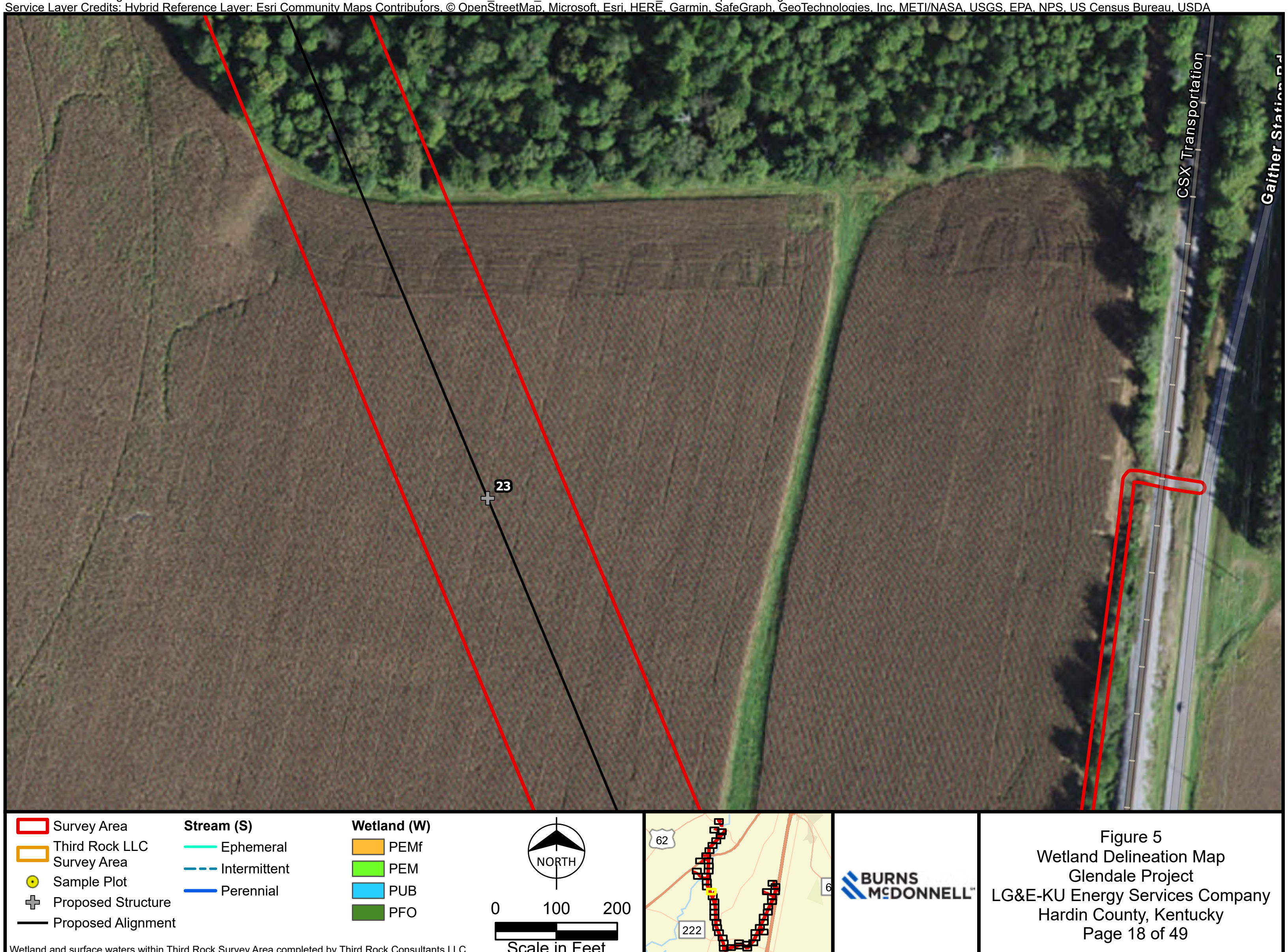

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 18 of 49

Source: Esri and Burns & McDonnell Engineering Company

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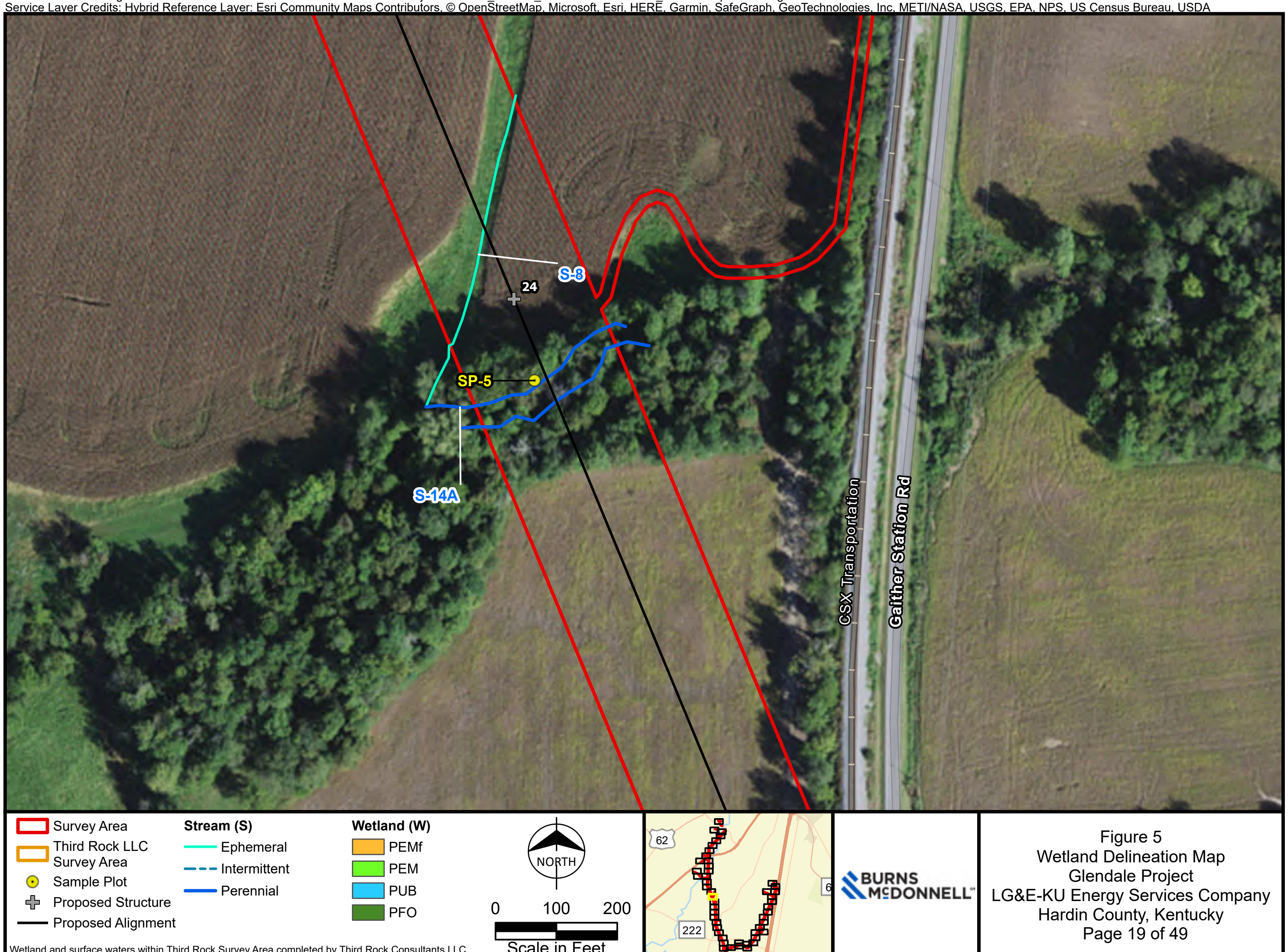

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 19 of 49

Source: Esri and Burns & McDonnell Engineering Company

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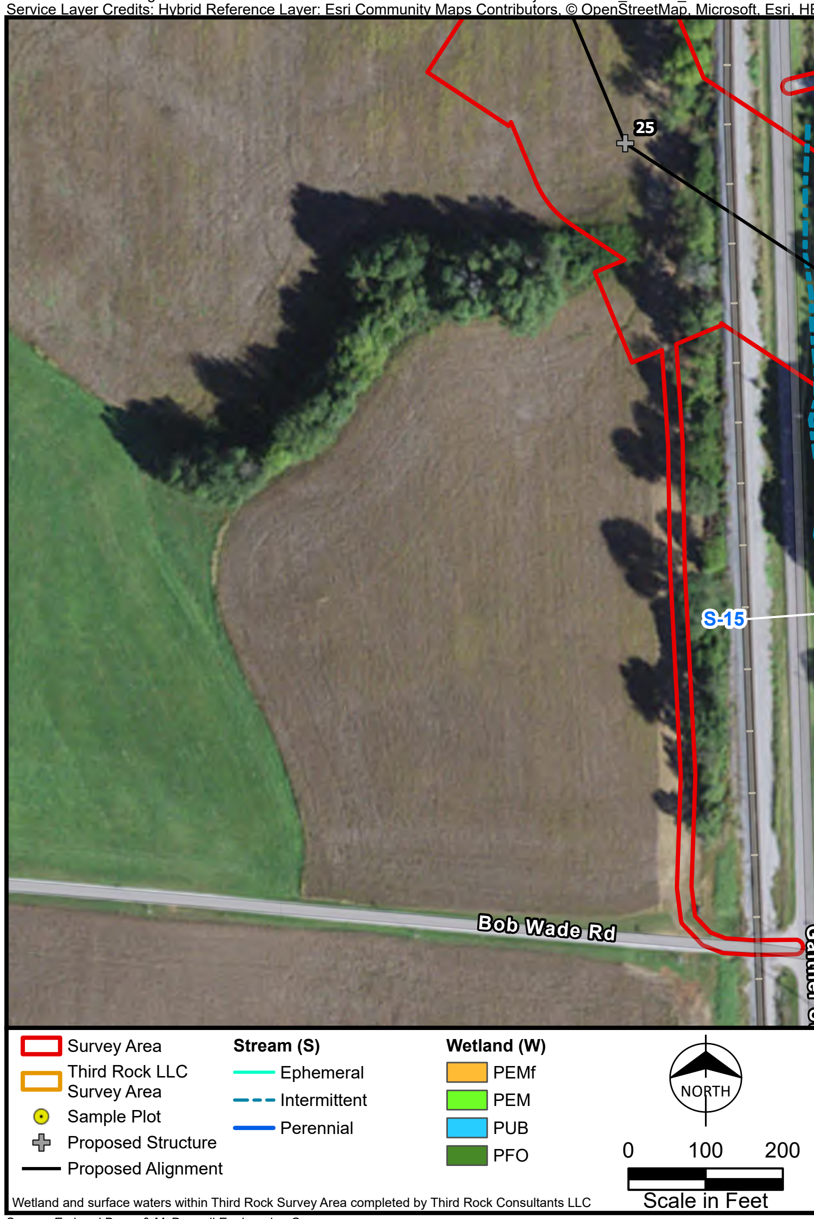

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

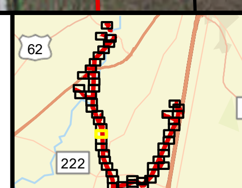

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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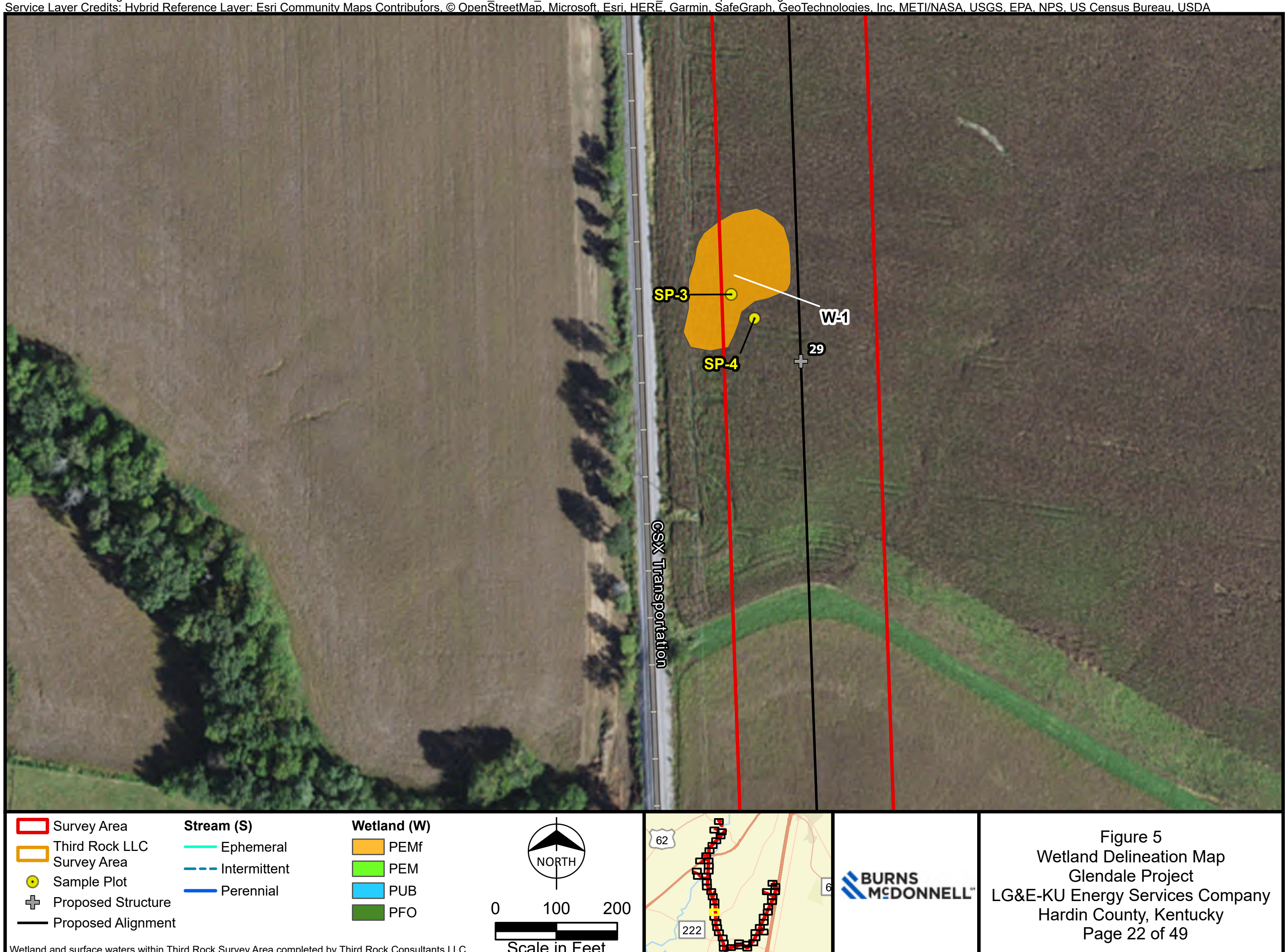

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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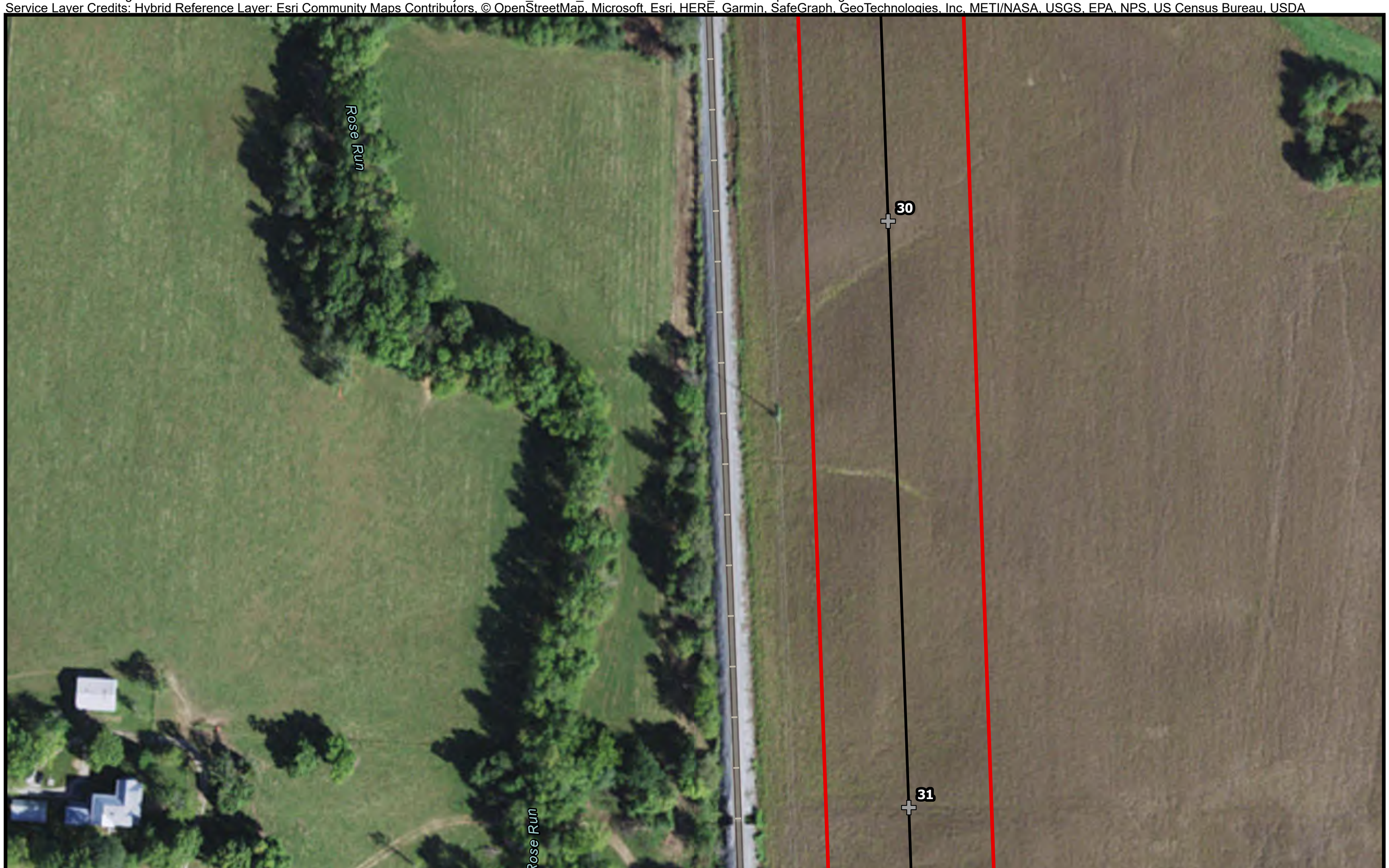

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

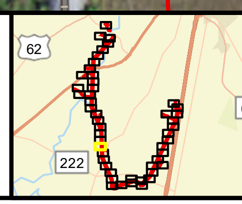

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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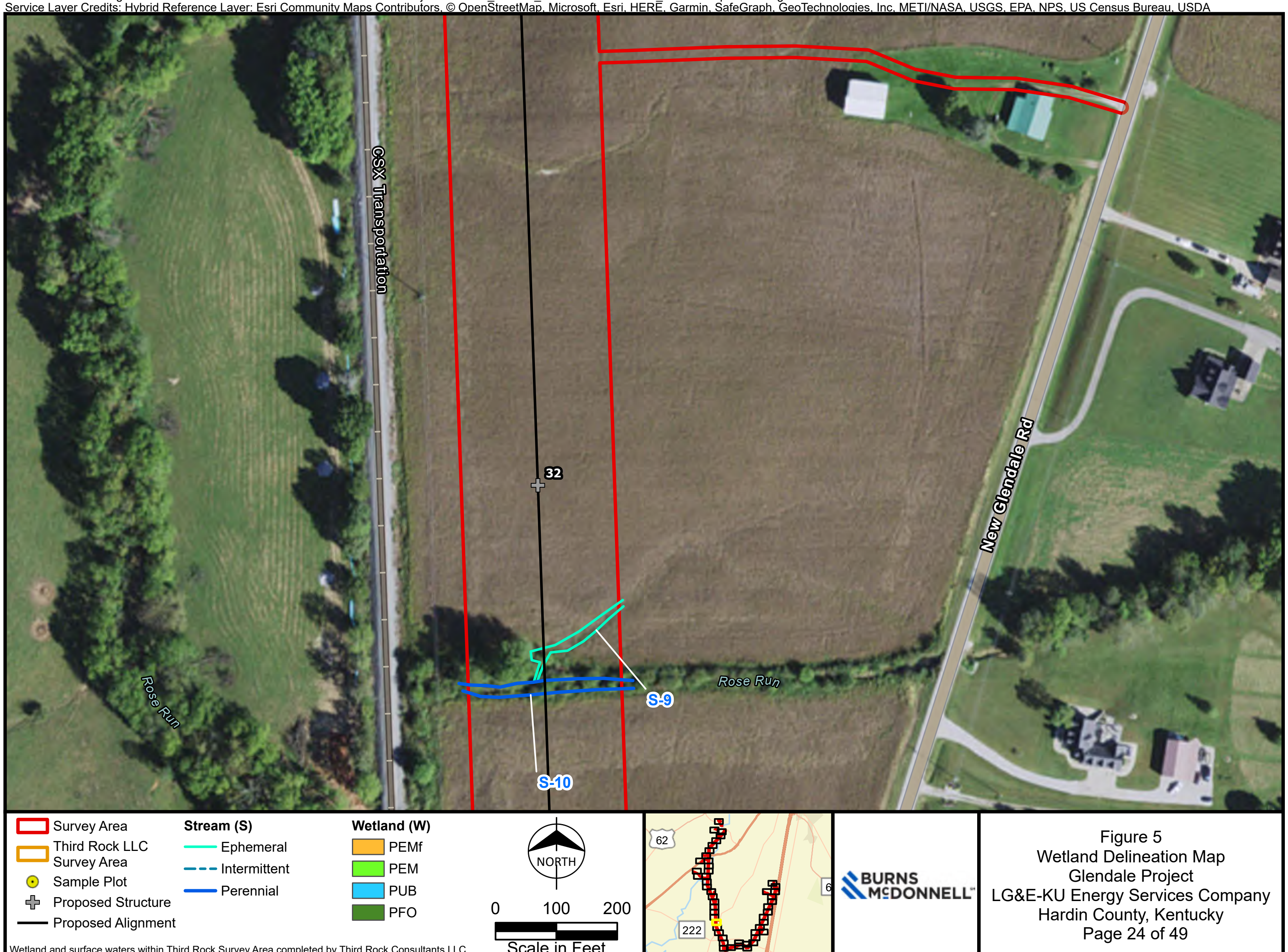

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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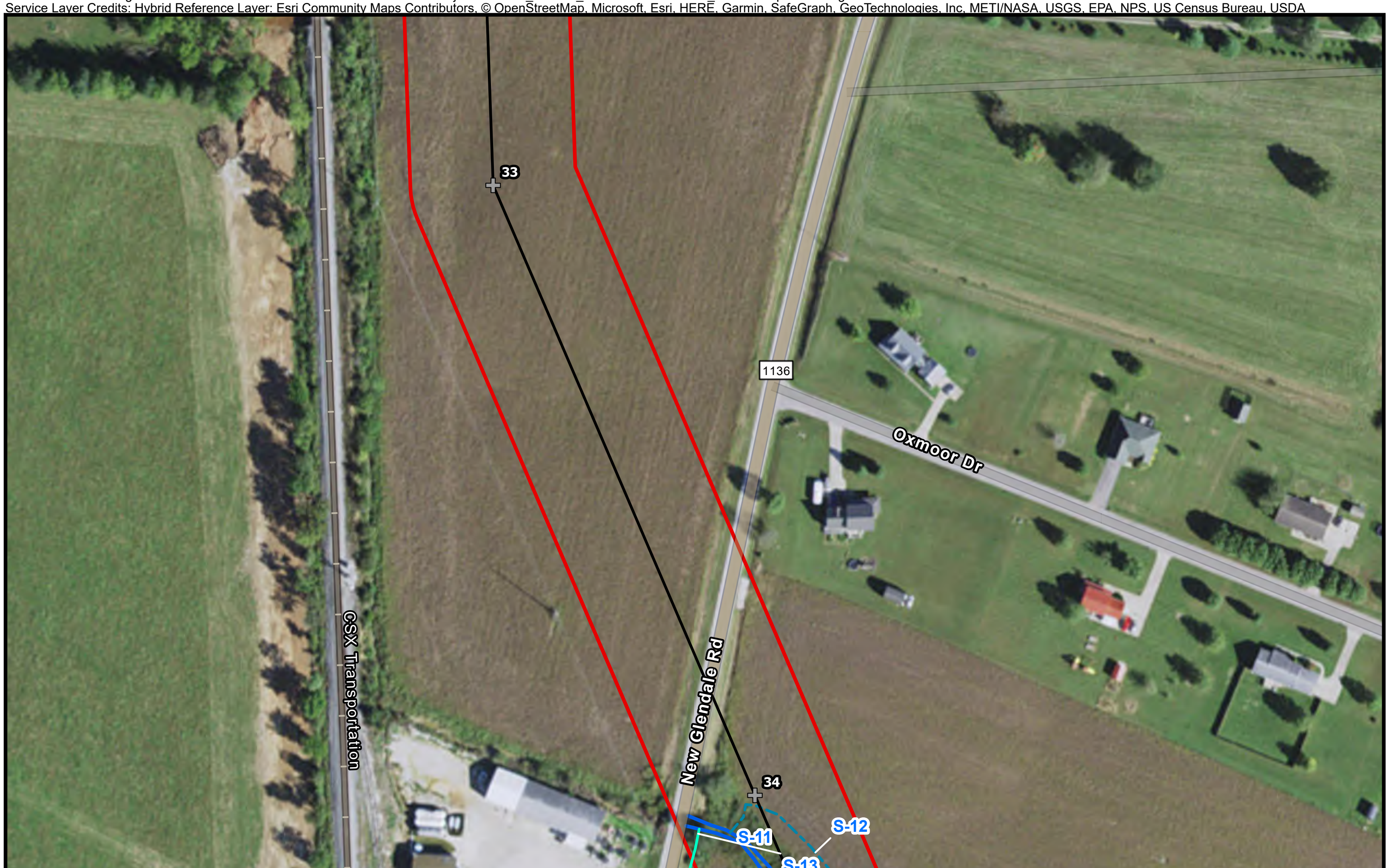

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

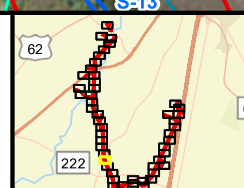

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 25 of 49

Source: Esri and Burns & McDonnell Engineering Company

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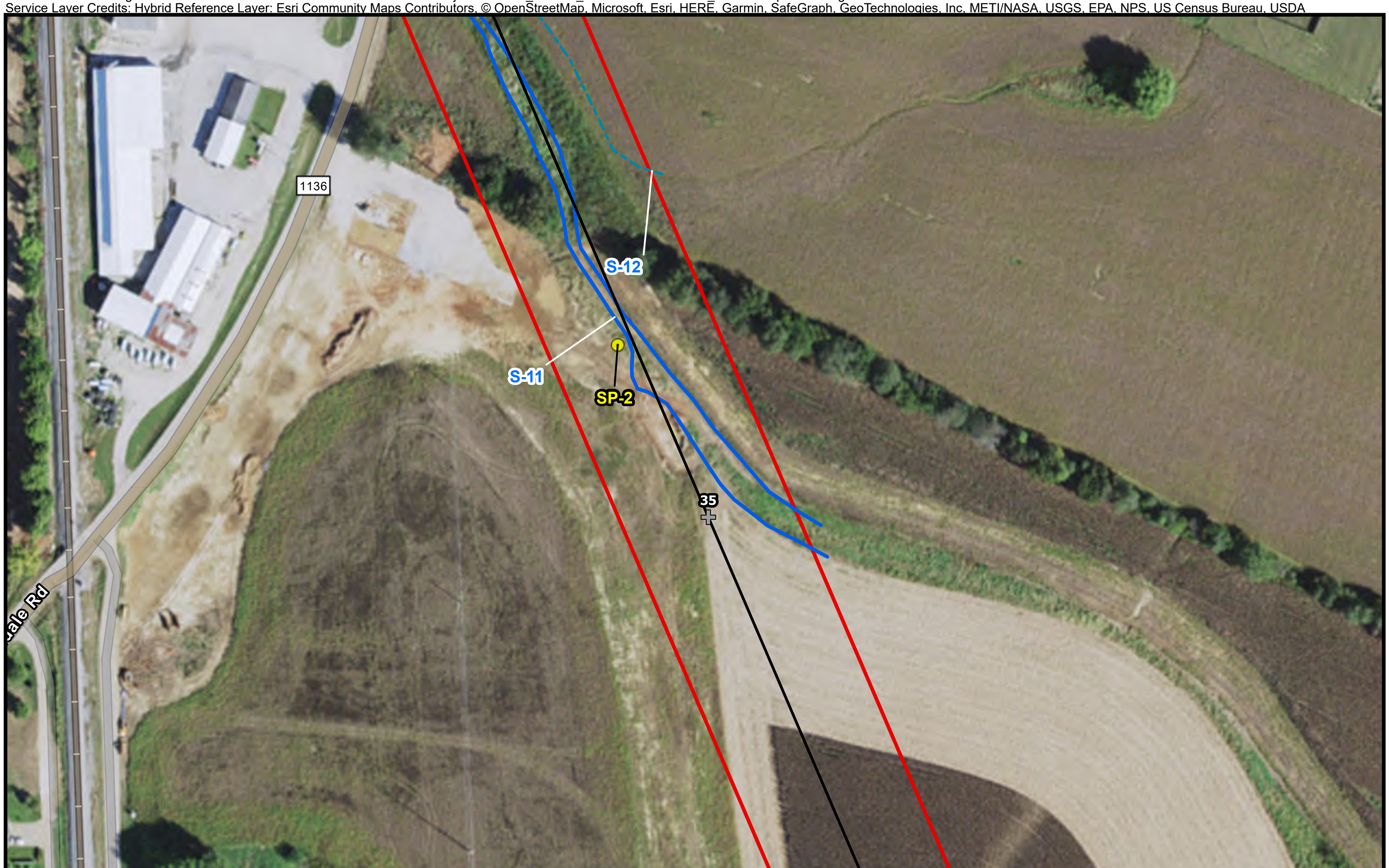

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

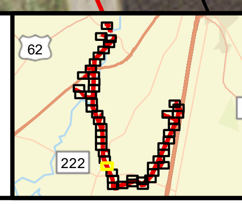

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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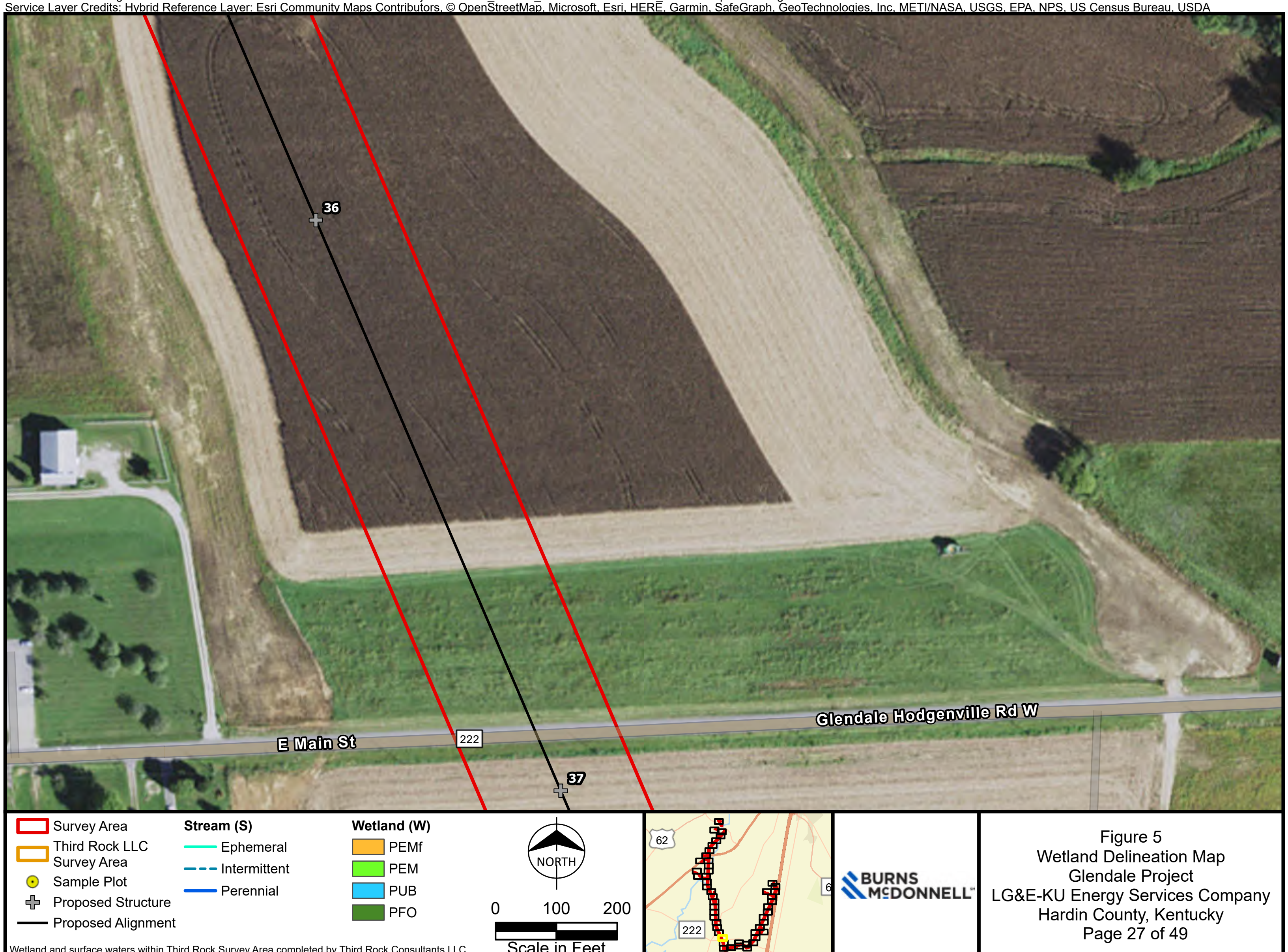

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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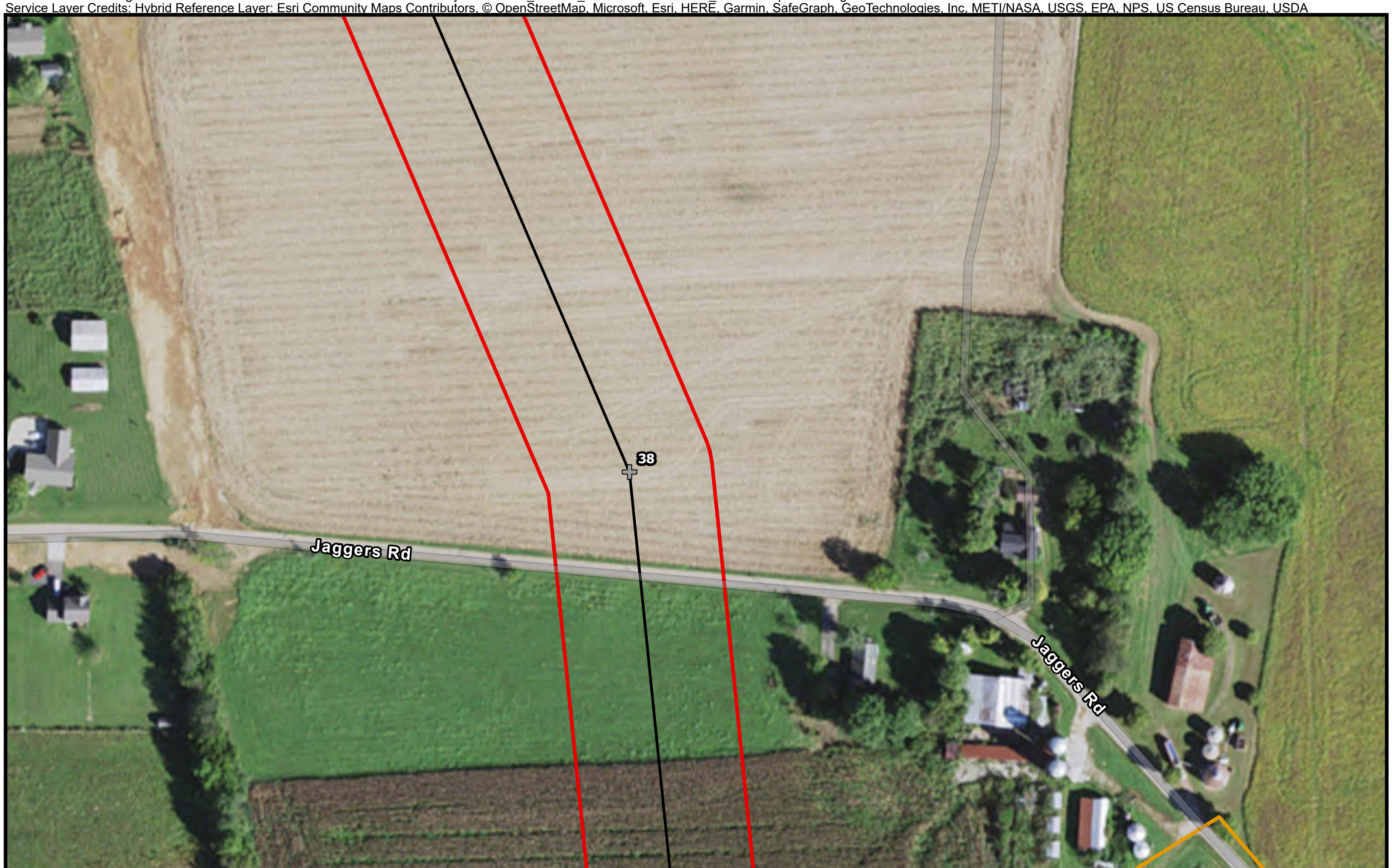

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 28 of 49

Source: Esri and Burns & McDonnell Engineering Company

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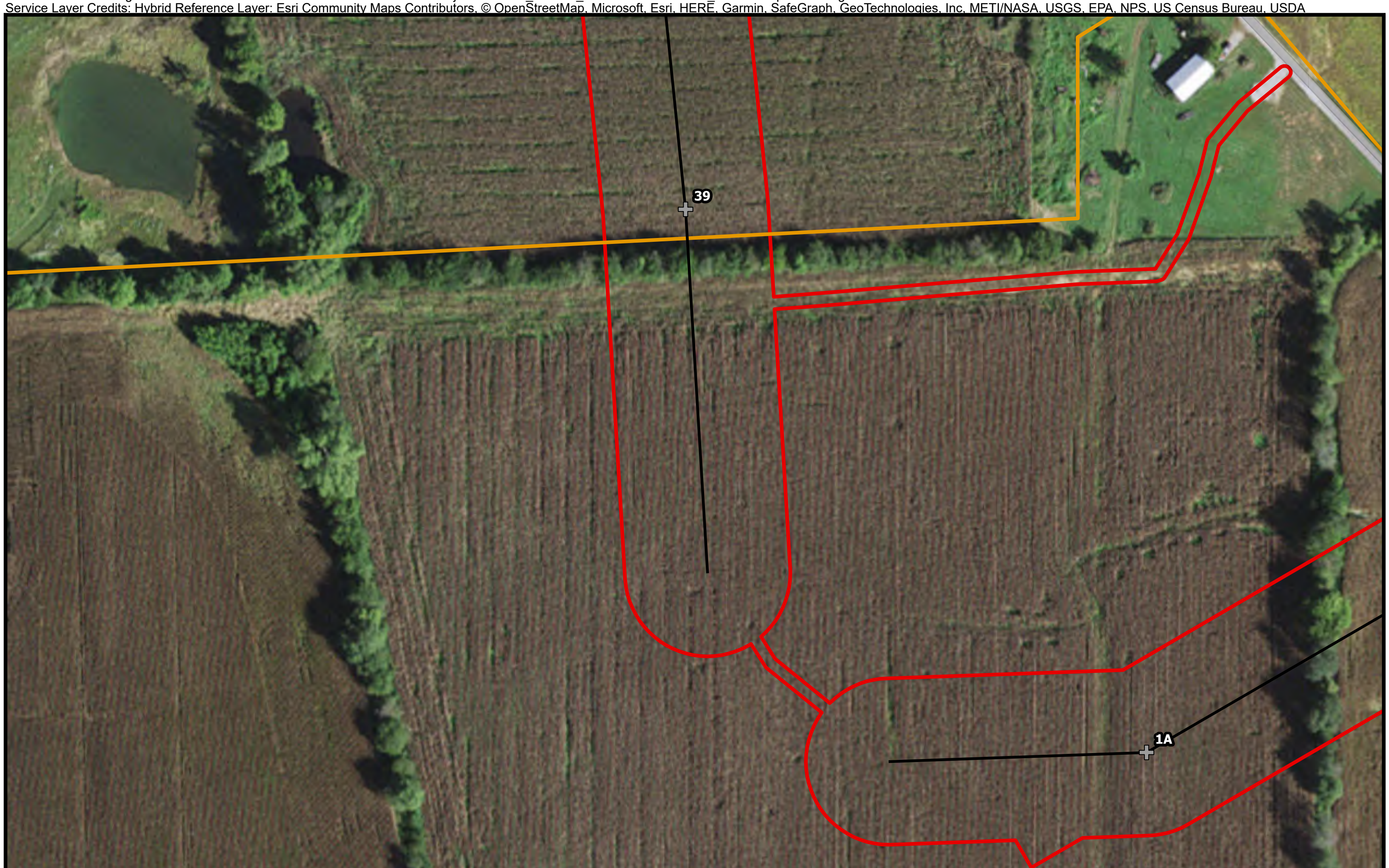

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

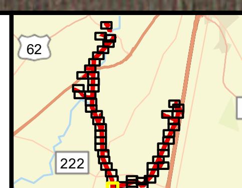

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC
Source: Esri and Burns & McDonnell Engineering Company

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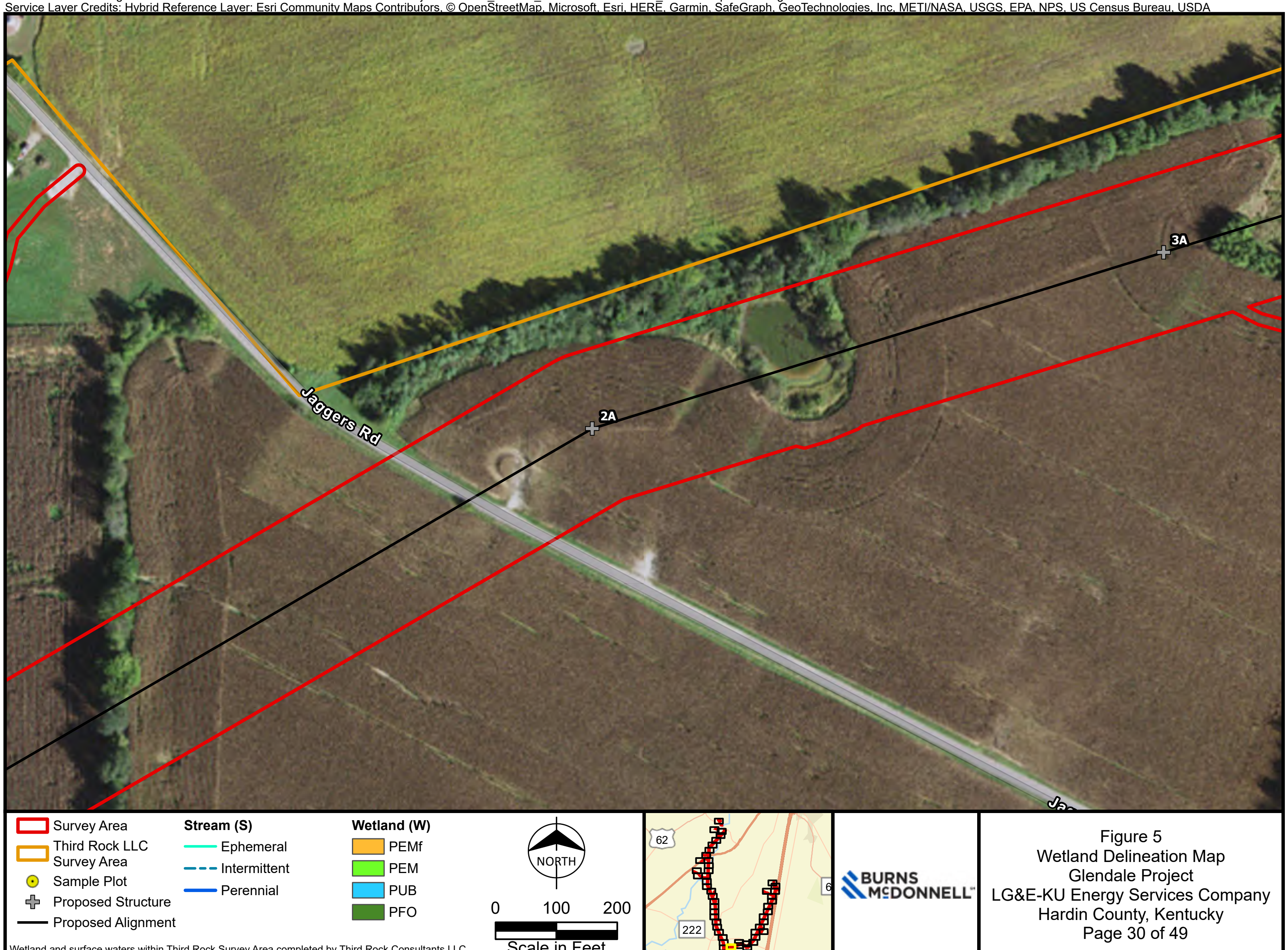

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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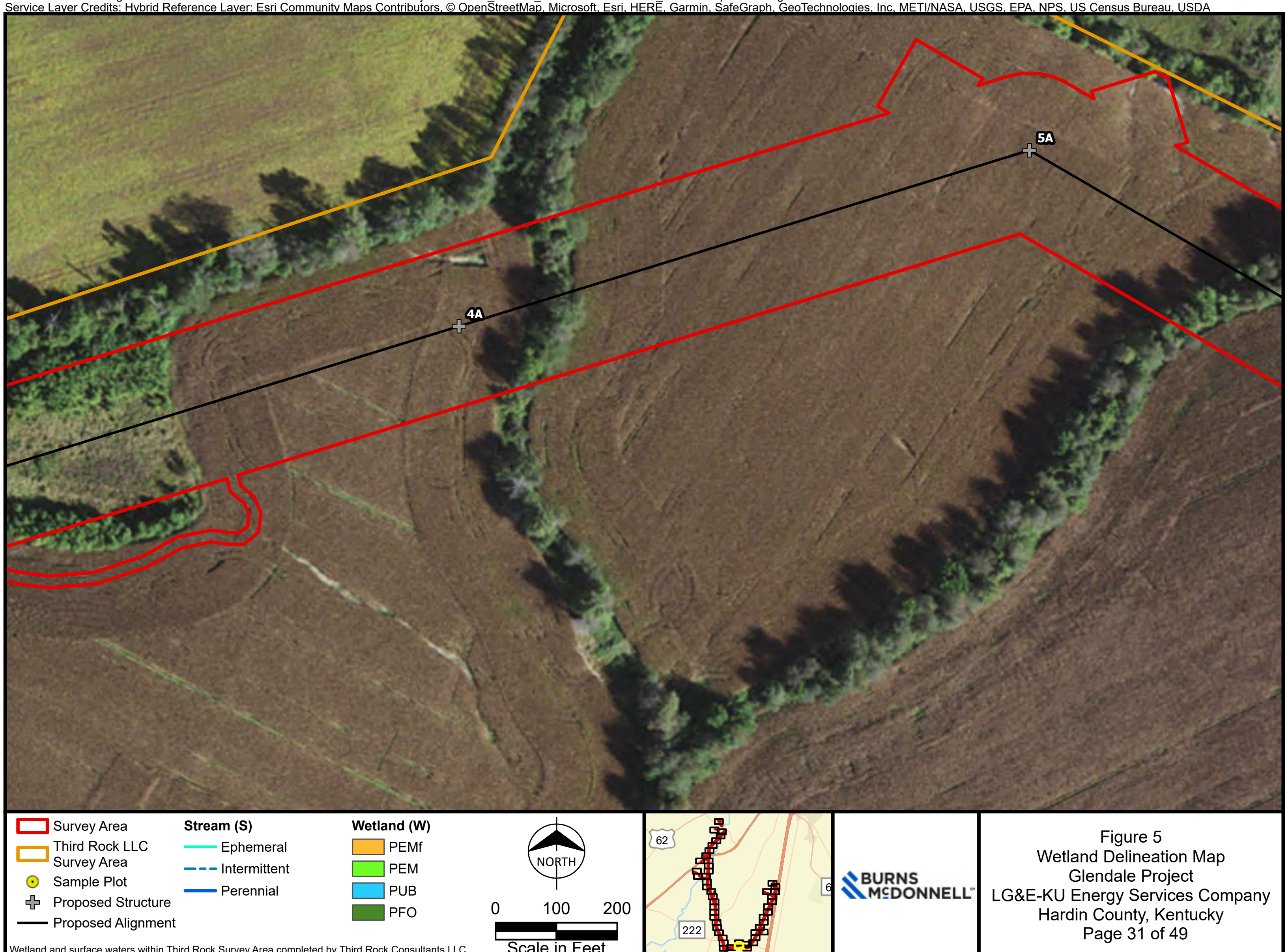

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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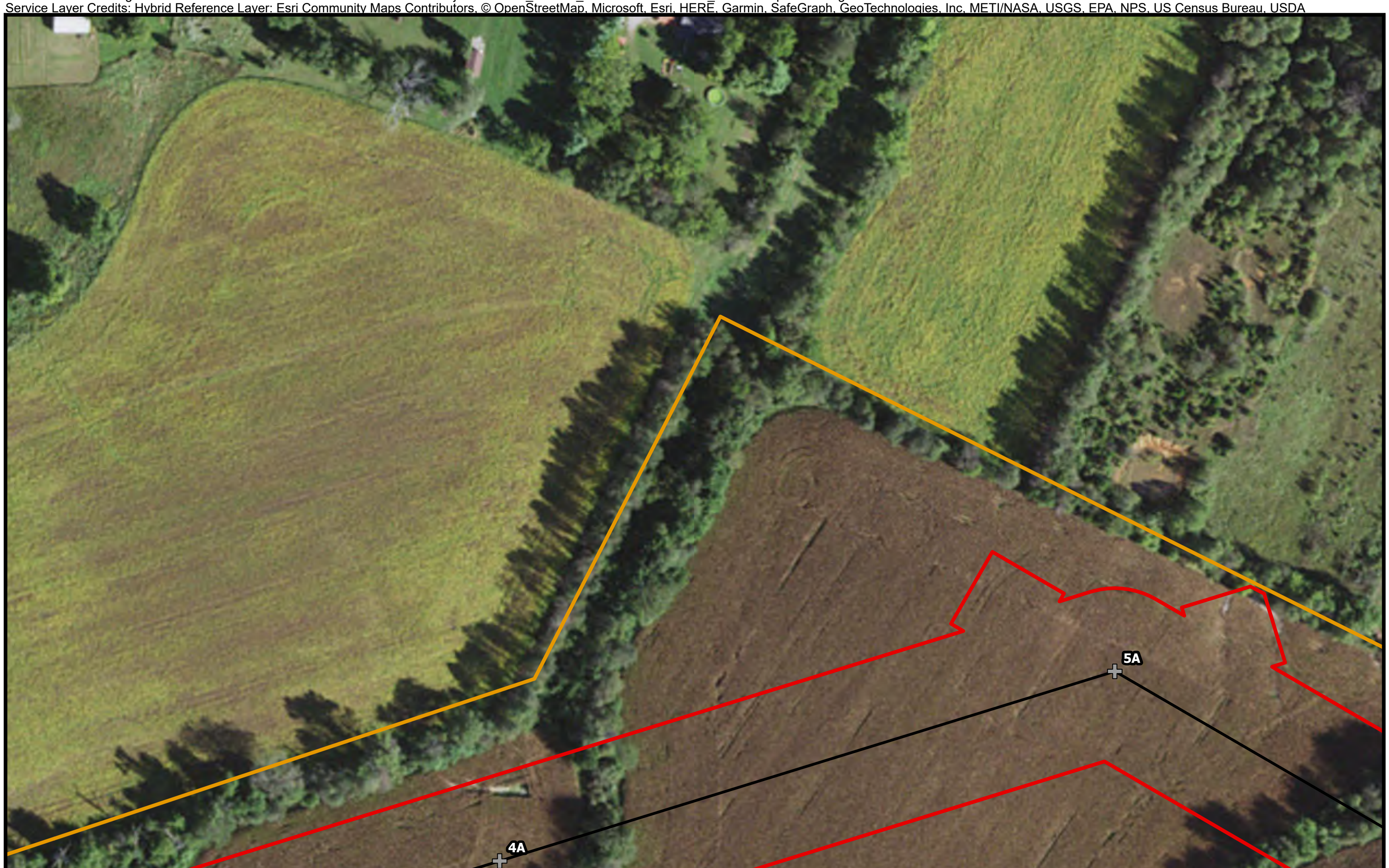

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

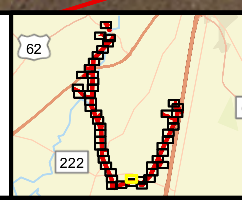

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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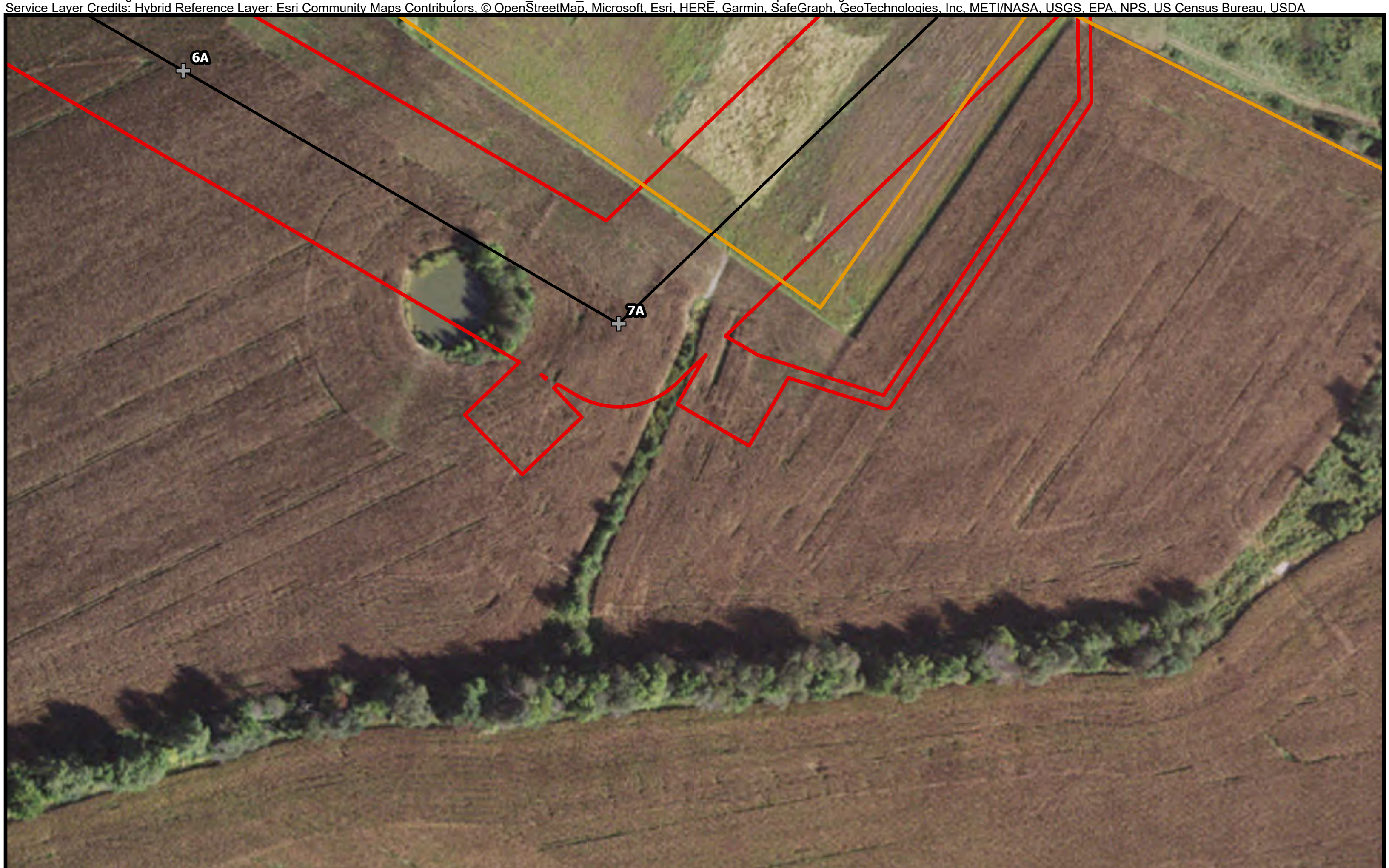

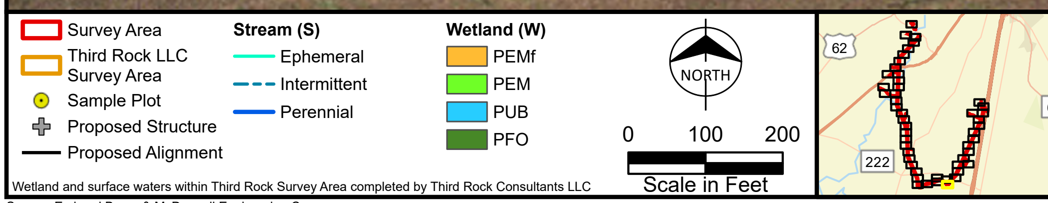

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 33 of 49

Source: Esri and Burns & McDonnell Engineering Company

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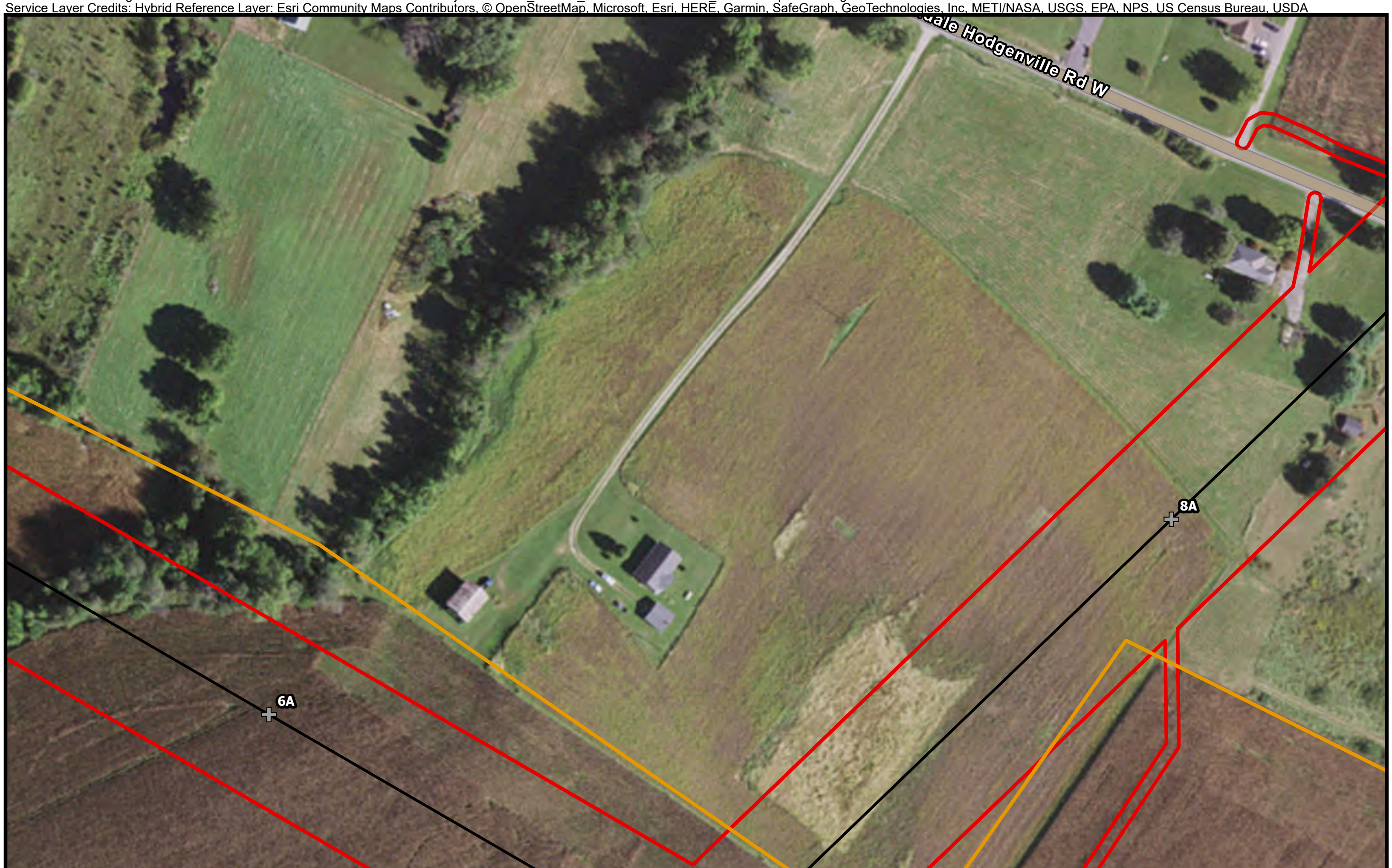

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 34 of 49

Source: Esri and Burns & McDonnell Engineering Company

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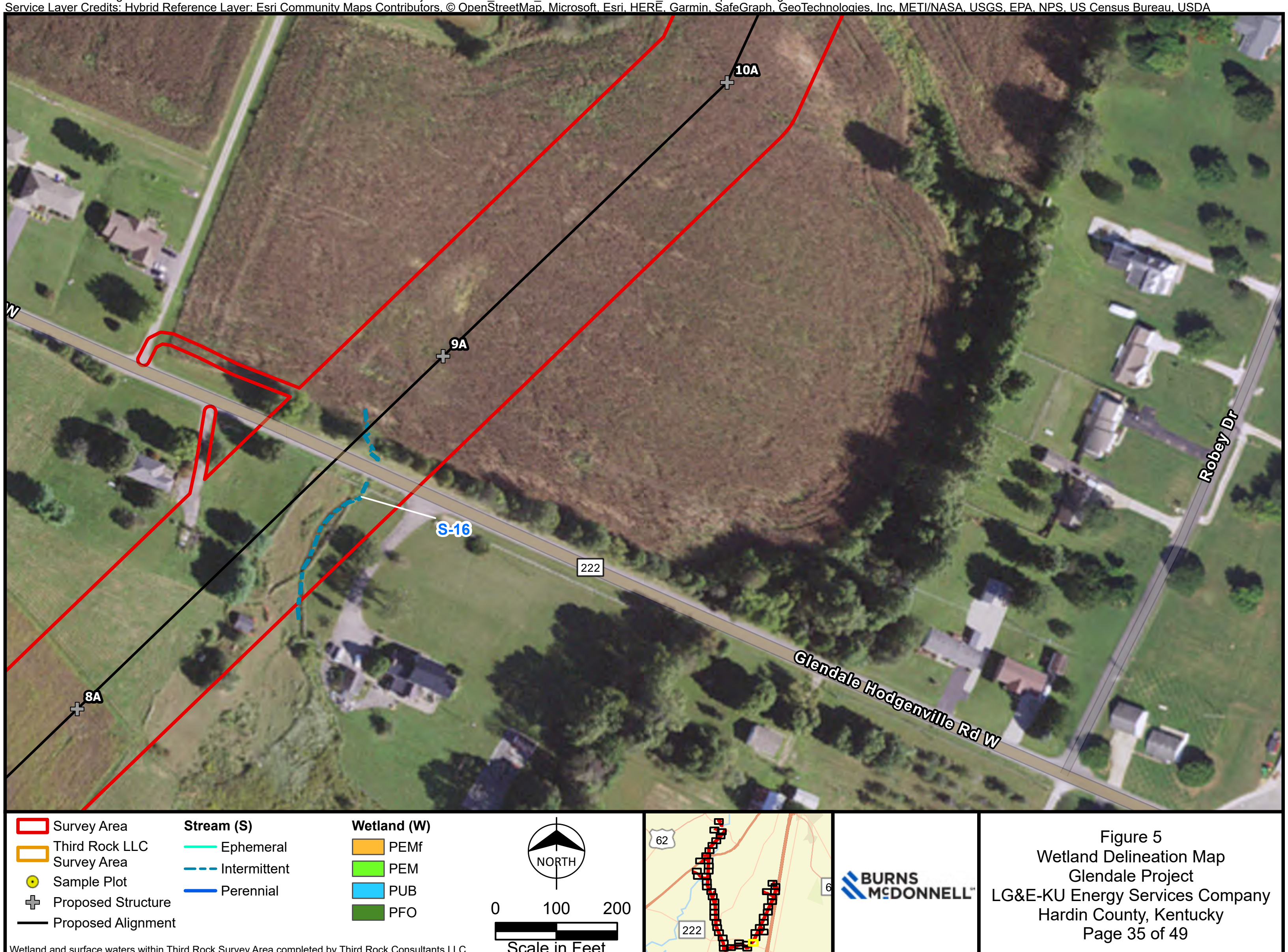

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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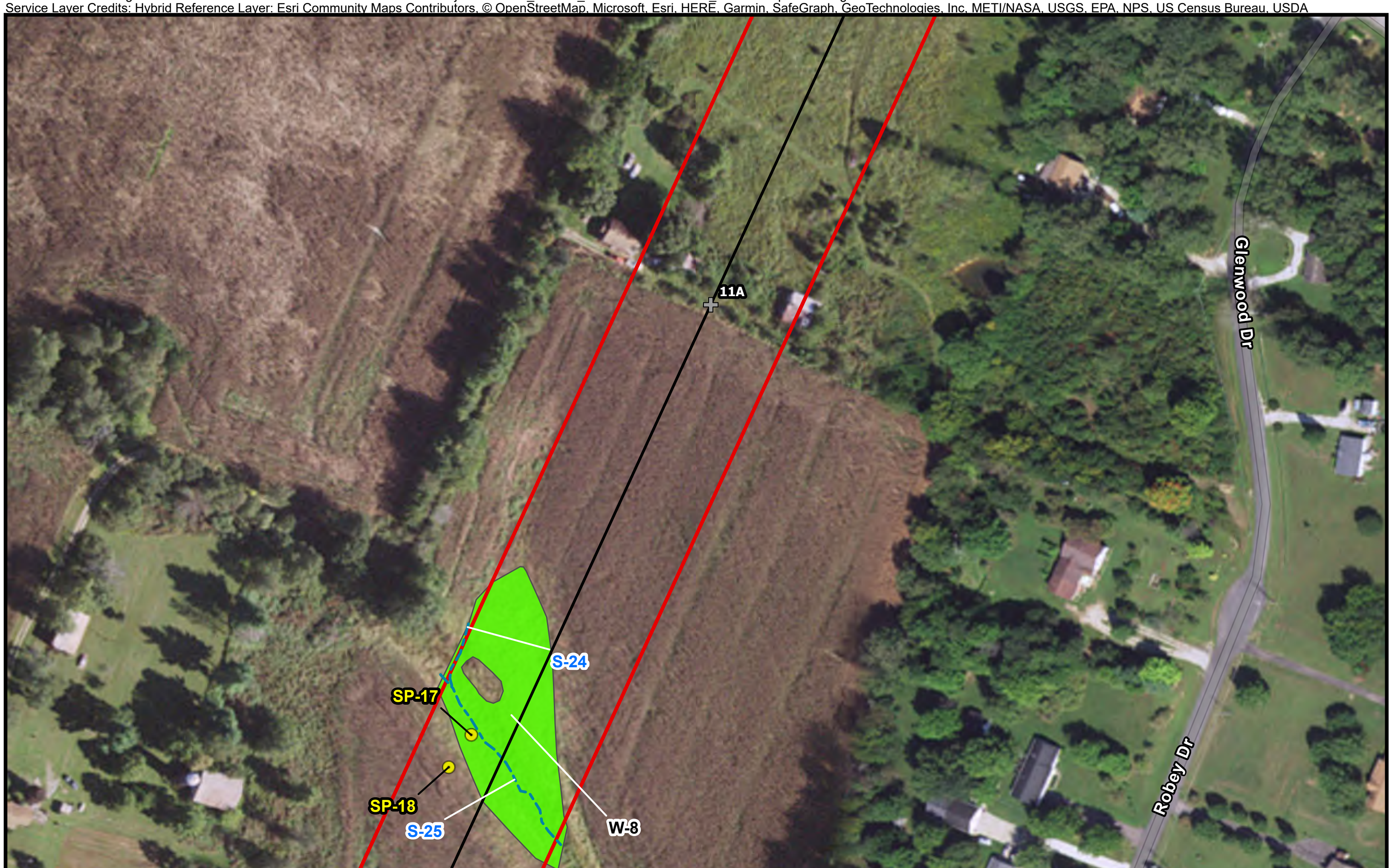

Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

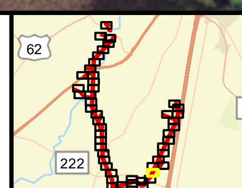

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Source: Esri and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH
0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

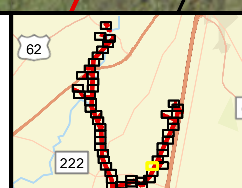

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Figure 5
Wetland Delineation Map
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LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

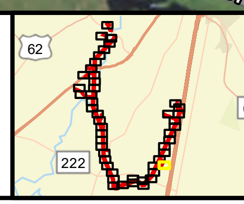

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
Page 38 of 49

Source: Esri and Burns & McDonnell Engineering Company

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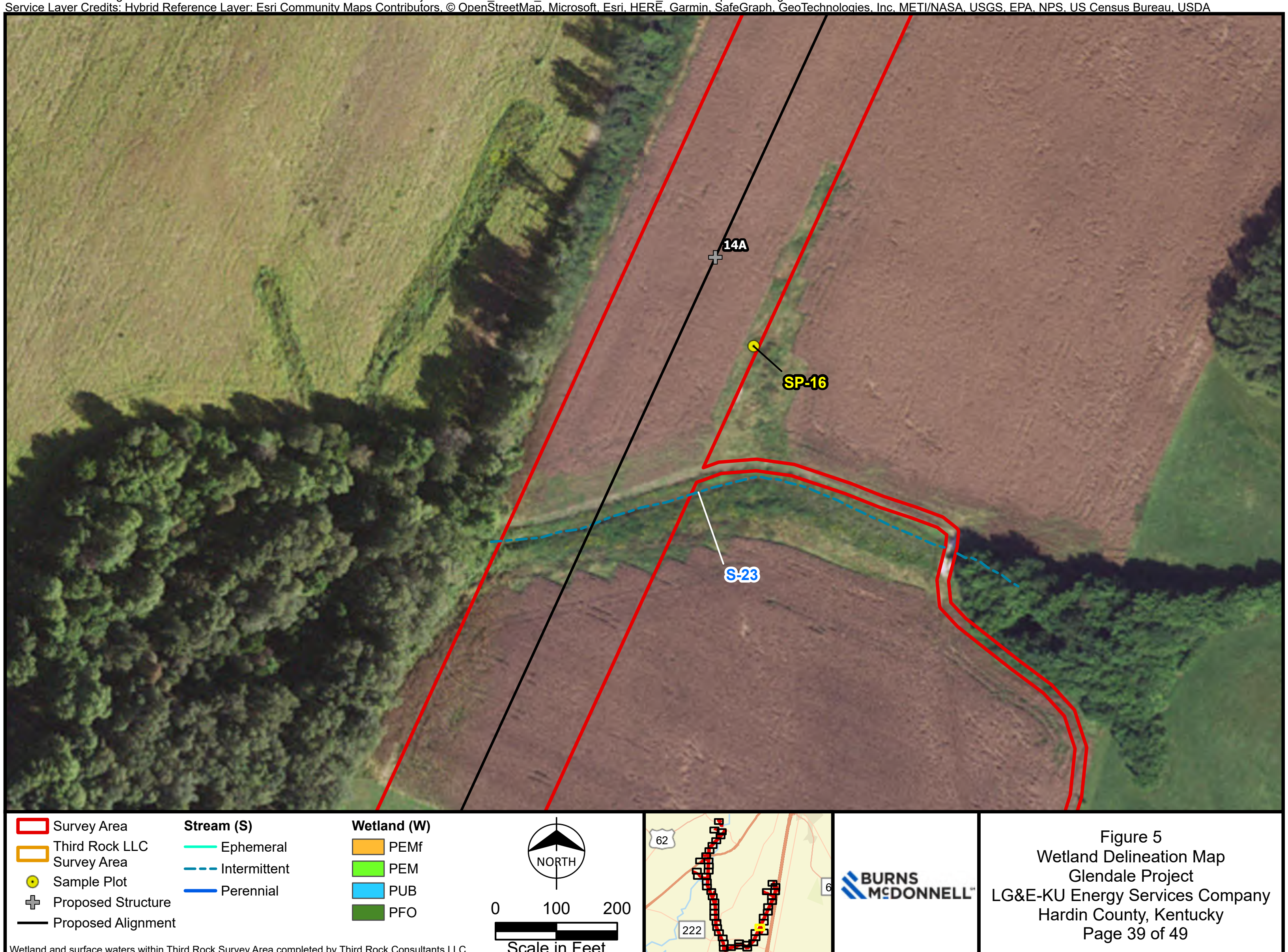

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
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Hardin County, Kentucky
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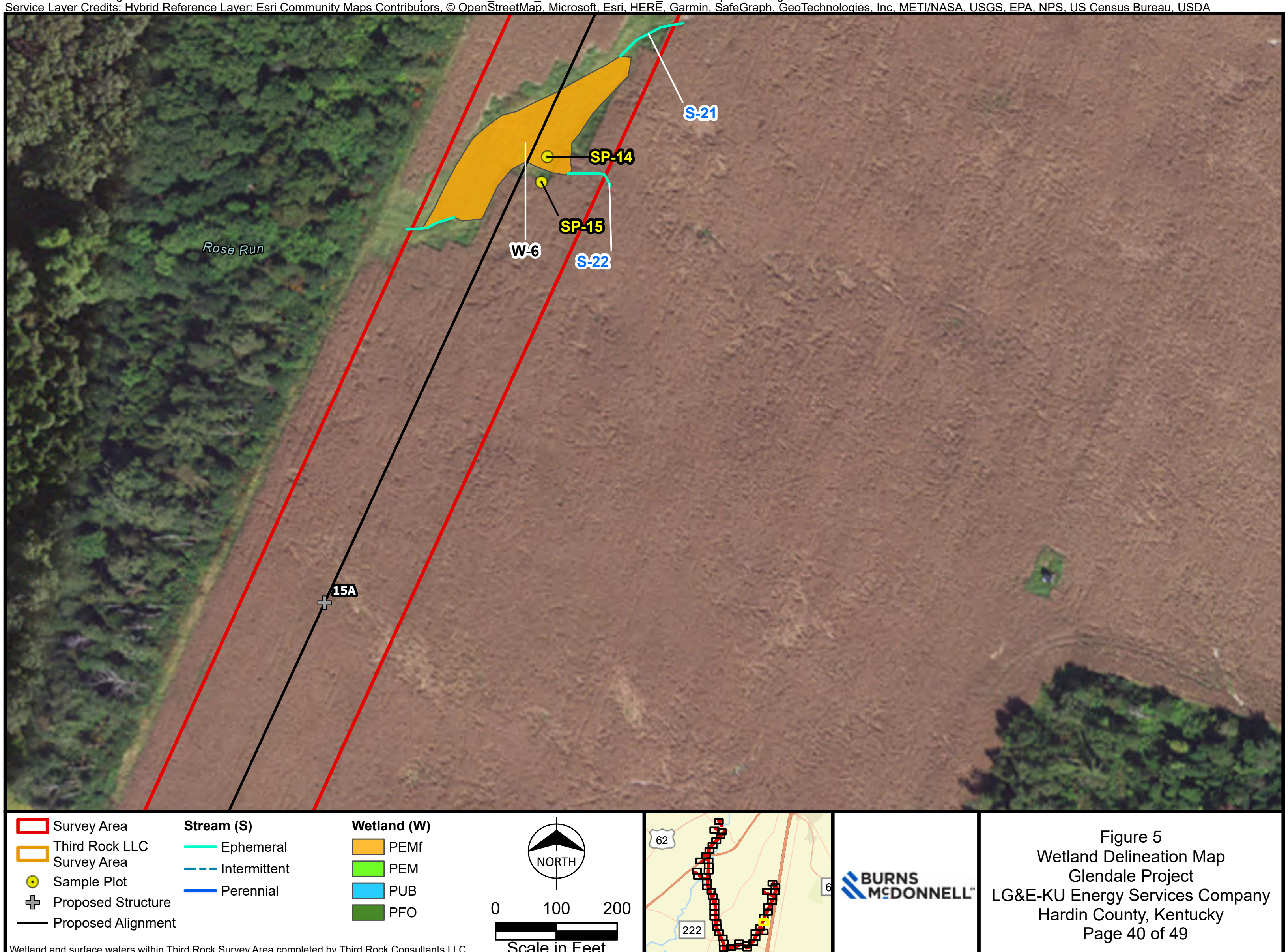

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Figure 5
Wetland Delineation Map
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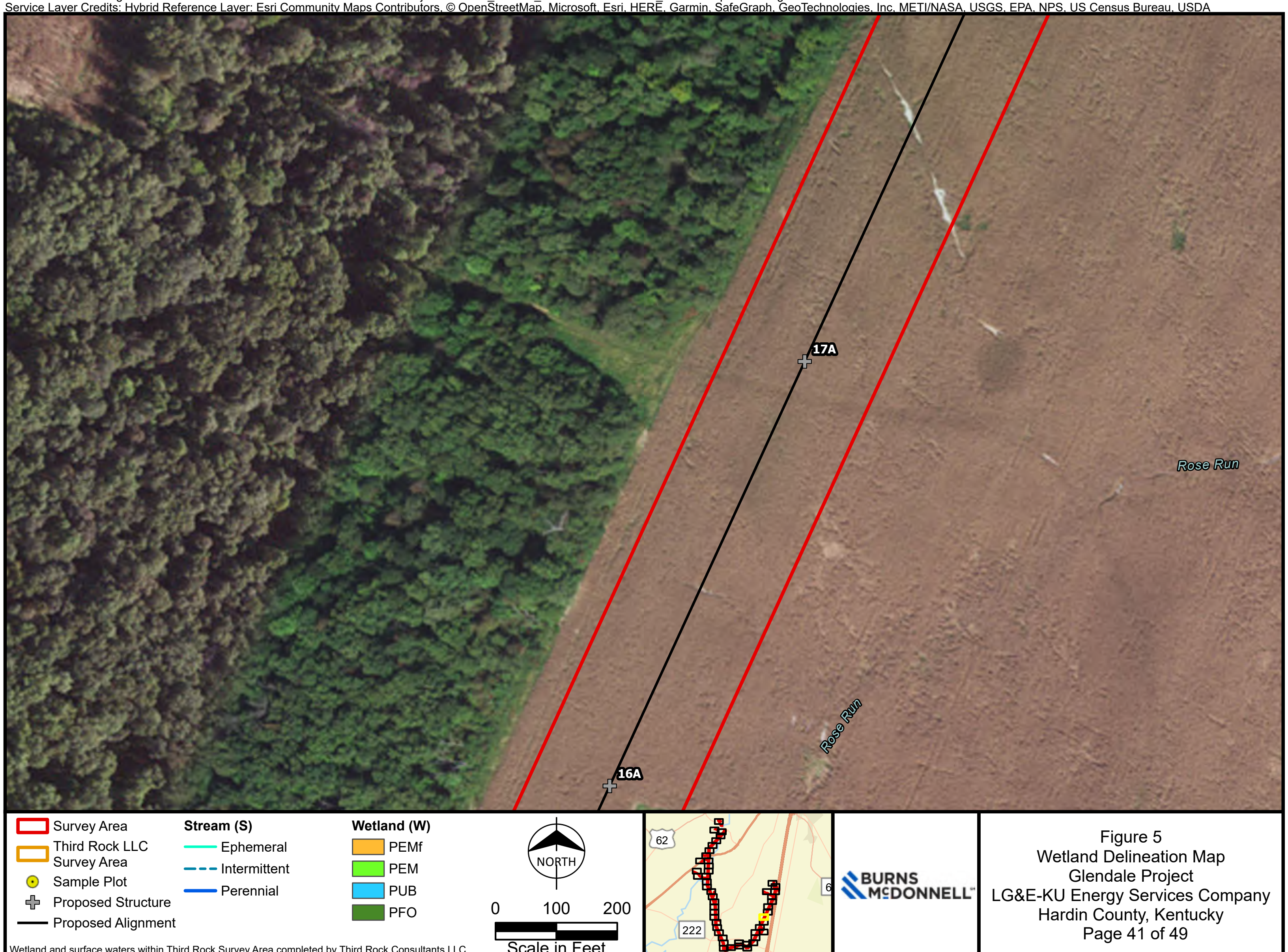

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

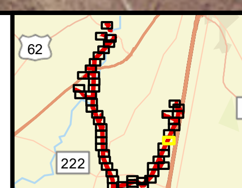

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Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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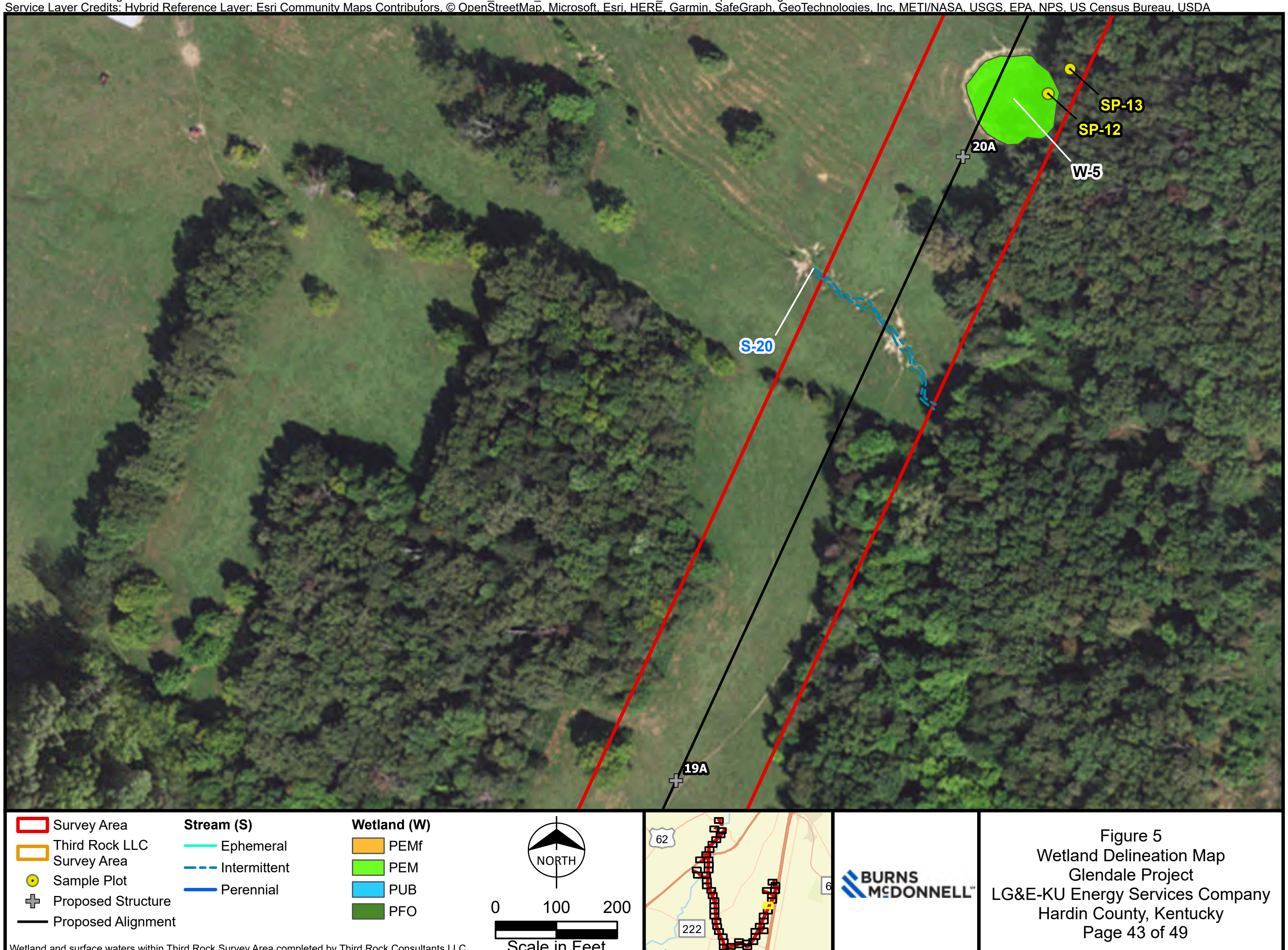

Figure 5
Wetland Delineation Map
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Hardin County, Kentucky
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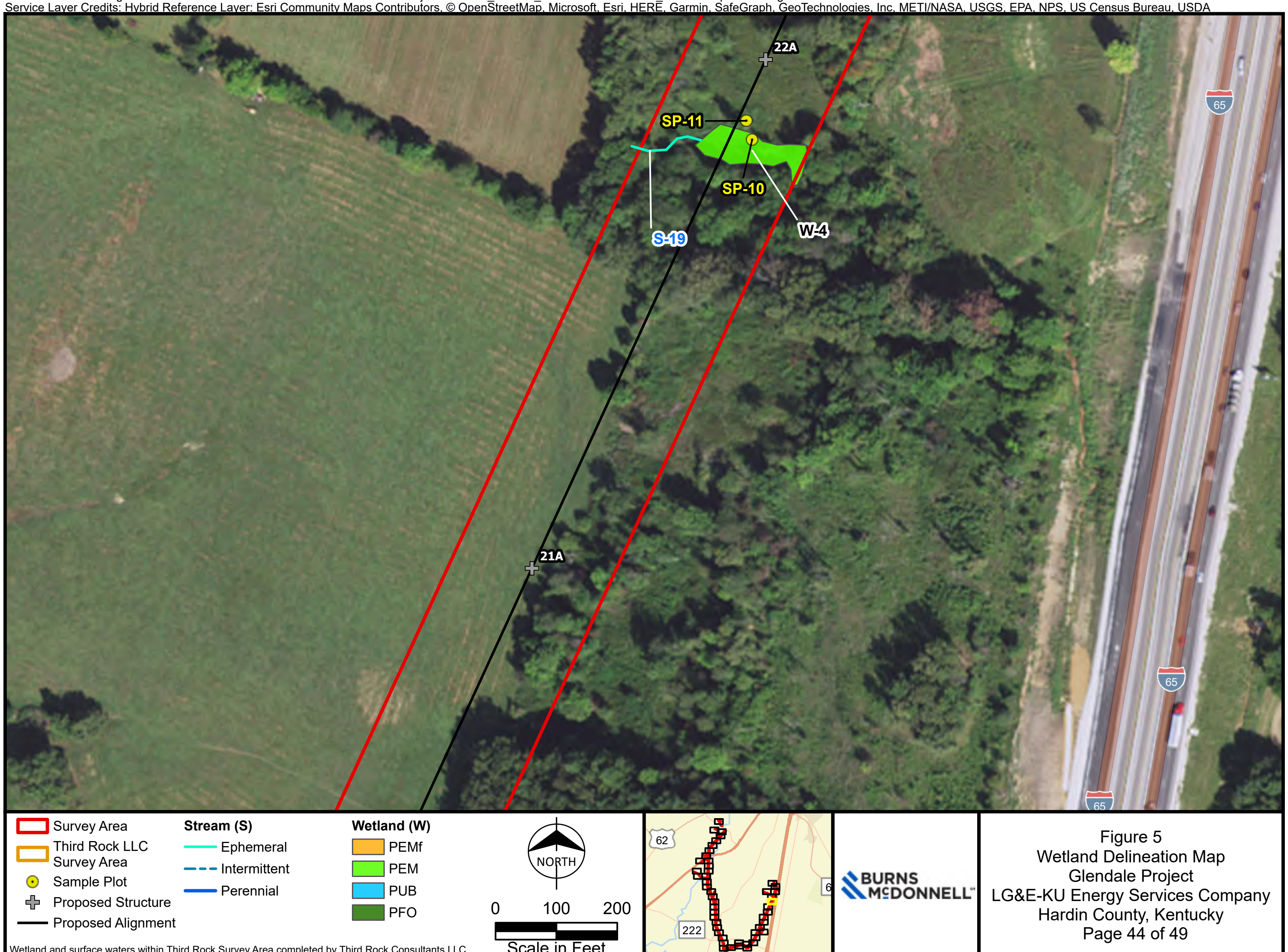

Figure 5
Wetland Delineation Map
Glendale Project
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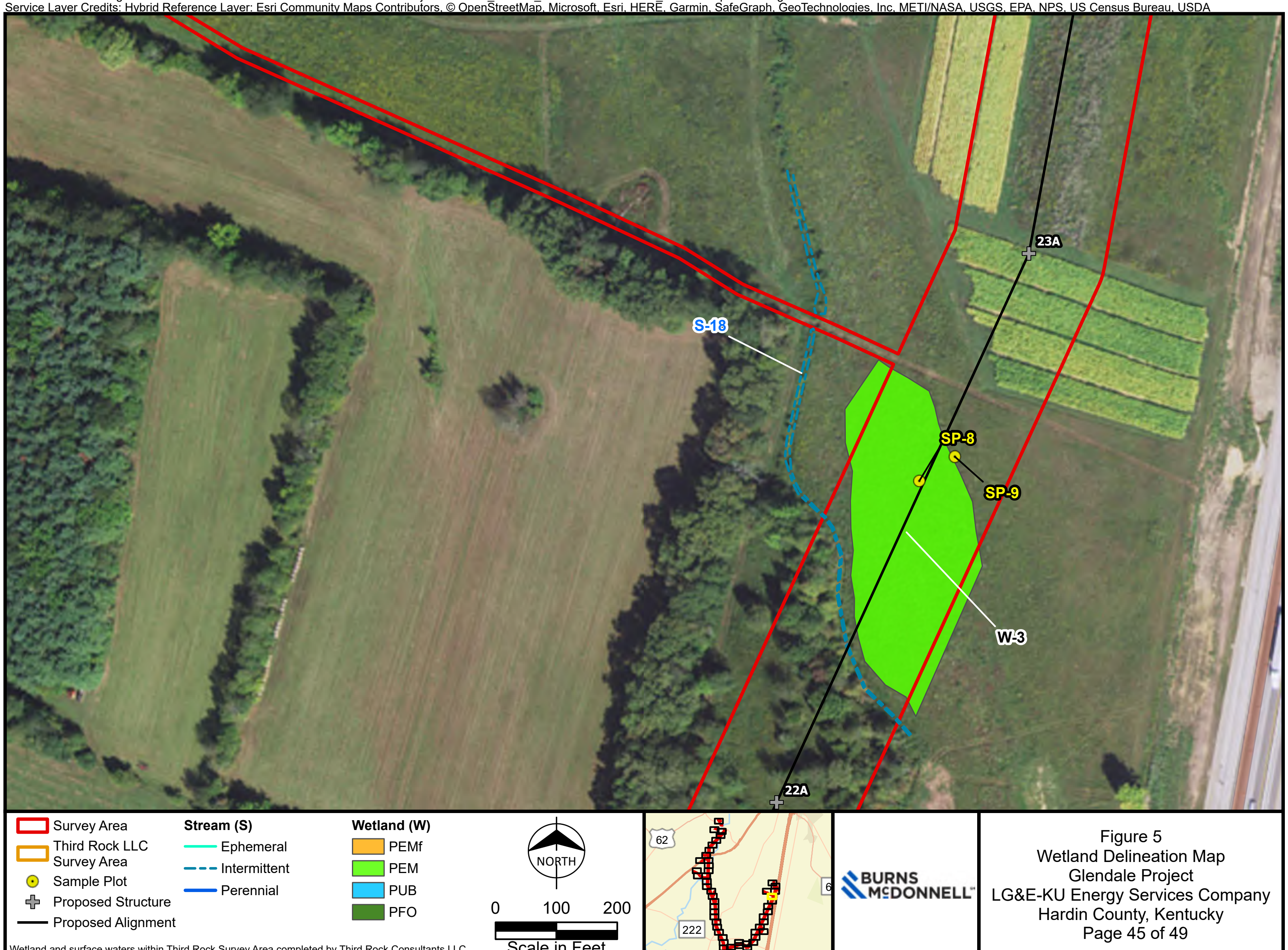

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Survey Area
Third Rock LLC Survey Area
Sample Plot
Proposed Structure
Proposed Alignment

Stream (S)
Ephemeral
Intermittent
Perennial

Wetland (W)
PEMf
PEM
PUB
PFO

NORTH

0 100 200
Scale in Feet

BURNS McDONNELL

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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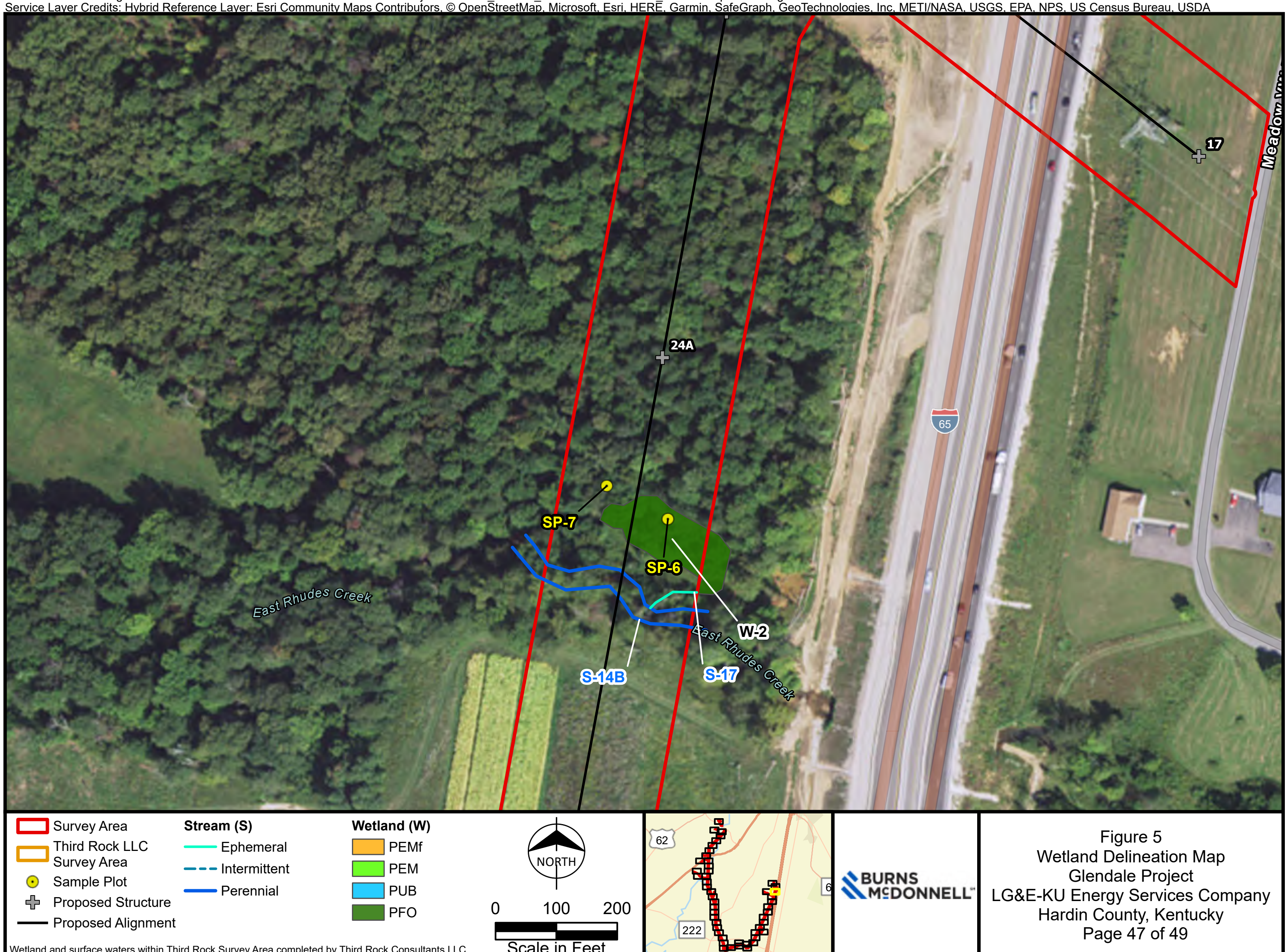

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

Figure 5
Wetland Delineation Map
Glendale Project
LG&E-KU Energy Services Company
Hardin County, Kentucky
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Source: Esri and Burns & McDonnell Engineering Company

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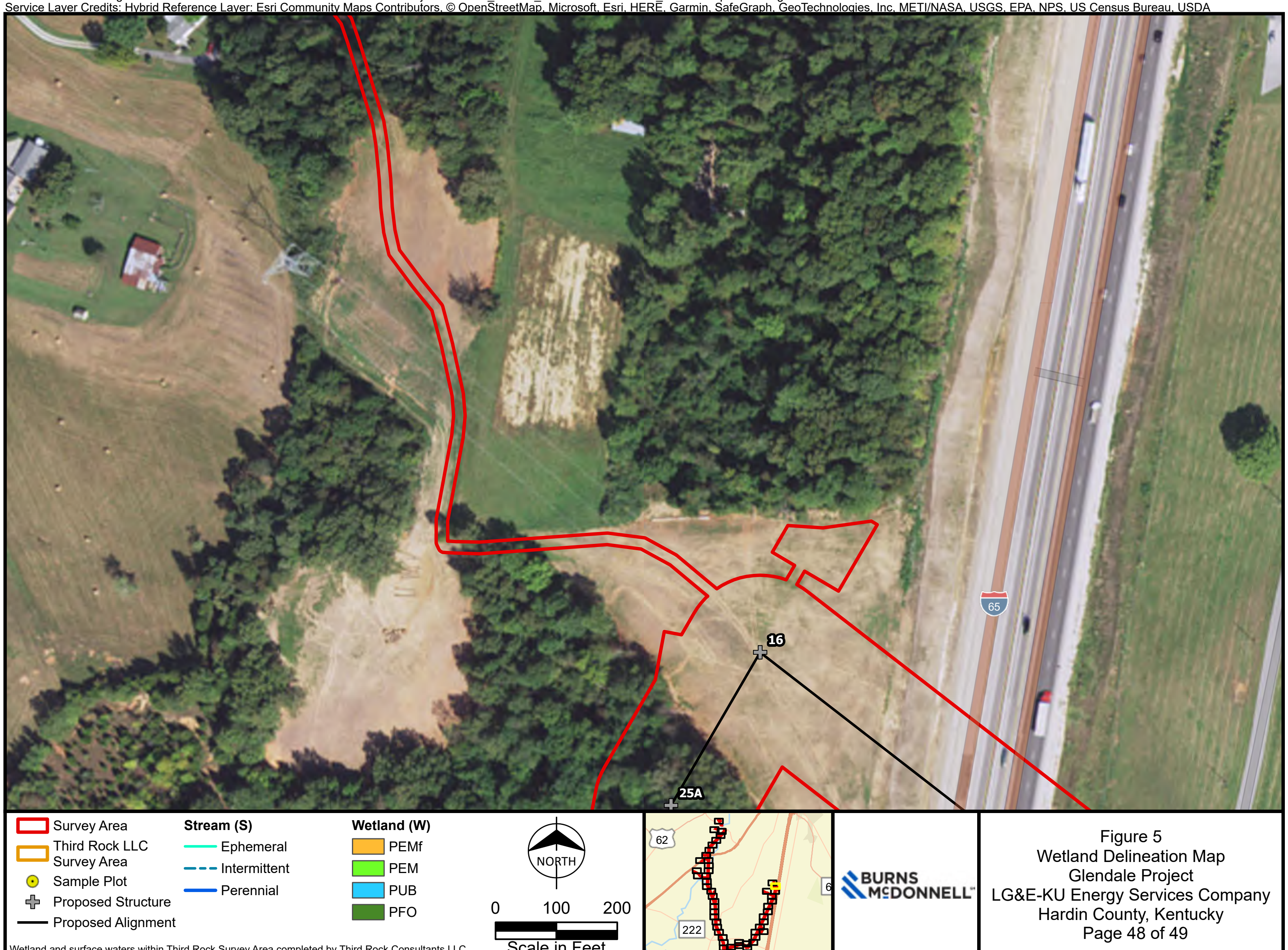

Wetland and surface waters within Third Rock Survey Area completed by Third Rock Consultants LLC

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Figure 5
Wetland Delineation Map
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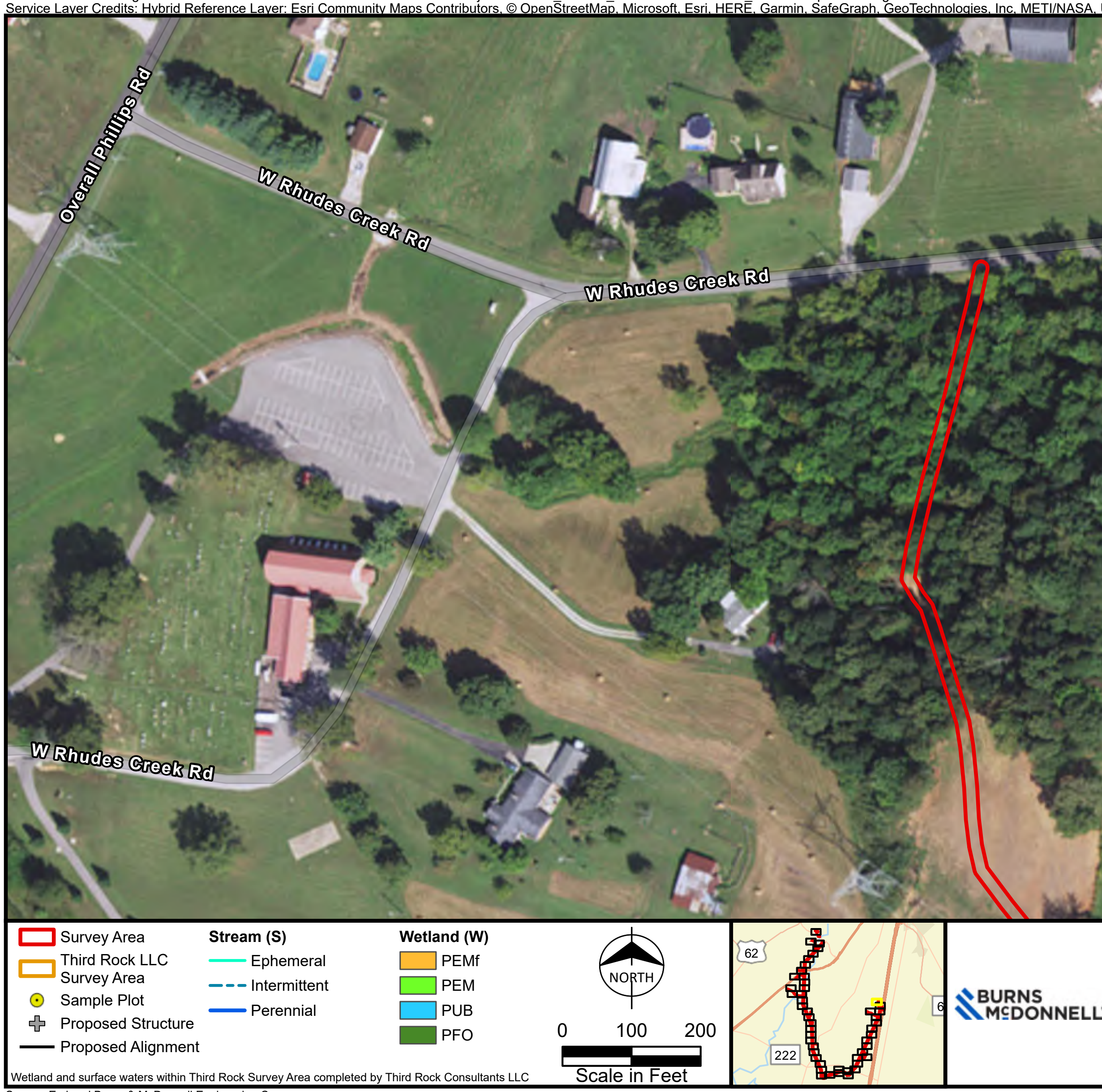

Figure 5
Wetland Delineation Map
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Source: Esri and Burns & McDonnell Engineering Company

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APPENDIX B – WETLAND DETERMINATION DATA FORMS & ANTECEDENT PRECIPITATION TOOL

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-08

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-1

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 10

Subregion (LRR or MLRA): N 122 Lat: 37.6453248 Long: -85.9096418 Datum: WGS 84

Soil Map Unit Name: Crider silt loam, 6 to 12 percent slopes NWI classification: PUBH

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	___	✔
Hydric Soil Present?	___	✔
Wetland Hydrology Present?	✔	___

Is the Sampled Area within a Wetland? Yes ___ No ✔

Remarks:

Sample Plot (SP)-1 is a test pit within a PUBH NWI feature. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ✔ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?	✔	___	6
Water Table Present?	___	✔	
Saturation Present? (includes capillary fringe)	___	✔	

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

One primary and one secondary indicator confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-1

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Poa pratensis*	70	✔	FACU
2. *Rosa multiflora*	15		FACU
3. *Rumex crispus*	2		FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	87%		

50% of total cover: 43.5 20% of total cover: 17.4

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ____ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit.

SOIL

Sampling Point: SP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 20	7.5YR 5/6	100					Clay Loam	
-								
-								
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-2

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 0

Subregion (LRR or MLRA): N 122 Lat: 37.6060007 Long: -85.9028756 Datum: WGS 84

Soil Map Unit Name: Melvin silt loam NWI classification: R4SBC

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		✔
Hydric Soil Present?		✔
Wetland Hydrology Present?	✔	

Is the Sampled Area within a Wetland? Yes ___ No ✔

Remarks:

SP-2 is a test pit adjacent to a perennial stream with wetland hydrology present and located within a R4SBC NWI feature. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		1
Saturation Present? (includes capillary fringe)	✔		0

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Two primary indicators confirmed wetland hydrology. The water table was likely higher due to flooded conditions from recent rainfall.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-2

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Panicum capillare*	40	✔	FAC
2. *Poa pratensis*	30	✔	FACU
3. *Rumex crispus*	5		FAC
4. *Andropogon virginicus*	1		FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	76% = Total Cover		
50% of total cover: 38.0	20% of total cover: 15.2		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit.

SOIL

Sampling Point: SP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 12	2.5Y 5/3	97	7.5YR 5/8	1	C	M	Clay Loam	
0 - 12	10YR 2/2	2					Clay Loam	
12 - 20	2.5Y 6/3	93	7.5YR 4/6	5	C	M	Clay Loam	
12 - 20	10YR 2/1	2					Clay Loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-3

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR or MLRA): N 122 Lat: 37.6174093 Long: -85.9052026 Datum: WGS 84

Soil Map Unit Name: Bedford silt loam, 0 to 2 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No ___	**Is the Sampled Area within a Wetland?**	Yes ✔ No ___
Hydric Soil Present?	Yes ✔	No ___		
Wetland Hydrology Present?	Yes ✔	No ___		

Remarks:

Wetland (W)-1 is a farmed wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✔ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ✔ Saturation Visible on Aerial Imagery (C9)
- ✔ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ✔	No ___	Depth (inches): 4
Water Table Present?	Yes ✔	No ___	Depth (inches): 0
Saturation Present? (includes capillary fringe)	Yes ✔	No ___	Depth (inches): 0

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Three primary and three secondary indicators confirmed wetland hydrology. The water table was likely higher due to flooded conditions from recent rain.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-3

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
50% of total cover:		20% of total cover:	
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
		= Total Cover	
50% of total cover:		20% of total cover:	
Herb Stratum (Plot size: 5 ft r)			
1. *Portulaca umbraticola*	10	✔	FAC
2. *Panicum capillare*	5	✔	FAC
3. *Poa pratensis*	5	✔	FACU
4. *Sonchus oleraceus*	2		UPL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	22%	= Total Cover	
50% of total cover: 11.0		20% of total cover: 4.4	
Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
50% of total cover:		20% of total cover:	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ______

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation. Sample plot location had standing water present with minimal vegetation growing. Vegetation displayed stressed growth.

SOIL

Sampling Point: SP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	2.5Y 5/2	100					Clay Loam	
4 - 16	2.5Y 5/2	98	10YR 6/6	2	C	M	Clay Loam	
-								
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ✔ No ______

Remarks:

Depleted Matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-4

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 0

Subregion (LRR or MLRA): N 122 Lat: 37.61739 Long: -85.9051949 Datum: WGS 84

Soil Map Unit Name: Pembroke silt loam, 2 to 6 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		✔
Hydric Soil Present?		✔
Wetland Hydrology Present?	✔	

Is the Sampled Area within a Wetland? Yes ___ No ✔

Remarks:

SP-4 is located adjacent to W-1. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		6
Saturation Present? (includes capillary fringe)	✔		2

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Two primary indicators confirmed wetland hydrology. The water table was likely higher due to flooded conditions from recent rainfall.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-4

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

50% of total cover: ________ 20% of total cover: ________

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		

50% of total cover: ________ 20% of total cover: ________

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Lamium amplexicaule*	80	✔	UPL
2. *Lepidium campestre*	5		FACU
3. *Allium schoenoprasum*	2		FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	87% = Total Cover		

50% of total cover: 43.5 20% of total cover: 17.4

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

50% of total cover: ________ 20% of total cover: ________

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	______	x 1 = ______
FACW species	______	x 2 = ______
FAC species	______	x 3 = ______
FACU species	______	x 4 = ______
UPL species	______	x 5 = ______
Column Totals:	______ (A)	______ (B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ______ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit.

SOIL

Sampling Point: SP-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 12	2.5Y 5/3	100					Clay Loam	
12 - 20	2.5Y 5/3	30					Clay Loam	
12 - 20	2.5Y 6/6	70					Clay Loam	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? **Yes** ______ **No** ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-5

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 2

Subregion (LRR or MLRA): N 122 Lat: 37.6257315 Long: -85.9074639 Datum: WGS 84

Soil Map Unit Name: Lindside silt loam, 0 to 2 percent slopes, frequently flooded NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	✔	
Hydric Soil Present?		✔
Wetland Hydrology Present?		✔
Is the Sampled Area within a Wetland?		✔

Remarks:

SP-5 is a test pit adjacent to a perennial stream. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ___ No ✔ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

One secondary indicator of wetland hydrology was present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-5

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Platanus occidentalis*	30	✔	FACW
2. *Prunus serotina*	20	✔	FACU
3. *Celtis occidentalis*	10		FACU
4. *Fraxinus pennsylvanica*	10		FACW
5.			
6.			
7.			
	70%	= Total Cover	
50% of total cover: 35.0	20% of total cover: 14.0		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
		= Total Cover	
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Arundinaria gigantea*	50	✔	FACW
2. *Poa pratensis*	5		FACU
3. *Alliaria petiolata*	2		FACU
4. *Euonymus fortunei*	2		
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	59%	= Total Cover	
50% of total cover: 29.5	20% of total cover: 11.8		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation.

SOIL

Sampling Point: SP-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10YR 3/2	100					Sandy Loam	
2 - 20	10YR 4/4	100					Sand	
-								
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: ______
Depth (inches): ______

Hydric Soil Present? Yes ______ No ✔

Remarks:
No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-6

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR or MLRA): N 122 Lat: 37.6280346 Long: -85.8631266 Datum: WGS 84

Soil Map Unit Name: Melvin silt loam NWI classification: PFO1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No ___
Hydric Soil Present?	Yes ✔	No ___
Wetland Hydrology Present?	Yes ✔	No ___

Is the Sampled Area within a Wetland? Yes ✔ No ___

Remarks:

Wetland (W)-2 is a palustrine forested (PFO) wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ✔ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ✔ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✔ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ✔	Depth (inches): ___
Water Table Present?	Yes ___	No ✔	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No ✔	Depth (inches): ___

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Four primary indicators and three secondary indicators confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-6

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus pennsylvanica*	15	✔	FACW
2. *Ulmus americana*	15	✔	FACW
3. *Betula nigra*	10	✔	FACW
4.			
5.			
6.			
7.			
	40% = Total Cover		
50% of total cover: 20.0	20% of total cover: 8.0		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ulmus americana*	15	✔	FACW
2. *Sambucus nigra*	5	✔	FAC
3. *Rosa multiflora*	2		FACU
4.			
5.			
6.			
7.			
8.			
9.			
	22% = Total Cover		
50% of total cover: 11.0	20% of total cover: 4.4		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation.

SOIL

Sampling Point: SP-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10YR 3/2	75	5YR 4/6	5	C	M	Clay Loam	
0 - 4	10YR 6/8	20					Sand	
4 - 20	10YR 6/8	70	5YR 4/6	10	C	M	Sandy Clay Loa	
4 - 20	10YR 3/2	20					Clay Loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✔ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✔ No ______

Remarks:

Redox Dark Surface (F6) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-09

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-7

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR or MLRA): N 122 Lat: 37.6281534 Long: -85.8633960 Datum: WGS 84

Soil Map Unit Name: Melvin silt loam NWI classification: PFO1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✔	**Is the Sampled Area within a Wetland?** Yes ___ No ✔
Hydric Soil Present?	Yes ___	No ✔	
Wetland Hydrology Present?	Yes ___	No ✔	

Remarks:

SP-7 is located adjacent to W-2. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ___ No ✔ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

One secondary indicator of wetland hydrology was present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-7

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Prunus serotina*	40	✔	FACU
2. *Acer saccharinum*	10		FACW
3. *Celtis occidentalis*	5		FACU
4.			
5.			
6.			
7.			
	55% = Total Cover		
50% of total cover: 27.5	20% of total cover: 11.0		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Celtis occidentalis*	10	✔	FACU
2. *Fraxinus pennsylvanica*	2		FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	12% = Total Cover		
50% of total cover: 6.0	20% of total cover: 2.4		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Lonicera maackii*	5	✔	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	5% = Total Cover		
50% of total cover: 2.5	20% of total cover: 1.0		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit.

SOIL

Sampling Point: SP-7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10YR 3/2	80					Silty Clay Loan	
0 - 2	5YR 5/8	20					Silty Clay Loan	
2 - 20	7.5YR 5/8	100					Sandy Clay Lo:	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-8

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR or MLRA): N 122 Lat: 37.6253245 Long: -85.8642004 Datum: WGS 84

Soil Map Unit Name: Melvin silt loam NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	✔	
Hydric Soil Present?	✔	
Wetland Hydrology Present?	✔	

Is the Sampled Area within a Wetland? Yes ✔ No ___

Remarks:

Wetland (W)-3 is a palustrine emergent (PEM) wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✔ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		8
Saturation Present? (includes capillary fringe)	✔		0

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Two primary indicators and three secondary indicators confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-8

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Dichanthelium clandestinum*	55	✔	FAC
2. *Juncus effusus*	30	✔	FACW
3. *Carex sp.*	10		UNK
4. *Rumex crispus*	5		FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100% = Total Cover		
50% of total cover: 50.0	20% of total cover: 20.0		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ___

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation. Carex sp. could not be identified to the species level during the site investigation. Vegetation was disturbed from mowing. Due to the presence of hydric soil, wetland hydrology, and other hydrophytic vegetation, it is assumed to be FACW. The wetland indicator status of this species does not change outcome for hydrophytic vegetation.

SOIL

Sampling Point: SP-8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 3	2.5Y 4/2	100					Silty Clay Loam	
3 - 10	2.5Y 5/2	88	5YR 4/6	2	C	M	Sandy Clay Loa	
3 - 10	10YR 7/8	10					Sandy Clay Loa	
10 - 20	2.5Y 6/4	70	5YR 5/6	30	C	M	Sandy Clay	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ✔ No ______

Remarks:

Depleted Matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-9
Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 3
Subregion (LRR or MLRA): N 122 Lat: 37.6254211 Long: -85.8640463 Datum: WGS 84
Soil Map Unit Name: Melvin silt loam NWI classification: No
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)
Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	✔	
Hydric Soil Present?		✔
Wetland Hydrology Present?		✔

Is the Sampled Area within a Wetland? Yes ___ No ✔

Remarks:

SP-9 is located adjacent to W-3. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?		✔	
Saturation Present? (includes capillary fringe)		✔	

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators of wetland hydrology were present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-9

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Dichanthelium clandestinum*	60	✔	FAC
2. *Poa pratensis*	15		FACU
3. *Rosa multiflora*	10		FACU
4. *Allium schoenoprasum*	5		FACU
5. *Solidago canadensis*	2		FACU
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	92%		

50% of total cover: 46.0 20% of total cover: 18.4

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation. Vegetation was disturbed from mowing.

SOIL

Sampling Point: SP-9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10YR 4/4	100					Silty Clay Loan	
4 - 10	10YR 5/4	100					Silty Clay Loan	
10 - 20	2.5Y 5/4	98	7.5YR 5/6	2	C	M	Silty Clay Loan	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ______ **No** ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-10

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR or MLRA): N 122 Lat: 37.6239090 Long: -85.8649320 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 6 to 12 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	✔	
Hydric Soil Present?	✔	
Wetland Hydrology Present?	✔	
Is the Sampled Area within a Wetland?		✔

Remarks:

Wetland (W)-4 is a palustrine emergent (PEM) wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ✔ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ✔ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		8
Saturation Present? (includes capillary fringe)	✔		2

Wetland Hydrology Present? Yes ✔ No___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Four primary indicators and two secondary indicators confirmed wetland hydrology. The water table was likely higher due to flooded conditions from recent rainfall.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-10

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer saccharinum*	15	✔	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	15% = Total Cover		
50% of total cover: 7.5	20% of total cover: 3.0		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. Juncus dudleyi	30	✔	FACW
2. *Carex sp.*	25	✔	FACW
3. *Dichanthelium clandestinum*	15		FAC
4. *Juncus effusus*	15		FACW
5. *Ludwigia alternifolia*	10		FACW
6. *Panicum capillare*	5		FAC
7.			
8.			
9.			
10.			
11.			
	100% = Total Cover		
50% of total cover: 50.0	20% of total cover: 20.0		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

✔ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

The Rapid Test for Hydrophytic Vegetation confirmed hydrophytic vegetation. Carex sp. could not be identified to the species level during the site investigation. Due to the presence of hydric soil, wetland hydrology, and other hydrophytic vegetation, it is assumed to be FACW.

SOIL

Sampling Point: SP-10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	2.5Y 6/2	95	5YR 4/6	5	C	PL / M	Silty Clay Loan	
4 - 20	2.5Y 6/2	80	5YR 4/6	20	C	PL / M		
-								
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✔ No ______

Remarks:

Depleted Matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-11

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 5

Subregion (LRR or MLRA): N 122 Lat: 37.6239715 Long: -85.8649404 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 2 to 6 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No	
Hydrophytic Vegetation Present?	✔		Is the Sampled Area within a Wetland? Yes ___ No ✔
Hydric Soil Present?		✔	
Wetland Hydrology Present?		✔	

Remarks:

SP-11 is located adjacent to W-4. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ___ No ✔ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators of wetland hydrology were present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-11

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer saccharinum*	15	✔	FACW
2. *Prunus serotina*	2		FACU
3.			
4.			
5.			
6.			
7.			
= Total Cover	17%		
50% of total cover: 8.5	20% of total cover: 3.4		

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
= Total Cover			
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Dichanthelium clandestinum*	50	✔	FAC
2. *Poa pratensis*	20	✔	FACU
3. *Panicum capillare*	10		FAC
4. *Geum canadense*	5		FACU
5. *Juncus effusus*	5		FACW
6. *Rumex crispus*	5		FAC
7.			
8.			
9.			
10.			
11.			
= Total Cover	95%		
50% of total cover: 47.5	20% of total cover: 19.0		

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ___

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation.

SOIL Sampling Point: SP-11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10YR 3/2	90					Silty Clay Loan	
0 - 4	10YR 6/6	10					Silty Clay Loan	
4 - 20	2.5Y 5/4	100					Silty Clay Loan	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-12

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Closed Depression Local relief (concave, convex, none): Concave Slope (%): 6

Subregion (LRR or MLRA): N 122 Lat: 37.6212417 Long: -85.8663058 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 2 to 6 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No	
Hydrophytic Vegetation Present?	✔		**Is the Sampled Area within a Wetland?** Yes ✔ No ___
Hydric Soil Present?	✔		
Wetland Hydrology Present?	✔		

Remarks:

Wetland (W)-5 is a palustrine emergent (PEM) wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		10
Saturation Present? (includes capillary fringe)	✔		4

Wetland Hydrology Present? Yes ✔ No___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Two primary indicators and two secondary indicators confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-12

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Sapling/Shrub Stratum (Plot size: 15 ft r)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)			
1. *Ranunculus repens*	30	✔	FAC
2. *Juncus effusus*	25	✔	FACW
3. *Poa pratensis*	10		FACU
4. *Trifolium campestre*	10		UPL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	75% = Total Cover		
50% of total cover: 37.5	20% of total cover: 15.0		

Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation.

SOIL

Sampling Point: SP-12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 3	2.5Y 4/2	70	5YR 4/6	5	C	M	Sandy Clay Loa	
0 - 3	10YR 4/3	25					Sandy Clay Loa	
3 - 8	2.5Y 5/2	80	5YR 4/6	20	C	M	Sandy Clay Loa	
8 - 16	2.5Y 5/2	60	5YR 4/6	40	C	M	Sandy Clay Loa	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
✔ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: Bedrock
Depth (inches): 16

Hydric Soil Present? Yes ✔ No ___

Remarks:
Depleted Matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-13

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 8

Subregion (LRR or MLRA): N 122 Lat: 37.6213373 Long: -85.8662083 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 2 to 6 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	___	✔
Hydric Soil Present?	___	✔
Wetland Hydrology Present?	___	✔
Is the Sampled Area within a Wetland?	___	✔

Remarks:

SP-13 is located adjacent to W-5. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches):
Surface Water Present?	___	✔	___
Water Table Present?	___	✔	___
Saturation Present? (includes capillary fringe)	___	✔	___

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators of wetland hydrology were present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: SP-13

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Juniperus virginiana*	20	✔	FACU
2. *Quercus falcata*	5	✔	FACU
3.			
4.			
5.			
6.			
7.			
	25%	= Total Cover	
50% of total cover: 12.5	20% of total cover: 5.0		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
		= Total Cover	
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ranunculus repens*	35	✔	FAC
2. *Trifolium campestre*	30	✔	UPL
3. *Poa pratensis*	20	✔	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	85%	= Total Cover	
50% of total cover: 42.5	20% of total cover: 17.0		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 20 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ______ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit.

SOIL

Sampling Point: SP-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 3	10YR 3/2	90					Silty Clay Loam	
0 - 3	10YR 5/6	10					Silty Clay Loam	
3 - 8	10YR 5/4	100					Silty Clay Loam	
8 - 20	7.5YR 5/8	100					Clay Loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-14
Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 20
Subregion (LRR or MLRA): N 122 Lat: 37.6124020 Long: -85.8716079 Datum: WGS 84
Soil Map Unit Name: Sonora silt loam, 6 to 12 percent slopes NWI classification: No
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)
Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔
Are Vegetation ✔, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No ___
Hydric Soil Present?	Yes ✔	No ___
Wetland Hydrology Present?	Yes ✔	No ___

Is the Sampled Area within a Wetland? Yes ✔ No ___

Remarks:

Wetland (W)-6 is a farmed wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ✔ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ✔	Depth (inches): ___
Water Table Present?	Yes ✔	No ___	Depth (inches): 14
Saturation Present? (includes capillary fringe)	Yes ✔	No ___	Depth (inches): 10

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

One primary and two secondary indicators confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-14

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover			
50% of total cover: 20% of total cover:			

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
= Total Cover			
50% of total cover: 20% of total cover:			

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Panicum capillare*	25	✔	FAC
2. *Poa pratensis*	15	✔	FACU
3. *Rumex crispus*	5		FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	45%		
50% of total cover: 22.5 20% of total cover: 9.0			

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			
50% of total cover: 20% of total cover:			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	15	x 4 =	60
UPL species	0	x 5 =	0
Column Totals:	45 (A)		150 (B)

Prevalence Index = B/A = 3.33

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Vegetation was disturbed from farming, dead soybeans from the previous year present. Due to the position in the landscape and the presence of hydric soil and wetland hydrology, we assume the vegetation would be hydrophytic if not disturbed.

SOIL

Sampling Point: SP-14

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	2.5Y 5/3	99	7.5YR 5/6	1	C	M	Sandy Clay Loa	
4 - 10	2.5Y 5/2	90	5YR 4/6	10	C	M	Clay Loam	
10 - 20	2.5Y 5/2	85	10YR 6/8	10	C	M	Clay Loam	
10 - 20			5YR 4/6	5	C	M		
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ✔ No ______

Remarks:

Depleted matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10
Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-15
Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 5
Subregion (LRR or MLRA): N 122 Lat: 37.6123179 Long: -85.8716343 Datum: WGS 84
Soil Map Unit Name: Sonora silt loam, 6 to 12 percent slopes NWI classification: No
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)
Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		✔
Hydric Soil Present?		✔
Wetland Hydrology Present?		✔

Is the Sampled Area within a Wetland? Yes ___ No ✔

Remarks:

SP-15 is located adjacent to W-6. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?		✔	
Saturation Present? (includes capillary fringe)		✔	

Wetland Hydrology Present? **Yes** ___ **No** ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators of wetland hydrology were present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-15

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Poa pratensis*	80	✔	FACU
2. *Rumex crispus*	5		FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	85% = Total Cover		
50% of total cover: 42.5	20% of total cover: 17.0		

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit. Vegetation was disturbed from farming, dead soybeans from the previous year were present.

SOIL

Sampling Point: SP-15

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 20	2.5Y 4/3	100					Silty Clay Loan	
-								
-								
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 136, 122)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ______ **No** ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-16

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 10

Subregion (LRR or MLRA): N 122 Lat: 37.6088454 Long: -85.8734014 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 2 to 6 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	___	✔
Hydric Soil Present?	___	✔
Wetland Hydrology Present?	___	✔
Is the Sampled Area within a Wetland?	___	✔

Remarks:

SP-16 is a test pit adjacent to standing water. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ___ No ✔ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators of wetland hydrology were present at the time of the site visit.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-16

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
50% of total cover:		20% of total cover:	

Sapling/Shrub Stratum (Plot size: 15 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
		= Total Cover	
50% of total cover:		20% of total cover:	

Herb Stratum (Plot size: 5 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Panicum capillare*	30	✔	FAC
2. *Poa pratensis*	20	✔	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	50%	= Total Cover	
50% of total cover:	25.0	20% of total cover:	10.0

Woody Vine Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
50% of total cover:		20% of total cover:	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit. Vegetation was disturbed due to farming.

SOIL

Sampling Point: SP-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10YR 4/4	100					Silty Clay Loan	
2 - 20	10YR 5/4	90	7.5YR 5/6	5	C	M	Silty Clay Loan	
2 - 20			10YR 7/4	5	D	M		
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-17

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 4

Subregion (LRR or MLRA): N 122 Lat: 37.6019887 Long: -85.8779142 Datum: WGS 84

Soil Map Unit Name: Melvin silt loam NWI classification: R4SBC

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔ No ___	Is the Sampled Area within a Wetland?	Yes ✔ No ___
Hydric Soil Present?	Yes ✔ No ___		
Wetland Hydrology Present?	Yes ✔ No ___		

Remarks:

Wetland (W)-8 is a palustrine emergent (PEM) wetland. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ✔ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ✔ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ✔	Depth (inches): ___	
Water Table Present?	Yes ✔	No ___	Depth (inches): 1	
Saturation Present? (includes capillary fringe)	Yes ✔	No ___	Depth (inches): 0	**Wetland Hydrology Present? Yes ✔ No ___**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Three primary indicators and three secondary indicators confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-17

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Carex sp.*	30	✔	FACW
2. *Panicum virgatum*	25	✔	FAC
3. *Scirpus atrovirens*	20	✔	OBL
4. *Ludwigia alternifolia*	15		FACW
5. *Poa pratensis*	5		FACU
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	95%		

50% of total cover: 47.5 20% of total cover: 19.0

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
= Total Cover			

50% of total cover: ____ 20% of total cover: ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

The Dominance Test confirmed hydrophytic vegetation. Carex sp. could not be identified to the species level. Due to the presence of hydric soil, wetland hydrology, and other hydrophytic vegetation, it is assumed to be FACW.

SOIL

Sampling Point: SP-17

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10YR 6/2	98	10YR 5/8	2	C	PL / M	Silty Clay Loan	
2 - 16	2.5Y 6/1	90	10YR 6/8	10	C	PL / M	Silty Clay Loan	
16 - 20	2.5Y 6/1	50	7.5YR 5/6	10	C	PL / M	Clay Loam	
16 - 20	5Y 2.5/1	40					Silty Clay Loan	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✔ No ______

Remarks:

Depleted Matrix (F3) confirmed hydric soil.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: LGEKU Glendale City/County: Glendale/Hardin Sampling Date: 2022-03-10

Applicant/Owner: LG&E-KU State: Kentucky Sampling Point: SP-18

Investigator(s): Burns & McDonnell (SB & CK) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 5

Subregion (LRR or MLRA): N 122 Lat: 37.6018793 Long: -85.8780115 Datum: WGS 84

Soil Map Unit Name: Sonora silt loam, 6 to 12 percent slopes NWI classification: No

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ✔ (If no, explain in Remarks.)

Are Vegetation ✔, Soil ___, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No ✔

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No	
Hydrophytic Vegetation Present?		✔	**Is the Sampled Area within a Wetland?** Yes ___ No ✔
Hydric Soil Present?		✔	
Wetland Hydrology Present?	✔		

Remarks:

SP-18 is located adjacent to W-8. Flooded conditions were observed at the time of the site visit due to recent rainfall.

According to the Antecedent Precipitation Tool (APT), the area was experiencing wet conditions at the time of the survey.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		✔	
Water Table Present?	✔		14
Saturation Present? (includes capillary fringe)	✔		10

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

One primary indicator confirmed wetland hydrology.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: SP-18

Tree Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

50% of total cover: ____ 20% of total cover: ____

Sapling/Shrub Stratum (Plot size: 15 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		

50% of total cover: ____ 20% of total cover: ____

Herb Stratum (Plot size: 5 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Poa pratensis*	30	✔	FACU
2. *Sonchus oleraceus*	10	✔	UPL
3. *Trifolium campestre*	10	✔	UPL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	50% = Total Cover		

50% of total cover: 25.0 20% of total cover: 10.0

Woody Vine Stratum (Plot size: 30 ft r)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

50% of total cover: ____ 20% of total cover: ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ____ **No** ✔

Remarks: (Include photo numbers here or on a separate sheet.)

No indicators of hydrophytic vegetation were present at the time of the site visit. Vegetation was disturbed from farming. Dead soybeans from the previous year were present.

SOIL

Sampling Point: SP-18

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 5	2.5Y 5/3	100					Silty Clay Loan	
5 - 12	2.5Y 5/3	98	10YR 5/8	2	C	M	Silty Clay Loan	
12 - 20	2.5Y 5/3	95	10YR 5/8	5	C	PL / M	Silty Clay Loan	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

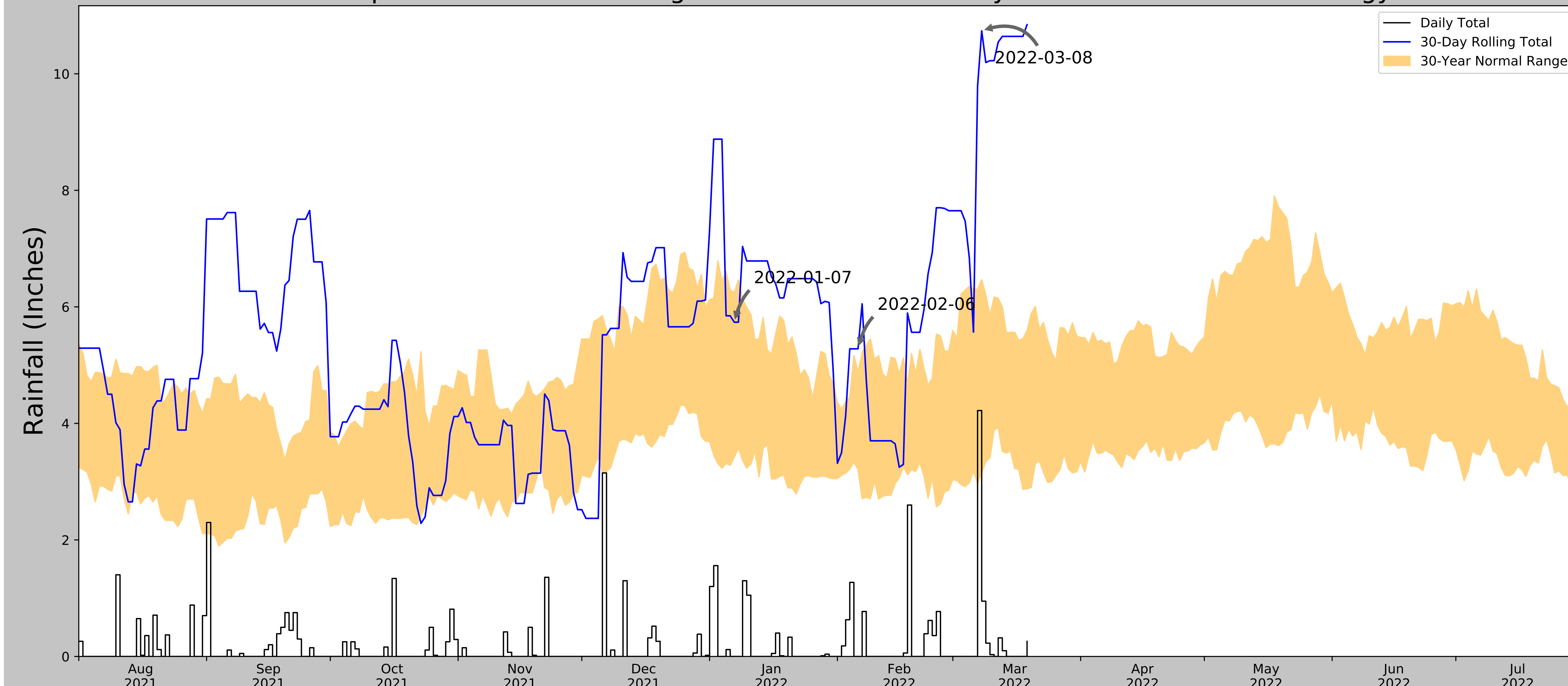
Depth (inches): ______________________

Hydric Soil Present? **Yes** ______ **No** ✔

Remarks:

No indicators of hydric soil were present at the time of the site visit.

Antecedent Precipitation vs Normal Range based on NOAA's Daily Global Historical Climatology Network



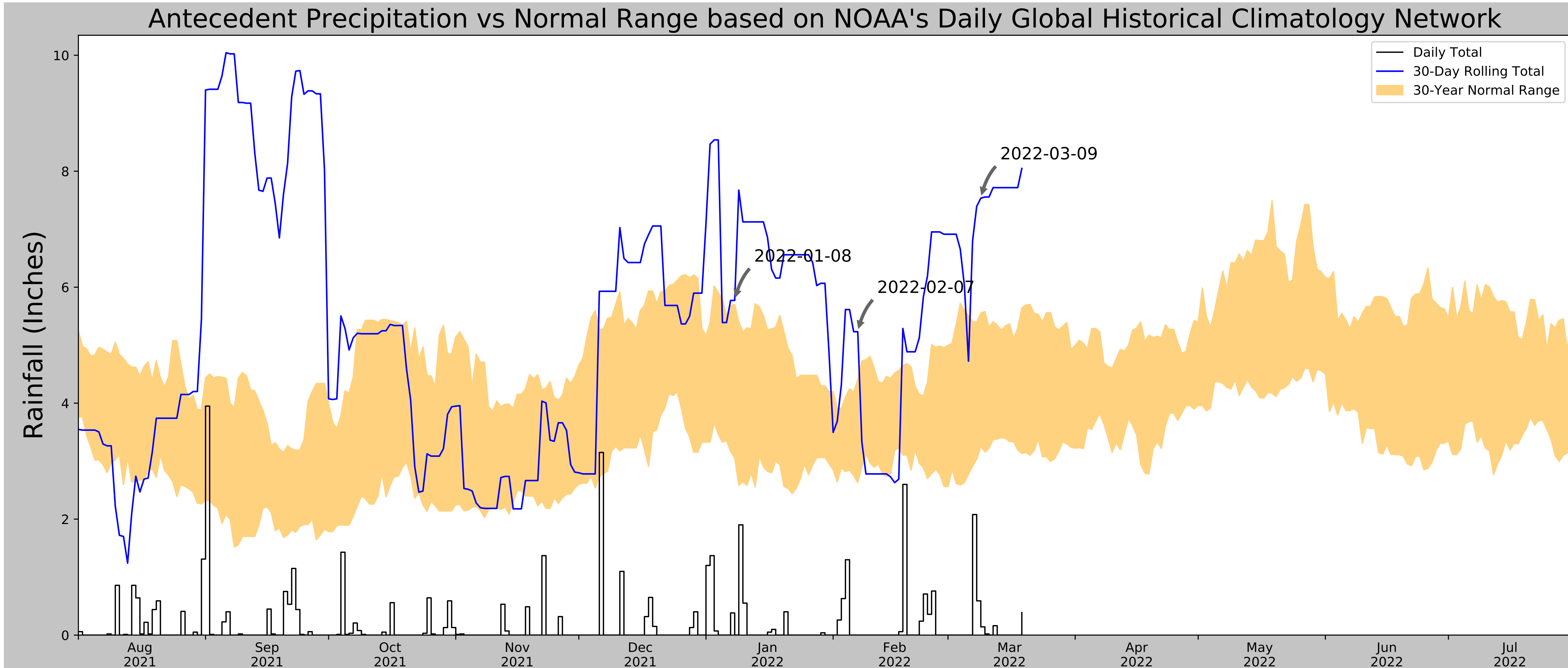
Coordinates	37.599659, -85.879601
Observation Date	2022-03-08
Elevation (ft)	738.25
Drought Index (PDSI)	Severe wetness (2022-02)
WebWIMP H_2O Balance	Wet Season

30 Days Ending	30^{th} %ile (in)	70^{th} %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2022-03-08	3.148032	6.466142	10.736221	Wet	3	3	9
2022-02-06	3.206693	4.879921	5.279528	Wet	3	2	6
2022-01-07	3.420866	6.251969	5.736221	Normal	2	1	2
Result							Wetter than Normal - 17

Figure and tables made by the
Antecedent Precipitation Tool
Version 1.0

Written by Jason Deters
U.S. Army Corps of Engineers

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
NOLIN RVR LAKE	37.2814, -86.2497	623.032	29.929	115.218	16.917	11188	63
BEE SPRING 4.3 NE	37.3305, -86.2267	583.005	3.62	40.027	1.774	0	21
LEITCHFIELD 2 N	37.5108, -86.2892	620.079	15.998	2.953	7.246	165	0
MILLERSTOWN 4E	37.4336, -86.0089	600.066	16.896	22.966	7.991	0	6



Coordinates	37.599659, -85.879601
Observation Date	2022-03-09
Elevation (ft)	738.25
Drought Index (PDSI)	Severe wetness (2022-02)
WebWIMP H_2O Balance	Wet Season

30 Days Ending	30^{th} %ile (in)	70^{th} %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2022-03-09	3.254331	5.55315	7.535433	Wet	3	3	9
2022-02-07	2.629528	4.409055	5.232284	Wet	3	2	6

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
RINEYVILLE 1 S	37.735, -85.9696	742.126	10.568	3.876	4.797	164	0
IRVINGTON 9.8 S	37.7385, -86.2581	807.087	22.815	68.837	11.837	894	0
GREENSBURG 3.5 W	37.262, -85.5576	743.11	29.264	4.86	13.311	571	0
BEE SPRING 4.3 NE	37.3305, -86.2267	583.005	26.612	155.245	16.107	28	82
RINEYVILLE 2.0 SE	37.7242, -85.9536	821.85	9.509	83.6	5.074	6	0
ELIZABETHTOWN 0.7 NW	37.71, -85.88	784.121	7.624	45.871	3.781	285	0
RADCLIFF 1.4 S	37.8068, -85.9524	752.953	14.855	14.703	6.903	113	0
ELIZABETHTOWN 7.9 ENE	37.7518, -85.7413	789.042	12.95	50.792	6.485	510	8
RADCLIFF 1.2 SSE	37.8089, -85.932	775.919	14.738	37.669	7.187	164	0
RINEVYILLE 2.0 NW	37.7731, -85.992	753.937	13.468	15.687	6.272	59	0
MAGNOLIA .7 NNW	37.4528, -85.749	854.003	12.417	115.753	7.025	22	0
BUFFALO 0.8 ESE	37.5078, -85.6858	829.068	12.368	90.818	6.689	243	0
ELIZABETHTOWN 1.8 SE	37.687, -85.845	714.895	6.325	23.355	2.994	1922	0
HODGENVILLE 1.1 N	37.5844, -85.7389	769.029	7.775	30.779	3.738	23	0
EKRON 2.6 ESE	37.9101, -86.1364	651.903	25.63	86.347	13.747	29	0
NEW HAVEN 6.4 NE	37.7327, -85.5174	613.845	21.839	124.405	12.544	1	0

Figure and tables made by the
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Version 1.0

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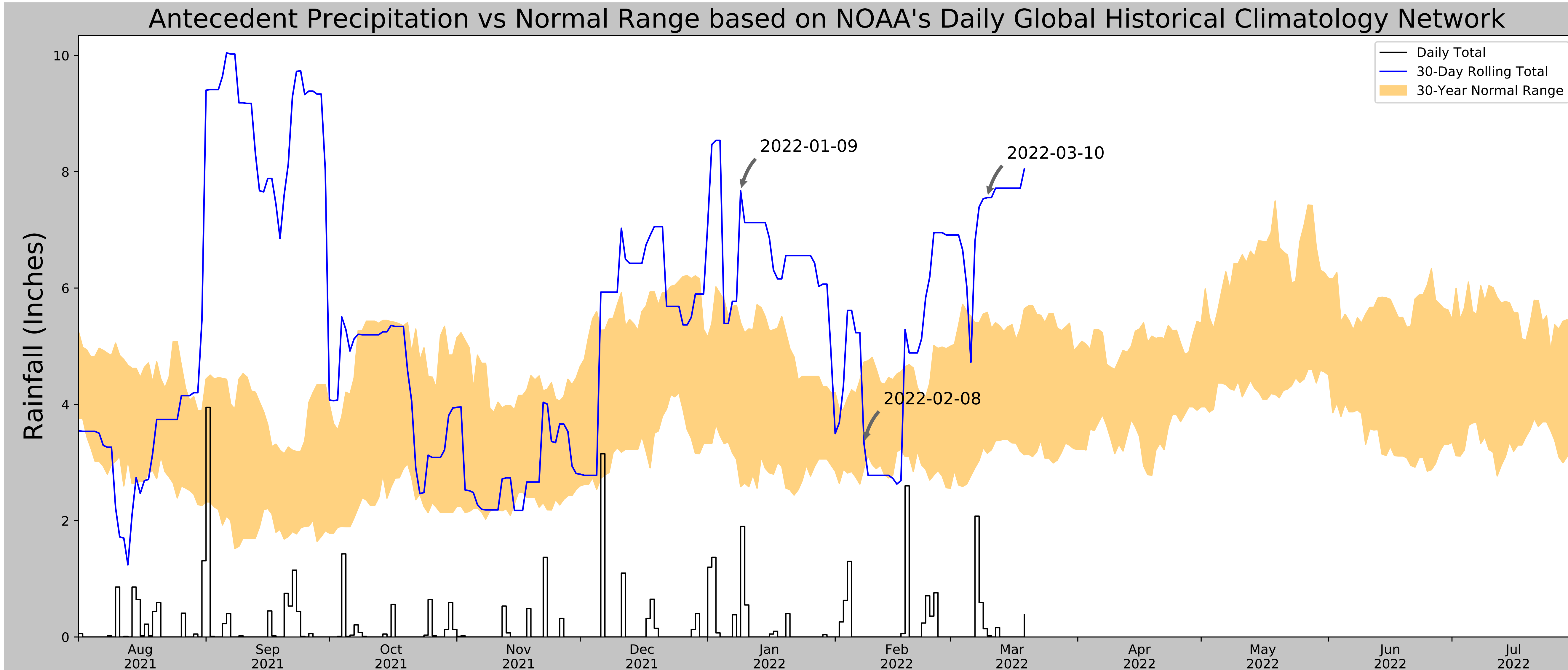
U.S. Army Corps of Engineers



Coordinates	37.599659, -85.879601
Observation Date	2022-03-10
Elevation (ft)	738.25
Drought Index (PDSI)	Severe wetness (2022-02)
WebWIMP H_2O Balance	Wet Season

30 Days Ending	30^{th} %ile (in)	70^{th} %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2022-03-10	3.158662	5.582284	7.555118	Wet	3	3	9
2022-02-08	2.905512	4.726378	3.330709	Normal	2	2	4

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
RINEYVILLE 1 S	37.735, -85.9696	742.126	10.568	3.876	4.797	164	0
IRVINGTON 9.8 S	37.7385, -86.2581	807.087	22.815	68.837	11.837	894	0
GREENSBURG 3.5 W	37.262, -85.5576	743.11	29.264	4.86	13.311	571	0
BEE SPRING 4.3 NE	37.3305, -86.2267	583.005	26.612	155.245	16.107	28	81
RINEYVILLE 2.0 SE	37.7242, -85.9536	821.85	9.509	83.6	5.074	6	0
ELIZABETHTOWN 0.7 NW	37.71, -85.88	784.121	7.624	45.871	3.781	285	0
RADCLIFF 1.4 S	37.8068, -85.9524	752.953	14.855	14.703	6.903	113	0
ELIZABETHTOWN 7.9 ENE	37.7518, -85.7413	789.042	12.95	50.792	6.485	510	9
RADCLIFF 1.2 SSE	37.8089, -85.932	775.919	14.738	37.669	7.187	164	0
RINEVYILLE 2.0 NW	37.7731, -85.992	753.937	13.468	15.687	6.272	59	0
MAGNOLIA .7 NNW	37.4528, -85.749	854.003	12.417	115.753	7.025	22	0
BUFFALO 0.8 ESE	37.5078, -85.6858	829.068	12.368	90.818	6.689	243	0
ELIZABETHTOWN 1.8 SE	37.687, -85.845	714.895	6.325	23.355	2.994	1922	0
HODGENVILLE 1.1 N	37.5844, -85.7389	769.029	7.775	30.779	3.738	23	0
EKRON 2.6 ESE	37.9101, -86.1364	651.903	25.63	86.347	13.747	29	0
NEW HAVEN 6.4 NE	37.7327, -85.5174	613.845	21.839	124.405	12.544	1	0

Figure and tables made by the
Antecedent Precipitation Tool
Version 1.0

Written by Jason Deters
U.S. Army Corps of Engineers

APPENDIX C – PHOTOGRAPH LOG

Photograph C-1: View of Sample Plot (SP)-1, located in a test pit facing south.

Photograph C-2: View of SP-2, located in a test pit facing northeast.

Photograph C-3: View of SP-3, facing northwest towards farmed Wetland (W)-1.

Photograph C-4: View of SP-4, in upland, facing northwest.

Photograph C-5: View of SP-5, located in a test pit facing east.

Photograph C-6: View of SP-6, facing southeast towards PFO W-2.

Photograph C-7: View of SP-7, in upland, facing southeast.

Photograph C-8: View of SP-8, facing west towards PEM W-3.

Photograph C-9: View of SP-9, in upland, facing southwest.

Photograph C-10: View of SP-10, facing west towards PEM W-4.

Photograph C-11: View of SP-11, in upland, facing southeast.

Photograph C-12: View of SP-12, facing southwest towards PEM W-5.

Photograph C-13: View of SP-13, in upland, facing southwest.

Photograph C-14: View of SP-14, facing north towards farmed W-6.

Photograph C-15: View of SP-15, in upland, facing north.

Photograph C-16: View of SP-16, located in a test pit facing east.

Photograph C-17: View of PUB W-7, facing southeast.

Photograph C-18: View of SP-17, facing northeast towards PEM W-8.

Photograph C-19: View of SP-18, in upland, facing northeast.

Photograph C-20: View of ephemeral Stream (S)-1, facing south.

Photograph C-21: View of perennial S-2, facing east.

Photograph C-22: View of perennial S-3, facing southeast.

Photograph C-23: View of intermittent S-4, facing northeast.

Photograph C-24: View of intermittent S-5, facing northwest.

Photograph C-25: View of perennial S-6, facing east.

Photograph C-26: View of perennial S-7, facing west.

Photograph C-27: View of ephemeral S-8, facing northeast.

Photograph C-28: View of ephemeral S-9, facing southwest.

Photograph C-29: View of perennial S-10, facing west.

Photograph C-30: View of perennial S-11, facing west.

Photograph C-31: View of intermittent S-12, facing east.

Photograph C-32: View of ephemeral S-13, facing north.

Photograph C-33: View of perennial S-14, facing east.

Photograph C-34: View of intermittent S-15, facing south.

Photograph C-35: View of intermittent S-16, facing north.

Photograph C-36: View of ephemeral S-17, facing southwest.

Photograph C-37: View of intermittent S-18, facing southeast.

Photograph C-38: View of ephemeral S-19, facing west.


Photograph C-39: View of intermittent S-20, facing west.


Photograph C-40: View of ephemeral S-21, facing southwest.

Photograph C-41: View of ephemeral S-22, facing east.

Photograph C-42: View of intermittent S-23, facing west.

Photograph C-43: View of intermittent S-24, facing south.

Photograph C-44: View of intermittent S-25, facing east.

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KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 2

Responding Witness: Elizabeth J. McFarland

Q-2. Refer to KU's response to Wade Family's Second Request, Item 7a. Confirm that KU is prepared to commit that the proposed 345 kV transmission line will be located to not interfere with the operation of the pivot irrigation system.

A-2. Yes, KU will not locate the proposed 345 kV transmission centerline or easement in such a way that it would interfere with the existing operation of the pivot irrigation system.

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 3

Responding Witness: Elizabeth J. McFarland

Q-3. Refer to the Application, the Direct Testimony of Beth McFarland, page 5, lines 7–10.

a. Describe all alternatives to rerouting the existing Brown North-Hardin County 345 kV line that were considered.

b. Provide any documentation or studies to support the decision to reroute the line.

c. Provide the cost-benefit analysis for the rerouting of the 345 kV line as opposed to tapping the existing 345 kV line.

d. Refer to KU's response to Staff's Third Request, Item 7. Provide where the $1.7 million figure appears in the Application.

A-3.

a. Given the size of the load, the Brown North-Hardin County 345 kV line is the closest nearby line capable of providing service to the Glendale Megasite and rerouting that line was the only viable option. Any other option would have been more expensive, less reliable, or both. The next closest 345 kV line to the Glendale Megasite is the Daviess County-Hardin County 345 kV line and is approximately 0.75 miles further away. Connecting to other nearby lower voltage lines, i.e. 69 kV was ruled out due to system capacity and reliability issues.

b. See the response to part (a).

c. Prudent transmission planning and reliability require this load to be served by two sources, as described in the response to PSC 2-1(a), and in the response to Wade 2-1. Tapping the existing 345 kV line in a radial manner is not a viable option because it would have only provided one transmission source to the Glendale South Substation. Thus, no cost-benefit analysis was completed.

d. The $1.7 million cost for removal of the existing 2.7 mile segment of the 345 kV line was included within the $48 million total for constructing the 345 kV and 138 kV lines as noted in Paragraph 5 of the Application.

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 4

Responding Witness: Elizabeth J. McFarland

Q-4. Provide a breakdown of all anticipated costs of constructing each of the proposed 138 kV transmission lines.

A-4. The preliminary estimates for the construction of the 138 kV East and West route are as follows:

138kV West Route

		($,000,000)
Equipment/Materials		
Steel Pole	$ 2.600	
Conductor	$ 0.400	
Shield Wire	$ 0.001	
OPGW	$ 0.025	
Insulators	$ 0.075	
Hardware	$ 0.180	
Overheads	$ 0.450	
Contingencies	$ 0.924	$ 4.655
Labor		$ 4.700
Total		$ 9.355

138kV East Route

			($,000,000)
Equipment/Materials			
	Steel Pole	$ 1.900	
	Conductor	$ 0.170	
	OPGW	$ 0.021	
	Insulators	$ 0.033	
	Hardware	$ 0.103	
	Overheads	$ 0.301	
	Contingencies	$ 0.619	$ 3.147
Labor			$ 4.000
	Total		$ 7.147

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 5

Responding Witness: Elizabeth J. McFarland

Q-5. Provide a breakdown of all anticipated costs of constructing Glendale South Substation.

A-5. The preliminary estimates for the construction of the Glendale South substation are as follows:

		($,000,000)
Engineering/PM		$ 4.000
Equipment/Materials		
Power Transformers	$10.000	
345KV Circuit Breakers	$ 1.500	
345KV Motor-operated Switches	$ 1.800	
345KV CCVT	$ 1.000	
138KV Circuit Breakers	$ 0.900	
138KV Disconnects	$ 0.300	
138KV CCVT	$ 0.360	
138KV SSVT	$ 0.150	
Control House	$ 3.000	
Grounding Materials (Lot)	$ 2.000	
Steel (Lot)	$ 2.500	
Aluminum Bus, connectors (Lot)	$ 2.500	
Control Cable (Lot)	$ 3.500	
Miscellaneous equipment	$ 2.500	$ 32.010
Labor		$ 12.000
Total		$ 48.010

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 6

Responding Witness: Elizabeth J. McFarland

Q-6. Provide a breakdown of all anticipated costs of constructing the Glendale Industrial Substation.

A-6. The preliminary estimates for the construction of the Glendale Industrial substation are as follows:

		($,000,000)
Engineering/PM		$ 2.000
138KV Circuit Breakers	$ 1.440	
138KV Disconnects	$ 0.800	
138KV CCVT	$ 0.560	
138KV SSVT	$ 0.150	
Control House	$ 3.000	
Grounding Materials (Lot)	$ 2.000	
Steel (Lot)	$ 0.700	
Aluminum Bus, connectors (Lot)	$ 1.500	
Control Cable (Lot)	$ 2.500	$ 12.650
Labor		$ 10.000
Total		$ 24.650

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 7

Responding Witness: Elizabeth J. McFarland

Q-7. Provide a breakdown of all anticipated costs of constructing each of the 345 kV transmission lines.

A-7. The preliminary estimates for the construction of the 345 kV East and West route are as follows:

345kV West Route

		($,000,000)
Equipment/Materials		
Lattice Tower	$ 0.679	
Steel Poles	$ 2.079	
Conductor	$ 0.340	
Shield Wire	$ 0.015	
OPGW	$ 0.038	
Insulators	$ 0.093	
Hardware	$ 0.220	
Overheads	$ 0.450	
Contingencies	$ 0.772	$ 4.686
Labor		$ 11.362
Removal Labor (Existing Line Segment)		$ 1.700
Total		$ 17.748

345kV East Route

		($,000,000)
Equipment/Materials		
Lattice Tower	$ 0.581	
Steel Poles	$ 1.696	
Conductor	$ 0.247	
Shield Wire	$ 0.011	
OPGW	$ 0.028	
Insulators	$ 0.077	
Hardware	$ 0.179	
Overheads	$ 0.366	
Contingencies	$ 0.628	$ 3.813
Labor		$ 9.544
Total		$ 13.357

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 8

Responding Witness: Elizabeth J. McFarland

Q-8. Refer to KU's response to Wade Family's Second Request, Item 6, as well as KU's response to Staff's Second Request, Item 6 and reconcile the two responses.

A-8. The response to Staff 2-6(b) references the 138 kV lines on the Glendale Megasite. The response is as follows.

> Separation of the lines is Good Utility Practice to maintain reliability for a proposed load of this size. Having parallel lines allows the Company to perform maintenance on the line and line structures while keeping the Glendale Industrial Substation in service. Additionally, the current design accommodates a future 138 kV circuit to support load growth in the region. This future circuit is planned to be double circuited on the west 138 kV route. This configuration also allows for increased reliability and maintenance flexibility during construction of this future 138 kV circuit.

The response to Wade 2-6 references the construction of a future 138 kV line on the "Western 345 kV Transmission Line's structures…". The Western 345 kV line is not located in the area referenced in the response to Staff 2-6 (Glendale South Industrial substation). Additionally, the line being double circuited on the north portion of the Glendale Megasite is the KU 138 kV line with the EKPC 69 kV line as stated in the answer to the staff in 6 (a).

There are no current plans to double circuit the Western 345 kV line on the Wade Family Farm with a future 138 kV line.

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 9

Responding Witness: Elizabeth J. McFarland

Q-9. Refer to KU's response to Browns' Second Request for Information, Items 2–5. State whether any material agreements were reached on May 3, 2022, between the parties with regard to locating the proposed transmission lines on the Browns' parcels.

A-9. At the May 3, 2022 meeting, KU agreed to study the Browns' routing preferences as expressed in that meeting and which were subsequently expressed in Mr. Allen Summers' May 12, 2022 intervenor testimony. To that end, KU is in the process of performing geotechnical work to analyze their routing preferences.

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 10

Responding Witness: Elizabeth J. McFarland

Q-10. Provide a list of all possible safety or code violations that could occur should KU build the transmission lines over the Wade Family Farms' irrigation system. Provide any studies or permits KU has performed or obtained to address the irrigation system and safety issues presented by water stream pressure.

A-10. KU's transmission line will not interfere with the existing Wade Family Farms' irrigation system. See the response to Question No. 2. The IEEE Standard 1542-2018 "IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines" was utilized for distances to a center pivot irrigation system. The transmission line falls outside of the distance specified by the IEEE standard. In addition, KU verified the clearance criteria to comply with NESC 2017 Rule 234 C. Based on these standards and the current location of the Wade Family Farms' irrigation system, there are no safety issues or clearance concerns.

KENTUCKY UTILITIES COMPANY

Response to Commission Staff's Fourth Request for Information
Dated May 11, 2022

Case No. 2022-00066

Question No. 11

Responding Witness: Robert M. Conroy

Q-11. Describe any contractual agreements related to fines or incentives to prevent power outages between KU and Ford. Provide copies of any executed agreements concerning commitments KU has made to Ford regarding outage prevention.

A-11. KU does not have any contractual agreements with Ford related to fines or incentives to prevent outages. KU expects the Ford facilities to be bound to KU's terms and conditions set out within its tariffs as it relates to power outages. Specifically tariff sheet P.S.C. No. 20, Original Sheet No. 98.1.