ADDENDUM NO. 2

TO

Hillsboro House Springs Road Bridge Replacement

STP-5403 (693)

COUNTY OF JEFFERSON, MISSOURI

June 2, 2022

This addendum forms a part of the bidding and contract documents and modifies the original bidding documents. Acknowledge receipt of this addendum in the space provided on this bid form. **FAILURE TO DO SO MAY SUBJECT BIDDER TO DISQUALIFICATION.**

PROJECT SPECIFICATIONS

STP-5403(693) - GEOTECHNICAL EXPLORATION REPORT:

Add Pages ADD 218 through ADD 240. The purpose is to update add the Geotechnical Exploration Report to the Project Specifications.

STATE OF MISSOURI
KURT WENGERT
6-2-2022
NUMBER
PE-2004017266
PROFESSIONAL ENGINEER

GEOTECHNICAL EXPLORATION
HILLSBORO HOUSE SPRINGS ROAD BRIDGE
HILLSBORO, MISSOURI

Prepared for:

CDG ENGINEERS
ST. LOUIS, MISSOURI

Prepared by:

GEOTECHNOLOGY, INC.
ST. LOUIS, MISSOURI

Date:

JULY 27, 2020

Geotechnology Project No.:

J035088.01

SAFETY
QUALITY
INTEGRITY
PARTNERSHIP
OPPORTUNITY
RESPONSIVENESS

St. Louis, MO | Erlanger, KY | Memphis, TN | Overland Park, KS | Cincinnati, OH | Fairview Heights, IL
Lexington, KY | Dayton, OH | Oxford, MS | Jonesboro, AR

GEOTECHNOLOGY INC
FROM THE GROUND UP

July 27, 2020

Mr. Tim Nugent, P.E.
CDG Engineers
One Campbell Plaza
St. Louis, Missouri 63139

Re: Geotechnical Exploration
Hillsboro House Springs Road Bridge
Hillsboro, Missouri
Geotechnology Project No. J035088.01

Dear Mr. Nugent:

Presented in this report are the results of a geotechnical exploration conducted for the referenced project. This report includes our project understanding, observed site conditions, conclusions and/or recommendations, and support data as given in the Table of Contents.

It has been our pleasure to provide geotechnical services to you, and we would welcome the opportunity to provide other services during the course of the project. Please contact us if you need further information or clarification about this document.

Very truly yours,

GEOTECHNOLOGY, INC.

STATE OF MISSOURI
BRIAN J. SANDERS
NUMBER
PE-2012000812
7-27-20
PROFESSIONAL ENGINEER

Brian J Sanders, P.E.
Project Manager

Daniel W Greenwood, P.E., R.G.
Geotechnical Manager

BJS/DWG:bjs/jf

Copies submitted: (1) pdf

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

The executive summary is provided solely for the purpose of overview and a number of details are omitted, each of which could be crucial to the recommended application of this report. A party who relies on this report should read the entire report.

- The project includes design and construction of a replacement bridge for Hillsboro House Springs Road Bridge in Hillsboro, Missouri. The bridge is proposed to be of precast arch construction and will be approximately 110-feet long, and approximately 36 feet wide. The new bridge will be located along a similar alignment of the existing bridge. Cast-in-place concrete wingwalls are planned at both abutments.

- The stratigraphy consists generally of approximately 5 feet of lean clay with limestone fragments. Beneath the lean clay layer, the material transitions to an interbedded zone of lean clay and weathered limestone ledges to the top of bedrock. Limestone bedrock occurs at an approximate depth of 18 to 21 feet (El 615 to 616[1]) measured from existing approach grades.

- Bedrock consists generally of strong to very strong, gray, very finely crystalline, slightly to moderately weathered limestone.

- The bridge can be supported on spread footings bearing on limestone bedrock with a nominal bearing resistance (q_n) of 200 ksf.

- In accordance with the general procedures of the American Association of State Highway and Transportation Official's (AASHTO) LRFD Bridge Design Specifications, the bridge site can be classified as Site Class C (Very Dense Soil and Soil Rock Profile) and Seismic Design Category B.

[1] Elevations herein are in units of feet and refer to North American Vertical Datum (NAVD) 1988.

GEOTECHNICAL EXPLORATION
HILLSBORO HOUSE SPRINGS ROAD BRIDGE
HILLSBORO, MISSOURI
July 27, 2020 | Geotechnology Project No. J035088.01

1.0 INTRODUCTION
The services documented in this report were provided in accordance with the terms, conditions and scope of services described in CDG's Subconsultant Services Agreement Subcontract No. 20018-SC-02, dated and authorized February 14, 2020.

The purposes of the geotechnical exploration were to develop a general subsurface profile at the site and prepare recommendations for the geotechnical aspects of the design and construction of the project as defined in our proposal. Our scope of services included site reconnaissance, drilling two geotechnical borings, laboratory testing, engineering analyses, and preparation of this report.

A copy of "Important Information about This Geotechnical-Engineering Report," published by the Geotechnical Business Council (GBC) of the Geoprofessional Business Association (GBA), is included in Appendix A for your review. The publication discusses report limitations and ways to manage risk associated with subsurface conditions.

2.0 PROJECT INFORMATION
The project includes design and construction of a replacement bridge for Hillsboro House Springs Road Bridge in Hillsboro, Missouri. The bridge is proposed to be of precast arch construction and will be approximately 110-feet long, and approximately 36 feet wide. The new bridge will be located along a similar alignment of the existing bridge. Cast-in-place concrete wingwalls are planned at both abutments.

The load-and-resistance factor design (LRFD) method will be used to design this structure in accordance with AASHTO LRFD Bridge Design Specifications and MoDOT's Engineering Policy Guide (EPG).

3.0 GEOTECHNICAL EXPLORATION
The field exploration consisted of drilling two borings, designated as Borings B-1 and B-2, at the approximate locations shown on Figure 2 in Appendix B. The borings were located in the field by Geotechnology by measuring distances from existing site features. The elevations at the boring locations, as shown on the boring logs, were estimated using the elevations shown on a site plan provided by the client. If more precise data are required, the client should retain a registered surveyor to establish boring locations and elevations.

Both borings were drilled to auger refusal using a CME 85 rotary drill rig equipped with hollow stem augers. Standard Penetration Tests (SPTs) were performed using an automatic hammer. Split-spoon and Shelby tube sample were obtained at the depths indicated on the boring logs presented in Appendix C. Rock was cored in both borings using double-tube NQ2 wireline methods.

Rock core photographs are included in Appendix D. A legend of the terms and symbols used on the boring logs and rock core descriptions are included in Appendix C.

An engineer from Geotechnology provided direction during field exploration, observed drilling and sampling, assisted in obtaining samples and prepared logs of the material encountered. The boring logs represent conditions observed at the time of exploration, and have been edited to incorporate results of the laboratory tests.

Unless noted on the boring logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials could be gradual or could occur between recovered samples. The stratification given on the boring logs, or described herein, is for use by Geotechnology in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The boring logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time could result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

4.0 LABORATORY TESTING

Laboratory testing was performed on the soil samples to estimate engineering and index properties. Moisture contents and Atterberg limits tests were performed on selected cohesive samples. Shelby tube samples were attempted to be collected; however, the material was too rocky to allow for Shelby tube sample collection. Sufficient soil samples were not able to be collected to perform chemical analytical testing for evaluation of soil.

Compressive strength tests were performed on representative rock core samples. Laboratory test results are presented on the boring logs and in Table 1. Rock core compressive strength results are also summarized in Table 1.

Table 1. Rock Compressive Strength Data

Boring No.	Sample		Unit Weight (pcf)	Compressive Strength		Type of Rock
	Depth (ft)	Elevation (NAVD 88)		(psi)	(ksf)	
B-1	23.0	615.2	168	27,010	3,889	Limestone
B-2	20.3	616.0	164	28,922	4,165	

5.0 SUBSURFACE CONDITIONS

5.1 Stratigraphy

The pavement section consists of approximately 6 to 8 inches of asphalt and approximately 12 to 16 inches of crushed rock to a depth of 1.5 to 2 feet. Below the pavement section, lean clay with limestone fragments occur to depths of approximately 4.5 to 5 feet. Below the lean clay, the stratigraphy consists of interbedded clay and weathered limestone ledges to limestone bedrock at depths of 18 to 20 feet.

Auger refusal occurred in the borings at approximate depths of 18 to 20 feet (El 616) below existing bridge approach grades. Auger refusal elevations at the boring locations are shown on Figure 2 in Appendix B. Drill rig augers can often penetrate several feet into soft or broken rock and, therefore, these elevations do not necessarily represent top of rock.

Coring was attempted in Boring B-1 in the interbedded zone, with little recovery or indication of significant rock present. Boring B-2 was advanced via auger through the interbedded zone, indicating the interbedded zone is mostly soil.

Bedrock generally consists of strong to very strong, white, very finely crystalline, medium to thin bedded, slightly to moderately weathered limestone. Outside of the interbedded zone, bedrock core samples obtained recoveries of 90 to 100 percent and rock quality designation (RQD)[2] values of 70 to 100 percent, indicating a fair to excellent quality rock.

5.2 Groundwater

Groundwater was not observed during drilling. Rock coring was performed in each boring. The coring process introduces water into the borehole and can mask the groundwater levels. Groundwater levels might not have stabilized before backfilling, which is typical in less permeable cohesive soil. Consequently, the lack of groundwater levels might not represent present or future levels. Groundwater levels could vary over time due to the effects of seasonal variation in precipitation, recharge, the water level of Bourne Creek, or other factors not evident at the time of exploration.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The precast arch bridge structures can be supported on spread footings bearing on limestone bedrock. Design and construction recommendations for spread footings bearing on rock are provided in general accordance with AASHTO LRFD Bridge Design Specifications and MoDOT's EPG. We have assumed that this bridge is classified as a bridge on a minor road.

[2] Rock quality designation is the ratio of the sum of the pieces of core measuring 4 inches or longer to the total length of the cored interval, expressed as a percentage.

6.1 Spread Footings Bearing on Rock

Bearing Resistance. The nominal bearing resistance for spread footings on rock of 200 kips per square foot (ksf) can be used for footings bearing on competent limestone. A resistance factor (ϕ_b) of 0.6 should be applied to the nominal resistance value.

Settlement. Settlement of spread foundations, designed and constructed in accordance with MoDOT EPG 751.38 and the recommendations given in this report, is expected to be 0.5-inch or less.

Uplift Resistance. Uplift loads can be resisted with the dead weight of the footing, and the weight of soil above the footing. A unit weight of 120 pounds per cubic foot (pcf) can be used for determining the soil weight above the footing, and the volume of soil acting on the footing can include a wedge of material within a line that extends from the top of footing and away from the footing edge to the ground surface at an angle of 30 degrees from the vertical.

Construction Considerations. Rock ledges will occur above the interpreted top of rock. Rock might need to be removed using hard rock excavating techniques that could include chipping with a hydraulic hoe-ram. A contingency should be included in the project budget to cover the costs of hard rock excavation.

6.2 Cast-in-Place Concrete Walls

Cast-in-Place retaining walls are planned at each abutment. Based on provided data the height of the retaining wall will be approximately 20 feet. It is our understanding that the cast-in-place wall will be designed by CDG.

The following geotechnical parameters may be used for design of the cast-in-place wall.

- For the retained soils, a friction angle of 26 degrees and cohesion of 10 pounds per square foot (psf) may be used for long term conditions. An undrained shear strength of 750 psf may be used for short term conditions.

- Cast-in-Place walls may be designed to bear on bedrock using a nominal bearing resistance of 200 ksf for footings bearing on competent limestone. A resistance factor (ϕ_b) of 0.6 should be applied to the nominal resistance value.

- Since the cast-in-place walls are bearing on bedrock, a global stability analysis was not performed. Internal stability of the wall should be verified by the designer.

6.3 Site Grading

Site grading and fill placement should be performed in accordance with Sections 201 through 213 of the Missouri Standard Specifications for Highway Construction.

6.4 Slopes

The stability of a slope depends on many factors, including slope geometry, slope height, soil type, and surface pressures. Based on MoDOT's Table 321.1 *Guide for Selection of Slope Inclination for Routine Design*, fill side slopes can be as steep as 1V:2.5H for lean clay.

6.5 Seismicity and Liquefaction

Site Class. In accordance with the general procedures of the AASHTO LRFD Bridge Design Specifications, the bridge site, in total, can be classified as Site Class C (Very Dense Soil and Soil Rock Profile).

Seismic Design Response Spectrum. In accordance with AASHTO LRFD Bridge Design Specifications, a summary of the seismic site class, mapped peak ground acceleration (PGA), mapped acceleration coefficients (i.e., S_s and S_1), design response spectrum coefficients (i.e., A_s, S_{DS} and S_{D1}), and seismic zone are provided in the following table. The accelerations given herein correspond to a seismic event with a seven percent probability of not being exceeded in 75 years.

Table 2. Seismic Design Parameter Summary

Seismic Site Class	PGA (g)	S_s (g)	S_1 (g)	A_s (g)	S_{DS} (g)	S_{D1} (g)	Seismic Design Category*
C (Very Dense Soil and Soil Rock)	0.166	0.341	0.098	0.199	0.409	0.167	B

*Based on MoDOT EPG Section 756, LRFD method

The stratigraphy at this site consists of cohesive soils underlain by bedrock. These strata are not considered susceptible to liquefaction during a seismic event.

7.0 RECOMMENDED ADDITIONAL SERVICES

The conclusions and recommendations given in this report are based on: Geotechnology's understanding of the proposed design and construction, as outlined in this report; site observations; interpretation of the exploration data; and our experience. Since the intent of the design recommendations is best understood by Geotechnology, we recommend that Geotechnology be included in the final design and construction process, and be retained to review the project plans and specifications to confirm that the recommendations given in this report have been correctly implemented. We recommend that Geotechnology be retained to participate in prebid and preconstruction conferences to reduce the risk of misinterpretation of the conclusions and recommendations in this report relative to the proposed construction of the subject project.

Since actual subsurface conditions between boring locations could vary from those encountered in the borings, our design recommendations are subject to adjustment in the field based on the subsurface conditions encountered during construction. Therefore, we recommend that Geotechnology be retained to provide construction observation services as a continuation of the design process to confirm the recommendations in this report and to revise them accordingly to accommodate differing subsurface conditions. Construction observation is intended to enhance compliance with project plans and specifications. It is not insurance, nor does it constitute a warranty or guarantee of any type. Regardless of construction observation, contractors, suppliers, and others are solely responsible for the quality of their work and for adhering to plans and specifications.

8.0 LIMITATIONS

This report has been prepared on behalf of, and for the exclusive use of, the client for specific application to the named project as described herein. If this report is provided to other parties, it should be provided in its entirety with all supplementary information. In addition, the client should make it clear that the information is provided for factual data only, and not as a warranty of subsurface conditions presented in this report.

Geotechnology has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. The recommendations and conclusions contained in this report are professional opinions. The report is not a bidding document and should not be used for that purpose.

Our scope for this phase of the project did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client. Our scope did not include an assessment of the effects of flooding and erosion of creeks or rivers adjacent to or on the project site.

The analyses, conclusions, and recommendations contained in this report are based on the data obtained from the geotechnical exploration. The field exploration methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Consequently, subsurface conditions could vary gradually, abruptly, and/or nonlinearly between sample locations and/or intervals.

The conclusions or recommendations presented in this report should not be used without Geotechnology's review and assessment if the nature, design, or location of the facilities is changed, if there is a lapse in time between the submittal of this report and the start of work at the site, or if there is a substantial interruption or delay during work at the site. If changes are contemplated or delays occur, Geotechnology must be allowed to review them to assess their impact on the findings, conclusions, and/or design recommendations given in this report. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party's interpretations of the subsurface data or with reuse of the subsurface data or engineering analyses in this report.

The recommendations included in this report have been based in part on assumptions about variations in site stratigraphy that can be evaluated further during earthwork and foundation construction. Geotechnology should be retained to perform construction observation and continue its geotechnical engineering service using observational methods. Geotechnology cannot assume liability for the adequacy of its recommendations when they are used in the field without Geotechnology being retained to observe construction.

APPENDIX A – IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

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

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

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode 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 parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

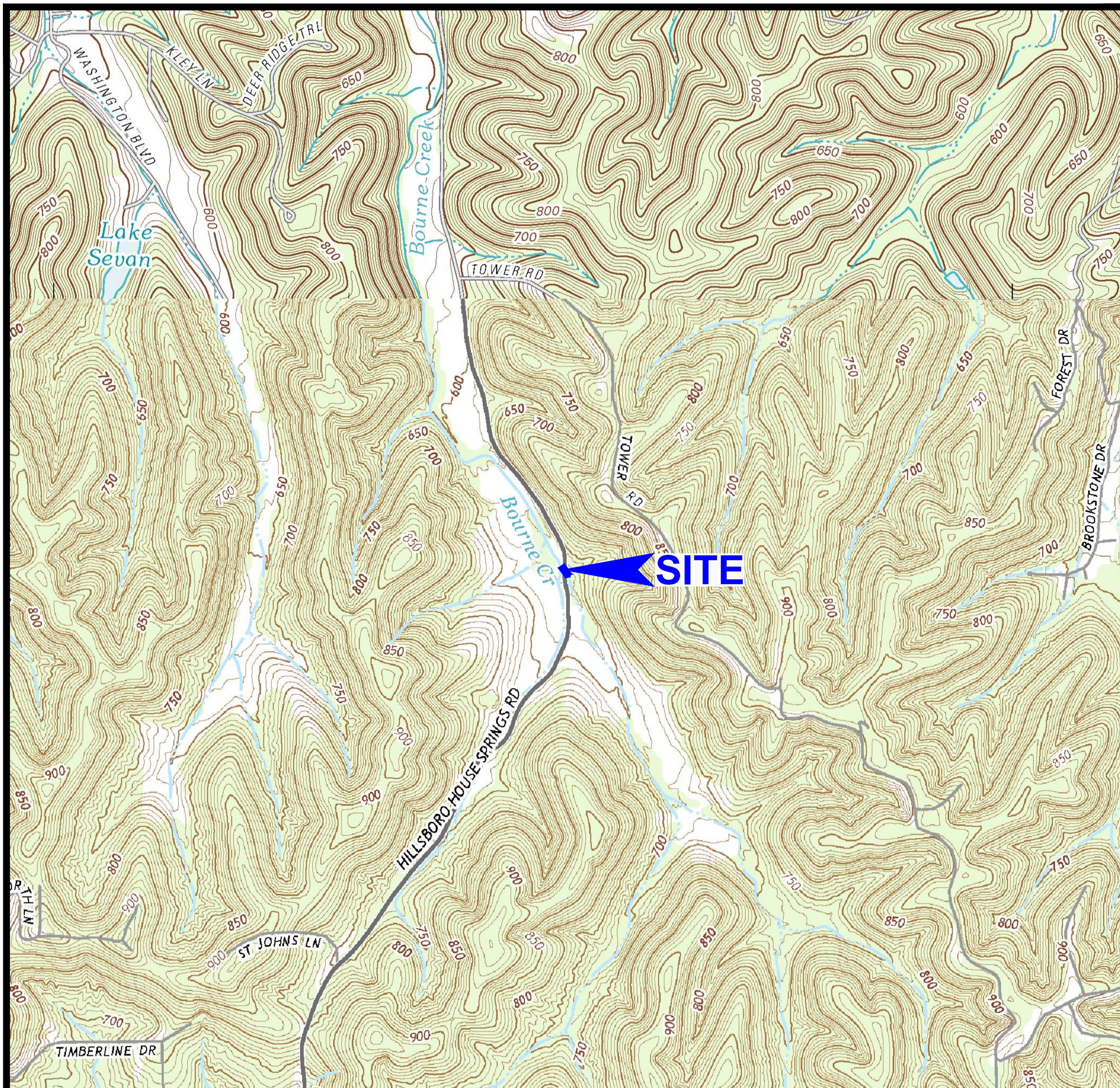
GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX B – FIGURES

Figure 1 - Site Location and Topography

Figure 2 - Aerial Photograph of Site and Boring Locations



NOTES

1. Plan adapted from 7.5 minute U.S.G.S. maps for Belews Creek and House Springs, Missouri quadrangles, last revised in 2015 and 2017, respectively.

0 2,000 4,000

SCALE IN FEET

N

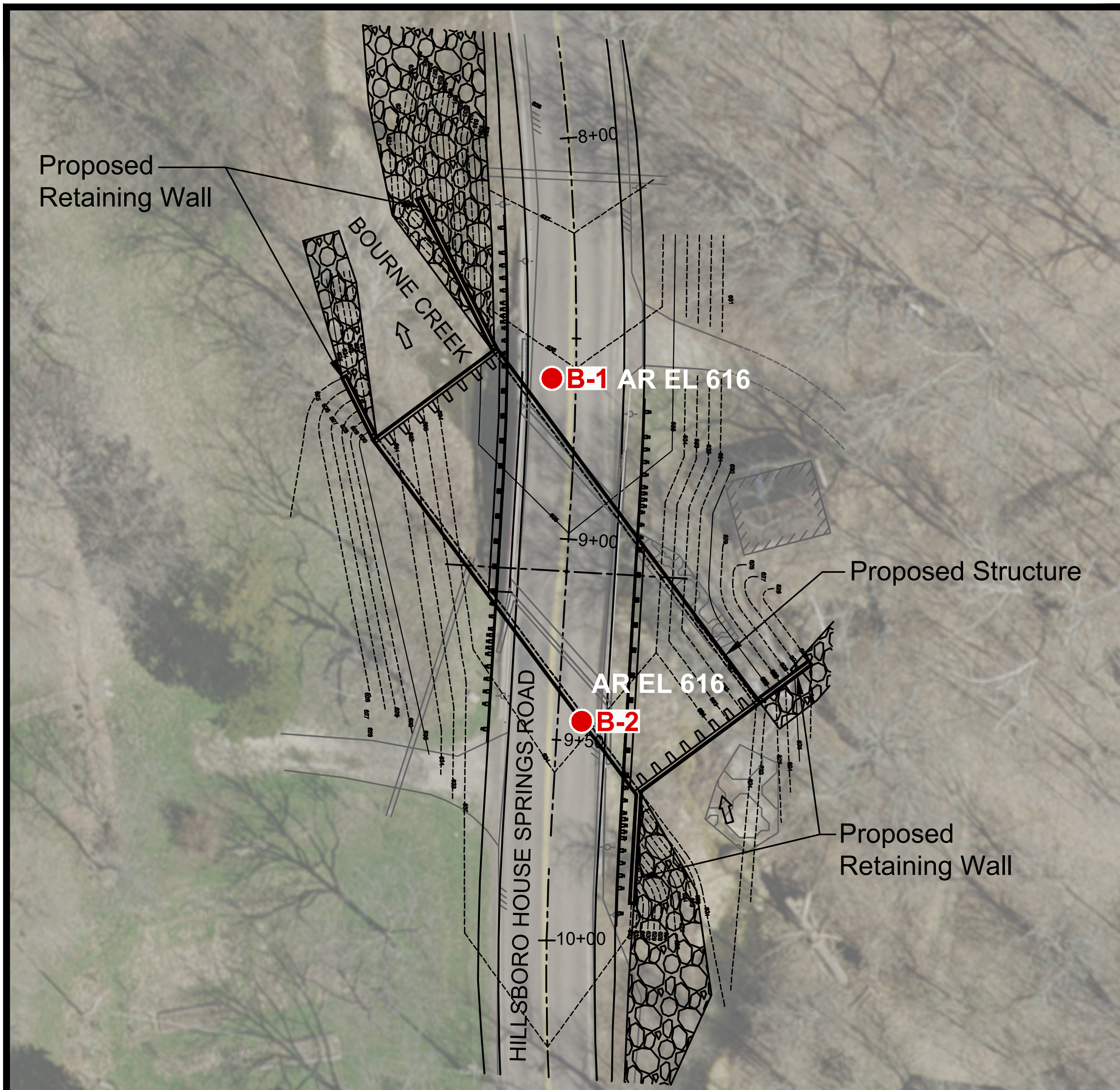
Drawn By: WAH	Ck'd By: BJS	App'vd By: DWG
Date: 7-21-20	Date: 7-27-20	Date: 7-27-20

GEOTECHNOLOGY INC
FROM THE GROUND UP

Geotechnical Exploration
Hillsboro House Springs Road
Bridge over Bourne Creek
Jefferson County, Missouri

SITE LOCATION AND TOPOGRAPHY

Project Number J035088.01	FIGURE 1



NOTES

1. Plan adapted from "2015 Aerial Imagery for the St. Louis Region" supplied by East-West Gateway Council of Governments and a "Preliminary" drawing dated June 19, 2020, titled "Bridge TS&L Federal Project No. STP-5403(693) Hillsboro-House Springs Road Bridge Replacement, Jefferson County, Missouri", prepared by CDG Engineers.

2. Borings were located in the field with reference to site features and are shown approximate only.

LEGEND

● Boring Location

0 20 40 80
SCALE IN FEET

N

Drawn By: WAH	Ck'd By: BJS	App'vd By: DWG
Date: 7-21-20	Date: 7-27-20	Date: 7-27-20

GEOTECHNOLOGY INC
FROM THE GROUND UP

Geotechnical Exploration
Hillsboro House Springs Road
Bridge over Bourne Creek
Jefferson County, Missouri

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATINS

Project Number J035088.01	FIGURE 2

APPENDIX C – BORING INFORMATION

Boring Logs

Boring Log Terms and Symbols

Rock Core Descriptions

Surface Elevation: 636 | Completion Date: 6/29/2020

Datum: NAVD88

SHEAR STRENGTH, tsf: Δ - UU/2, ○ - QU/2, □ - SV (0.5, 1.0, 1.5, 2.0, 2.5)

STANDARD PENETRATION RESISTANCE ▲ N-VALUE (BLOWS PER FOOT) (ASTM D 1586)

WATER CONTENT, % PL |—●—| LL (10, 20, 30, 40, 50)

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Asphalt - 6 inches			
	Crushed Rock - 12 inches			
	Medium stiff, LEAN CLAY with limestone fragments - (CL)		6-12-9	SS1
			6-50/4"	SS2
5	Interbedded LEAN CLAY and weathered limestone ledges - CL		44% / 27%	NQ1
			13% / 0%	NQ2
10				
			10% / 0%	NQ3
15				
			5% / 0%	NQ4
20	Strong to very strong, white, very finely crystalline, medium to thin bedded, slightly to moderately weathered LIMESTONE			
	Unconfined compressive strength = 27,010 psi (3,889 ksf)		90% / 85%	NQ5
	Core loss - 3 inches			
25	Strong to very strong, white, very finely crystalline, medium to thin bedded, slightly to moderately weathered LIMESTONE			
	Core loss - 3 inches			
	Strong to very strong, white, very finely crystalline, medium to thin bedded, slightly to moderately weathered LIMESTONE			
	Boring terminated at 26 feet			
30				
35				

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J035088.01 - HILLSBORO.GPJ 00 CLONE ME.GPJ 7/23/20

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

AK DRILLER RFW LOGGER

CME 85 DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: EKG	Checked by: BJS	App'vd. by: DWG
Date: 7/15/2020	Date: 7-27-20	Date: 7-27-20

GEOTECHNOLOGY INC FROM THE GROUND UP

Geotechnical Exploration Hillsboro House Springs Road Bridge over Bourne Creek Jefferson County

LOG OF BORING: B-1

Project No. J035088.01

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation: 634 | Completion Date: 6/30/2020 | Datum: NAVD88

SHEAR STRENGTH, tsf: Δ - UU/2, ○ - QU/2, ▯ - SV (0.5, 1.0, 1.5, 2.0, 2.5)

STANDARD PENETRATION RESISTANCE ▲ N-VALUE (BLOWS PER FOOT) (ASTM D 1586)

WATER CONTENT, % PL ⊢—●—⊣ LL (10, 20, 30, 40, 50)

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES
0	Asphalt - 8 inches		
	Crushed Rock - 16 inches		
2	Very stiff, LEAN CLAY with limestone ledges - CL	4-4-3	SS1
			ST2
		8-10-10	SS3
5	Interbedded LEAN CLAY and weathered limestone ledges - CL		
		5-15-21	SS4
		12-21-11	SS5
15		5-10-12	SS6
18	Weathered Limestone	50/2"	SS7
	Soft, gray calcareous SHALE	100% / 70%	NQ1
20	Strong to very strong, white, very finely crystalline, thin to medium bedded, slightly weathered LIMESTONE with shale partings Unconfined compressive strength = 28,922 psi (4,165 ksf)	100% / 95%	NQ2
	Medium strong, gray, very finely crystalline, thin bedded, slightly weathered, dolomitic LIMESTONE		
25	Strong to very strong, white, very finely crystalline, thin to medium bedded, slightly weathered LIMESTONE with shale partings	100% / 100%	NQ3
28	Boring terminated at 28 feet		

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

TD DRILLER RFW LOGGER

CME 55HTX DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: EKG	Checked by: BJS	App'vd. by: DWG
Date: 7/15/2020	Date: 7-27-20	Date: 7-27-20

GEOTECHNOLOGY INC FROM THE GROUND UP

Geotechnical Exploration
Hillsboro House Springs Road Bridge over Bourne Creek
Jefferson County

LOG OF BORING: B-2

Project No. J035088.01

LOG OF BORING 2002 WL J035088.01 - HILLSBORO.GPJ 00 CLONE ME.GPJ 7/23/20

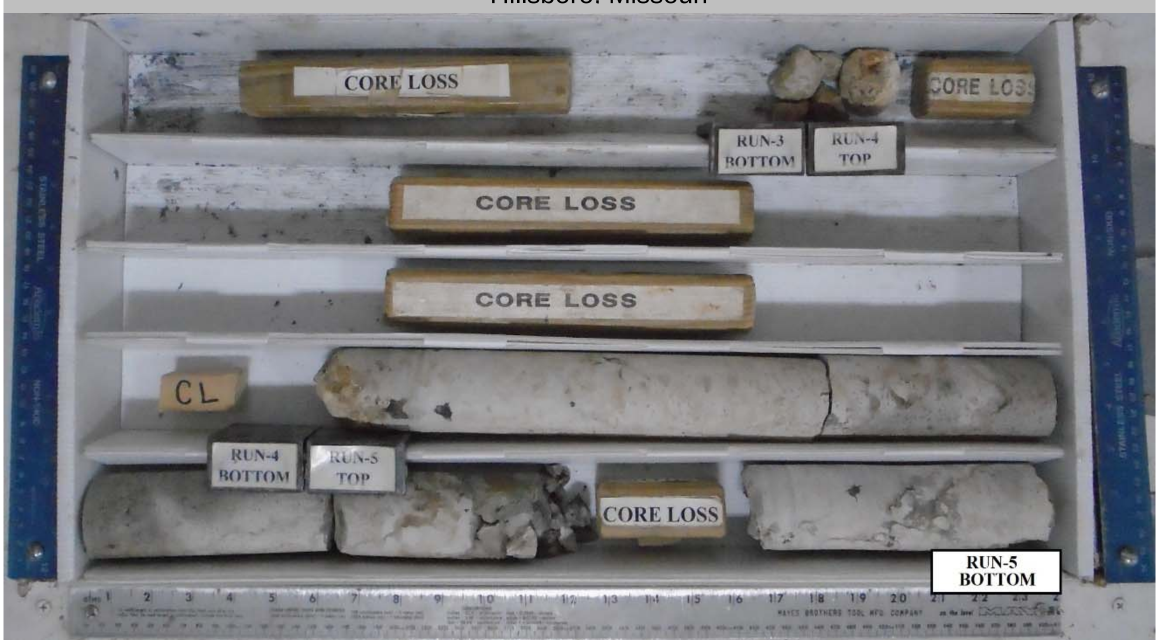
APPENDIX D – ROCK CORE PHOTOGRAPHS

J035088.01	Geotechnical Exploration Hillsboro House Springs Road Bridge Hillsboro, Missouri	B-1 Box 1 of 2

BORING B-1

RUN	ELEVATION, FT	RECOVERY, %	RQD, %
1	631.5-630.0	44	27
2	630.0-625.0	13	0
3	625.0-cont.	10	0

J035088.01	Geotechnical Exploration Hillsboro House Springs Road Bridge Hillsboro. Missouri	B-1 Box 2 of 2



BORING B-1

RUN	ELEVATION, FT	RECOVERY, %	RQD, %
3	cont.-620.0	10	0
4	620.0-615.0	5	0
5	615.0-610.0	90	85

J035088.01

Geotechnical Exploration
Hillsboro House Springs Road Bridge
Hillsboro, Missouri

B-2
Box 1 of 1

BORING B-2

RUN	ELEVATION, FT	RECOVERY, %	RQD, %
1	615.8-613.5	100	70
2	613.5-608.5	100	95
3	608.5-606.0	100	100