Geophysical Testing Report

White House Business Park
White House, Robertson County, TN
July 30, 2021
Terracon Project No. 18215095

Prepared for:
Thomas & Hutton
Nashville, TN

Prepared by:
Terracon Consultants, Inc.
Nashville, TN

July 30, 2021

Thomas & Hutton
615 Main Street
Nashville, TN 37206

Attn: Messrs. Travis Todd and Chad Grass
E: Todd.T@tandh.com
Grass.C@tandh.com

Re: DRAFT Geophysical Testing Report
White House Business Park
NEQ) of Union Road and Melton Road
White House, Robertson County, TN
Terracon Project No. 18215095

Dear Messrs. Travis Todd and Chad Grass

We have completed the Geophysical Testing services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P18215095 dated April 19, 2021. Additionally, a limited geotechnical boring exploration to provide physical correlation to the geophysical data, referred to as ground truthing, was completed in general accordance with our Supplemental Change Order, dated May 28, 2021. This report presents the findings of the geophysical testing and provides general commentary concerning soil conditions in the vicinity of the proposed White House Business Park.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

John E. Agee, P.E.
Regional Manager
Tennessee P.E. No. 102047

Nicholas B. Ratcliff, P.G.
Senior Staff Geophysicist

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geophysical Testing Report

White House Business Park
NEQ of Union Road and Melton Road
White House, Robertson County, TN
Terracon Project No. 18215095
July 30, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed business park to be located at the northeast quadrant (NEQ) of Union Road and Melton Road which is near the I-65 Interstate and Highway 31-W in White House, Robertson County, TN. The purpose of these services is to provide information and geotechnical engineering commentary relative to:

- Subsurface soil conditions
- Geophysical findings and commentary

The geotechnical engineering Scope of Services for this project included geophysical testing and the advancement of 3 test borings to the auger refusal depth, varying from approximately 16.5 to 20.4 feet below existing site grades.

Maps showing the site and boring locations are shown in the Site Location and Exploration Plan sections, respectively. The geophysical images and boring logs are included in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located along the east side of Union Road, south of Highway 31-W near the NEQ) of Union Road and Melton Road in White House, Robertson County, TN See **Site Location**
Existing Improvements	Agricultural farmland, grass cover, some gravel roadways. Fill from unknown source in the northwest corner of the project site.
Current Ground Cover	Grass, agricultural, clay fill.

Item	Description
Existing Topography (from USGS LiDAR LPC TN Middle B1 2018 1758765NE & NW, 1758773SE & SW)	The area of interest varies from approximate elevation 864 feet, MSL, in the northeast corner of the site to as low as 800 feet in ditches and drainage features. Average elevations are estimated to be between 830 and 840 feet.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Planned Construction

Item	Description
Information Provided	Three primary locations are proposed for building locations. The entire site maybe developed as part of the future business park, but specific layouts and details are not available at this time. Preliminary geotechnical information is being provided for planning purposes only.
Project Description	Approximately 200-acre site, planned for a business park at some point in the future.
Estimated Start of Remediation	2022

GEOTECHNICAL CHARACTERIZATION

Site Geology

Formation [1]	Description
St. Louis Limestone and Warsaw Limestone	St. Louis Limestone - Residuum of nodules and blocks of chert in sandy clay. (Originally grayish-brown, medium-bedded limestone.) Maximum preserved thickness about 50 feet. Warsaw Limestone - Residuum of porous chert blocks in sandy clay. (Originally gray, medium- to coarse-grained, thick- bedded limestone.) Thickness about 60 feet..

1. *Greene, D.C., and Wolfe, W.J., 2000, Superfund GIS - 1:250,000 Geology of Tennessee, USGS, (geo250k).*
2. *Hardeman, W.D., Miller, R.A., and Swingle, G.D., 1966, Geologic Map of Tennessee: Division of Geology, Tennessee Department of Environment and Conservation, 4 sheets, scale 1:250,000*

The site is underlain by carbonate limestone that is highly susceptible to dissolution along joints and bedding planes in the rock mass. This results in voids and solution channels within the rock strata and a highly irregular bedrock surface. The weathering of the bedrock and subsequent collapse or erosion of the overburden into these openings results in what is referred to as karst topography. Any construction in karst topography is accompanied by some degree of risk for future internal soil erosion and ground subsidence that could affect the stability of the rock supported structure. Our review of the available topographic and geologic mapping, as well as our field exploration indicated two known sinkhole features on the site. The borings drilled at the site did not disclose additional obvious signs of impending overburden collapse or soil softening at depth or any deep soil slots in bedrock due to karst activity. The geophysical imagery indicated some areas where future karst risk may still be present. Additional information is contained in our Geophysical Findings section, as well as in the **Figures** section of this report.

Subsurface Conditions

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization forms the basis of our geotechnical evaluation of site preparation and remedial options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the geophysical model results can be found in the **Figures** section of this report.

In general, the area was overlain with a yellowish to reddish-brown, lean clay fill containing organics and mineral nodules. Below the first layer of lean clay, we encountered stiff to very stiff, reddish-brown and red lean clay with chert fragments, siltstone fragments, and mineral nodules. Next, we typically encountered a layer of brown and red fat clay with trace mineral nodules, chert fragments, possible phosphates, and sand lenses. Finally, we encountered auger refusal or high velocity materials as shown in our geophysical cross sections, indicative of bedrock.

Terracon performed surface geophysical exploration services consisting of 2D Electrical Resistivity Tomography (ERT). The primary goal of these surveys was to attempt to determine the top of bedrock at select locations at the project site and assess potential karst risk at the building pad locations. Seventeen (17) ERT survey lines were conducted in the vicinity of planned buildings, as presented on Exhibit 1. The ERT survey used an Electrical Resistivity system alternating between an Advanced Geosciences Inc. (AGI) SuperSting R8 control unit and an ABEM Terrameter LS2 control unit. The method uses an array of potential and current electrodes, driven into the ground, that collects resistivity measurements as a 2D section below the survey array. The different units were engaged for comparison data collections. After field collection, selective resistivity data was processed using Earth Imager 2D (engineered by AGI) and Res2DInv (engineered by Geotomo), inversion and modeling software packages, dependent on the hardware used to collect the data. Changes in the earth resistivity can indicate changes in lithology, saturation, and amount of fracturing. ERT survey lines were conducted between May 14 and 19 and June 7 and 8, 2021. A description of each line is listed in the table below.

Line	Building Pad	Approximate Line Orientation	Length of Testing (feet)	Spacing between Electrodes (feet)	Control Unit Used
Line 1	Building 1	N-S	550	10	Supersting
Line 2	Building 1	N-S	350	10	Terrameter
Line 3	Building 1	W-E	420	10	Terrameter
Line 4	Building 2	W-E	280	10	Supersting
Line 5	Building 2	N-S	300	10	Terrameter
Line 6	Building 2	S-N	280	10	Supersting
Line 7	Building 2	W-E	300	10	Terrameter
Line 8	Building 3	S-N	1,120	10	Supersting
Line 9	Building 3	S-N	690	15	Terrameter
Line 10	Building 1	S-N	820	10	Supersting
Line 11	Building 3	W-E	690	15	Terrameter
Line 12	Building 1	W-E	550	10	Supersting
Line 13	Building 1	W-E	550	10	Supersting
Line 14	Building 1	N-S	550	10	Supersting
Line 15	Building 3	W-E	550	10	Supersting
Line 16	Building 3	W-E	550	10	Supersting
Line 17	Building 1	N-S	550	10	Supersting

Borings B-1 through B-3 were drilled in the vicinity of the planned building pads, where accessible. The borings were located in the field based on our initial geophysical exploration results.

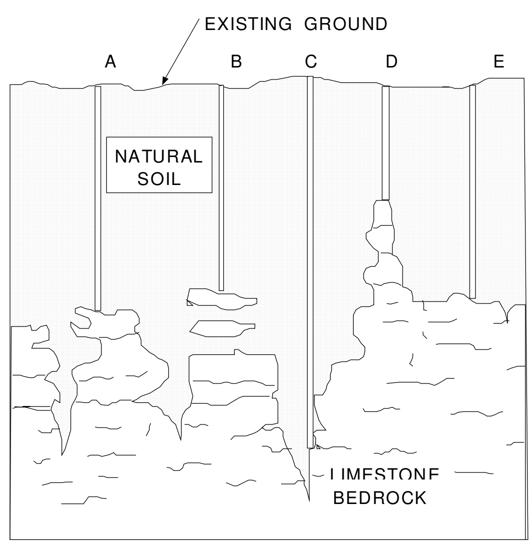
The natural clay is typically firm to very stiff based on Standard Penetration Test (SPT) N-values varying from 8 to 24 blows per foot (bpf).

The depth to auger refusal at our boring locations varied from about 16 ½ to 20 ½ feet below the existing ground surface in most locations, with the exception being location B-5. The following table summarizes the depth to auger refusal at each boring location.

Boring No.	Depth to Refusal (feet)
B-1	16.5
B-2	20.4
B-3	18.6

In an area of existing fill auger refusal can occur on man-made material, such as boulders, shot rock or construction debris. In an area of limestone bedrock, auger refusal can result on slabs of unweathered limestone suspended in the residual soil matrix ("floaters"), on rock "pinnacles" rising above the surrounding bedrock surface, in widened joints that may extend well below the surrounding bedrock surface, or on the upper surface of continuous bedrock. Several of these possible auger refusal conditions are illustrated in the figure below.

AUGER REFUSAL ILLUSTRATION



THIS FIGURE IS FOR ILLUSTRATIVE PURPOSES ONLY AND DOES NOT NECESSARILY DEPICT THE SPECIFIC BEDROCK CONDITIONS AT THIS SITE

The St. Louis Limestone bedrock formation is known for producing several obstructions that can cause the augers to refuse above sound bedrock. These obstructions can range from floaters to rock pinnacles as illustrated in examples A, B, C, and D in the above figure. Depth to competent bedrock in areas of karst geology can vary greatly over short distances. The possibility of varying depths to bedrock should be considered when developing the design and construction plans for this project.

Rock coring procedures are generally required to determine the character and continuity of the auger refusal material and these factors must be considered when evaluating the depth to auger refusal in those test borings that are not cored. Rock core operations were not performed for the purposes of evaluating rock quality.

GEOTECHNICAL OVERVIEW

The cross-sectional images generated from the ERT testing are displayed on Exhibits 2 through 6. The images are representations of the electrical resistivity of the subsurface materials. Resistivity is sensitive to clay content, water, sand content, and bedrock quality (clay seams and fractures). Water and clay (including fractured bedrock) produce low resistivity values (purple, blue, and dark green hues). Massive limestone units with minimal fracturing produce high resistivity values (red, orange, yellow, and light green hues). The following items were noted based upon our review of the geophysical data:

The top of rock surface appears to be generally between 20 and 35 feet below ground surface across the project site, with some features indicating shallower bedrock near the northern portion of Building 1 and some deeper bedrock near Building 3. Most of the difference in depth to the top of rock surface is anticipated to be due to topographic changes. In general, the top of rock surface is expected to be relatively flat, with some undulations and minimal variability.

Around the 390, 500, and 550-foot distances from the start of ERI-1 and the 330-foot distance from the start of ERI-8, potential karst features were observed at the bedrock surface. It is possible that these are simply changes in material properties such as a geologic formation change or joints within the bedrock, the ground truthing exploration did not encounter specific karst features, such as soil softening or degradation of soils at depth.

Observations of Note

In the northwest corner of the site, a fill pad was being constructed during our exploration. We understand the fill placement is ongoing, with unknown methods and an unknown fill source. Our electrical resistivity results indicate a change in resistivity values in the near surface of the fill pad. This can indicate a different fill source, differences in the compaction effort applied to the fill materials, or other anomalies within the fill. Each of these possibilities present potential risk, including long term settlement which could be realized in future building construction. As with each building pad, a design level geotechnical engineering study should be performed for the intended building and its use.

Two sinkholes with surface entry points were also noted in the general vicinity of the fill pad, as indicated on Exhibit 1. These sinkholes are along stream lineaments that we do not anticipate construction activities near; however, should the project require construction near the sinkhole features, Terracon should be retained to provide specific remediation recommendations, based on project needs.

Additional, deep-seated potential karst features are noted on Exhibits 2 through 6. Excavations for mass grading should be considered in these areas as deeper excavations have the potential of removing a bridging soil stratum, resulting in surface collapses. Collapses and subsurface areas of karst concern are typically remediated using inverted rock filters, a variety of subsurface grouting techniques, or a variety of building support systems.

Future grading and construction plans should incorporate design level geotechnical engineering and exploration efforts. Positive drainage is significantly important in mass grading and construction in karst geologies and should be planned into both efforts.

Should deeper excavations for mass grading occur, the potential also increases for encountering bedrock that could require excavation for project utilities.

The **General Comments** section provides an understanding of the report limitations.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer to provide design phase geotechnical engineering for the project infrastructure and buildings, and continue with observation and testing services during pertinent construction phases.

Environmental-related efforts were not part of this scope of work.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for planning purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE PLAN

White House Business Park ■ White House, Robertson County, TN

July 30, 2021 ■ Terracon Project No. 18215095

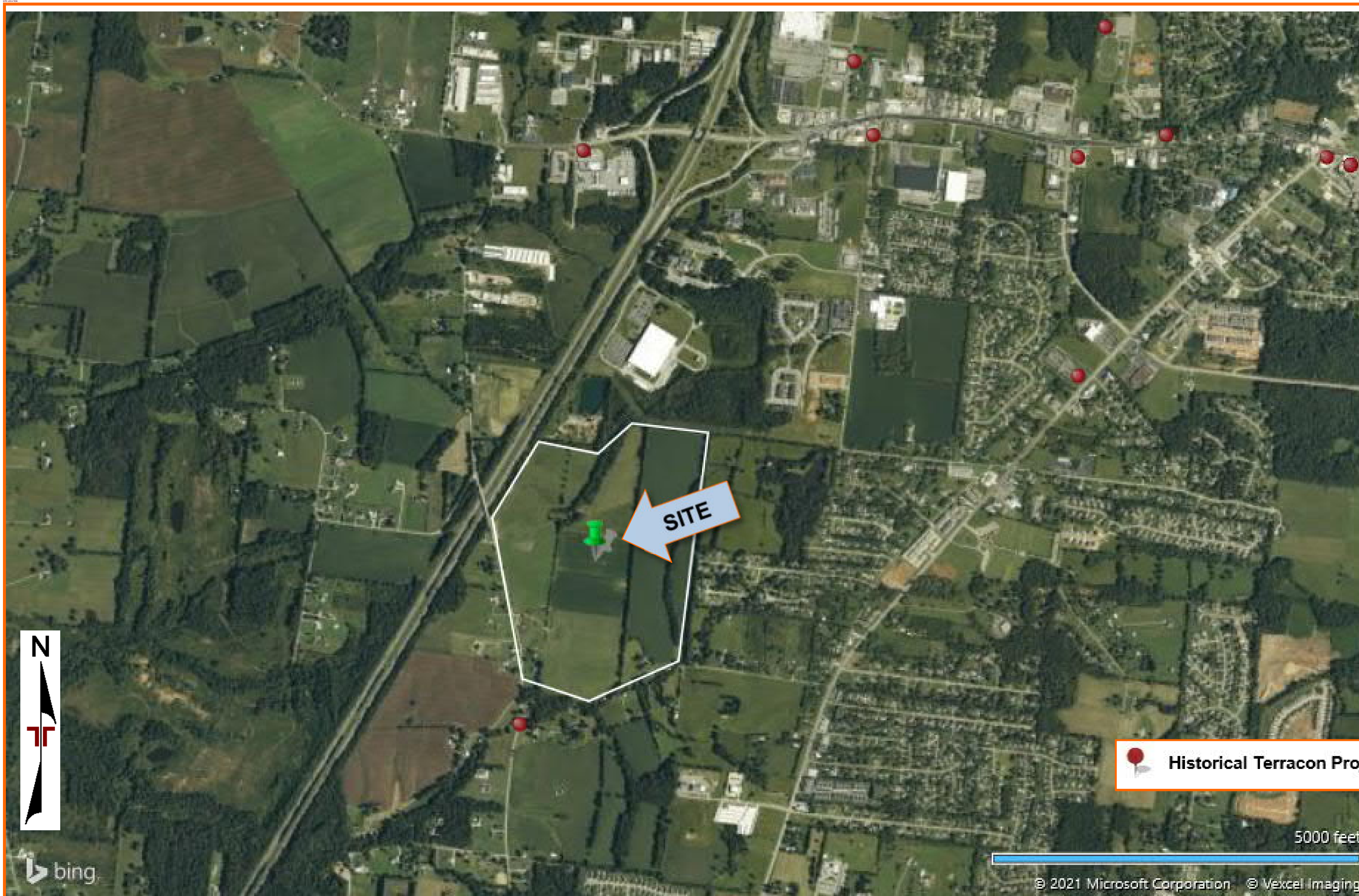


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

White House Business Park ■ White House, Robertson County, TN
July 30, 2021 ■ Terracon Project No. 18215095

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

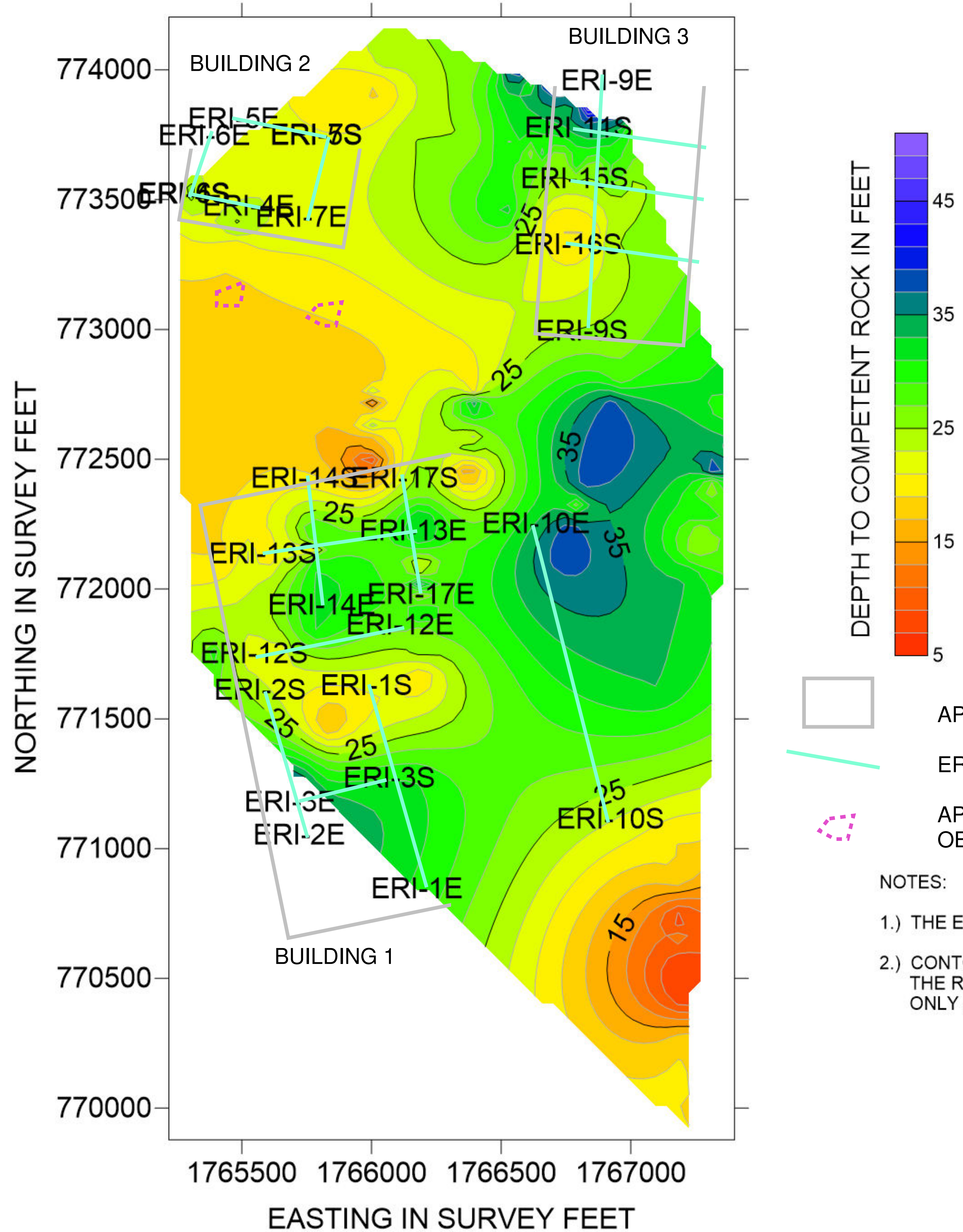
EXPLORATION RESULTS

Contents:

Geophysical Cross Sections (Exhibits 2 through 6)

Boring Logs (B-1 through B-3)

Note: All attachments are one page unless noted above.



Imagery Date: 10/22/2019

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

APPROXIMATE BUILDING EXTENT

ERI LINE

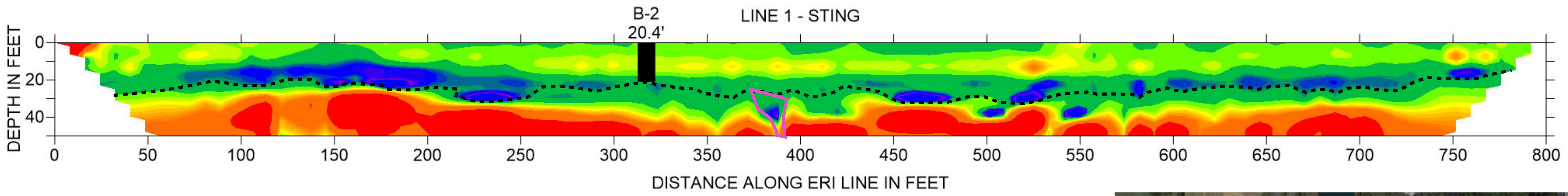
APPROXIMATE LOCATION OF OBSERVED SINKHOLE

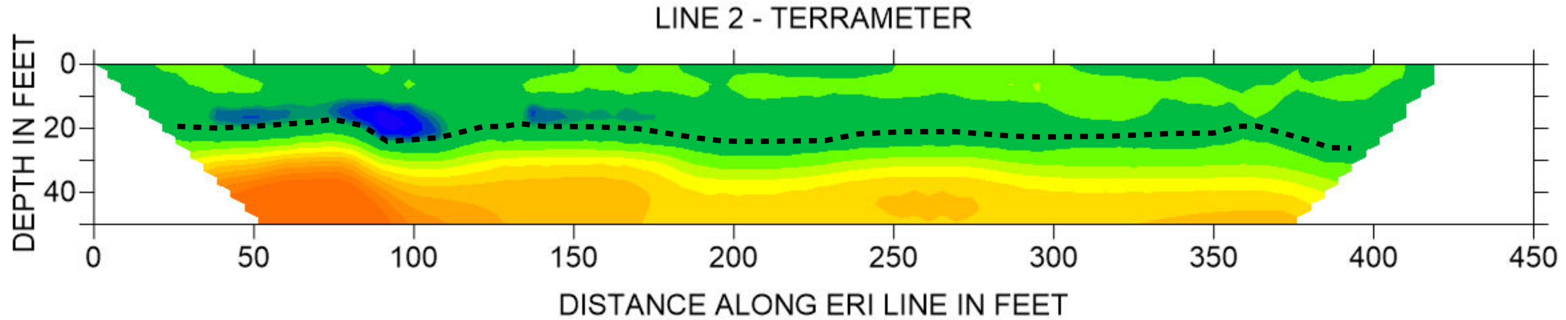
NOTES:

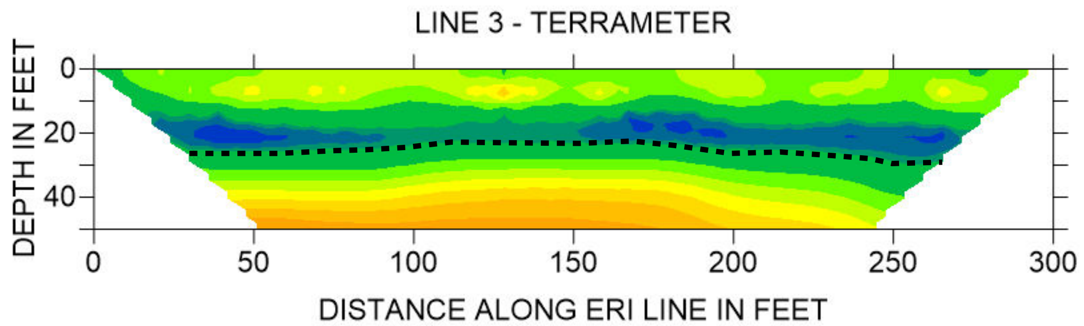
1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

2.) CONTOURS ARE DERIVED FROM THE ELECTRICAL RESISTIVITY DATA ONLY. THE RESULTS PRESENTED HEREIN SHOULD BE USED FOR VISUAL PURPOSES ONLY AND BE CONSIDERED AS APPROXIMATE.

Project Manager: NBR	Project No. 18215095	Terracon Consulting Engineers & Scientists	Electrical Resistivity Top of Rock Contours	EXHIBIT
Drawn by: NBR	Scale: NTS	5217 Linbar Drive, Suite 309 Nashville, TN 37211	White House Business Park White House, TN	1
Checked by: KJS	File Name: ToRContour.srf			
Approved by: JEA	Date: 7/30/2021			

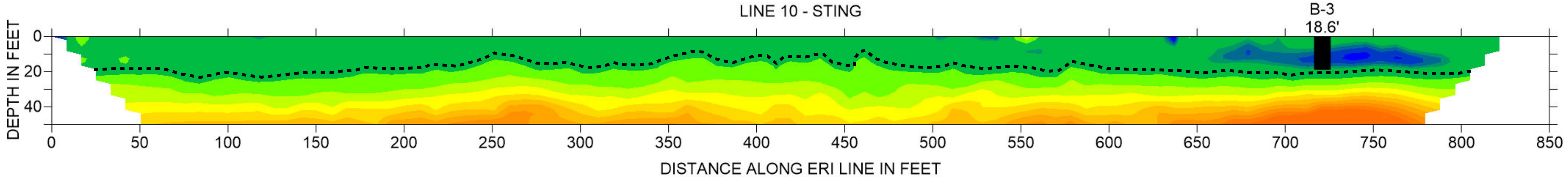


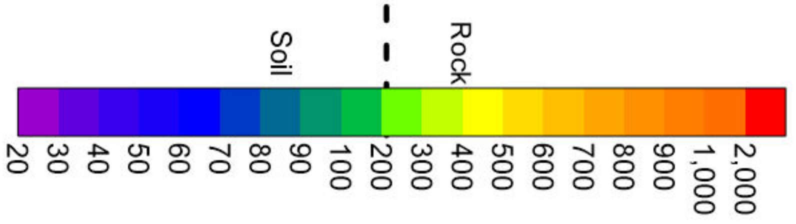




Imagery Date: 10/22/2019

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES





ELECTRICAL RESISTIVITY IN OHM-M

POTENTIAL KARST ANOMALY

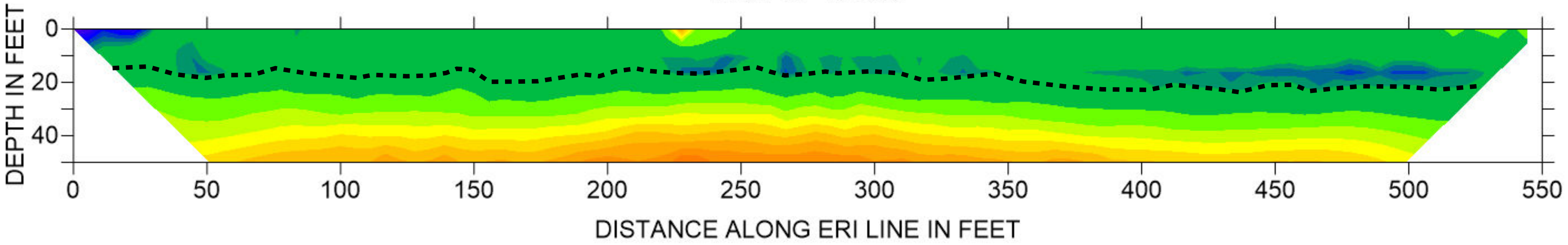
INFERRED TOP OF ROCK SURFACE

NOTES:

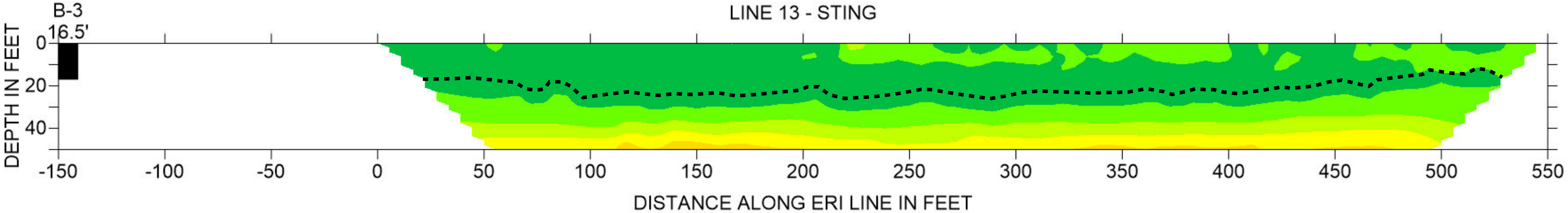
1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

Project Manager: NBR	Project No. 18215095	Terracon Consulting Engineers & Scientists	Electrical Resistivity Cross-Sections - Building 1	EXHIBIT
Drawn by: NBR	Scale: 1" = 60'	5217 Linbar Drive, Suite 309 Nashville, TN 37211	White House Business Park White House, TN	2
Checked by: KJS	File Name: ERI - 1.srf			
Approved by: JEA	Date: 7/21/2021			

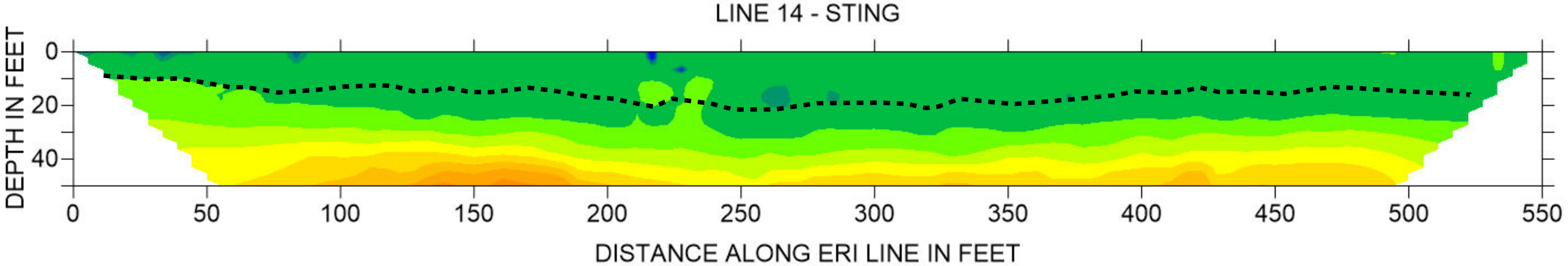
LINE 12 - STING



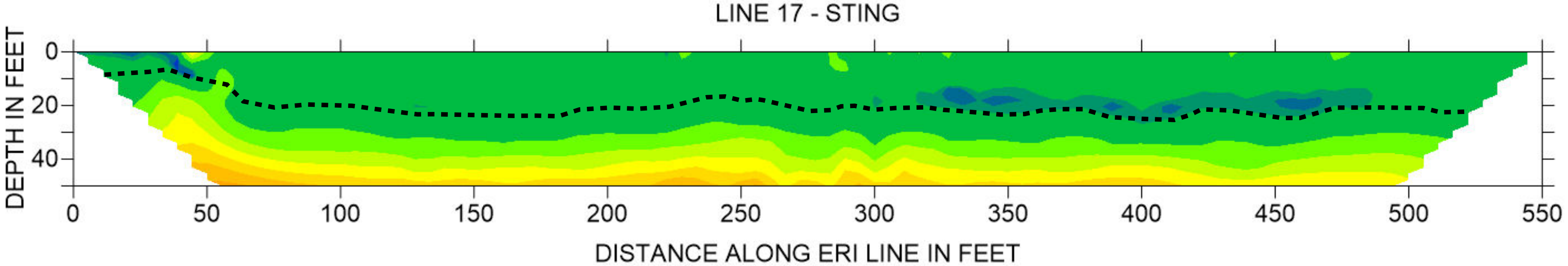
LINE 13 - STING

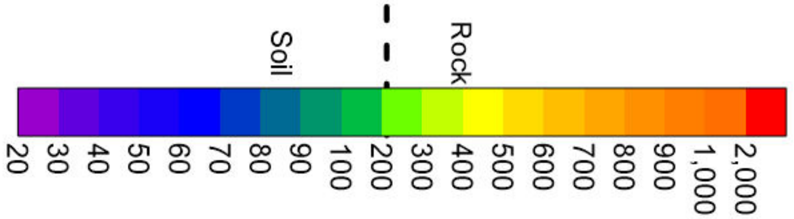


LINE 14 - STING



LINE 17 - STING





ELECTRICAL RESISTIVITY IN OHM-M

POTENTIAL KARST ANOMALY

INFERRED TOP OF ROCK SURFACE

Imagery Date: 10/22/2019

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOTES:

1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

Project Manager: NBR	Project No. 18215095
Drawn by: NBR	Scale: 1" = 60'
Checked by: KJS	File Name: ERI - 1-2.srf
Approved by: JEA	Date: 7/21/2021

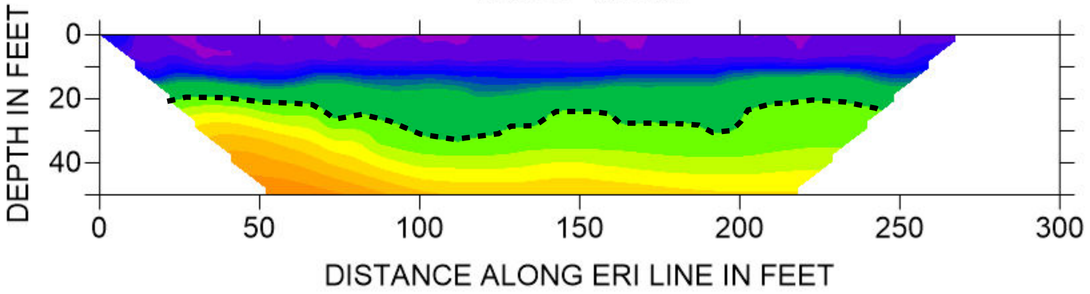
Terracon
Consulting Engineers & Scientists
5217 Linbar Drive, Suite 309
Nashville, TN 37211

Electrical Resistivity Cross-Sections - Building 1

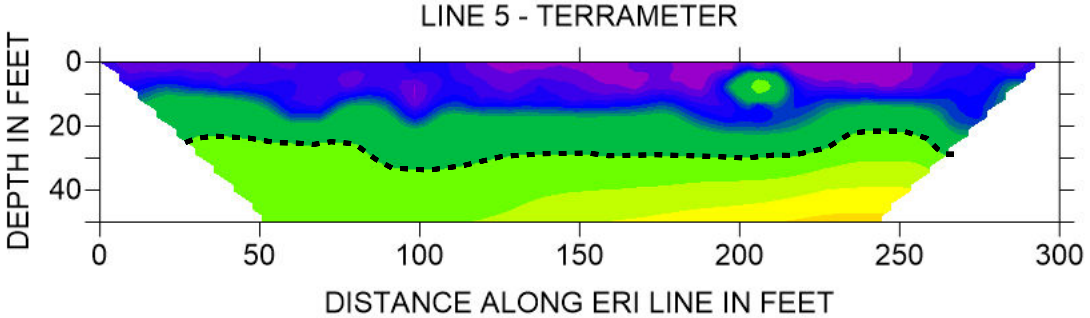
White House Business Park
White House, TN

EXHIBIT
3

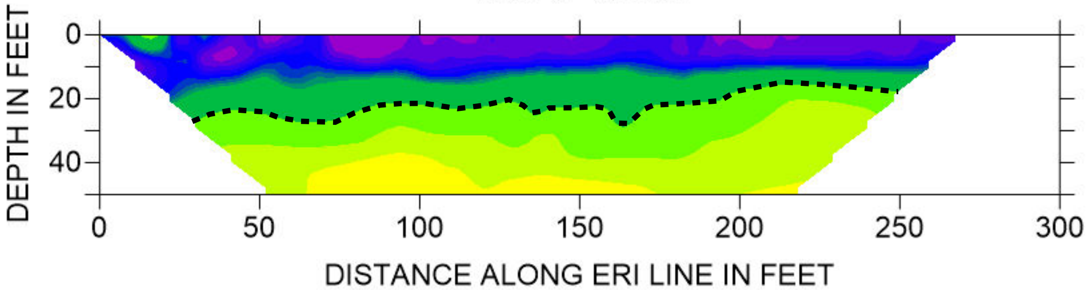
LINE 4 - STING



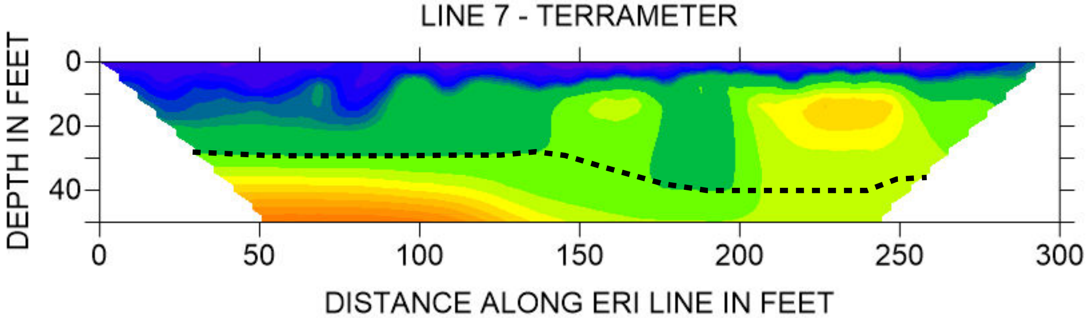
LINE 5 - TERRAMETER

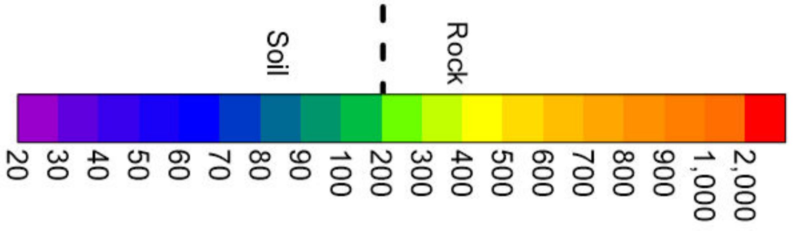


LINE 6 - STING



LINE 7 - TERRAMETER





ELECTRICAL RESISTIVITY IN OHM-M

POTENTIAL KARST ANOMALY

INFERRED TOP OF ROCK SURFACE

Imagery Date: 10/22/2019

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOTES:

1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

Project Manager: NBR	Project No. 18215095
Drawn by: NBR	Scale: 1" = 60'
Checked by: KJS	File Name: ERI - 2.srf
Approved by: JEA	Date: 7/21/2021

Terracon
Consulting Engineers & Scientists

5217 Linbar Drive, Suite 309
Nashville, TN 37211

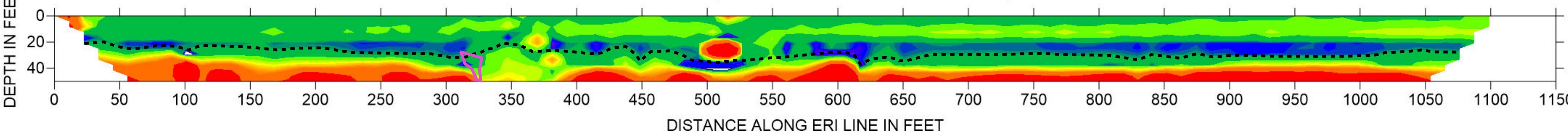
Electrical Resistivity Cross-Sections - Building 2

White House Business Park
White House, TN

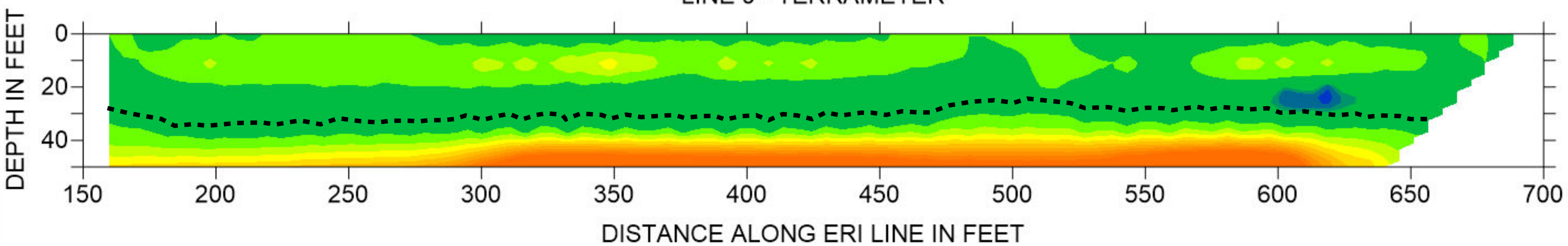
EXHIBIT

4

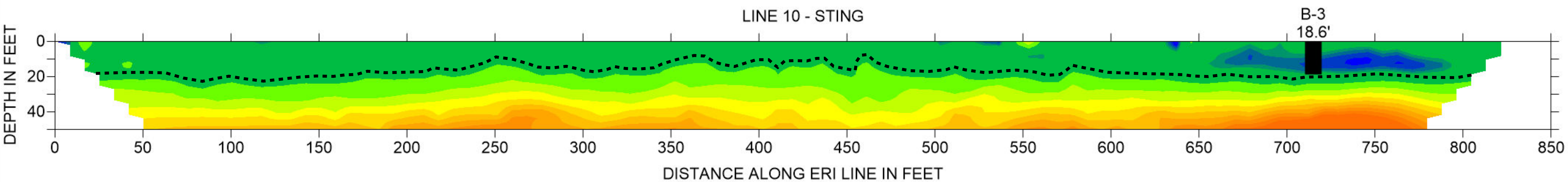
LINE 8 - STING (PLOTTED ON 80 SCALE TO FIT PAGE)



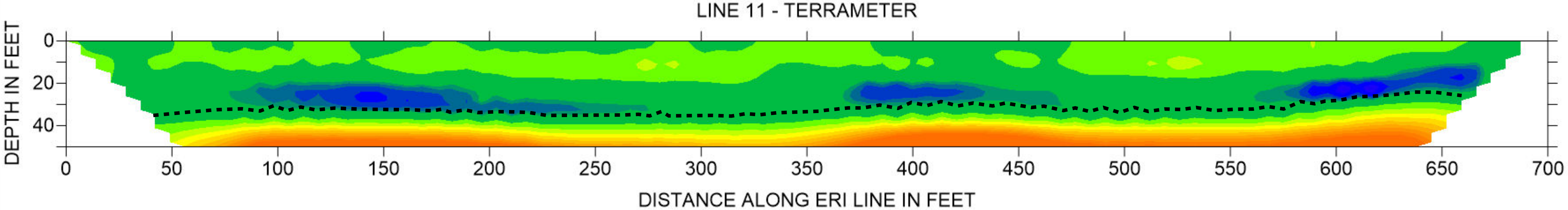
LINE 9 - TERRAMETER

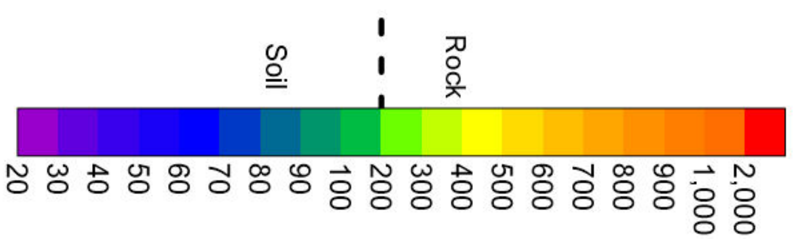


LINE 10 - STING



LINE 11 - TERRAMETER





ELECTRICAL RESISTIVITY IN OHM-M

POTENTIAL KARST ANOMALY

INFERRED TOP OF ROCK SURFACE

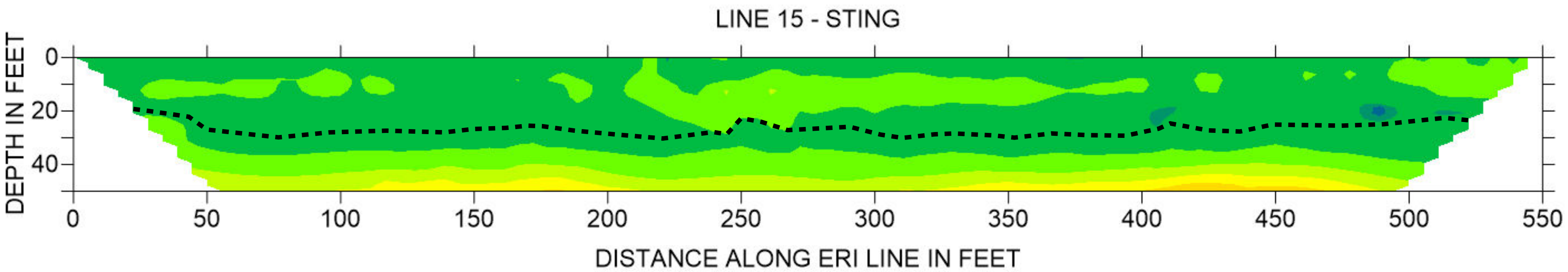
Imagery Date: 10/22/2019

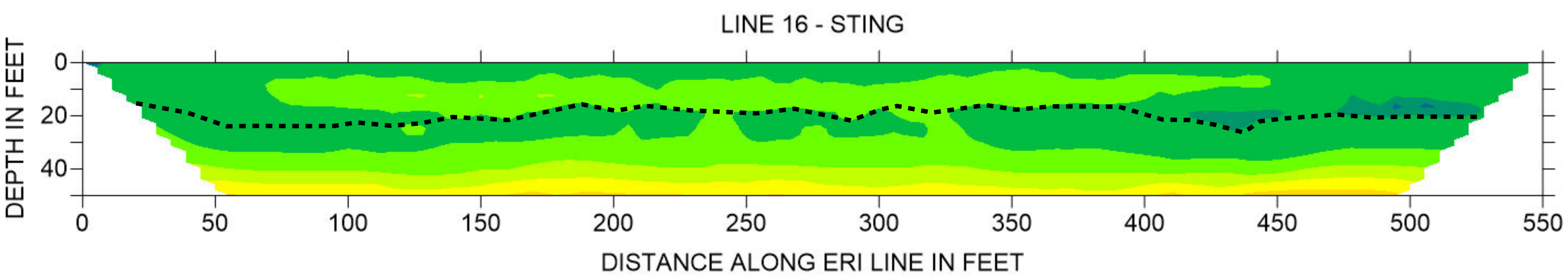
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

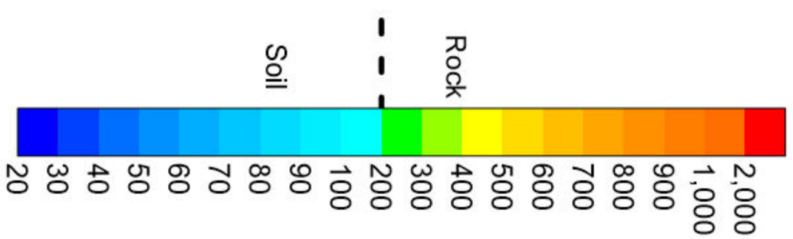
NOTES:

1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

Project Manager: NBR	Project No. 18215095	Terracon Consulting Engineers & Scientists	Electrical Resistivity Cross-Sections - Building 3	EXHIBIT
Drawn by: NBR	Scale: 1" = 60'	5217 Linbar Drive, Suite 309 Nashville, TN 37211	White House Business Park White House, TN	5
Checked by: KJS	File Name: ERI - 3-1.srf			
Approved by: JEA	Date: 7/21/2021			







ELECTRICAL RESISTIVITY IN OHM-M

POTENTIAL KARST ANOMALY

INFERRED TOP OF ROCK SURFACE

NOTES:

1.) THE ERI LINES PERFORMED BY TERRACON ARE SHOWN IN CYAN.

Imagery Date: 10/22/2019

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: NBR	Project No. 18215095	Terracon Consulting Engineers & Scientists 5217 Linbar Drive, Suite 309 Nashville, TN 37211	Electrical Resistivity Cross-Sections - Building 3
Drawn by: NBR	Scale: 1" = 60'		White House Business Park White House, TN
Checked by: KJS	File Name: ERI - 3-1.srf		EXHIBIT 6
Approved by: JEA	Date: 7/21/2021		

BORING LOG NO. B-1

PROJECT: White House Business Park - ERT

CLIENT: Thomas & Hutton Engineering Co Brunswick, GA

SITE: NEQ of Union Road and Melton Road White House, TN

LOCATION See Exploration Plan

Latitude: 36.4525° Longitude: -86.6899°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.3	**4" TOPSOIL**						
2.5	**LEAN CLAY (CL)**, trace mineral nodules and staining, trace chert, trace organics, yellowish brown, stiff			X	3-4-6 N=10		
10.0	**LEAN CLAY (CL)**, few chert, few silt, trace mineral nodules and siltstone, reddish black, very stiff to stiff	5		X	6-7-8 N=15		
				X	6-10-14 N=24		
		10		X	3-4-9 N=13		
16.5	**FAT CLAY (CH)**, reddish brown, stiff	15		X	3-4-9 N=13		
	Auger Refusal at 16.5 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
5217 Linbar Dr, Ste 309
Nashville, TN

Boring Started: 07-20-2021	Boring Completed: 07-20-2021
Drill Rig:	Driller: Tri-State Drilling
Project No.: 18215095	

BORING LOG NO. B-2

PROJECT: White House Business Park - ERT

CLIENT: Thomas & Hutton Engineering Co Brunswick, GA

SITE: NEQ of Union Road and Melton Road White House, TN

LOCATION See Exploration Plan

Latitude: 36.4501° Longitude: -86.6875°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		2.5	**LEAN CLAY (CL)**, trace mineral nodules and staining, dark yellowish brown to yellowish red, stiff			X	6-7-7 N=14		
		7.5	**LEAN CLAY (CL)**, trace silt, trace mineral nodules, dark red, stiff	5		X	4-5-7 N=12		
						X	3-6-2 N=8		
		15.0	**FAT CLAY (CH)**, trace chert, trace mineral nodules, dark red, stiff	10		X	3-5-7 N=12		
						X	3-6-9 N=15		
		20.4	**FAT CLAY (CH)**, few phosphates, brown, stiff	15		X	6-6-13 N=19		
			Auger Refusal at 20.4 Feet	20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
5217 Linbar Dr, Ste 309
Nashville, TN

Boring Started: 07-20-2021	Boring Completed: 07-20-2021
Drill Rig:	Driller: Tri-State Drilling
Project No.: 18215095	

BORING LOG NO. B-3

PROJECT: White House Business Park - ERT

CLIENT: Thomas & Hutton Engineering Co
Brunswick, GA

SITE: NEQ of Union Road and Melton Road
White House, TN

LOCATION See Exploration Plan

Latitude: 36.4565° Longitude: -86.6842°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		LEAN CLAY (CL), trace organics, trace mineral nodules, reddish brown, stiff				4-5-5 N=10		
		2.5 **LEAN CLAY (CL)**, trace mineral nodules, trace chert, reddish brown, stiff	5			4-5-7 N=12		
						4-6-11 N=17		
			10			4-4-8 N=12		
		10.0 **No Sample Recovered**	15			6-7-9 N=16		
		18.6 ***Auger Refusal at 18.6 Feet***				50/1"		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
5217 Linbar Dr, Ste 309
Nashville, TN

Boring Started: 07-20-2021	Boring Completed: 07-20-2021
Drill Rig:	Driller: Tri-State Drilling
Project No.: 18215095	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

White House Business Park - ERT ■ White House, TN

Terracon Project No. 18215095

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $[Cc<1$ or $Cc>3.0]$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $[Cc<1$ or $Cc>3.0]$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above “A” line		CL	Lean clay [K, L, M]
			$PI < 4$ or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

A Based on the material passing the 3-inch (75-mm) sieve.

B If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

E $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

F If soil contains $\geq$ 15% sand, add “with sand” to group name.

G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

H If fines are organic, add “with organic fines” to group name.

I If soil contains $\geq$ 15% gravel, add “with gravel” to group name.

J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

K If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

L If soil contains $\geq$ 30% plus No. 200 predominantly sand, add “sandy” to group name.

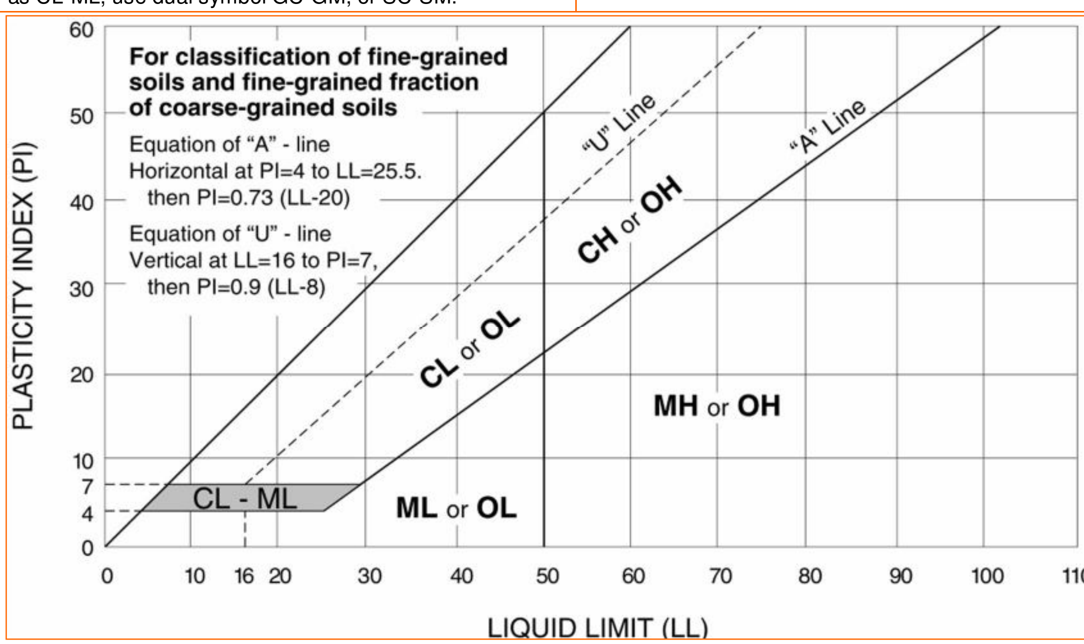
M If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

N $PI \geq 4$ and plots on or above “A” line.

O $PI < 4$ or plots below “A” line.

P PI plots on or above “A” line.

Q PI plots below “A” line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

DESCRIPTION OF ROCK PROPERTIES

Terracon GeoReport

WEATHERING	
Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" no discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)	
Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [1]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

1. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) [1]

RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

1. RQD (given as a percentage) = length of core in pieces 4 inches and longer / length of run

Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.