Geotechnical Data Report

Emergency Bridge Package 6 Richland County, South Carolina

May 12, 2016 SCDOT Project ID.: P029942, P029943, P029944 Terracon Project No. 73155050L (Rev. 1)

Prepared for:

South Carolina Department of Transportation Columbia, South Carolina

Prepared by:

Terracon Consultants, Inc. Columbia, South Carolina



May 12, 2016



South Carolina Department of Transportation P.O. Box 191 Columbia, South Carolina 29202-0191

- Attn: Mr. Trapp Harris, P.E. Geotechnical Design Engineer – Design-Build Section
- Re: Geotechnical Data Report Emergency Bridge Package 6 Richland County, South Carolina Project ID.: P029942, P029943, P029944 Terracon Project Number: 73155050L (Rev. 1)

Dear Mr. Harris:

Terracon Consultants Inc. (Terracon) has completed the geotechnical exploration and testing services for the above referenced project. These services were conducted in general accordance with the SCDOT Scope of Services, dated April 15, 2016. This geotechnical data report presents the findings of the subsurface exploration and laboratory testing along with an overview of testing activities.

1.0 INTRODUCTION

The South Carolina Department of Transportation (SCDOT) has contracted Terracon to perform subsurface exploration and laboratory testing for the replacement of three bridges along the SC 48 (Bluff Road) alignment in Richland County, South Carolina. The bridges to be replaced are as follows:

- n Back Swamp (Pin # P029942)
- n Cedar Creek (Pin # P029943)
- n Dry Branch (Pin # P029944)

The purpose this work is to develop information relative to subsurface soil and groundwater conditions at the end bent locations for the aforementioned bridge locations. This report presents the results of that work. No geotechnical recommendations are associated with the requested scope of study.

The following sections of this report contain a summary of the activities our field exploration and laboratory testing. The logs of the soil test borings, CPT soundings, MASW arrays, the Site Location Map and the Boring Location Plans are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during



Terracon Consultants, Inc.521 Clemson RoadColumbia, South Carolina 29229P[803] 741 9000F[803] 741 9900terracon.com



the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 **PROJECT DESCRIPTION**

The project sites are located along SC 48 (Bluff Road) in Richland County, SC and span Back Swamp, Cedar Creek, and Dry Branch. Site location and boring locations plans are presented in Appendix A of this report. It is our understanding that the project will include the demolition/removal of each existing bridge and will be replaced with a new structure on the existing or similar horizontal alignment. The existing bridges are multi-span structures that are supported on a driven pile foundation system. The original structures appears to be supported on driven timber piles whereas subsequent widenings utilized Pre-Stressed Concrete (PSC) piles. At the time of the field exploration, the surface of the stream flow was generally about 10 feet below the existing bridge decks.

3.0 GEOTECHNICAL TESTING

The geotechnical exploration for this project was performed between April 26 and May 3, 2016. The results of our field work and our associated laboratory testing is attached in appendixes A and B of this report.

3.1 Field Exploration

Our field exploration at the site consisted of the following:

- n Six (6) Standard Penetration Test (SPT) Borings (B-1, B-2, B-3, B-4, B-5, and B-6)
- n Six (6) Cone Penetration Test (CPT) Soundings (CPT-1, CPT-2, CPT-3, CPT-4, CPT-5, and CPT-6)
- n Geophysical testing consisting of three (3) Multi-channel Analysis of Surface Waves (MASW) arrays (MASW-1, MASW-2, and MASW-3)

The shear wave velocity profile is provided in Appendix A for each bridge. The 100-foot average shear wave velocity value shown on each profile is based on the data obtained below the fill embankment.

The tests were performed at the locations requested by the SCDOT. A description of our testing methods and graphical logs outlining the soil conditions at each test location are presented in Appendix A. Test locations were established in the field by Terracon and surveyed by Construction Support Services, LLC, after completion. The rig set ups at the boring/sounding locations are provided in photographs in Appendix A.



3.2 Laboratory Testing

The following laboratory tests were performed on the soil samples collected at the site:

- n Thirty (30) Natural Moisture Content Tests (ASTM D2216)
- n Eleven (11) Atterberg Limits Tests (ASTM D4318)
- n Twenty Four (24) Material Finer than No. 200 by Washing (ASTM D1140-14)

The scope of the laboratory testing frequency was determined by the SCDOT. The tested samples were chosen by Terracon to provide lithological information. The laboratory procedures and results of the laboratory tests are presented in Appendix B.

4.0 CLOSURE

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

Sincerely, Terracon Consultants, Inc.

Kenneth J. Zur, P.E. Senior Geotechnical Engineer SC Registration No. 25833

Attachments

Copies: Addressee (1 via email) File (1) Phillip A. Morrison, P.E. Geotechnical Department Manager SC Registration No. 17275

APPENDIX A FIELD EXPLORATION

Exhibit A-1 – Site Location Map Exhibits A-2 – A-4 – Boring Location Plans Exhibit A-5 – Field Testing Summary Exhibits A-6 – A-8 – MASW Results Exhibit A-9 – Field Testing Description Exhibit A-10 – Soil Description Terms Exhibit A-11 to A-16 – Boring Logs Exhibits A-17 – A-22 – CPT Sounding Logs Exhibits A-23 to A-28 – CPT Correlative Logs Exhibit A-29 – Photographic Log



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Terracon

Field Testing Summary

Boring No.	Location	Offset	Ground Elevation (ft)	Test Depth (ft)	Northing	Easting	Latitude	Longitude
B-1	WBL	Lane Center	121.1	100.0	739225.62	2036420.75	33.865054	-80.880004
B-2	EBL	Lane Center	121.4	100.0	739184.78	2036566.17	33.864941	-80.879525
B-3	WBL	Lane Center	132.1	100.0	736293.80	2050977.36	33.856940	-80.832060
B-4	EBL	Lane Center	132.1	100.0	736257.14	2051159.89	33.856838	-80.831459
B-5	WBL	Lane Center	137.9	100.0	734624.32	2059285.09	33.852311	-80.804702
B-6	EBL	Lane Center	137.8	100.0	734592.87	2059373.86	33.852224	-80.804410
CPT-1	EBL	Lane Center	121.2	44.8	739214.76	2036417.90	33.865024	-80.880014
CPT-2	WBL	Lane Center	121.4	39.8	739196.41	2036569.48	33.864973	-80.879514
CPT-3	EBL	Lane Center	131.9	19.3	736281.78	2050976.26	33.856907	-80.832064
CPT-4	WBL	Lane Center	132.1	20.3	736244.89	2051157.48	33.856895	-80.831467
CPT-5	EBL	Lane Center	137.8	33.3	734612.33	2059281.90	33.852278	-80.804712
CPT-6	WBL	Lane Center	137.9	32.0	734605.14	2059375.77	33.852258	-80.804403

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FIELD EXPLORATION DESCRIPTION

Overview

The testing locations were provided by the SCDOT and located in the field by Terracon by taking measurements from existing structures shown on the provided drawings. The borings were surveyed by Construction Support Services, LLC after testing and drilling was complete. The locations as shown in the Exploration Location Plan are shown to the scale indicated.

A field log of each test location was prepared by our engineer. The final boring logs included with this report represent the engineer's description of the encountered conditions modified as necessary based on laboratory test results of the individual samples.

Soil Test Borings (STB)

All boring and sampling operations were conducted in general accordance with the following procedures:

- n SCDOT Geotechnical Design Manual 2010
- n ASTM D5783, "Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geo-environmental Exploration"
- n ASTM D1586 "Test Method for Penetration Test and Split-Barrel Sampling of Soils"
- n ASTM D4220 "Standard Practices for Preserving and Transporting Soil"

Each boring was advanced using rotary wash drilling techniques. Five samples were collected in the upper 10 feet. Below that depth, samples were obtained at 5 foot intervals. Soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-barrel sampler, also known as a standard split-spoon. The sampler is advanced into the soil a total of 18 inches by striking the drill rod using a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler for each of three, 6-inch increments is recorded. The sum of the number of blows for the second and third increments is called the "Standard Penetration Value", or N-value (N_{meas}, blows per foot). The N-value, when properly evaluated, is an index to the soil strength.

Soil Classification provides a general guide to the engineering properties of various soil types and enables the engineer to apply his experience to current situations. In our exploration, samples obtained during drilling operations are examined and visually classified by a geotechnical engineer using the procedures outlined in ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System). Laboratory testing was also performed on select split-spoon samples to evaluate index properties for further classification. The soils are described according to color, texture, and relative density or consistency (based on standard penetration resistance). The designations shown on the logs are described on Exhibit A-10 and Exhibit C-2.

Due to the drilling method (i.e. rotary wash), time-of-drilling water levels were not be recorded. The 24-hour groundwater readings were collected from the borings. These are indicated on the

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boring logs. At the conclusion of the work, the boreholes were backfilled with drill cuttings and capped with cold-patch asphalt.

Cone Penetration Test Soundings (CPT)

Cone Penetration Test soundings were conducted in general accordance with ASTM D5778 Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils. To facilitate CPT testing, the asphalt pavement at each location was pre-drilled exposing the underlying soils.

Seismic Surface Wave Testing

Multi-Channel Analysis of Surface Waves (MASW testing) was performed to determine the shear wave velocity profile of the layered soil system. At the test location both MASW readings (active) and Microtremor Array Measurement (MAM) readings (passive) were recorded. The MASW test was conducted using the 24-channel Geometrics Geode seismographs and 4.5-Hz geophones with a linear geometry at an interval of 10-ft. Surface waves were generated by a 20-pound sledgehammer striking a polyethylene plate at four locations. MAM testing was performed along the same survey line.

MASW (Active) Testing - Multi-Channel Analysis of Surface Waves (MASW) is a seismic method that uses the dispersive characteristics of Rayleigh-type surface waves to determine the variation of the shear-wave velocity of layered soils with depth.

MAM (Passive) Testing - Microtremor Array Measurement (MAM) "for lower frequency surface waves (passive waves) arising from microtremors and/or urban (traffic) noise and recorded them using a linear or two dimensional (triangle, circle, semicircle, and "shapes") array of geophones (Zywicki and Rix, 1999; Lie et al., 2000). Multiple noise records are required for analysis. The data filters out the Rayleigh waves through a technique called spatial auto-correction (SPAC). This allows the development of a dispersion curve that is defined as the lower envelope of the measured energy peaks. MAM testing results in lower peak energy selections than the active testing described above.

SOIL DESCRIPTION TERMS

Relative Density/Consistency Terms

Relative Density¹ Consistency² SPT Blow Unconfined Descriptive Term Relative Density SPT Blow Count Descriptive Term Compression Count Strength (q_u) (tsf) 0.25 and less 2 and less Very Loose 0 to 15% 4 and less Very Soft Soft 16 to 35% 5 to 10 0.26 to 0.50 3 to 4 Loose Medium Dense 36 to 65% 11 to 30 Firm 0.51 to 1.00 5 to 8 Stiff Dense 66 to 85% 31 to 50 1.01 to 2.00 9 to 15 Very Dense 86 to 100% 51 and more Very Stiff 2.01 to 4.00 16 to 30 Hard 4.01 and more 31 and more

Moisture Condition

Descriptive Term	<u>Criteria</u>
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

Color

Describe the sample color while sample is still moist.

Angularity¹

Descriptive Term	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

HCI Reaction³

Descriptive Term	<u>Criteria</u>
None Reactive	No visible reaction
Weakly Reactive	Some reaction, with bubbles forming slowly
Strongly Reactive	Violent reaction, with bubbles forming immediately

Cementation³

Criteria
Crumbles or breaks with handling or little finger pressure
Crumbles or breaks with considerable finger pressure
Will not crumble or break with finger pressure

Particle-Size Range¹

Gravel	Diameter, mm	Sieve Size	<u>Sand</u>	Diameter, mm	Sieve Size
Fine	4.76 to 19.1	#4 to ¾ inch	Fine	0.074 to 0.42	#200 to #40
Coarse	19.1 to 76.2	3/4 inch to 3 inch	Medium	0.42 to 2.00	#40 to #10
			Coarse	4.00 to 4.76	#10 to #4

Primary Soil Type^{1, 2}

The primary soil type will be shown in all capital letters.

USCS Soil Designation

Indicate USCS soil designation as defined in ASTM D-2487 and D-2488

AASHTO Soil Designation

Indicate AASHTO soil designation as defined in AASHTO M-145 and ASTM D-3282

¹ Applies to coarse-grained soils (major portion retained on No. 200 sieve)

² Applies to fine-grained soils (major portion passing No. 200 sieve)

³ Use as required

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Elev.:	121.1	ft	Latitud	e:	33.8	865054	L	ongit	ude:	-	80.8	3800	04	0	Date	Star	ed:		4/2	6/2016	i
Total D	epth:	100	ft S	Soil I	Depth:	100	ft	Co	ore De	epth:		0 ft			Date	Com	plet	ed:	4/2	8/2016	i
Bore H	ole Dia	imeter ((in):	2.94	4 Sam	npler Co	nfig	uratio	on	Li	ner	Rec	luire	ed:	Y	N)	Line	r Usec	I: Y	N
Drill Ma	achine	CM	E-550X	C	orill Meth	od: R	W			Ham	mer	Тур	e: /	Auto	omat	ic	E	nergy	Ratio	: 74.2	2%
Core S	ize:	N.A.			Oriller:	A. La	rge			Grou	ndv	vate	r: '	TOE	8 I	N.A.		24	4HR	9 ft	
																		• SPT	N VAL	UE	
5	6							<u>.</u>	e –	e	B				e		P	Ļ	MC	LL	
vati (ft)	(ff)	N	MATERIA	AL C	ESCRIP	TION		aph -og	epth (#)		, i		.0	50	Valı			`	0	~	
Ele						-		5_	So	Sa		lst	Snd	3rd (ź	0 10	20	FINES		ENT (%)	0 00
		Mediur	n dense, v	wet, t	prownish y	ellow,		888				-					20	30 40	000		0 90
		subrou	nded to su	uban	gular, fine	to mediur	n										:				
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										SS-	12	7	6	12	18		•				
76.1-											_										
																÷	:				
-	-									-											
	47.0																				
-	1	Hard, d	dry, gray, l	Lean	CLAY (CL	.) (A-6)				-											
_		10YR 6	5/1														-				
					00 51 40				48.5												
		@55-1	13: LL=34,	, PL=	22, PI=12,	NMC=19	9.0					~ -	o /="								
										55-	13	26 5	0/5"		50/5"		Q K ∶				>>
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	1 -									-											
	52.0																				
		Very d	ense, moi	st, gr	ay, fine Si	Ity SAND										:	÷				-
-	-	10YR 6	6/1	n sea	ins (Sivi) (A-2-4)				_											
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- 18	-	,						<i>\////</i>	E0 F	-											
r J								V////	58.5		+						:				
-	1 -							V////		ss-	15	22	35	46	81						
61 1 -	_							V////													
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	62.0	Dense	to very de	ense	wet arav			<i> </i>		-							:				-
5 i		subrou	inded to si	uban	gular, fine	to mediur	n														
L	I							LF	GENI)						<u> </u>		Co	ntinue	d Nex	t Page
			SAMPL	ER T	YPE					-				DF	RILLIN	IG MI	THO	D			
SS -	Split Spo Undistur	on hed Sami	nle	NC	2 - Rock C	ore, 1-7/8'	•		HS	SA - Ho	ollow	Sten	1 Aug Fliab	ger t Au	here	F F	- W 2C	Rotary	Wash		
AWG-	Rock Co	re, 1-1/8"		C	F - Continu	ous Tube				<u> </u>	iving	Casi	ng	, nu	3010				0010		

Pro	ject	ID: F	029942					Co	unty:	Ric	chlan	d			Borin	g No.	: B-1		
Site	e Des	scripti	on:	Emerge	ncy Bridge I	Package	6								R	oute:	SC	48	
Eng	g./Ge	eo.: F	R. Sarka	r	Boring L	ocation:	WBL		(Offse	et:	L	ane	Ctr	Align	ment	: E	xisting	j
Ele	v.:	121.1	ft	Latitude	: 33.8	65054	Longit	ude:	-80	.880	004	C	Date	Start	ed:		4/26	/2016	
Tot	al De	epth:	100	ft Sc	oil Depth:	100 ft	Co	ore De	pth:	0 f	t	D	Date	Com	pleted	l:	4/28	/2016	
Bo	re Ho	ole Dia	ameter (i	in): 2	2.94 Sam	pler Con	figuratio	on	Line	er Re	quire	ed:	Y	N	L	iner l	Jsed:	Y	N
Dri	ll Ma	chine	CM	E-550X	Drill Meth	od: RW	/		Hamme	er Ty	pe:	Auto	omat	ic	Ene	rgy R	atio:	74.29	%
Co	re Si	ze:	N.A.		Driller:	A. Larg	е		Ground	dwat	er:	TOB	8 1	N.A.		24⊦	IR	9 ft	
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Ē							Ū	ыс	N N N	1st (2nd	3rd	z	0 10	▲ FII 20_30	NES CO 0 40 5	ONTEI 50 60	NI(%) 7080	90
			Silty SA	ND with m	nica (SM) (A-2	-4) 10YR		63.5	_										
		_	4/1																_
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		_																	
								68.5]										
	_	-	@SS-1	7: NMC=17	7.3, %#200=20).2			_										-
									SS-17	16	28	26	54			÷	•		:
5	51.1-	-							-										
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101																			
14.G		_						78.5]							÷			
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12 30									SS-19	26	50/5"		50/5"			÷			>>
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1550				044451 5			LE	GENE)						TUOS	Cont	inuec	l Next	Page
≍ ⊨ ss	- S	Split Spo	oon	SAMPLE	RIYPE NQ - Rock Co	ore, 1-7/8"		HS	A - Hollo	w Ste	m Auc	DF ger	KILLIN	NG ME R'	W - R	otary W	Vash		
	- U	Indistur	bed Samp	le	CU - Cuttings			CF	A - Cont	inuou	s Fligh	t Aug	gers	R	C - R	ock Co	re		
S AN	/G - F	KOCK CC	re, 1-1/8"		CI - Continu	ous lube			, - Drivir	ng Ca	sing								

Project	t ID: F	29942	2				Coi	unty:	Ri	chlar	nd			Boring	g No.	: B-1	1	
Site De	scripti	on:	Emergen	cy Bridge F	ackage 6	6		-						R	oute	SC	; 48	
Eng./G	eo.: F	R. Sarka	ir	Boring L	ocation:	WBL		(Offs	et:		Lane	Ctr	Aligni	ment	: E	xistin	g
Elev.:	121.1	ft	Latitude:	33.86	65054	Longi	tude:	-80	.880	0004		Date	Start	ed:		4/26	/2016	
Total D	epth:	100	ft Soi	I Depth:	100 ft	Co	ore De	pth:	01	ft		Date	Com	pleted	:	4/28	/2016	
Bore H	ole Dia	imeter (in): 2.	94 Sam	pler Conf	igurati	on	Line	er Re	equir	ed:	Y	N	Li	iner I	Jsed:	Y	N
Drill Ma	achine	CM	E-550X	Drill Metho	od: RW			Hamme	er Ty	/pe:	Aut	omat	ic	Ene	rgy F	Ratio:	74.2	%
Core S	ize:	N.A.		Driller:	A. Larg	e		Ground	dwat	er:	то	B I	N.A.		24ŀ	IR	9 ft	
														•	SPT N	VALU	IE ●	
														PI		10		
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(fileva	D Del		/IATERIAL	DESCRIP	ION	Cap	Del	San lo.∩	t 6"	d 6'	d 6"	×		▲ FIN	NES C	ONTEI	NT (%)	
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31.1-																		
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2			SAMPLER	TYPE							D	RILLIN	IG ME	THOD				
	Split Spo	on hed Samr	hle	NQ - Rock Co	re, 1-7/8"			A - Hollo	w Ste		ger ht ∆	Idere	R	W - Ro	otary V	Vash		
AWG-I	Rock Co	<u>re, 1-1</u> /8"		<u>CT - Continuo</u>	us Tube			<u>- Drivir</u>	ng Ca	sing		9013		J - NU				

Project	: ID: F	029942	2						Со	unty:	Ri	chla	nd			Bor	ing N	lo.: [3-2	
Site De	scripti	on:	Emerge	ency	Bridge I	Packa	age (3	·								Rout	te: 🕄	SC 48	
Eng./G	eo.: F	. Sarka	ar	E	Boring L	_ocati	ion:	EBL			Offse	et:	L	Lane	Ctr	Alig	jnme	nt:	Exist	ing
Elev.:	121.4	ft	Latitude	e :	33.8	6494	1	Longi	tude:	-80).879	9525	I	Date	Start	ed:		4/2	27/201	16
Total D	epth:	100	ft S	oil D	epth:	10	00 ft	C	ore De	epth:	0 f	ft		Date	Com	plet	ed:	4/	28/20 ⁻	16
Bore H	ole Dia	meter	(in):	2.94	Sam	pler (Conf	igurat	on	Lin	er Re	equi	red:	Y	N)	Line	r Use	ed: `	Y N
Drill Ma	achine:		IE-550X	Dr	ill Meth	od:	RW			Hamm	er Ty	/pe:	Auto	omat		E	nergy	/ Rati	o: 74	.2%
Core S	IZE:	N.A.		Dr	iller:	A. I	Larg	е		Groun	awat	er:	TOP	3	N.A.		2	4HK	91	τ
																	• SP1		LUE ●	
																	-	MC	· ·	
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leva (ft	Dep (ff	r	MATERIA	AL DE	SCRIP	TION		Lo P	Dep	Sam No./T	t 6"	d 6"	1 6"	2			FINES	CON	TENT (%)
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		ASPH/	ALT (12 INC	cnes)					1.0											
	1.0	FILL -	Medium de	ense t	o loose, r	noist.			1.0	-										
		grayisł	n brown, su	ubrour	nded to si	ubangi	ular,		3	SS-1	10	6	6	12						
		SAND	with clay s	a, inte seams	(SC) (A-	2-6) 10	9ey 0YR		§]						-				
		5/2	-		. , .	,			3.0											
									}	55-2	5	6	6	12						
	-								8	- 00-2		0	0	12					· · ·	
116.4-									5.0											
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-									8	SS-3	4	5	6	11						
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									<pre></pre>	SS-4	2	2	2	4	•					
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	9.0	<u> </u>	/// IBA \/			0	-l		9.0											
		Lean C	CLAY (CL)	y soπ, (A-7-6	wet, gra 3)10YR 6	y, San /1	ay			SS-5	_{\^}	/∩⊔/1	8"			_:				
111.4-			()		,					- 00-0			0			<u> </u>			<u>-</u>	
		@SS-	5: LL=45, F	PL=17	, PI=28, N	NMC=3	32.8,								1					
		%#200)=59.4																	
	12.0	0046				dork				-										
		brown,	subrounde	ed to	subangula	ar, wea	akly													
	-	cemen	(100, 100)) medi	um Claye	ey SAN	١D		13.5	-										
/10		(00) (/	-2-0) 1011	11 0/0															· · ·	
5/12										SS-6	2	4	6	10	•					
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IPLAI		Loose, suban	wet, brow	n, sub to coa	rounded	to v Grac	ded													
- IEV	-	SAND	(SP) (A-3)) 10YF	R 4/3	, 0.00			10-	-						:				-
DATA									18.5											
100 -										SS-7	4	4	4	8						
¹⁰⁰																				
GD																:				
20201								<u>[사진]</u> 기 1		<u>ו</u>					:	:	<u> </u>	ntin	ind Na	avt Pare
2315			SAMPLE	ER TY	PE					,			D	RILLIN	NG ME	THO				ni i aye
	Split Spo	on Ded Sam	nle	NQ	- Rock Co	ore, 1-7	7/8"		HS		w Ste		iger	nere	R	W -	Rotar	y Was	h	
S AWG-I	Rock Co	re, 1-1/8"		CT	- Continu	, ous Tu	ibe			<u> - Drivi</u>	ng Ca	ising	nt Au	9015	rt		NUCK	JUIE		

Proje	ct ID:	P02	9942										Co	unty	-	Ric	chla	nd			B	orir	ng No	o.:	B-2		
Site Description: Emergency Bridge Package 6 I Eng./Geo.: R. Sarkar Boring Location: EBL Offset: Lane Ctr Align Elev.: 121.4 ft Latitude: 33.864941 Longitude: -80.879525 Date Started:														Rout	e:	SC	48										
Eng./	Geo.:	R. S	arka	r			Bor	ing L	oca	tion:	EB	L			C	offse	et:		Lane	e Ctr	A	ligr	nmer	nt:	E	xistin	g
Elev.:	121.	4 ft		Latit	ude:			33.86	5494	11	Lo	ngit	tude:		-80.	879	525	;	Date	Sta	rteo	:t		4	/27/	2016	i
Total	Depth:		100	ft	Soi	il D)ept	h:	1	00 ft		Co	ore De	pth:		0 f	t		Date	Cor	npl	ete	d:	4	/28/	2016	j
Bore	Hole D	iame	eter (i	in):	2	.94	•	Sam	pler	Con	figu	rati	on	L	.ine	r Re	qui	red:	Y	(<u></u>		iner	' Us	ed:	Y	<u>N</u>
Drill N	<i>l</i> lachin	e:	CM	E-55()X	D	rill I	Netho	od:	RV	V			Ham	nme	r Ty	pe:	Aut	oma	tic		Ene	ergy	Rat	tio:	74.2	2%
Core	Size:	N.	Α.			D	rille	r:	A.	Larg	je			Gro	und	wat	er:	ТО	B	N.A	•		24	4HR		9 ft	
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(ft)			N	1ATE	RIAL	D	ESC	RIPT	ΓΙΟΝ	١	0	Ę Š)ep (#)		É	.9	16"	.0	Va			▲ FI	NES	CON	JTEN	IT (%)	
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		@)SS-8	: NMC	=21.6	6, %	6#20	0=64.8	3		-		23.5											:	:		-
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2020	42.0										<u> </u>	LF	GEN)									Co	ntin	ued	Nex	t Page
/3/2				SAM	IPLER	R TY	/PE							-				D	RILLI	NG M	1ETI	HOD					ugt
	- Split Sp - Undist	ooon Irhed	Samn	le) - Ro ا - Ci	ock Cou	re, 1-	7/8"			HS	SA - H	lollov	v Ste	m Au s Flio	uger iht Ai	Iders		RW RC	7 - F	Rotary Rock (Wa Core	sh		
g AWG	- Rock C	ore, '	1-1/8"			CT	- Co	ontinuo	us Ti	ube) - D	rivin	g Ca	sing	,	-9010					2010			

F	Project	ID: P	029 <mark>9</mark> 4	2				Со	unty:	Rich	nland			Boring N	o.: B-	2	
Ś	Site De	scripti	on:	Emerger	ncy Bridge F	ackage	6							Rout	e: SC	C 48	
	Eng./G	eo.: F	R. Sarka	ar	Boring L	ocation:	EBL		(Offset		Lane	Ctr	Alignmer	nt: E	Existing	J
E	lev.:	121.4	ft	Latitude:	33.86	64941	Longit	tude:	-80	.8795	25	Date	Starte	ed:	4/27	7/2016	
	fotal D	epth:	100	ft So	il Depth:	100 ft	Co	ore De	pth:	0 ft		Date	Com	pleted:	4/28	3/2016	
	Bore H	ole Dia	meter	(in): 2	.94 Sam	oler Con	figurati	on	Line	er Rec	uired	: Y	<u>N</u>	Liner	Used	: Y	N
	Drill Ma	achine		1E-550X	Drill Metho	od: RV	V		Hamme	er Typ		itomat		Energy	Ratio	: 74.2%	%
ľ	Jore S	ze:	N.A.		Driller:	A. Larg	je		Ground	awate	r: IC	B	N.A.	24	IHK	9 π	
														• SPT	N VAL	JF ●	
	tion	, th					d hic	t be	ype			lue		РL Х		\xrightarrow{LL}	
	(ft.	Dep (ft	I	MATERIAL	_ DESCRIP1	ION	Log	Dep	o./T	.e"	d 6"	l <a< td=""><td></td><td>▲ FINES</td><td>CONTE</td><td>ENT (%)</td><td></td></a<>		▲ FINES	CONTE	ENT (%)	
	ш		.,						°'Z	1 <u>s</u>	3 3 3		0 10	20 30 40	50 60	<u>70 80 70 80 70 70 70 80 70 80 70 80 80 80 80 80 80 80 80 80 80 80 80 80</u>	90
			Very s	tiff, moist, gr A-6) 10YR 6/	ray, Sandy Lea /1	IN CLAY											
	-		(02)((0) 1011(0)					_								-
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	-	47.0_	Mediu	m dense, we	et, gray, subrou	unded to			-								-
			suban	gular, fine to	medium Silty	SAND											
			(3111) (A-2-4) 101R	0/1			48.5]								
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									SS-13	2	11 12	2 23		•			
	71.4-	_															
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	664-	_							_								
	00.4																
12/16	-								-								-
-1 5(E7 0															
4.GD	-	57.0_	Hard,	moist, dark g	gray, Lean CLA	AY (CL)			-								-
			(A-6) ²	10YR 4/1													
2_30			.			MO-40 0		58.5				_	1				
ЦЦ ЦЦ	-		@SS-	15: LL=31, P	′∟=22, PI=9, N	MC=19.3				10		4. 50/4		\sim	· · ·		
APLA									55-15	12	30 50/	4 50/4		$\nabla \mathbf{x} \rightarrow \mathbf{x}$			>>(
TEN	61.4-								+								
DAT																	
DOT	-								1								
SC	-								-								-
Ъ,																	
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7315				SAMPLEF	R TYPE		LC		ر			DRILLI	NG ME	THOD	unue		, aye
101	SS - S	Split Spc	on bed Sam	nle	NQ - Rock Cor	re, 1-7/8"		HS	SA - Hollo	w Sterr	Auger	unere	R	W - Rotary	Wash		
sc	<u>AWG - F</u>	Rock Co	re, 1-1/8	י אוכ	CT - Continuo	us Tube			$\frac{1}{2} - Drivin$	ng Casi	ng	ayers					

Project	t ID: F	2029942	2				Οοι	inty:	Rie	chla	nd			Borin	g No).: B	-2	
Site De	scripti	on:	Emerger	ncy Bridge I	Package 6	3								F	Route): S	C 48	
Eng./G	eo.: F	R. Sarka	ar	Boring L	ocation:	EBL		(Offse	et:	L	_ane	Ctr	Align	men	t:	Existing)
Elev.:	121.4	ft	Latitude:	33.8	64941	Longi	tude:	-80	.879	9525		Date	Start	ed:		4/2	7/2016	
Total D	epth:	100	ft Soi	il Depth:	100 ft	Co	ore De	pth:	0 f	ť	I	Date	Com	plete	d:	4/2	8/2016	
Bore H	ole Dia	ameter ((in): 2	.94 Sam	pler Conf	igurati	on	Line	er Re	qui	red:	Y	N		.iner	Used	1: Y	N
Drill Ma	achine	: CM	E-550X	Drill Meth	od: RW			Hamme	er Ty	pe:	Auto	omat	ic	Ene	ergy	Ratio	: 74.29	%
Core S	ize:	N.A.		Driller:	A. Large	е		Ground	dwat	er:	TOE	3	N.A.		24	HR	9 ft	
														-	CDT			
															011		.02 •	
tion	÷					hic	th Se	ole vpe				lue		PL ×			——X	
eva (ft)	(ff)	N	MATERIAL	DESCRIP	TION	Log	Epen (ff)	o./T	.9	1 6"	.9	Va Va		▲ FI	NES (CONT	ENT (%)	
Ξ							<i>w</i> –	٥ž	1st	2nc	3rd	Z	0 10	20 3	0 40	50 6	0 70 80	90
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-							-	00.40	10	~~	50/4	50/4						
								55-16	12	32	50/4	50/4						>>(
56.4-	-	-					- 1											
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_	67.0_						-											-
		Very de	ense to dens	se, wet, gray, medium Silty	SAND										÷			-
-	-	(SM) (A	A-2-4) 10YR	6/1	OAND													-
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							13.5								÷			
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40.4																		
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	77.0																	
	//.0_	Hard, d	dry, dark gra	y, Lean CLA	(CL) (A-6)		- 1	1							:			-
-		10YR 4	4/1	-														
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41.4-		-					- 1					-						
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5							83.5						-					
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				TYPF		LE					ח	RILIN	IG MF	THON	COL	unue		rage
ss -	Split Spo	pon		NQ - Rock Co	ore, 1-7/8"		HS	A - Hollo	w Ste	em Au	uger		R	W - R	otary	Wash		
AWG-	Undistur Rock Co	ped Samp re. 1-1/8"	pie	CU - Cuttings CT - Continue	; ous Tube			Conti - ۸ Drivir -	inuou 1g Ca	s ⊢lig Isina	int Au	gers	R	C - R	OCK C	ore		
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Project	t ID: F	029942					Со	unty:	Ric	chlan	nd			Borir	ng No	.: В-2	2	
Site De	scripti	on:	Emerge	ency Bridge F	Package (6								F	Route	: SC	; 48	
Eng./G	eo.: F	R. Sarka	r	Boring L	ocation:	EBL		(Offse	et:	L	.ane	Ctr	Aligr	nmen	t: E	Existing)
Elev.:	121.4	ft	Latitude	: 33.8	64941	Longit	ude:	-80) <u>.</u> 879	525	C)ate	Start	ed:		4/27	/2016	
Total D	epth:	100	ft So	oil Depth:	100 ft	Co	ore De	pth:	0 f	t	C	Date	Com	plete	d:	4/28	/2016	
Bore H	ole Dia	imeter (i	in): 2	2.94 Sam	pler Conf	igurati	on	Line	er Re	quir	ed:	Y	N		iner	Used:	Y	N
Drill Ma	achine	CM	E-550X	Drill Metho	od: RW	/		Hamme	er Ty	pe:	Auto	omat	ic	Ene	ergy I	Ratio:	74.2	%
Core S	ize:	N.A.		Driller:	A. Larg	е		Ground	dwat	er:	TOB	 	N.A.		24	HR	9 ft	
														•	SPII	N VALU		
<u>.</u>	ے ا					<u>i</u>	e c	be be				ne		PL ×			LL —X	
(ft)	(ff)	Ν	IATERIA	L DESCRIP	TION	Log	(f)		<u>.</u>	.9	.9	Val						
Ĕ						G	юц	ω N	1st	2nd	3rd	z	0 10	20 3	0 40	50 60	70 80	90
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36.4-																		
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-	-							1										
																		-
							88.5											
_		@SS-2	1: NMC=3	3.5, %#200=96	6.0													
								SS-21	14	16	20	36						
31.4-	-							-										
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							93.5											
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26.4-	-																	
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-	-						98.5	1										-
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								SS-23	25	34	50/5"	50/5"			-			>>
21.4-	100.0	Derim	Toursing	ad at 400 F= -4		/////												
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	.		SAMPLE	R TYPE	,						DF	RILLIN	NG ME	THOD)			
UD - I	Split Spo Undistur	on bed Samn	ole	NQ - Rock Co CU - Cuttings	ore, 1-7/8"		HS CF	A - Hollo A - Cont	w Ste	m Aug s Fliat	ger ht Auc	aers	R	W - F C - F	Rotary N Rock C	Wash ore		
AWG-I	Rock Co	re, 1-1/8"		CT - Continue	ous Tube			- Drivir	ng Ca	sing		,						

Project	ID: F	29943	3						Co	unty:	Ric	chlan	d			Borin	g No	.: В-:	3	
Site De	scripti	on:	Emerg	genc	y Bridge	Pack	age (6								F	Route	: SC	248	
Eng./G	eo.: F	R. Sarka	r		Boring	Locat	ion:	WBL			Offse	et:	La	ane	Ctr	Align	ment	:: E	Existing)
Elev.:	132.1	ft	Latitud	le:	33.8	85694	•	Longi	tude:	-80	.832	06	D	ate	Start	ed:	_	4/28	8/2016	
Total D	epth:	100	ft s	Soil	Depth:	10	00 ft		ore De	pth:	0 f	t .	Da	ate	Com	pleted	: 	4/29	/2016	
Bore H		imeter (in):	2.9	4 San	npler	Conf	igurati	on		er Re	quir	ed:	Y	<u>(N)</u>		iner	Used	Y	<u>(N)</u>
	acnine		E-550X		Drill Metr	100: ^		<u> </u>		Group	er i y	pe:		mati		Ene	ergy F	katio:	14.2%	/0
	120.	N.A.			Jinei.	<u> </u> Λ.	Lary	с		Ground	Iwai			1	<u>ч.</u> д.		241		1111	
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atio ft)	ft)							og	pth f	Type	-	-	-	alue		×		0	—X	
		Deedw					N	Gra	Sar	No./	st 6'	nd 6	rd 6	> Z	0.40	▲ FI	NES C	ONTE	NT (%)	00
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	_	FILL - I	Loose, m	noist, l	brown, sul	bround	ed to	- 💥			5	5	5	10						
		subang	jular, wea	akly c	emented,	fine to			2	00-1		5	5	10			-			-
		5/3	II Clayey	SAN	D (30) (A-	-2-0) 1			2.0	_										-
										SS-2	5	4	4	8	•		-			
	-								2	1										-
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		@SS-3 %#200	=29.5	PL=1	14, PI=12,	NMC=	13.5,		2	66.3	1	3	3	6		x				
127.1-									2	- 33-3	4	5	5	0		× : / ×	· :			
									6.0											
									*											
									2	SS-4	2	2	3	5						-
	80								80											
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_		to suba	ingular, fi (SC) (A-2	ine to 2-6) 1	0 medium (0YR 5/2	Slayey			2	SS-5	2	1	1	2	•					-
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122.1-									*	-							:			
	_	V								_										_
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-	12.0	COAST		IN - N	<i>l</i> edium de	nse w	et	-		-										-
		grayish	brown, s	subro	unded to s	subang	ular,													
_	-	fine to ((A-3) 1	coarse Po 0YR 5/2	oorly	Graded S	AND (S	SP)		13.5	1										
	-	/ -						 • • •					4	00		•				-
5										55-6	9	11	15	26		•				
117.1	-									+										
	_									_										-
5																				-
-	17.0	Mediun	n dense	wet	grav. subr	ounder	d to			-										-
		subang	ular, fine	e to co	barse Silty	SAND	(SM)													-
		(A-2-4)	101 K 6/	1					18.5								-	· · ·		
i –											4	11	11	22						-
										33-1	4	11	· ·	22		-				
112.1										1										
			0 4 4 4 5 1					LE	GENE)						TUAR	Con	tinued	d Next	Page
ss - s	Split Spo	on	SAIVIPL	LER I N	Q - Rock C	ore, 1-	7/8"		HS	A - Hollo	w Ste	m Au	ger	ILLIN	R	W - R	otary V	Vash		
UD - U AWG - F	Undistur Rock Co	bed Samp re, 1-1/8"	ble	CI C	U - Cutting T - Contini	s Jous Ti	ube			A - Conti ; - Drivir	nuou: ng Ca	s Fligh sina	nt Auge	ers	R	C - R	ock Co	ore		
·		-,							0		5 2 3									

Project	: ID: F	2029943					Co	unty:	Rio	chlar	nd			Boring	g No.:	B-3		
Site De	scripti	on:	Emerger	ncy Bridge I	Package	6								R	oute:	SC 4	48	
Eng./G	eo.: F	R. Sarka	r	Boring L	ocation:	WBL		(Offse	et:	L	ane	Ctr	Alignr	nent:	Ex	isting	
Elev.:	132.1	ft	Latitude:	33.8	5694	Longi	tude:	-80	.832	206	0	Date	Start	ed:	4	1/28/2	2016	
Total D	epth:	100	ft So	il Depth:	100 ft	Co	ore De	pth:	0 f	ť	0	Date	Com	pleted	: 4	4/29/2	2016	
Bore H	ole Dia	ameter (i	i n): 2	.94 Sam	pler Conf	igurati	on	Line	er Re	quir	ed:	Y	N	Li	ner Us	sed:	Y	(N)
Drill Ma	achine	: CMI	E-550X	Drill Meth	od: RW	1		Hamme	er Ty	/pe:	Auto	mat	ic	Ene	rgy Ra	tio:	74.2%	6
Core S	ize:	N.A.		Driller:	A. Larg	е		Ground	dwat	er:	TOE	8	N.A.		24HF	२	11 ft	
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														• 9	SPT N \	/ALUE	•	
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atio ft)	ft)					bild bild	t) fth	Type		-	-	alue		X	0)	\rightarrow	
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									"	7	31		0 10	20 30	40 50	0 60	70 80	90
	00.0															:		÷
-		Very loo	ose, wet, w	hite, subround	led to			-										
		subang	ular, fine to	medium Silty	SAND											:		-
-] _	(SIVI) (A	101R	K Ø/ I			23.5	1								:		
-	- 1	@\$\$_8	• NMC=26	1 %#200=12	9			-				_						
		000-0		i, /u#200-12.	0			SS-8	1	1	1	2	•					
107.1-	-	-					•	_									<u> </u>	
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	27.0																	÷
-		Medium	n dense, we	et, white, subro	ounded to		•	1										
		Subang	ular, fine Si	ilty SAND mic	aceous			_										
			(24) 1011				28.5						-					-
										-	10	47						-
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102.1-	-	-														:		:
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							33.5											
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071-	_																	
5/.1																		
- I	-	-						-										-
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- 1	37.0_	Medium	n dense. we	et, brown. sub	rounded to		-	-									· · ·	
		subang	ular, fine to	medium Silty	SAND													
_] –	(SM) (A	-2-4) 10YR	5/3			38.5	1								:		
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								SS-11	7	7	12	19		•		-		
92.1-	-	-						+								:		
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																<u> </u>	<u> </u>	
						LE	GENE)							Contir	nued	Next	Page
<u>ee</u> 4	Solit Co		SAMPLEF		vro 1 7/0"		ЦС		W C+-	m Ar	DF	RILLIN		THOD	ton/\//	ach		-
UD -1	Undistur	bed Samp	le	CU - Cuttings	ne, 1-770		CF	A - Cont	w Ste	s Flig	ht Aug	gers	R	vv - Ko C - Ro	ck Core	2011 9		
AWG-I	Rock Co	ore, 1-1/8"		CT - Continue	ous Tube		DC	- Drivir	ng Ca	sing		-						

Project II	D: P(029943					Co	unty:	Ric	chlan	d			Borin	g No.	: B-3	}	
Site Desc	criptic	n:	Emerger	ncy Bridge I	Package	6								F	loute	: SC	48	
Eng./Geo	.: R.	Sarka		Boring L	ocation:	WBL		(Offse	et:	La	ane	Ctr	Align	ment	: E	xisting	3
Elev.: 1	32.1	ft	Latitude:	33.8	5694	Longi	tude:	-80	.832	206	D	ate	Start	ed:		4/28	/2016	
Total Dep	pth:	100 1	ft So	il Depth:	100 ft	C	ore De	pth:	0 f	ť	D	ate	Com	plete	d:	4/29	/2016	
Bore Hol	e Diar	neter (i	n): 2	.94 Sam	pler Conf	igurati	on	Line	er Re	quir	ed:	Y	N		iner l	Jsed:	Y	N
Drill Mac	hine:	CM	E-550X	Drill Metho	od: RW	1		Hamme	er Ty	pe:	Auto	mat	ic	Ene	ergy F	Ratio:	74.29	%
Core Size	e:	N.A.		Driller:	A. Larg	е		Ground	dwat	er:	тов		N.A.		24	IR	11 ft	
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														•	SFIN	IVALU		
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(ft)	(ff)	N	IATERIAL	DESCRIP	TION	Log)ept		0	"9 	0	Val					NT (%)	
Ĕ						U U	S	° ≥	1st	2nd	3rd	z	0 10	20 3	0 40	50 60	<u>70 80</u>	90
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	_							_										
							43.5											
-	-							55-12	9	10	14	24						
07.4															÷			
87.1-	1																	
	_							_										
-	47.0	Medium	dense, we	et. white. subro	ounded to			-										-
		subang	ular, fine Si	ilty SAND with	clay										-			
	-	seams	(SM) (A-2-4	4) 10YR 8/1			48.5	-										
															-			-
								SS-13	7	6	11	17		•				
82.1-	-													: :			<u> </u>	
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77.4															-			÷
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5																		
	51.0	Hard. d	ry, dark bro	wn, SILT (MI) (A-7)		-	-										-
		10YR 3	/3	, <u></u>	/ \ - /													
	1						58.5	1										
	_	@SS-1	5: LL=45, P	PL=27, PI=18,	NMC=24.4				_	<i></i>								-
								SS-15	9	22	25	47		\mathbb{X}				
72.1	-							+						: :	<u>:</u>			
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			SAMPI FF	R TYPE		LE		,			DR		IG MF	THOD	Cont	inuec	ivext	rage
SS - Sp	lit Spoc	on ad Carro		NQ - Rock Co	ore, 1-7/8"		HS	A - Hollo	w Ste	m Aug	ger		R	W - R	otary V	Vash		
AWG-Ro	iaisturb	ea Samp e, 1-1/8"	ie	CT - Cuttings	ous Tube			A - Conti Conti	nuou: 1g Ca	s ⊢iigh sing	it Aug	ers	R	U - R	OCK CC	bre		

Project	: ID: F	29943	3							Co	unty:	Ri	chlar	nd			Bo	ring N	lo.:	B-3		
Site De	scripti	on:	Emer	geno	cy Bric	lge F	Packag	e 6										Rou	ite:	SC	48	
Eng./G	eo.: F	R. Sarka	ar		Bori	ng L	ocatio	n:∣V	VBL			Offse	et:		Lane	Ctr	Ali	gnme	ent:	E>	cisting)
Elev.:	132.1	ft	Latitud	de:		33.85	5694	L	ongi	tude:	-80	.832	206		Date	Star	ted:		4	/28/2	2016	
Total D	epth:	100	ft	Soil	Depth	า:	100	ft	Co	ore De	pth:	0 f	ť		Date	Con	nplet	ted:	4	/29/2	2016	
Bore H	ole Dia	ameter ((in):	2.9	94 🗄	Samj	oler Co	onfig	urati	on	Line	er Re	quir	ed:	Y	N		Line	er Us	ed:	Y	N
Drill Ma	achine	: CN	1E-550>	<	Drill N	letho	od: F	RM			Hamme	ər Ty	/pe:	Aut	omat	ic	E	nerg	y Rat	tio:	74.2	%
Core S	ize:	N.A.			Driller	:	A. La	irge			Ground	dwat	er:	TO	B I	N.A.		2	24HR	2	11 ft	
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																		• SP	TNV	ALUE	•	
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62.1-]																				
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	72.0	Modiu	m donao	to do		ot br					-											-
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-		Silty S	AND (SN	1) (A-	-2-4) 10	YR 5	/3			72 6	-											-
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	o		SAMP	LER	TYPE		•						-	D	RILLIN	NG M	ETHO					
- SS - S	Split Spo Undistur	oon bed Sam	ple	N C	NQ - Ro CU - Cu	ck Co ttinas	re, 1-7/8			HS CF	A - Hollo A - Cont	w Ste	em Au s Flial	ger ht Ai	iders	F	≺₩ - גC -	 Rock 	ry Wa Core	sh		
AWG-I	Rock Co	ore, 1-1/8"		Č	CT - Co	ntinuo	us Tube	•			- Drivir	ng Ca	ising			'			2010			

Project	t ID: F	29943	3							Co	unty:	Ri	chla	nd			Borir	ng No).: B-:	3	
Site De	escripti	on:	Emerg	jenc	y Bri	dge F	Packag	e 6									F	Route	: SC	248	
Eng./G	eo.: F	R. Sarka	r		Bor	ing L	ocatio	n: \	NBL			Offse	et:		Lane	Ctr	Aligr	nmen	t: E	Existing	9
Elev.:	132.1	ft	Latitud	e:		33.85	5694	I	ongit	ude:	-80).832	206	1	Date	Star	ted:		4/28	/2016	
Total D	epth:	100	ft S	Soil I	Dept	h:	100	ft	Co	ore De	pth:	01	ft	1	Date	Com	plete	d:	4/29	/2016	
Bore H	ole Dia	ameter (in):	2.9	4	Sam	pler Co	onfig	gurati	on	Line	er Re	equi	red:	Y	N)	Liner	Used	: Y	N
Drill Ma	achine	: CM	E-550X		Drill N	leth	od: F	ิรพ			Hamm	er Ty	/pe:	Aut	omat	ic	En	ergy	Ratio:	74.29	%
Core S	ize:	N.A.		C	Drille	r:	A. La	arge			Ground	dwat	er:	TO	3	N.A.		24	HR	11 ft	
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47.1-		-									_										
																	÷				
-	1 -	1									7										
_	87.0										_										-
		Hard, c	lry, dark g	gray,	Lean	CLAY	(CL) (A	A-6)									-				
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42.1-	1 -																				
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-	92.0										_						÷				
		Dense,	, wet, gray Jular, fine	y, sut to m	oroun edium	ded to Silty	SAND	with									-				-
-		clay se	ams (SM)) (A-2	2-4) 1	0YR 6	/1				-						-				
										93.5							-				
-	- 1	-										7	19	26	45						
07.4																					
37.1-	1 -	1																			
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-	97.0	llord		Cand		Tuith	alay				_						÷				÷
		seams	and mica	Sand (ML	iy Si∟) (A-4) 10YF	Ciay R 6/1														
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1		Boring	Termina	nted a	at 100	Feet															-
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			0.4.45						LE	GENE)										
ss -	Split Spo	oon	SAMPL	.⊨R ſ N0	175 Q - Ro	ck Co	re, 1-7/8	8"		HS	A - Hollo	w Ste	em Ai	D uger	KILLI	NG ME F	ETHOD RW - F	Rotary	Wash		
UD -	Undistur	bed Samp	ble	CL	U - Ci	ittings	us Tub			CF	A - Cont	inuou	s Flig	ght Au	gers	F	RC - F	Rock Ć	ore		
AVVG-	KUCK CO	ne, 1-1/8"		U	i - CC	ทนทนอ	us IUDE	;			- Drivi	ig Ca	ising								

Project	: ID: F	29943						Co	unty:	Ric	chlan	d		E	Boring	g No.	: B-4	1	
Site De	scripti	on:	Emerge	ency Bridge	Packa	age 6									R	oute:	SC	; 48	
Eng./G	eo.: J	. Freder	ndall	Boring	Locat	ion:	EBL		(Offse	et:	La	ine C	Ctr 7	Align	ment	: E	xistin	g
Elev.:	132.1	ft	Latitude	: 33.	85683	8	Longit	ude:	-80	.831	459	Da	ate S	tarte	ed:		4/29	/2016	
Total D	epth:	100	ft Se	oil Depth:	10	00 ft		ore De	pth:	0 f	t .	Da	ate C	omp	oleted	:	5/2/2	2016	~
Bore H	ole Dia	meter (in): [2	2.94 Sar	npler (guratio	on	Line	er Re	quir	ed:	Y	N		iner l	Jsed:	Y	<u>N</u>
			E-990X						Hamme	er iy	pe:	Autor	natic	<u>,</u>	⊢⊨ne	rgy R	atio:	14.2	%
Core S	ize:	N.A.		Driller:	A.	Large			Ground	iwat	er:	IUБ	IN.	.A.		246	IK	911	
													•	SPT N	VALU				
									0						PI	Ν	/C	П	
atior (t)	t) tf				ואסודר		phic	the f	Type			_	alue		×		Ŏ—	$-\overline{X}$	
Elev (f					TION		Gra	San De	San Vo./	st 6"	9 pr	-9 p	> z		▲ FII	NES C	ONTE	NT (%)	
	0.0	Asnhal	ay - Cedar (9 inches	Creek Bridge	9				-	<u> </u>	Ъ,	л.	0	10	20 30) <u>40</u> (<u>50 60</u>	70 8	0 90
	0.8			, ,				10											
-	-	brown.	vledium de subanqula	nse, dry, lign r. weaklv cen	t yellow hented.	risn fine		1.0											
_	_	to med	um Silty S	AND (SM) (A	-2-4) 10	OYR			SS-1	4	6	7	13	•					-
		6/4																	
-	-							3.0											-
									SS-2	7	7	7	14	•					
_	-																		-
127.1-	5.0_	Marili		مر المامة	dala ku			5.0											
		suband	n dense, di Iular, weak	ry, light yellov lv cemented.	vish bro fine to	own,			66.2		F	6	11						
-	-	mediun	n Silty SAN	D with grave	I (SM)				33-3	4	5	0	· ·	Ē					-
	70	(A-2-4)	10YR 6/4					70				-+					· · ·		
	'	Very lo	ose, moist	, light yellowis	sh brow	'n,	Ĭ	,.0											-
_	_	subang mediun	ular, weak n Siltv SAN	IV cemented,	tine to 4) 10YI	R 6/4			SS-4	2	2	2	4				· · ·		-
		moduli	. City Or a		.,														
-	9.0		IUM - Ven	loose moist	dark			9.0											-
100.1		yellowi	sh brown, s	ubangular, weakly					SS-5	w	'OH/18	в"	0		:: ×⊖▲	×			
122.1-	-	cement with ar	ed, fine to avel (SC) (medium Clay A-2-6) 10YR	∕ey SAN 4/6	ND			1										
_	_			_ ,								T							-
		@SS-5	: LL=35, P	L=19, PI=16,	NMC=2	23.8,													
-	12.0	%#200	=30.2						-										-
		COAST		- Medium de	nse, m	oist,													•
	-	cement	enowish bro ed, fine to	wn, subangu medium Siltv	ar, wea	акіу (SM)		13.5	1								· ·		
	_	(A-2-4)	10YR 6/4			(2)]						-
5									SS-6	3	4	7	11	• • •	Q :		· · ·		
117.1-	-	@SS-6	: NMC=19	.8, %#200=16	ö.1							-+					<u> </u>		
į																			-
	_																		
-	17.0	Madher	donas	olot light are-					-										-
1		subang	ular, weak	loist, light gra	y, fine to														
- 1	-	medium	n Silty SAN	D with grave	I (SM)			18 5	1										-
		(A-2-4)	101 K 2//					10.0				+					· ·		
									SS-7	3	4	7	11	•					
112.1-														:					
5																			
	I						<u>וווווו</u> F	GENF)	I		I				Cont	inuer	Nex	t Page
			SAMPLE	R TYPE						_		DRI	LLING	6 ME	THOD				
SS - 8	Split Spo Undistur	oon bed Samr	le	NQ - Rock C CU - Cutting	Core, 1-7 Is	7/8"		HS CF	A - Hollo A - Conti	w Ste	m Aug s Fliat	ger ht Auge	ers	R\ R(V - Ro C - Ro	otary V ock Co	Vash re		
AWG-F	Rock Co	re, 1-1/8"		CT - Contin	uous Tu	ibe			- Drivir	ng Ca	sing								

Projec	rt ID: F	029943	3				Co	unty:	Ric	chland	t		E	oring	No.:	B-4		
Site D	escripti	on:	Emerge	ncy Bridge F	Package 6	3	·							Ro	oute:	SC	48	
Eng./0	Geo.: J	. Frede	ndall	Boring L	ocation:	EBL		(Offse	et:	Lar	ne C	tr 🖌	lignn	nent:	E	kisting	J
Elev.:	132.1	ft	Latitude:	33.8	56838	Longi	tude:	-80	.831	459	Dat	e St	tarte	d:	4	/29/	2016	
Total	Depth:	100	ft So	oil Depth:	100 ft	Co	ore De	pth:	0 f	t	Dat	e Co	omp	leted:	5	5/2/2	016	
Bore I	Hole Dia	imeter ((in): 2	2.94 Sam	pler Conf	igurati	on	Line	er Re	quire	d:	Y	N	Li	ner Us	sed:	Y	N
Drill N	lachine	CM	E-550X	Drill Metho	od: RW			Hamme	er Ty	pe: /	Autom	atic		Ener	gy Ra	tio:	74.2%	%
Core	Size:	N.A.		Driller:	A. Larg	е		Ground	lwat	er:	OB	N.	А.		24HF	ł	9 ft	
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tion	÷					hic	e the	ple						РL Х—		ر ا	\rightarrow	
eva (ff)	(ff)	Ν	MATERIAL	_ DESCRIP	ΓΙΟΝ	Log	Sam Dep	o./T	o.	16"	.9			▲ FIN	FS CO	NTEN	IT (%)	
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	_ 22.0_	Mediur	n dense dr	v liaht arav si	ibrounded			_										-
		weakly	cemented,	fine Poorly Gr	aded													-
		SAND	with silt (SF	P-SM) (A-3) 10	YR 7/2		23.5	-					:	: :	: :			
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								SS-8	3	6	7 1	3	•					
107.1								_										
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							28.5											
									7	6	11 1	7						
102.1													:			:		-
102.1																		
								_										-
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							33.5											
		@SS-1	10: NMC=22	2.6, %#200=11	.5				_	•								-
ω.								55-10		8	10 1	8						
17.1 97.1								+						· · ·				
DT																		
14.0																		
<u>80</u> _20								-										-
12																		
ATE							38 5	-										-
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TATI								SS-11	6	7	10 1	7					· · ·	
92.1													:	<u> </u>				
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PJ S								-										-
OL.G	42.0														<u> </u>		<u> </u>	
5505						LE	GENE)						(Contir	nued	Next	Page
231	Split Spr	on	SAMPLE		re 1_7/9"		ЦС		w Sta	m Aug		LING		HOD	ary M/	heh		
8 UD -	Undistur	bed Samp	ple	CU - Cuttings	ie, i-1/0		CF	A - Conti	nuous	s Flight	Auger	S	RC	- Ro	ck Core	; ;		
୍ଡ AWG-	Rock Co	re, 1-1/8"		CT - Continuo	ous Tube		DC	- Drivir	ng Ca	sing								

Project	: ID: P	029943						Со	unty:	Ric	hlanc			Boring	No.:	B-4	
Site De	scripti	on:	Emerge	ency Bridg	je Pack	age 6	6							Ro	oute:	SC 48	
Eng./G	eo.: J	Freder	ndall	Borin	g Loca	tion:	EBL		(Offse	t:	Lane	e Ctr	Alignn	nent:	Existi	ng
Elev.:	132.1	ft	Latitude	: 33	3.85683	38	Longit	ude:	-80	.8314	459	Date	Start	ed:	4	/29/201	6
Total D	epth:	100	ft S	oil Depth:	1	00 ft	Co	ore De	epth:	0 ft		Date	Com	pleted:	5	/2/2016	
Bore H	ole Dia	meter (i	in):	2.94 S a	ampler	Conf	igurati	on	Line	er Re	quire	d: Y	<u>′</u> (N)		ner Us	ed: Y	<u>N</u>
Drill Ma	achine:		E-550X	Drill Me	ethod:	RW			Hamme	er Typ)e: A	utoma	tic	Ener	gy Rat	io: 74.	2%
Core S	ize:	N.A.		Driller:	A.	Larg	е		Ground	awate	er: I	OB	N.A.		24HR	9π	
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_														DI	MC		
t)	£ Ω						g	oth	, Jype			alue		×	-	——————————————————————————————————————	
(f	Del Del	IV	IATERIA	L DESCR		N	Cal	San Del	San Vo./	it 6"	19 pi	_9 ≥ 2 2		▲ FIN	ES CON	NTENT (%)
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		subang	ular, weak	dy cemente	d, fine to)											
-		coarse	Silty SAN	D (SM) (A-2	2-4) 10YF	R 4/2		43 5	-								
_																	
									SS-12	13	19	22 41			•		
87.1-																	<u> </u>
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-									-								
-	47.0																-
		Hard, n	noist, dark	grayish bro	wn, Leai	n											
-			02)(/(0)	1011(4/2					-								-
		@SS-1	3: NMC=2	28.9, %#200	=92.3			48.5					-				
-		-							SS-13	18	23	27 50		0	÷	· ·	
82 1 -																	
02.1																	· · ·
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									00-14		00/1	00/1					
77.1-									-								
- 2/16									_								-
5/1																	
-	57.0	Hard n	noist. dark	vellowish h	rown. Sa	andv			-								
2017		lean CL	AY (CL) (Á-6) 10YR 4	4/4	··· • • •											
- 530								58.5	1								
₩ -									$\left \right _{1}$							· · ·	: : -
IPLA									SS-15	38	27 5	0/4" 50/4	"			· · ·	>>
72.1-	-								+					: :	: :		<u> </u>
DATA														· · ·		· · ·	
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- sci	62.0								_								-
GPJ		Hard, n	noist, light vith organi	yellowish bi ics (CL) (A-6	rown, Sa 3) 10YR	ndy 6/4										· · ·	· · ·
20201						<i></i>	<u>//////</u>		<u>ר</u>				;	: :	Contin	und No.	t Paar
23,151			SAMPLE	R TYPE			LĽ		,			DRILLI	NG ME	THOD			u r-ayt
	Split Spo	on Ned Same		NQ - Rock	Core, 1-	7/8"		HS	A - Hollo	w Ster	n Auge	er Augere	R	W - Rot	ary Was	sh	
S AWG-I	Rock Co	re, 1-1/8"		CT - Cont	inuous Ti	ube			2 - Drivir	ng Cas	ing	ruyers		- KU			

Project	t ID: F	29943	3				Со	unty:	Ri	chlar	nd			Boring	No.:	B-4		
Site De	scripti	on:	Emerger	ncy Bridge F	Package 6	3								Ro	oute:	SC 4	48	
Eng./G	eo.: J	. Frede	ndall	Boring L	ocation:	EBL		(Offse	et:	L	ane	Ctr	Alignn	nent:	Ex	isting	
Elev.:	132.1	ft	Latitude:	33.8	56838	Longi	tude:	-80).831	459	0	Date	Start	ed:		4/29/2	2016	
Total D	epth:	100	ft So	oil Depth:	100 ft	Co	ore De	pth:	0 f	ť		Date	Com	pleted:		5/2/20)16	
Bore H	ole Dia	imeter (in): 2	2.94 Sam	pler Conf	igurati	on	Line	er Re	quir	ed:	Y	<u>N</u>		ner U	sed:	Y	N
Drill Ma	achine:		E-550X	Drill Metho	od: RW			Hamme	er Ty	/pe:	Auto	omat		Ener	gy Ra	atio:	74.2%	6
Core S	IZE:	N.A.		Driller:	A. Larg	е		Ground	dwat	er:	TOF	3 [N.A.		24H	R	9 ft	
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tion	Ę.					d hic	the de	ple				lue		РL Х—) 	\rightarrow	
(ft (ft	Dep [/ATERIAL	_ DESCRIP ⁻	TION	Lo	Dep Can	Sam lo./T	t 6"	d 6"	1 6"	1 < 3		▲ FIN	ES CC	ONTEN	T (%)	l
ш								°,Z	- <u>s</u>	2n	Зrc	~	0 10	20 30	40 5	0 60	<u>70 80</u>	90
							63.5						-					-
-								SS-16	21	34	36	70	:	: :			•	-
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67.1-	-																	
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-	67.0_	Hard, r	noist, liaht v	ellowish brow	n. Sandv			-										-
		lean C	LAY (CL) (A	-7) 10YR 6/4	, eaay													
-	-						68.5											
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								SS-17	24	38	29	67		: :				-
62.1-																		
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		തടട_1	8.11=45 E	PI = 26 PI = 10	NMC=22.4		73.5											
-		<u>@</u> 33-1	10. LL-43, F	L-20, F1-19,	1110-22.4			55-18	23	25	49	74	:	: ••••	X			
57.1-	-																	
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12_3(SS-19	23	39	47	86					•	•
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L.GP							83.5						1				· · ·	
22020	1					LE	GENE)	1			I	1 .		Conti	nued	Next	Page
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L SS -	Split Spo Undistur	oon bed Sami	ole	NQ - Rock Co CU - Cuttinas	ore, 1-7/8"		HS CF	A - Hollo A - Cont	w Ste inuou	em Au s Flia	ger ht Au	gers	R	W - Roi C - Roi	tary W ck Cor	ash e		
ပ္တ AWG -	Rock Co	re, 1-1/8"		CT - Continuo	ous Tube		DC	- Drivir	ng Ca	ising								

Project	t ID: F	P029943					Οοι	unty:	Ri	chlar	nd			Borin	g No.:	: B-4	ŀ					
Site De	scripti	on: E	Emergen	ncy Bridge F	ackage 6	6		-						R	oute:	SC	48					
Eng./G	eo.: J	. Fredend	all	Boring L	ocation:	EBL		(Offse	et:		Lane	Ctr	Align	ment	E	xistin	g				
Elev.:	132.1	ft La	atitude:	33.8	56838	Longi	tude:	-80	.831	459		Date	Start	ed:		4/29	/2016	;				
Total D	epth:	100 ft	Soi	I Depth:	100 ft	Co	ore De	pth:	01	ft		Date	Com	pleted	l:	5/2/2	2016					
Bore H	ole Dia	ameter (in)	: 2.	.94 Sam	oler Conf	igurati	on	Line	er Re	equir	ed:	Y	N	Li	iner L	Jsed:	Y	N				
Drill Ma	achine	: CME-	550X	Drill Metho	d: RW	1		Hamme	er Ty	/pe:	Aut	omat	ic	Ene	rgy R	atio:	74.2	2%				
Core Si	ize:	N.A.		Driller:	A. Larg	е	(Ground	dwat	er:	TO	B I	N.A.		24H	IR	9 ft					
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UD -1	Split Spo Undistur	oon bed Sample		NQ - Rock Co CU - Cuttings	re, 1-7/8"		HS. CF.	A - Holla A - Cont	w Ste	em Au s Flia	ger ht Au	iders	R	W - Ro C - Ro	otary W ock Co	/ash re						
AWG-I	Rock Co	re, 1-1/8"		CT - Continuo	us Tube			- Drivi	ng Ca	ising		35.5										
Project	ID: F	02994	4							Со	unty:	Rie	chlar	nd			Bo	ring	No.:	B-5	5	
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Site De	scripti	on:	Emer	rgen	icy E	Bridge I	Packa	age 6	i									Roi	ute:	SC	; 48	
Eng./G	eo.: J	. Frede	endall		В	oring L	.ocat	ion:	WBL		(Offse	et:	L	ane	Ctr	Ali	gnm	ent:	E	xistin	g
Elev.:	137.9	ft	Latitu	de:		33.8	5231	1	Longit	ude:	-80	.804	702	0	Date	Star	ted:			5/2/2	2016	
Total D	epth:	100) ft	Soi	l De	pth:	10)0 ft	Co	ore De	pth:	0 f	ť		Date	Con	nple	ted:		5/3/2	2016	
Bore H	ole Dia	meter	(in):	2.	94	Sam	pler	Confi	gurati	on	Line	er Re	quir	ed:	Y	<u> </u>) 	Lin	er U	sed:	Y	<u>N</u>
Drill Ma	achine		/E-550)	X	Dri	II Meth	od:	RW			Hamme	er Ty	/pe:	Auto	omat		E	nerg	<u>iy R</u> i	atio:	74.2	%
Core S	IZE:	N.A.			Dri	lier:	A.	Large	9		Ground	awat	er:	TOE	5	N.A.			24H	ĸ	10 π	
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-	-	FILL -	Medium	dens	se, d	ry, dark	yellow	vish		1.0	-								-			-
		to me	dium Silty	y SAI	ND (SM) (A-2	2-4) 10	0YR			SS-1	10	9	6	15		•		-			
		4/6																	-			
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		weakl	y cement	ted, fi	ine to	o mediui	n Silty	, V			SS-2	6	5	4	9				-			
_) with cru	shed	l agg	regate (SM) (A	4-2-4)					U	•			:		:			
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AWG-F	Rock Co	re, 1-1/8	,"	(CT -	Continue	ous Tu	ıbe		DC	- Drivir	ng Ca	sing									

Project	t ID: F	2994 ²	1							Со	unty:	Ri	chlai	nd			Bo	oring	j No.	: B-	5	
Site De	scripti	on:	Emerg	enc	y Br	idge F	Packa	ige 6										R	oute:	SC	2 48	
Eng./G	i eo.: J	. Frede	ndall		Bo	ring L	ocati	on:	WBL			Offse	et:	l	Lane	Ctr	A	ignr	nent	: E	Existing	g
Elev.:	137.9	ft	Latitude	e:		33.8	5231 ⁻	1	Longi	tude:	-80	.804	1702		Date	Star	rted	:		5/2/2	2016	
Total D	epth:	100	ft S	Soil	Dept	th:	10	0 ft	C	ore De	epth:	0 f	ft		Date	Cor	nple	eted		5/3/2	2016	
Bore H	ole Dia	ameter ((in):	2.9	4	Sam	pler C	Confi	gurati	on	Line	er Re	iupe	red:	Y	()	Li	ner l	Jsed	: Y	<u>N</u>
Drill Ma	achine	: CM	E-550X		Drill	Metho	od:	RW			Hamm	er Ty	/pe:	Aut	omat	tic	E	Ene	gy R	atio:	74.2	%
Core S	ize:	N.A.			Drille	er:	A. L	arge	•		Ground	dwat	er:	TO	3	N.A.			24⊦	IR	10 ft	
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UD -	Split Spo Undistur	bed Sam	ole	N C	น - ห ป - C	UCK CO	re, 1-7	/ð`			A - Hollo A - Cont	w Ste inuou	s Flig	iger ht Au	gers		кw RC	- Ro	ck Co	rasn re		
AWG-	Rock Co	re, 1-1/8"		C	T - Ć	ontinuc	ous Tul	be		DC	C - Drivi	ng Ca	sing		-							

Project	t ID: P	029944	Ļ					Со	unty:	Rie	chlan	d		E	Boring	No.:	B-5	
Site De	scripti	on:	Emerç	genc	y Bridge F	Package	6								Ro	ute:	SC 48	
Eng./G	eo.: J	Frede	ndall		Boring L	ocation	: WBL			Offse	et:	La	ne (Ctr 🛛	Alignm	ent:	Existi	ng
Elev.:	137.9	ft	Latitud	de:	33.8	52311	Longi	tude:	-8	0.804	702	Da	ate S	Starte	ed:	5/	2/2016	
Total D	epth:	100	ft s	Soil	Depth:	100 ft		ore De	epth:	0 f	t .	Da	ate C	Comp	oleted:	5/	3/2016	
Bore H	ole Dia	meter (in):	2.9		pler Con	figurati	on	Lin	er Re	quire	ed:	Y	N	Lin	er Use	ed: Y	<u>(N)</u>
	achine:		E-550X		Drill Metho		/V		Hamm	eriy	pe:	Autor	natio		Energ	Jy Rat	IO: 74.	2% #
Core 5	ize:	N.A.		L	Jriller:	A. Lar	ye		Groun	awat	er:	ЮВ		.A.		24 N R	10	11
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	Undistur	bed Samp	ole	C	U - Cuttings	13, 1-7/0			A - Con	tinuou	s Fligh	t Auge	ers	R	\sim - Roc	k Core	211	
୍ଥ AWG - I	Rock Co	re, 1-1/8"		C	T - Continuc	us Tube		DC	C - Driv	ing Ca	sing							

Project	t ID: F	2994	4							Со	unty:	Ri	chlai	nd			Bori	ng No): B	-5	
Site De	escripti	on:	Eme	ergen	cy Brid	ge P	acka	ge 6										Rout	e: S	C 48	
Eng./G	i eo.: J	. Frede	ndall		Borii	ng Lo	ocatio	on: ۱	WBL			Offse	et:	I	Lane	Ctr	Alig	nmer	nt:	Existin	g
Elev.:	137.9	ft	Latit	ude:	3	33.85	52311		Longit	ude:	-80	.804	702		Date	Star	ed:		5/2	/2016	
Total D	epth:	100	ft	Soi	I Depth	:	100) ft	Co	ore De	epth:	0 f	ť		Date	Com	plete	ed:	5/3	/2016	
Bore H	ole Dia	meter	(in):	2.	94 8	Samp	oler C	onfi	gurati	on	Line	er Re	quir	red:	Y	<u>N</u>		Liner	Used	1: Y	N
Drill M	achine	: CN	1E-550)X	Drill M	etho	od:	RW			Hamm	er Ty	/pe:	Aut	omat	ic	En	ergy	Ratio	: 74.2	.%
Core S	ize:	N.A.			Driller	:	A. L	arge			Ground	dwat	er:	TO	3	N.A.		24	HR	10 fi	
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SS -	Split Spo	on	GAIVI		NQ - Roc	k Co	re, 1-7/	8"		HS	SA - Hollo	w Ste	em Au	iger	INLEI	F	W - 1	Rotary	Wash		
	Undistur	bed Sam	ple '		CU - Cut CT - Cor	tings	us Tub	Þ			A - Cont	inuou	s Flig	ht Au	gers	F	C - I	Rock C	Core		
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Project	ID: F	2994 ⁴	4				Co	unty:	Ric	hland	t		Boring N	l o.: B-5	5
Site De	scripti	on:	Emerge	ency Bridge	Package	6							Rou	te: SC	\$ 48
Eng./G	eo.: J	. Frede	ndall	Boring I	ocation:	WBL		(Offse	et:	Lane	e Ctr	Alignme	nt: E	Existing
Elev.:	137.9	ft	Latitude	: 33.8	52311	Longit	ude:	-80	.804	702	Date	Star	ted:	5/2/2	2016
Total D	epth:	100	ft Sc	oil Depth:	100 ft	Co	re De	pth:	0 ft	t	Date	Com	pleted:	5/3/2	2016
Bore H	ole Dia	ameter ((in): 2	2.94 Sam	pler Conf	iguratio	n	Line	er Re	quire	d: ו	((N) Line	r Used:	Y (N)
Drill Ma	achine	: CN	E-550X	Drill Meth	od: RW	.		Hamme	er Ty	pe: /	Automa	tic	Energy	Ratio:	74.2%
Core Si	ize:	N.A.		Driller:	A. Larg	е		Ground	dwate	er: 1	ОВ	N.A.	2	4HR	10 ft
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								SS-21	13	14	14 28		•		
47.9-															
-	92.0														
	92.0 Dense, moist, very dark brown, subrounded, moderately cemented, fine to														
	92.0 Dense, moist, very dark brown, subrounded, moderately cemented, fine to														
	92.0 Dense, moist, very dark brown, subrounded, moderately cemented, fine to medium Clayey SAND with organics (SC)														
-	 92.0 Dense, moist, very dark brown, subrounded, moderately cemented, fine to medium Clayey SAND with organics (SC) (A-2-6) 10YR 2/2 93.5 														
		(A-2-0)) 10111 2/2				00.0								
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42 9-	_														
42.0															
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-	97.0_	Mediur	m dense m	oist dark velk	wich			-							
,		brown,	, subrounde	ed, weakly cen	nented, fine										
		to med	lium Silty S	AND (SM) (A-3	2-4) 10YR		08 5	-							
5		4/4					90.0								
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57.8		Boring	g Terminate	ed at 100 Feel	:										
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	-							1							
e –															
	LEGEND														
	SAMPLER TYPE DRILLING METHOD S Split Spoon NO - Rock Core, 1-7/8" HSA - Hollow Stem Auger RW - Rotary Wash														
UD - 1	S - Split Spoon NQ - Rock Core, 1-7/8" HSA - Hollow Stem Auger RW - Rotary Wash D - Undisturbed Sample CU - Cuttings CFA - Continuous Flight Augers RC - Rock Core														
AWG-F	Rock Co	re, 1-1/8"	i	CT - Continu	ous Tube		DC	- Drivir	ng Cas	sing	0				

Project	ID: F	02994	4							Со	unty:	Ri	chla	nd			Bori	ng No	b.: B-	6	
Site De	scripti	on:	Emer	rgen	cy E	ridge P	acka	ge 6										Route	e: SC	C 48	
Eng./G	eo.: J	. Frede	ndall		B	oring L	ocatio	on:	EBL			Offs	et:		Lane	Ctr	Alig	nmen	t: E	Existing]
Elev.:	137.8	ft	Latitu	de:		33.85	52224	1	Longit	ude:	-8	0.804	141		Date	Star	ed:		5/3/	2016	
Total D	epth:	100	ft	Soil	l De	pth:	100	0 ft	Co	ore De	epth:	0 1	ft		Date	Com	plete	ed:	5/4/	2016	
Bore H	ole Dia	meter	(in):	2.9	94	Samp	oler C	onfi	guratio	on	Lin	er Re	equi	red:	Y	N		Liner	Used	: Y	N
Drill Ma	achine	: CN	1E-550)	X	Dril	I Metho	d:	RW			Hamm	er Ty	/pe:	Aut	omat	ic	En	ergy	Ratio:	: 74.2	%
Core Si	ize:	N.A.			Dril	ler:	A. L	arge			Groun	dwat	ter:	ТО	B	N.A.		24	HR	9 ft	
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																		JF I			
ion	£								Jic f	e t	be /pe				ne		PL ×			—X	
(ft)		1	MATER	RIAL	DES	SCRIPT	ION		Log	Jep (#)		. 9	1 6"	.0	Va		A F			NT (%)	
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		Aspha	lt (12 inc	hes)																	-
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		yellow	ish brow	n, su	brou	nded, we	akly	ĸ			SS-1	8	7	6	13						
-		cemer	nted, fine	to m	ediu	m Clayey	/ SÁNI	D					'	Ŭ				· ·			
		(30)(/	n-2-0) II		+/4					3.0							-				
-											SS-2	5	4	4	8						
	50									5 0							-				-
132.8-	5.0	Very lo	oose to le	oose,	dry,	dark yel	lowish	1		5.0	-										
		brown	, subrou	nded,	wea	kly ceme	ented,	fine			SS-3	1	1	1	2	•					
_		10YR	alum Cia 4/4	yey S	SAINL) (SC) (A	-2-0)				1						-				
_										7.0						-	-				-
											CC 4	-	F	F	10						
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	۹۵	-								9.0											
-	. 5.0_	ALLU	VIUM - V	'ery lo	oose	, wet, bro	wnish	1		5.0	1	1									
127 8-	_	yellow	, subrou lium Cla	nded, vev S	, wea	akly ceme	ented,	fine			SS-5	1	1	1	2		£0				
		(SC) (/	A-2-6) 10	OYR 6	6/6		jamoo					_				-					
											-							· · ·			
	12.0	@SS-	5: LL=15	5, PL=	=12,	PI=3, N№	1C=15	.8													
-	12.0	COAS	TAL PL	AIN -	Med	ium dens	se to				1						-				
_	_	loose,	moist, d	ark y		vish brow	n, ne to														
		mediu	m Silty S	SAND	(SIV	l) (A-2-4)	10YR	R 4/2		13.5						-					
-	-											1	F	Q	12			· · ·			-
		@SS-(6: NMC=	16.6	, %#	200=20.0)				33-0	1	5	0	15						-
122.8-	-										1							· · ·	· · ·		
_	_																				
-											-										
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											SS-7	3	3	5	8						
117.8-	-										+										
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	I								LEO LEO	GENI)					<u> </u>		Cor	ntinue	d Next	Page
	LEGEND Continued Next Page SAMPLER TYPE DRILLING METHOD																				
SS - S	Split Spo Undistur	oon bed Sam	ole	1	NQ -	Rock Cor Cuttings	re, 1-7/	/8"			A - Holl	ow Ste	em Au	uger iht Ai	iders	R R	W - F	Rotary Rock C	Wash		
AWG-F	Rock Co	re, 1-1/8	, ,	(CT -	Continuo	us Tub	be			<u>- Driv</u>	ing Ca	asing		.9010		- I		5.5		

Project	ID: F	029944				Co	unty:	Ric	chlai	nd			Boring	g No.:	B-6		
Site De	scripti	on: Emerger	ncy Bridge P	ackage	5								R	oute:	SC	48	
Eng./G	eo.: J	. Fredendall	Boring Lo	ocation:	EBL			Offse	et:	L	ane	Ctr	Align	ment:	E	xisting]
Elev.:	137.8	ft Latitude:	33.85	52224	Longi	tude:	-80	.804	41	1	Date	Star	ted:		5/3/2	016	
Total D	epth:	100 ft So	il Depth:	100 ft	Co	ore De	pth:	0 f	t		Date	Corr	pleted	l:	5/4/2	016	
Bore H	ole Dia	meter (in): 2	.94 Sam p	oler Conf	igurati	on	Line	er Re	quir	red:	Y	<u>N</u>) L	iner U	sed:	Y	<u>N</u>
Drill Ma	achine	CME-550X	Drill Metho	d: RW			Hamme	er Ty	pe:	Auto	omat		Ene	rgy R	atio:	74.2	%
Core S	IZE:	N.A.	Driller:	A. Larg	е		Ground	dwat	er:	TOF	3	N.A.		24H	ĸ	9 ft	
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tion	÷.				d hic	the ple	ple				lue		PL X—	())	\rightarrow	
(ff.	Dep (ff.	MATERIAL	. DESCRIPT	ION	Log	Dep	o./T	.0	d 6"	l 6"	l Va		▲ FIN	NES CO		NT (%)	
						0)	0 Ž	1st	2nc	3rd	2	0 10	20 30	40 5	0 60	70 80	90
-	22.0_	Loose moist dark	aravish brown			-	-								· · ·		
		subrounded, weak	y cemented, fi	ne to													
-		medium Silty SANI	D with gravel (SM)		23.5	-										
_	_	(1) 1 /2										1					
		@SS-8: NMC=20.7	1, %#200=17.8	3			SS-8	5	4	4	8	•	<u>له</u>		· · ·		-
112.8-		_	-											:	· · ·		
-							-										-
_	27.0													-			
		Loose to medium of	lense, moist, d	lark													
		cemented, fine to r	nedium Silty S	AND (SM)			_								· · ·		-
		(A-2-4) 10YR 4/2		. ,		28.5											
								5	3	3	6						-
107.0															· · ·		
107.8-																	
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							SS-10	7	9	12	21	:		÷			:
102.8-																	
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- 15	1 -						1										
- 17							_										
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- L	-					20.5	-										-
						38.5						1					
- 4	1 -						SS-11	6	7	13	20		•				-
97.8-																	
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	+2.0	I			LE	GENE)	I			I	1 '		Conti	nued	Next	Pade
	LEGEND Continued Next Page SAMPLER TYPE DRILLING METHOD																
	Split Spo Undistur	oon bed Sample	NQ - Rock Cor CU - Cuttinas	e, 1-7/8"		HS CF	A - Hollo A - Conti	w Ste	m Au s Flia	iger ht Au	gers	F	KW - RO RC - RO	otary W ock Cor	ash e		
AWG-I	Rock Co	re, 1-1/8"	CT - Continuo	us Tube		DC	- Drivir	ng Ca	sing						-		

Project	t ID: F	029944	4						Co	our	nty:	Rio	chla	nd			Borin	g No	.: B-6	6	
Site De	escripti	on:	Emerg	genc	y Bridge	e Pa	ackage	6									R	loute	: SC	248	
Eng./G	ieo.: J	. Frede	ndall		Boring	j Lo	cation:	EBL			C	Offse	et:		Lane	Ctr	Align	ment	:: E	Existing	J
Elev.:	137.8	ft	Latitud	de:	33	.852	2224	Long	tude:		-80	.804	41		Date	Start	ted:		5/3/2	2016	
Total D	epth:	100	ft S	Soil	Depth:		100 ft	C	ore D	ep	th:	0 f	t		Date	Com	pletec	1:	5/4/2	2016	
Bore H	lole Dia	imeter ((in):	2.9	94 Sa	mp	ler Con	igurat	ion		Line	r Re	qui	red:	Y	N) L	iner	Used:	: Y	N
Drill Ma	achine	CM	IE-550X		Drill Met	ho	1: RW	/		H	amme	er Ty	pe:	Aut	omat	ic	Ene	rgy F	Ratio:	74.2%	%
Core S	ize:	N.A.		1	Driller:		A. Larg	е		G	round	lwat	er:	TO	B	N.A.		24ł	HR	9 ft	
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		Soft, m	noist, gray	yish b	prown, Sa	ndy	SILT			_		~	N	(1)			20 30	<u> </u>	50 00	10 80	90
		(ML) (A	4-6) 10YF	R 5/2					1.									÷			÷
-	1 -								43.	5											
-		@SS-1 %#200	12: LL=36)=67.6	6, PL=	=25, PI=1	1, N	MC=31.6			_								-			-
		/0#200	-07.0							1	SS-12	3	1	3	4		X	€ €			
92.8-	-									+											
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	47.0																				
		Dense	to mediu	ım de	nse, wet,	ligh	t											-			
-		cemen	sn gray, s ited. fine t	subro to me	edium Silt	v SA	ND (SM)			_								÷			-
		(A-2-4)) 10YR 6/	2		, -	(-)		48.	5						-					-
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87.8-										Ť											
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82.8-																					
02.0																					-
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77.8-										+									<u> </u>		
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šr			SAMDI	FRT	TYPE			LE		ט					RILI			Con	tinued	a Next	Page
ss -	SAMPLER TYPE DRILLING METHOD S - Split Spoon NQ - Rock Core, 1-7/8" HSA - Hollow Stem Auger RW - Rotary Wash																				
AWG-	Undistur	bed Sam re. 1-1/8"	ple	С С	U - Cuttin T - Contir	gs ານດາ	s Tube		ר C	FA C	- Contii - Drivin	nuou: Ig Ca	s Flig sina	int Au	igers	F	RC - R	ock Co	ore		
		,/0		0						-		. y 00	Sing								

Project	: ID: F	29944					Co	unty:	Ri	chla	nd			Borin	g No	.: B-6	6	
Site De	script	on: I	Emerger	ncy Bridge F	Package 6	i								F	loute	: SC	248	
Eng./G	eo.:	. Fredenc	lall	Boring L	ocation:	EBL			Offse	et:	l	Lane	Ctr	Align	ment	t: E	Existing	3
Elev.:	137.8	ft L	atitude:	33.8	52224	Longit	ude:	-80	.804	41	I	Date	Star	ted:		5/3/2	2016	
Total D	epth:	100 ft	So	il Depth:	100 ft	Co	ore De	pth:	0 f	ft	I	Date	Com	pleted	:t	5/4/2	2016	
Bore H	ole Dia	ameter (in): 2	.94 Sam	pler Confi	gurati	on	Line	er Re	equi	red:	Y	N) L	.iner	Used	: Y	N
Drill Ma	achine	: CME	-550X	Drill Metho	od: RW			Hamme	er Ty	/pe:	Aut	omat	ic	Ene	ergy F	Ratio:	74.29	%
Core S	ize:	N.A.		Driller:	A. Large	9		Ground	dwat	ter:	TOE	3	N.A.		24	HR	9 ft	
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		vellow, si	ubrounded	iense, moist, i 1. weakly cem	ented, fine													
-	-	to mediur	m Silty SA	ND (SM) (A-2	-4) 10YR			-							÷			:
		6/6					68.5								:			
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07.0		@\$\$-17:	NMC=28	.9, %#200=16	.3													
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62.8-	-							-										
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-	77.0	N4- 1		lat day!				-							:	· · ·		
		brown si	uense, mo ubrounded	list, dark yello	wish ented fine										:			
-		to mediu	n Clayey	SAND (SC) (A	-2-6)		70 5	-							:			
		10YR 4/4					/8.5						1					
-	-							SS-19	8	7	8	15		•	:	· · ·		
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57.8-	1 -	1													:			
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-	82.0	Denga	of light	allowish brown				-							:			
		subround	led, light ye	v cemented. f	ine to										÷			:
-		medium	Silty SANE	O (SM) (A-2-4)) 10YR 6/4		00 -	-										-
							83.5		-				1					
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			SAMPLER	R TYPE		LL		,			D	RILLI	NG ME	THOD	0011	andet		i ay
SS -	Split Sp	on		NQ - Rock Co	re, 1-7/8"		HS	A - Hollo	w Ste	em Au	lger		R	W - R	otary \	Nash		
AWG-	Rock Co	re, 1-1/8"		CT - Continuo	us Tube			A - Cont ; - Drivir	ng Ca	is riig Isina	nii Au	yers	Ч	R		ore		
									<u> </u>	<u> </u>								

Project	: ID : F	P029944				Co	unty:	Ric	chla	nd			Borir	ng No	.: В-6	6	
Site De	script	on: Emerge	ency Bridge F	ackage 6	6								F	Route	: SC	348	
Eng./G	eo.: J	. Fredendall	Boring L	ocation:	EBL		(Offse	et:	L	ane	Ctr	Aligr	nment	t: E	Existing	9
Elev.:	137.8	ft Latitude	: 33.85	52224	Longit	ude:	-80	.804	41	[Date	Star	ted:		5/3/2	2016	
Total D	epth:	100 ft S	oil Depth:	100 ft	Co	ore De	pth:	0 fl	t	1	Date	Com	plete	d:	5/4/2	2016	
Bore H	ole Dia	ameter (in):	2.94 Sam	oler Conf	iguratio	on	Line	er Re	qui	red:	Y	(N) [iner	Used:	Y	(N)
Drill Ma	achine	: CME-550X	Drill Metho	d: RW	Ĩ		Hamme	er Ty	pe:	Auto	omat	ic	Ene	ergy F	Ratio:	74.2	%
Core S	ize:	N.A.	Driller:	A. Large	Э		Ground	dwate	er:	TOE	3	N.A.		24	HR	9 ft	
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f)	De De	MATERIA	L DESCRIPT	ION	Gra	De	lo./	t 6"	9 p	d 6"	2		▲ Fl	INES C	ONTE	NT (%)	
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							SS-20	12	15	20	35			•			
52.8-							_					:					
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-	07.0 ₋	Very dense. mois	t, black. subrou	nded.			-							· · ·			
		moderately ceme	nted, fine to me	dium											· · ·		
-		Clayey SAND wit	h organics (SC)	(A-2-6)		88 5	-					:					÷
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-	92.0	Medium dense to	dense moist o	lark			-					:					-
		yellowish brown,	subrounded, we	eakly										· · ·			
-		cemented, fine to	medium Silty S	AND (SM)		02 5	-					:	-	· · ·			-
		(A-2-4) 10YR 4/4				93.5											:
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37.8-		Boring Terminat	ed at 100 Feet														
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SS - S	SAMPLER TYPE DRILLING METHOD S - Split Spoon NQ - Rock Core, 1-7/8" HSA - Hollow Stem Auger RW - Rotary Wash																
UD -	Undistur	bed Sample	CU - Cuttings				A - Conti	nuous	s Flig	ht Au	gers	F	RC - F	Rock Co	ore		
AWG-		15, 1-1/0					וועווס - י	iy Ud	əniy								

























Geotechnical Data Report

Emergency Bridge Package 6
Richland County, SC
May 12, 2016
Terracon Project No. 73155050L (Rev. 1)

Terracon



1. Photograph of rig on B-1



3. Photograph of rig on B-3



2. Photograph of rig on B-2



4. Photograph of rig on B-4



5. Photograph of rig on B-5



6. Photograph of rig on B-6

Responsive Resourceful Reliable

Geotechnical Data Report

Emergency Bridge Package 6 = Richland County, SC May 12, 2016 = Terracon Project No. 73155050L (Rev. 1)

Terracon



7. Photograph of rig on CPT-1



9. Photograph of rig on CPT-3



8. Photograph of rig on CPT-2



10. Photograph of rig on CPT-4



11. Photograph of rig on CPT-5



12. Photograph of rig on CPT-6

Responsive Resourceful Reliable

Exhibit A-29

Geotechnical Data Report

Emergency Bridge Package 6
Richland County, SC May 12, 2016 Terracon Project No. 73155050L (Rev. 1)

Terracon



13. Photograph of MASW Array Back Swamp Bridge



14. Photograph of MASW Array Cedar Branch Bridge



15. Photograph of MASW Array Dry Branch Bridge

APPENDIX B LABORATORY TESTING

Exhibit B-1 – Laboratory Testing Description Exhibit B-2 – Summary of Laboratory Data Exhibit B-3 - Laboratory Data Sheets



LABORATORY TESTING DESCRIPTION

The samples collected during the field exploration were taken to our laboratory for additional testing. The laboratory testing program was developed by Terracon at the request of the SCDOT. Using the determined testing program, the laboratory tests were conducted on selected soil samples to determine lithological information. The test results are presented in this appendix

The laboratory test results were used to confirm the soil descriptions presented on the boring logs in Appendix A. Laboratory tests were performed in general accordance with the applicable ASTM, AASHTO, SCDOT or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- n Material Finer than No. 200 Sieve by Washing
- n Atterberg Limits
- n Moisture Content Determination

AASHTO T88/(ASTM D1140-14) AASHTO T89/T90(ASTM D4318) AASHTO T265/(ASTM D2216)

			1										Sneet	1 OT 1
	Boring ID	Depth	USCS Classification and Soil Description	Compressive Strength (tsf)	Liquid Limit	Plastic Limit	Plasticity Index	% <#200 Sieve	% Gravel	% Sand	% Silt	% Clay	Water Content (%)	Dry Density (pcf)
	B-1	3 - 5						47.9	0.0	0.0			20.1	
	B-1	7 - 9	SANDY LEAN CLAY(CL)		28	15	13	53.8	0.0	0.0			23.2	
	B-1	18.5 - 20						4.0	0.0	0.0			13.3	
	B-1	48.5 - 50			34	22	12						19.0	
	B-1	68.5 - 70						20.2	0.0	0.0			17.3	
	B-2	9 - 11	SANDY LEAN CLAY(CL)		45	17	28	59.4	0.0	0.0			32.8	
	B-2	23.5 - 25						64.8	0.0	0.0			21.6	
	B-2	38.5 - 40						20.0	0.0	0.0			20.5	
	B-2	58.5 - 60			31	22	9						19.3	
	B-2	88.5 - 90						96.0	0.0	0.0			33.5	
9	B-3	4 - 6	CLAYEY SAND(SC)		26	14	12	29.5	0.0	0.0			13.5	
12/1	B-3	23.5 - 25						12.9	0.0	0.0			26.1	
DT 5	B-3	58.5 - 60			45	27	18						24.4	
012.G	B-3	78.5 - 80						24.1	0.0	0.0			16.6	
CON2(B-3	88.5 - 90						95.1	0.0	0.0			27.5	
RAC	B-4	9 - 11	CLAYEY SAND(SC)		35	19	16	30.2	0.0	0.0			23.8	
) TE	B-4	13.5 - 15						16.1	0.0	0.0			19.8	
A.GP.	B-4	33.5 - 35						11.5	0.0	0.0			22.6	
ENEX.	B-4	48.5 - 50						92.3	0.0	0.0			28.9	
3 - LE	B-4	73.5 - 75			45	26	19						22.4	
STING	B-5	7 - 9						28.3	0.0	0.0			13.7	
B TE	B-5	9 - 11						37.1	0.0	0.0			28.6	
OL LA	B-5	23.5 - 25			43	19	24						23.3	
5505	B-5	28.5 - 30						10.7	0.0	0.0			26.3	
\$ 731	B-5	63.5 - 65						18.7	0.0	0.0			28.0	
USCS	B-6	9 - 11			15	12	3						15.8	
ARY:	B-6	13.5 - 15						20.0	0.0	0.0			16.6	
UMM	B-6	23.5 - 25						17.8	0.0	0.0			20.1	
AB SI	B-6	43.5 - 45	SANDY SILT(ML)		36	25	11	67.6	0.0	0.0			31.6	
LD-L	B-6	68.5 - 70						16.3	0.0	0.0			28.9	
NOT VALID IF SEPARATED FROM ORIGINAL REPORT.														
TS ARE	PROJECT:	Emergeno	cy Bridge Package 6					PRO	JECT N	UMBE	R: 73	31550	50L	
TORY TES	SITE: SC 4 Rich	18 (Bluff Ro land Count	ad) y, South Carolina	Jlern	6	CC	Π	CLIE	NT: SC Cc	DOT Dumbia	i, SC			
-ABORA				521 C Colu	lemso Imbia,	on Rd SC		EXH	BIT: B-	-2				

Summary of Laboratory Results





APPENDIX C SUPPORTING DOCUMENTS

Exhibit C-1 – Unified Soil Classification System Exhibit C-2 – CPT General Notes Exhibit C-3 – Rig Calibration Report

UNIFIED SOIL CLASSIFICATION SYSTEM

				5	Soil Classification
ing Group Symbols	and Group Names	S Using Laboratory	Tests ^A	Group Symbol	Group Name ^B
Gravels:	Clean Gravels:	$Cu \geq 4$ and $1 \leq Cc \leq 3^{E}$		GW	Well-graded gravel F
More than 50% of	Less than 5% fines ^c	Cu < 4 and/or 1 > Cc > 3	E	GP	Poorly graded gravel F
coarse fraction retained	Gravels with Fines:	Fines classify as ML or N	IH	GM	Silty gravel F,G,H
on No. 4 sieve	More than 12% fines ^c	Fines classify as CL or C	Н	GC	Clayey gravel F,G,H
Sands:	Clean Sands:	$Cu \geq 6$ and $1 \leq Cc \leq 3^{E}$		SW	Well-graded sand ¹
50% or more of coarse	Less than 5% fines D	Cu < 6 and/or 1 > Cc > 3	E	SP	Poorly graded sand
fraction passes No. 4	Sands with Fines:	Fines classify as ML or N	IH	SM	Silty sand G,H,I
sieve	More than 12% fines ^D	Fines classify as CL or C	H	SC	Clayey sand G,H,I
	Inorganic	PI > 7 and plots on or abo	ove "A" line ^J	CL	Lean clay ^{K,L,M}
Silts and Clays:	morganic.	PI < 4 or plots below "A" I	ine ^J	ML	Silt ^{K,L,M}
Liquid limit less than 50	Organia	Liquid limit - oven dried	< 0.75	0	Organic clay ^{K,L,M,N}
	Organic.	Liquid limit - not dried	< 0.75	UL	Organic silt ^{K,L,M,O}
	Inorganic	PI plots on or above "A" I	ine	СН	Fat clay ^{K,L,M}
Silts and Clays:	morganic.	PI plots below "A" line		MH	Elastic Silt K,L,M
Liquid limit 50 or more	Organic	Liquid limit - oven dried	< 0.7E	ОЦ	Organic clay K,L,M,P
	Organic.	Liquid limit - not dried	< 0.75	On	Organic silt K,L,M,Q
Primarily	v organic matter, dark in c		PT	Peat	
	ing Group Symbols Gravels: More than 50% of coarse fraction retained on No. 4 sieve Sands: 50% or more of coarse fraction passes No. 4 sieve Silts and Clays: Liquid limit less than 50 Silts and Clays: Liquid limit 50 or more Primarily	ing Group Symbolsand Group NamesGravels: More than 50% of coarse fraction retained on No. 4 sieveClean Gravels: 	ing Group Symbols and Group Names Using LaboratoryGravels: More than 50% of coarse fraction retained on No. 4 sieveClean Gravels: Less than 5% fines ° $Cu \ge 4$ and $1 \le Cc \le 3^E$ $Cu < 4$ and/or $1 > Cc > 3$ Gravels with Sines: ore than 12% fines °Fines classify as ML or M Fines classify as CL or CSands: 50% or more of coarse fraction passes No. 4 sieveClean Sands: Less than 5% fines °Cu ≥ 6 and $1 \le Cc \le 3^E$ $Cu < 6$ and/or $1 > Cc > 3$ Sands with Fines: bow or more of coarse fraction passes No. 4 sieveClean Sands: Less than 5% fines °Cu ≥ 6 and $1 \le Cc \le 3^E$ $Cu < 6$ and/or $1 > Cc > 3$ Silts and Clays: Liquid limit less than 50Inorganic:PI > 7 and plots on or abore PI < 4 or plots below "A" I PI plots on or above "A" I PI plots below "A" I PI plots on or above "A" I PI plots below "A" I <b< td=""><td>Ing Group Symbols and Group Names Using Laboratory Tests AGravels: More than 50% of coarse fraction retained on No. 4 sieveClean Gravels: Less than 5% fines C$Cu \ge 4$ and $1 \le Cc \le 3^E$ $Cu < 4$ and/or $1 > Cc > 3^E$Sands: 50% or more of coarse fraction passes No. 4 sieveClean Sands: Less than 5% fines DFines classify as ML or MHSands: 50% or more of coarse fraction passes No. 4 sieveClean Sands: Less than 5% fines D$Cu \ge 6$ and $1 \le Cc \le 3^E$ $Cu < 6$ and/or $1 > Cc > 3^E$Sands: tow or than 12% fines DCu \ge 6 and $1 \le Cc \le 3^E$ $Cu < 6$ and/or $1 > Cc > 3^E$Sands with Fines: hore than 12% fines DFines classify as ML or MH Fines classify as CL or CHSands with Fines: hore than 12% fines DFines classify as CL or CHSands and Clays: Liquid limit less than 50Inorganic:PI > 7 and plots on or above "A" line JSilts and Clays: Liquid limit 50 or moreInorganic:PI plots on or above "A" line dSilts and Clays: Liquid limit 50 or moreInorganic:PI plots on or above "A" line dCuganic:Cuganic:PI plots on or above "A" line dCuganic:Cuganic:Liquid limit - 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^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 = D₆₀/D₁₀ Cc =
$$\frac{(D_{30})^2}{D_{10} \times D_{60}}$$

 $^{\sf F}$ If soil contains \geq 15% sand, add "with sand" to group name. $^{\sf G}$ 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.
- $^{\rm I}$ If soil contains \geq 15% gravel, add "with gravel" to group name.
- $^{\rm J}\,$ 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 ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
- ^N $PI \ge 4$ 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.





Effective Friction Angle, ϕ

Sensitivity, St

Undrained Shear Strength, Su

Relative Density, Dr

Over Consolidation Ratio, OCR





WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated:" *Measured - Depth to water directly measured in the field*

Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance (q), friction resistance (fs), and porewater pressure (U2). The normalized friction ratio (FR) is used to classify the soil behavior type.

Typically, silts and clays have high FR values and generate large excess penetration porewater pressures; sands have lower FRs and do not generate excess penetration porewater pressures. Negative pore pressure measurements are indicative of fissured fine-grained material. The adjacent graph (Robertson et al.) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



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DRILL RIG SPT HAMMER ENERGY CALIBRATION REPORT

Drill Rig Model CME-550X SN 347863 Terracon Drill Rig No. 975 Columbia, SC

> October 5, 2015 Project No. 73150500

Prepared for: Terracon Consultants, Inc. Columbia, SC

Prepared by: Terracon Consultants, Inc. North Charleston, SC



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October 5, 2015

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Terracon Consultants Inc. 521 Clemson Road Columbia, SC 29229

- Attn: Mr. Phillip Morrison P: (803) 212-0062 M: (803) 518-3788 E: Phillip.Morrison@terracon.com
- Re: SPT Rig Calibration Report Columbia, SC Terracon Project Number: 73150500

Mr. Morrison:

The Charleston office of Terracon Consultants, Inc. (Terracon) has completed the SPT rig calibration for the above referenced rig. This report provides Energy Transfer Ratio (ETR) for the SPT hammer found on CME-550X (Serial Number 347863).

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.**

yun A Kun

Yulian A. Kebede, Project Manager Geotechnical Services



toyan T. Shi

Bryan T. Shiver, P.E. Department Manager Geotechnical Services SC Registration No. 27816



Terracon Consultants, Inc. 1450 Fifth Street West North Charleston, South Carolina 29405 P [843] 884 1234 F [843] 884 9234 terracon.com



1.0 PROJECT INFORMATION

ITEM	DESCRIPTION
Drill Rig Identification	CME-550X, SN: 347863 (see photograph on cover page)
Drill Rig Owner	Terracon
Drill Rig Operator	Jared Pawless
Testing Date	September 25, 2015
Testing Location	Columbia, SC
Terracon Project Number	73150500
Boring Identification	Test Hole (1)
Energy Measurement Depths	23.5 feet, 28.5 feet, 33.5 feet, and 38.5 feet
Hammer Type	Automatic
Boring Method	Hollow Stem Augers
Drill Rods	 AWJ 1¾" outside diameter 3/16" wall thickness
SPT Calibration Testing Equipment	 2 foot AWJ rod instrumented w/ 2 strain gauges and 2 accelerometers Model PAX Pile Driving Analyzer™ (PDA)
SPT Calibration Personnel	Kenneth Zur

2.0 TEST RESULTS

Table 1:

SPT Hammer Energy Calibration Testing Summary.

Boring	Start Depth ¹ (ft)	Rod Length ² (ft)	Rod Sections ³			Measured Blow Counts (blows/6 inches)				SPT	Soil
Boning			2 ft	5 ft	10 ft	1 st Inc.	2 nd Inc.	3 rd Inc.	4 th Inc.	(bpf) Type ⁴	Туре⁴
Test Hole (1)	23.5	28.8	0	1	2	18	10	11	-	21	Sand
	28.5	33.8	0	0	3	7	8	8	-	16	Sand
	33.5	38.8	0	1	3	5	7	9	-	16	Sand
	38.5	43.8	0	2	3	4	8	11	-	19	Sand

1. Depth from existing ground surface to bottom of drill rods at the beginning of SPT

2. Total rod length measured from instrumentation to bottom of sampler

3. Two foot section is instrumented and is located at top of drill rods

4. Soil type provided by Terracon personnel.



Table 2:

Energy Measurement and Analysis Summary.

Boring	Start Depth ¹ (ft)	SPT	No. of [–] Blows²		EFV (I	ETR (%) ³			
		N _m (bpf)		Max.	Min.	Ave.	Std. Dev.	Ave.	Std. Dev.
Test Hole (1)	23.5	21	38	0.280	0.250	0.262	0.008	74.8	2.29
	28.5	16	22	0.270	0.240	0.256	0.007	73.1	2.10
	33.5	16	19	0.270	0.250	0.254	0.006	72.5	1.71
	38.5	19	21	0.280	0.260	0.268	0.007	76.5	2.00
		Average:	25	0.275	0.250	0.260	0.007	74.2	2.02

1. Boring ID and depth from existing ground surface to bottom of drill rods at the beginning of SPT

2. Number of blows used in energy calibration analysis; limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the first increment if refusal were encountered
 3. EFV = Measured Transferred Energy, ETR = Energy Transfer Ratio.

Table 3:

Hammer Blow Rate Summary.

Boring	Start Depth ¹ (ft)	SPT N _m (bpf)	No. of – Blows²	BPM ³				
				Max.	Min.	Ave.	Std. Dev.	
Test Hole (1)	23.5	21	38	52.0	48.9	50.2	0.8	
	28.5	16	22	54.0	51.0	52.4	0.7	
	33.5	16	19	53.0	52.1	52.5	0.2	
	38.5	19	21	55.1	52.1	54.1	0.5	
		Average:	25	53.5	51.0	52.3	0.56	

1. Boring ID and depth from existing ground surface to bottom of drill rods at the beginning of SPT.

2. Number of blows used in energy calibration analysis. Limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the 1st increment if refusal conditions were encountered.

3. BPM = Blows per minute

3.0 CONCLUSIONS

3.1 Energy Transfer Ratio (ETR) and Hammer Efficiency Correction (CE)

Based on our testing and subsequent analysis, CME-55 (Serial Number 347863) has an **ETR** of **74.2% \pm 2.02%**. Based on this ETR, the hammer efficiency correction (**C**_E) is **1.24**.