

# Geotechnical Data Report

**S-13-757 (Davis Rivers Road)  
Emergency Bridge Replacement over Adams Creek  
Chesterfield County, South Carolina**

February 7, 2019

SCDOT Project ID.: P038247

Terracon Project No. 7318P119E

Prepared for:

South Carolina Department of Transportation  
Columbia, South Carolina

Prepared by:

Terracon Consultants, Inc.  
Columbia, South Carolina

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Employee-Owned

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**Terracon**

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

February 7, 2019



South Carolina Department of Transportation  
955 Park Street, Room 421  
Columbia, South Carolina 29201

Attn: Mr. Trapp Harris, P.E.  
Geotechnical Design Engineer – Design-Build Section

Re: Geotechnical Data Report  
S-13-757 (Davis Rivers Road) Emergency BRO Adams Creek  
Chesterfield County, South Carolina  
SCDOT Project ID.: P038247  
Terracon Project Number: 7318P119E

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 Request for Subsurface Exploration and Laboratory Testing (SCDOT Project ID: P038247, authorized on November 5, 2018). 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 the S-13-757 (Davis Rivers Road) bridge over Adams Creek in Chesterfield County, SC. The purpose of this work is to develop information relative to subsurface soil and groundwater conditions at the bridge location. No geotechnical recommendations are associated with the requested scope of study.

The following sections of this report contain a summary of the activities for our field exploration and laboratory testing. The logs of the borings, the Site Location Map and the Exploration Plan are included in Appendix A. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B. Descriptions of the field exploration and laboratory testing are included in their respective appendices.



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## **2.0 PROJECT DESCRIPTION**

The project site is located at the bridge crossing of S-13-757 (Davis Rivers Road) and Adams Creek in Chesterfield County, South Carolina. It is our understanding that the project will include the replacement of the previously damaged bridge with a new structure on the existing or similar horizontal alignment. The original structure appears to have been supported with round timber piles and steel H-piles.

## **3.0 GEOTECHNICAL TESTING**

The geotechnical exploration for this project was performed between January 31 and February 6, 2019. 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:

- Two (2) Standard Penetration Test (SPT) Borings (B-1 and B-2)

The tests were performed at the approximate locations provided 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. Photographs of the drill rig set up at each boring location are provided in Appendix A.

### **3.2 Laboratory Testing**

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

- Eight (8) Natural Moisture Content Tests
- Eight (8) No. 200 Wash Tests
- Six (6) Atterberg Limits Tests
- Six (6) Unconfined Compressive Strength of Rock

The general scope of the laboratory testing frequency was determined by the SCDOT. The laboratory procedures and results of the laboratory tests are presented in Appendix B.

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S-13-757 (Davis Rivers Road) RBO Adams Creek ■ Chesterfield County, SC  
February 7, 2019 ■ Terracon Project No. 7318P119E/Project ID.: P038247



**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.**

Ryan D. Starcher, E.I.T.  
Senior Staff Engineer

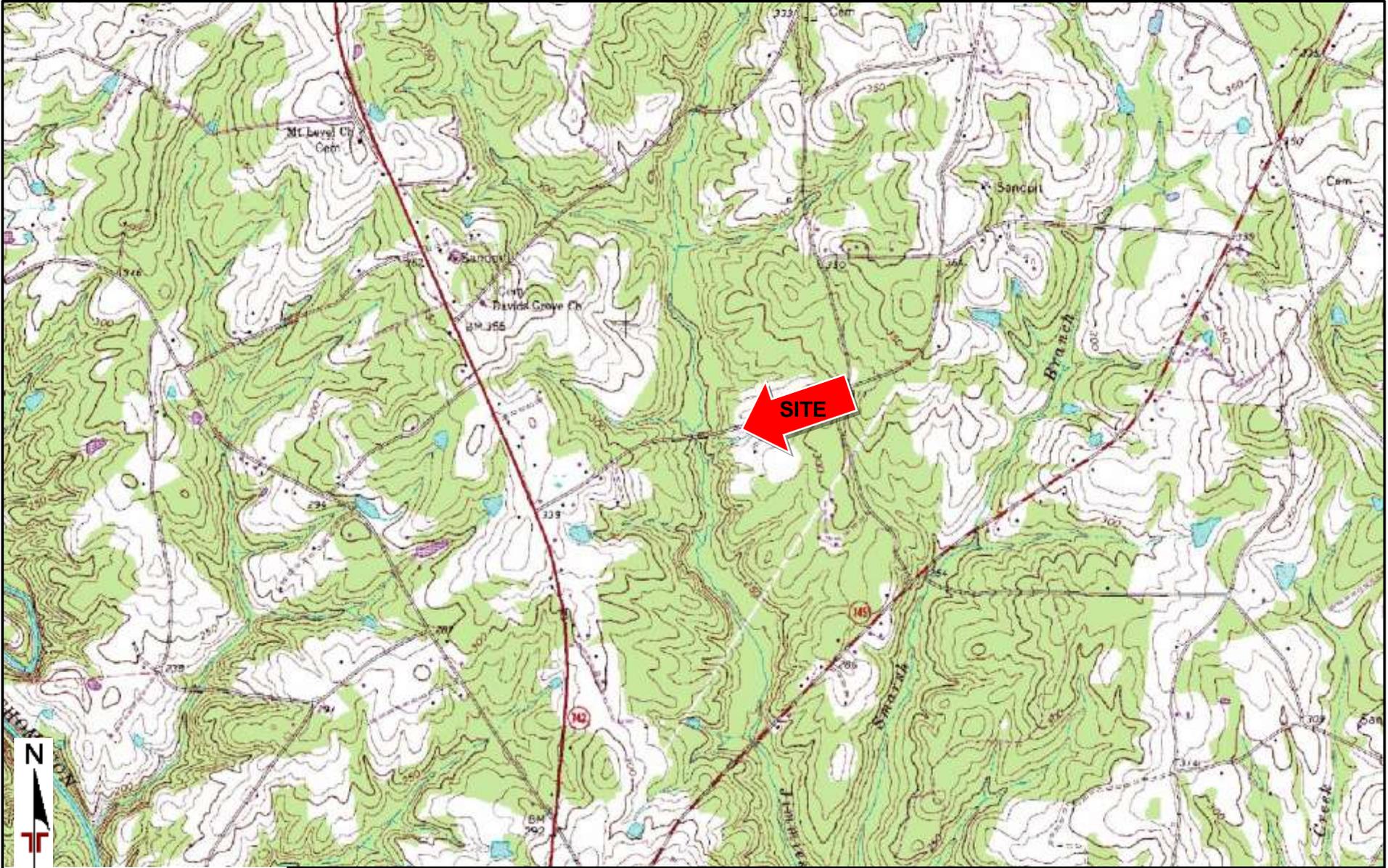
Phillip A. Morrison, P.E.  
Geotechnical Department Manager  
SC Registration No. 17275

Attachments:

- Appendix A
- Appendix B
- Appendix C

**APPENDIX A**  
**FIELD EXPLORATION**

- Exhibit A-1 – Site Location Map**
- Exhibit A-2 – Exploration Plan**
- Exhibit A-3 – Summary of Field Data**
- Exhibit A-4 – Field Exploration Description**
- Exhibit A-5 – Soil Description Terms**
- Exhibit A-6 – Rock Description Terms**
- Exhibit A-7 – Soil Rock Symbol Log**
- Exhibit A-8 – Boring Logs**
- Exhibit A-9 – Rock Photographic Log**
- Exhibit A-10 – Drill Rig Photograph Log**



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY  
 QUADRANGLES INCLUDE: MORVEN WEST, NC (1/1/1988).

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

Project Manager: RDS	Project No. 7318P119E
Drawn by: PTK	Scale: 1"=2,000'
Checked by: RDS	File Name: A-1 & A-2
Approved by: PAM	Date: Feb. 2019

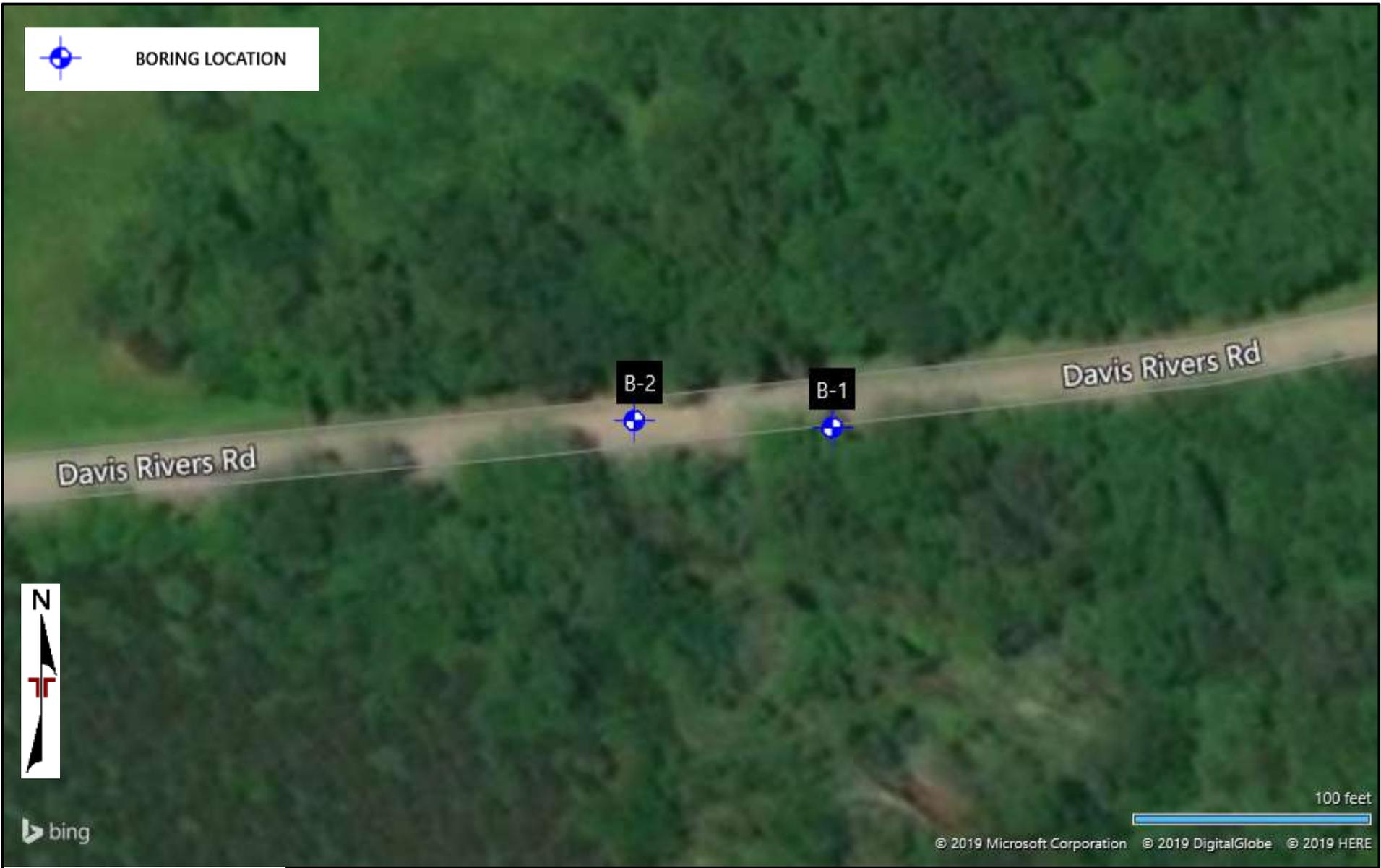
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 Columbia, SC 29229-4307

**SITE LOCATION MAP**  
 S-13-757 (Davis Rivers Road)  
 RBO Adams Creek  
 Chesterfield County, South Carolina

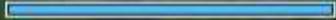
Exhibit  
**A-1**



**BORING LOCATION**



100 feet



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AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

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

Project Manager:	RDS
Drawn by:	PTK
Checked by:	RDS
Approved by:	PAM

Project No.	7318P119
Scale:	AS SHOWN
File Name:	A-1 & A-2
Date:	Feb. 2019



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**EXPLORATION PLAN**

S-13-757 (Davis Rivers Road)  
RBO Adams Creek  
Chesterfield County, South Carolina

Exhibit

**A-2**

**Geotechnical Data Report**

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**Summary of Field Data**

Test No.	Ground Elevation (ft)	Test Depth (ft.)	Northing	Easting	Latitude	Longitude
B-1	252.69	39.6	1076069.721	2276390.380	N34.787403	W80.079514
B-2	252.35	47.7	1076071.917	2276306.394	N34.787411	W80.079794

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## FIELD EXPLORATION DESCRIPTION

### Overview

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

A field log of each test location was prepared by our field 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:

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

Each boring was advanced using rotary wash drilling techniques to the planned termination depths. The sampling program is summarized in the following table:

Test ID	Total Depth	Interval of Continuous Sampling
B-1	100 feet or refusal and 20 feet of coring	0 to 10 feet
B-2	100 feet or refusal and 20 feet of coring	0 to 10 feet

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 to 24 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 to four, 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.

The borings were advanced to refusal of the drilling equipment and continued below this depth using diamond bit rock coring techniques. NQ2 sized cores were recovered from the borehole. The rock recovery ratios (REC, percentage of the total core run), Rock Quality Designation (RQD, percentage of the total core run of pieces greater than 4 inches) were recorded along with a

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description of the rock. An explanation of the rock descriptions shown on the logs is provided in Exhibit 6. Photos of the recovered rock core specimens are provided on Exhibit A-9 of the Appendix.

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-5.

Consistent with SCDOT GDM, the borings were drilled using mud rotary drilling techniques. As the drilling method introduces water into the borehole, time-of-drilling water levels could not be recorded. As noted on the boring log, the water levels of the borings were recorded at least 1 day after the start of drilling activities. These water levels are indicated on the boring logs. At the conclusion of the work, the boreholes were backfilled with sand and the borings were capped with cold-patch asphalt.

## SOIL DESCRIPTION TERMS

### Relative Density/Consistency Terms

<u>Relative Density<sup>1</sup></u>			<u>Consistency<sup>2</sup></u>		
Descriptive Term	Relative Density	SPT Blow Count	Descriptive Term	Unconfined Compression Strength ( $q_u$ ) (tsf)	SPT Blow Count
Very Loose	0 to 15%	4 and less	Very Soft	0.25 and less	2 and less
Loose	16 to 35%	5 to 10	Soft	0.26 to 0.50	3 to 4
Medium Dense	36 to 65%	11 to 30	Firm	0.51 to 1.00	5 to 8
Dense	66 to 85%	31 to 50	Stiff	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

<u>Descriptive Term</u>	<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.

### Angularity<sup>1</sup>

<u>Descriptive Term</u>	<u>Criteria</u>
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.

### HCl Reaction<sup>3</sup>

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

### Cementation<sup>3</sup>

<u>Descriptive Term</u>	<u>Criteria</u>
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Moderately Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

### Particle-Size Range<sup>1</sup>

<u>Gravel</u>	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	¾ 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<sup>1,2</sup>

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

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

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

<sup>3</sup> Use as required

## DESCRIPTION OF ROCK PROPERTIES

### 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" not 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 <sup>a</sup>

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

a. 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) a

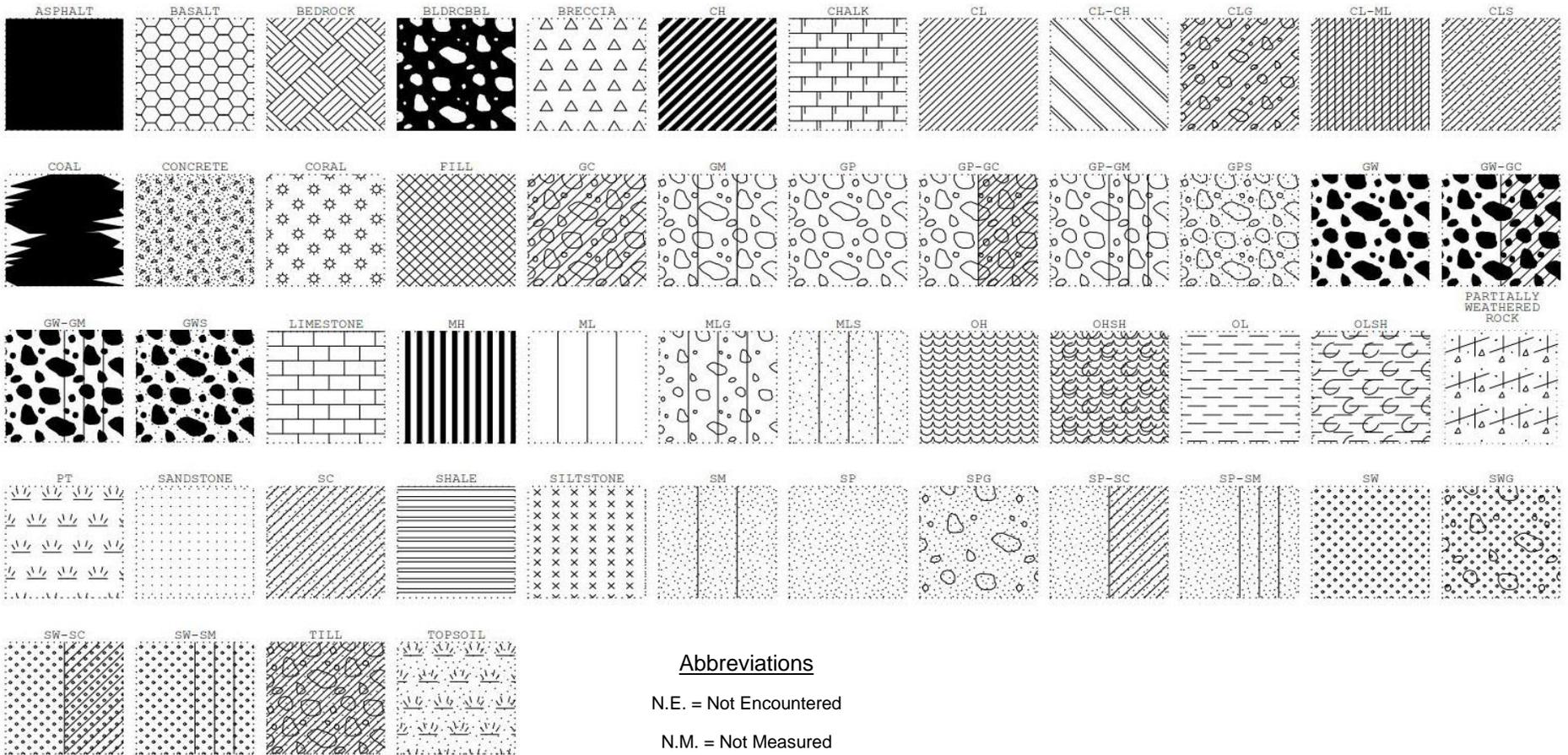
RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

a. RQD (given as a percentage) = length of core in pieces 4 in. 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.



Abbreviations

N.E. = Not Encountered

N.M. = Not Measured

Project Manager:	PAM	Project No.	7318P119E
Drawn by:	KJZ	Scale:	N.T.S.
Checked by:	KJZ	File Name:	Soil - Rock - Log
Approved by:	PAM	Date:	February 7, 2019

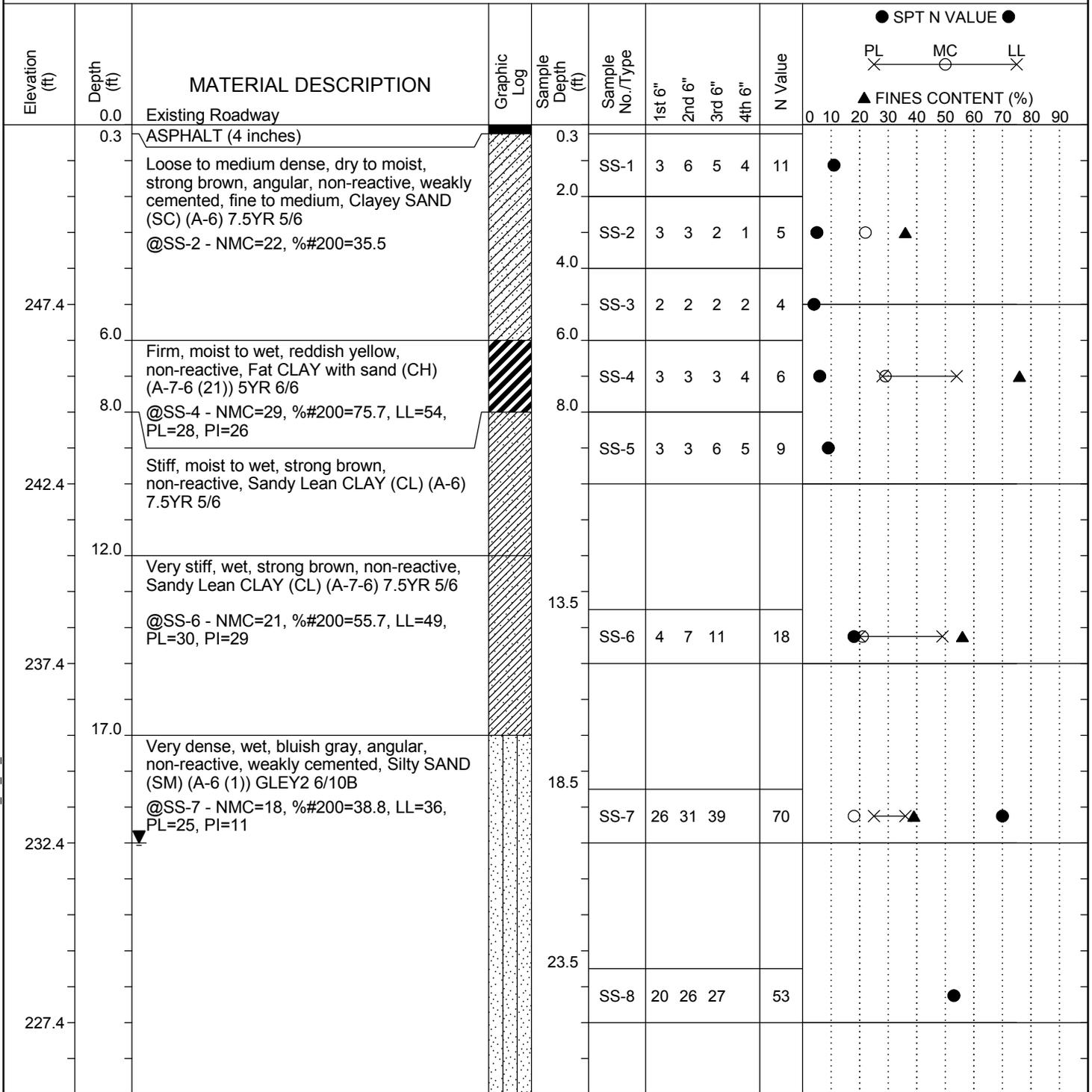
**Terracon**  
Consulting Engineers & Scientists

521 Clemson Road Columbia, South Carolina 29229  
PH. (803) 741-9000 FAX. (803) 741-9900

SOIL / ROCK / LOG SYMBOL LEGEND

# SCDOT Soil Test Log

<b>Project ID:</b>	PO38247	<b>County:</b>	Chesterfield	<b>Boring No.:</b>	B-1
<b>Site Description:</b>	S-13-757 (Davis Rivers Road) RBO Adams Creek			<b>Route:</b>	S-13-757
<b>Eng./Geo.:</b>	RDS	<b>Boring Location:</b>		<b>Offset:</b>	
<b>Elev.:</b>	252.4 ft	<b>Latitude:</b>	34.787403	<b>Longitude:</b>	-80.079514
<b>Total Depth:</b>	47.7 ft	<b>Soil Depth:</b>	28.2 ft	<b>Core Depth:</b>	19.5 ft
<b>Bore Hole Diameter (in):</b>	3	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Drill Machine:</b>	CME-45/543	<b>Drill Method:</b>	RW/RC	<b>Hammer Type:</b>	Automatic
<b>Core Size:</b>	NQ2	<b>Driller:</b>	BH	<b>Energy Ratio:</b>	97.1%
		<b>Groundwater:</b>	TOB	N.A.	24HR
					20 ft



## LEGEND

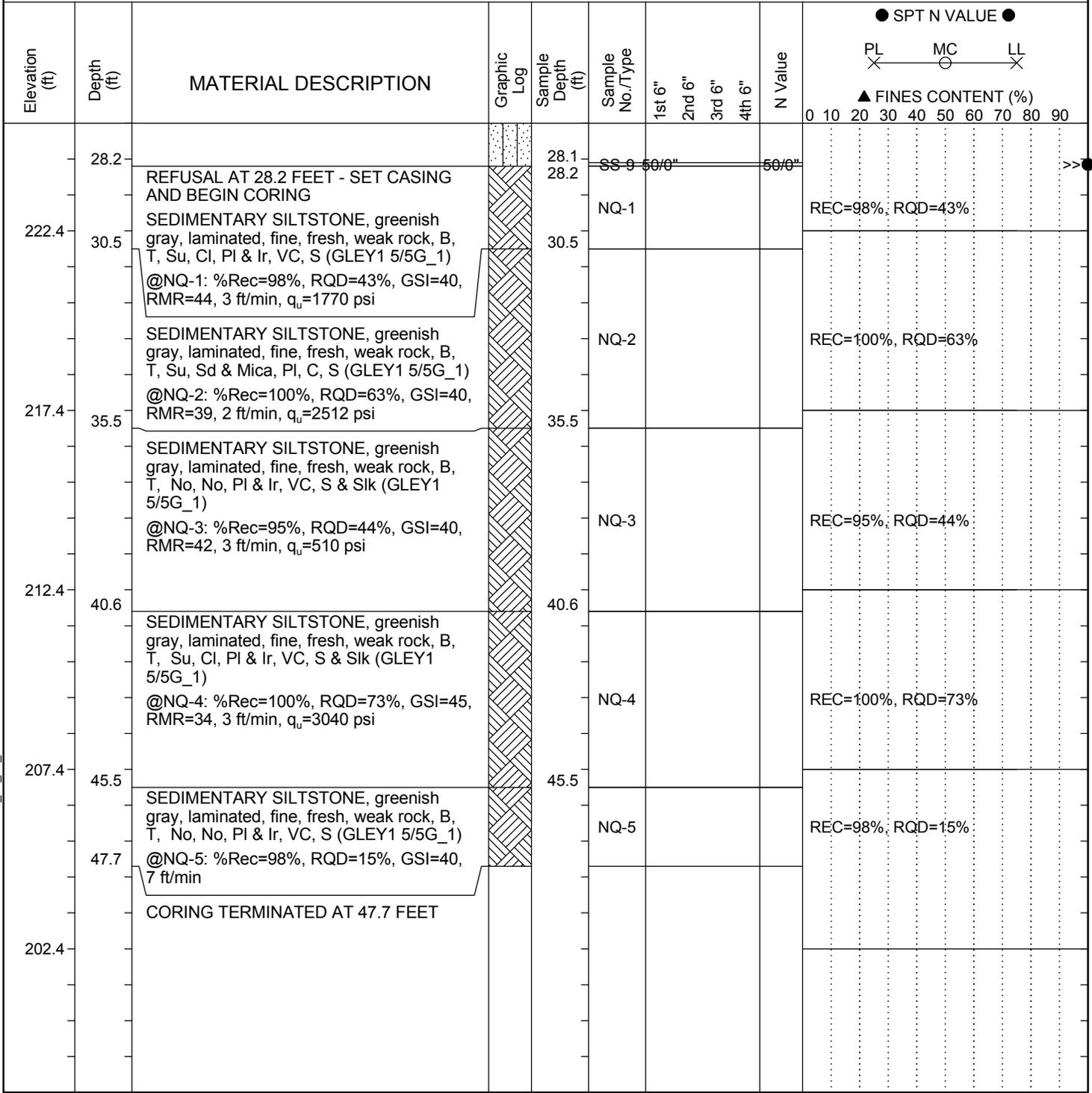
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC\_DOT\_7318P119E S-13-757 SCDOT DATA TEMPLATE\_01\_30\_2015.GDT\_2/7/19

# SCDOT Soil Test Log

<b>Project ID:</b>	PO38247	<b>County:</b>	Chesterfield	<b>Boring No.:</b>	B-1
<b>Site Description:</b>	S-13-757 (Davis Rivers Road) RBO Adams Creek			<b>Route:</b>	S-13-757
<b>Eng./Geo.:</b>	RDS	<b>Boring Location:</b>		<b>Offset:</b>	
<b>Elev.:</b>	252.4 ft	<b>Latitude:</b>	34.787403	<b>Longitude:</b>	-80.079514
<b>Total Depth:</b>	47.7 ft	<b>Soil Depth:</b>	28.2 ft	<b>Core Depth:</b>	19.5 ft
<b>Bore Hole Diameter (in):</b>	3	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Drill Machine:</b>	CME-45/543	<b>Drill Method:</b>	RW/RC	<b>Hammer Type:</b>	Automatic
<b>Core Size:</b>	NQ2	<b>Driller:</b>	BH	<b>Energy Ratio:</b>	97.1%
		<b>Groundwater:</b>	TOB	N.A.	24HR
					20 ft



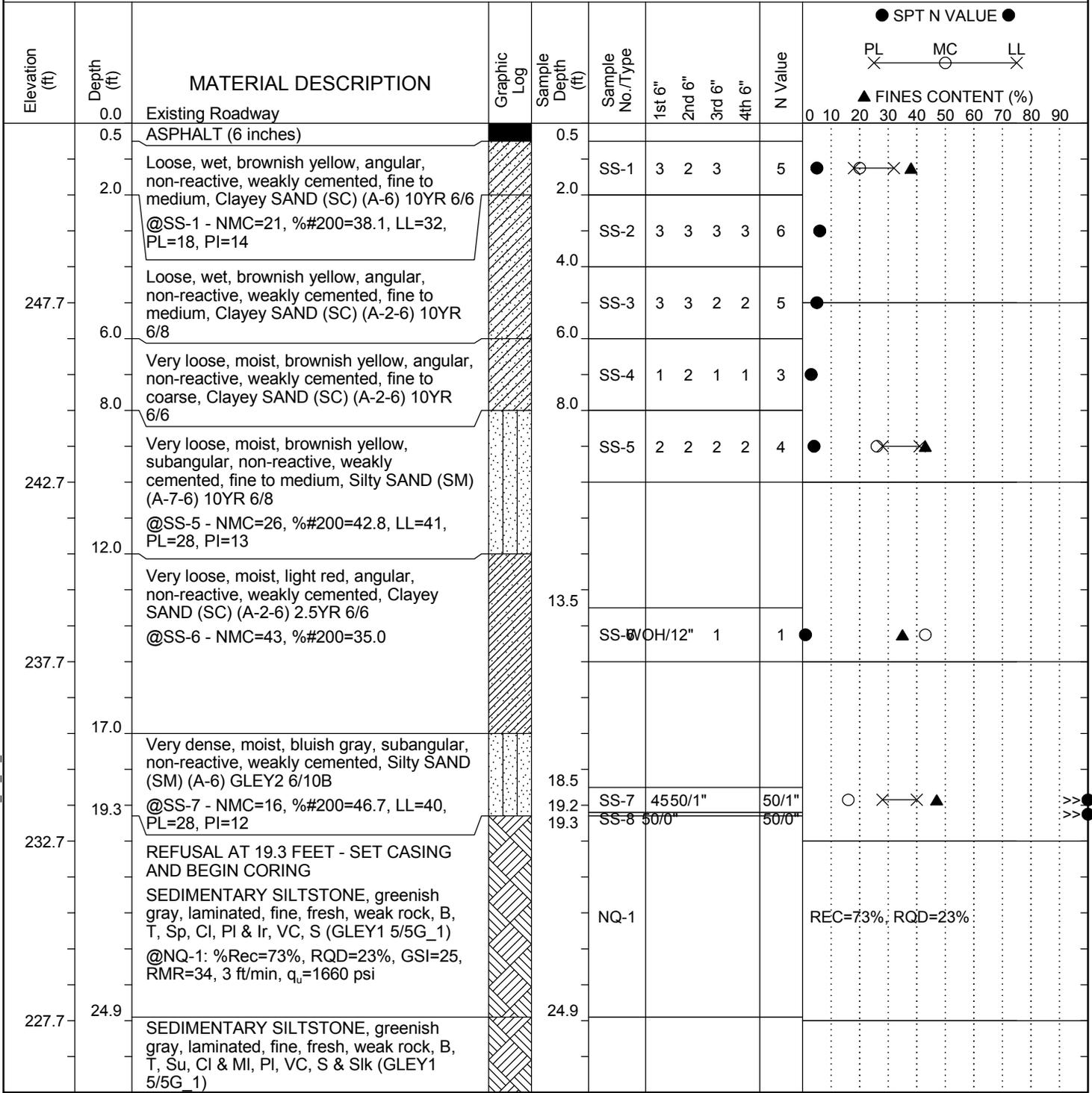
### LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC\_DOT\_7318P119E S-13-757 SCDOT DATA TEMPLATE\_01\_30\_2015.GDT 2/7/19

# SCDOT Soil Test Log

<b>Project ID:</b>	PO38247	<b>County:</b>	Chesterfield	<b>Boring No.:</b>	B-2
<b>Site Description:</b>	S-13-757 (Davis Rivers Road) RBO Adams Creek			<b>Route:</b>	S-13-757
<b>Eng./Geo.:</b>	RDS	<b>Boring Location:</b>		<b>Offset:</b>	
<b>Elev.:</b>	252.7 ft	<b>Latitude:</b>	34.787411	<b>Longitude:</b>	-80.079794
<b>Total Depth:</b>	39.6 ft	<b>Soil Depth:</b>	19.3 ft	<b>Core Depth:</b>	20.3 ft
<b>Bore Hole Diameter (in):</b>	3	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Drill Machine:</b>	CME-45/543	<b>Drill Method:</b>	RW/RC	<b>Hammer Type:</b>	Automatic
<b>Core Size:</b>	NQ2	<b>Driller:</b>	AM	<b>Energy Ratio:</b>	97.1%
				<b>Groundwater:</b>	TOB N.A. 24HR N.E.



### LEGEND

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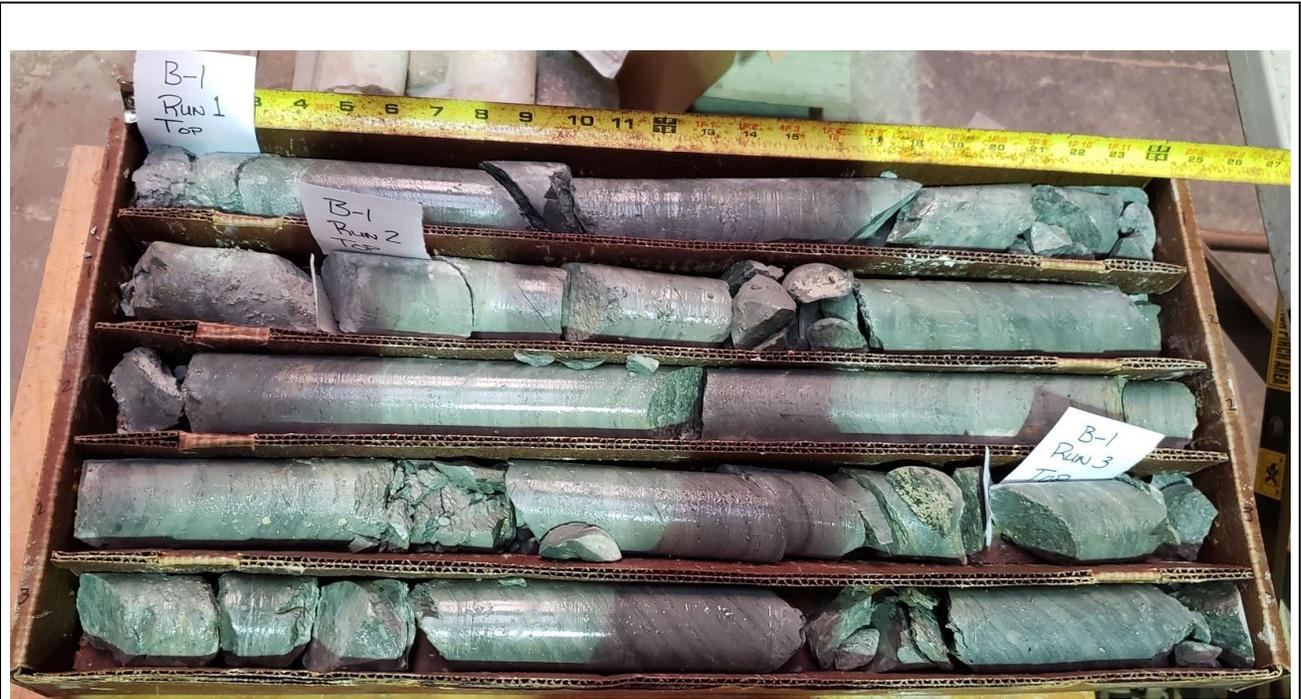
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
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SC\_DOT\_7318P119E S-13-757 SCDOT DATA TEMPLATE\_01\_30\_2015.GDT 2/7/19

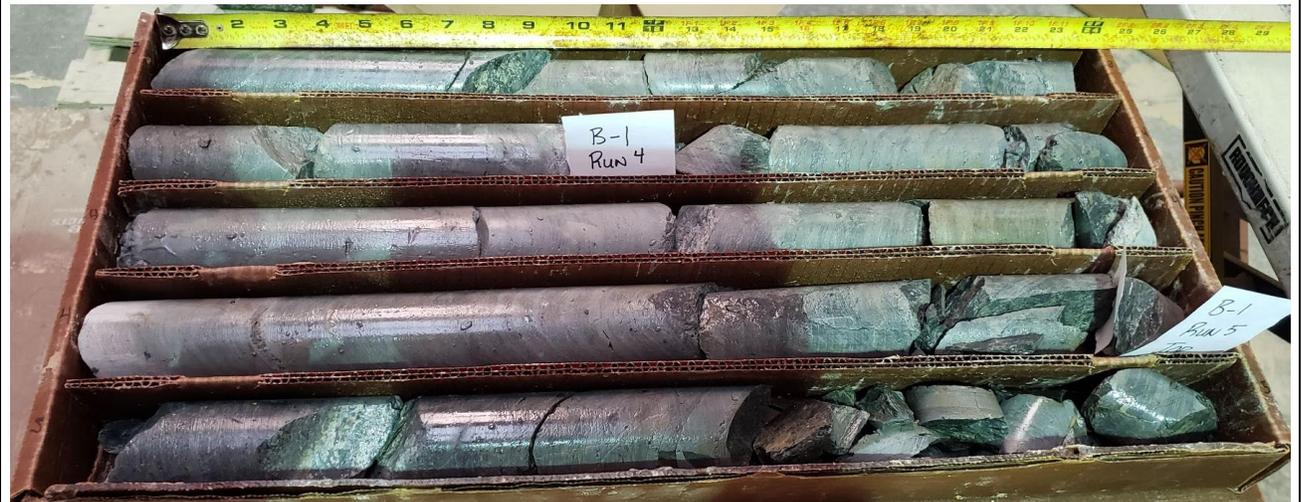


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B-1: NQ-1: 28.2-30.5 feet; NQ-2: 30.5-35.5 feet; and NQ-3: 35.5-40.6 feet



B-1 NQ-3: 35.5-40.6 feet, cont.; NQ-4: 40.6-45.5 feet; and NQ-5: 45.5-47.7 feet

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B-2 NQ-1:19.3-24.9 feet, NQ-2: 24.9-29.9 feet, and NQ-3: 29.9-34.8 feet



B-2 NQ-4: 34.8-39.6 feet

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Drill rig on B-1



Drill rig on B-2

**APPENDIX B**  
**LABORATORY TESTING**

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

## Geotechnical Data Report

S-13-757 (Davis Rivers Road) RBO Adams Creek ■ Chesterfield County, SC  
February 7, 2019 ■ Terracon Project No. 7318P119E/Project ID.: P038247



### 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 the SCDOT. Using the provided testing program, the laboratory tests were conducted on selected soil samples from the borings. 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:

- |   |                            |
|---|----------------------------|
| ■ Materials Finer Than 75- $\mu$ m (No. 200) Sieve          | AASHTO T11/(ASTM D1140)    |
| ■ Liquid Limit, Plastic Limit and Plasticity Index of Soils | AASHTO T89/90/(ASTM D4318) |
| ■ Determination of Moisture Content of Soils                | AASHTO T265/(ASTM D2216)   |
| ■ Compressive Strength of Rock Cores                        | AASHTO T226/(ASTM D7012)   |

# Summary of Laboratory Results

BORING ID	Depth (Ft.)	% Fines	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)
B-1	2 - 4	35.5				22
B-1	6 - 8	75.7	54	28	26	29
B-1	13.5 - 15	55.7	49	20	29	21
B-1	18.5 - 20	38.8	36	25	11	18
B-2	0.5 - 2	38.1	32	18	14	20
B-2	8 - 10	42.8	41	28	13	26
B-2	13.5 - 15.5	35.0				43
B-2	18.5 - 20.5	46.7	40	28	12	16

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-PORTRAIT\_7318P119E S-13-757 LAB DATA.GPJ TERRACON\_DATATEMPLATE.GDT 2/6/19

PROJECT: S-757 (Davis Rivers Road) RBO Adams Creek	 <p style="font-size: small;">521 Clemson Rd Columbia, SC</p>	PROJECT NUMBER: 7318P119E
SITE: Chesterfield County		CLIENT: SCDOT Columbia, SC
		EXHIBIT: B-2





# INDEX PROPERTIES VERSUS DEPTH

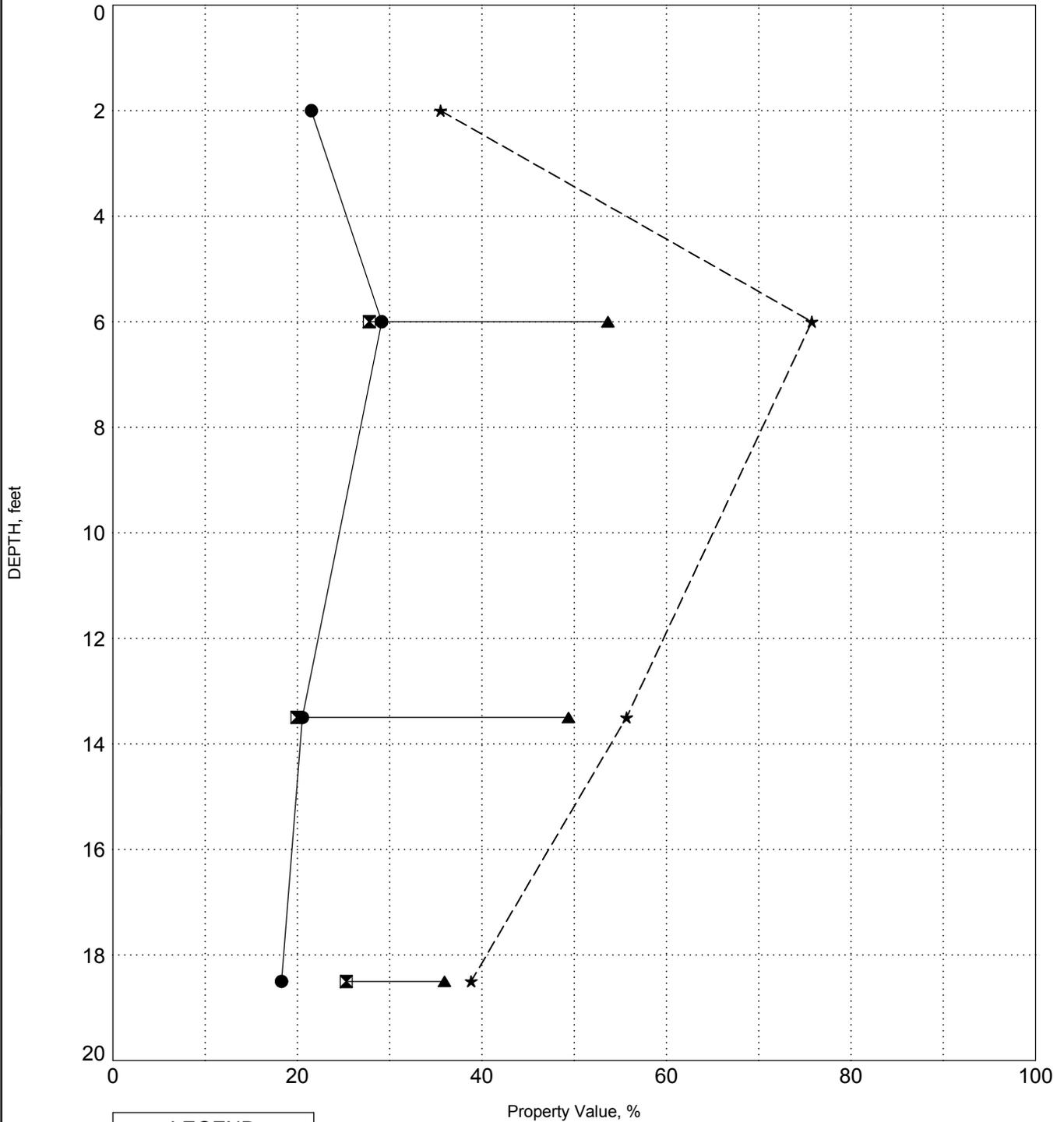
PROJECT ID PO38247

PROJECT NAME S-13-757 (Davis Rivers Road) RBO Adams Creek

PROJECT COUNTY Chesterfield

## BORING B-1

SURFACE ELEVATION: 252.4



LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

INDEX PROPS 7318P119E S-13-757 SCDOT.GPJ SCDOT DATA TEMPLATE\_01\_30\_2015.GDT 2/6/19



# INDEX PROPERTIES VERSUS DEPTH

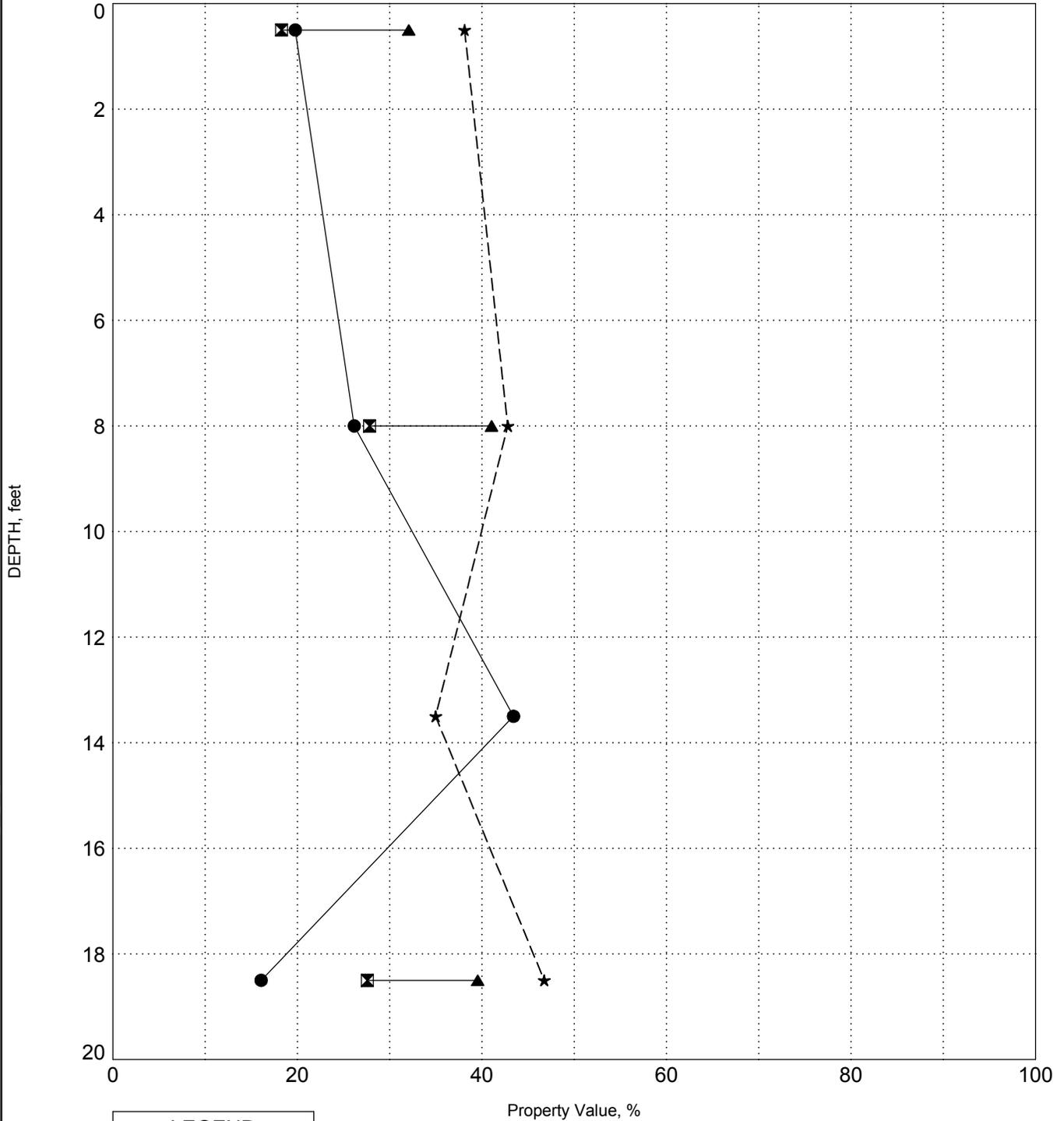
PROJECT ID PO38247

PROJECT NAME S-13-757 (Davis Rivers Road) RBO Adams Creek

PROJECT COUNTY Chesterfield

SURFACE ELEVATION: 252.7

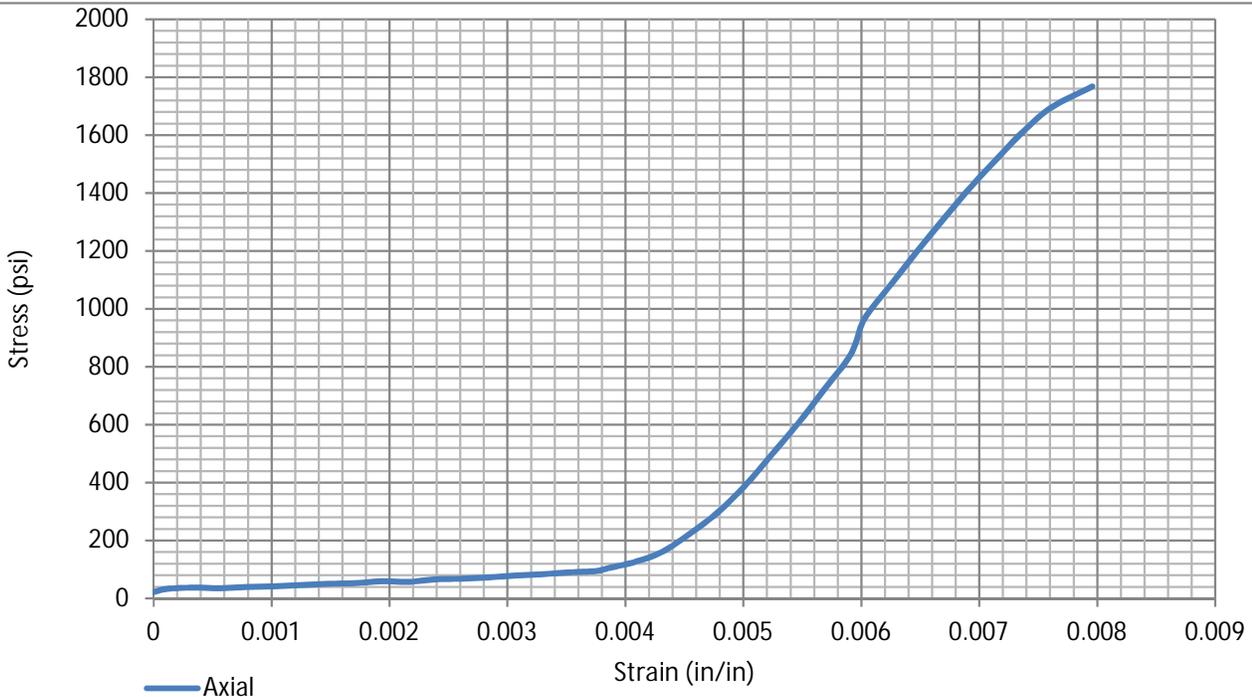
## BORING B-2



LEGEND	
●	Water Content
☒	Plastic Limit
▲	Liquid Limit
★	Fines

INDEX PROPS 7318P119E S-13-757 SCDOT.GPJ SCDOT DATA TEMPLATE\_01\_30\_2015.GDT 2/6/19

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



**SAMPLE LOCATION**

Boring:	1-B-1	Depth (feet):	28.2-30.5
---------	-------	---------------	-----------

**SPECIMEN INFORMATION**

Sample No.:	1	Mass (g):	483.94
Length (in.):	4.42	Diameter (in.):	1.82
L/D Ratio:	2.42	Density (pcf):	159.63

**TEST RESULTS**

Failure Load (lbs):	4,620
Failure Strain (%):	0.80
Unconfined Compressive Strength (psi):	1,768
Elastic Modulus, E, (ksi):	
Poisson's Ratio, v:	

Description: GR SILTSTONE W/ PYRITE

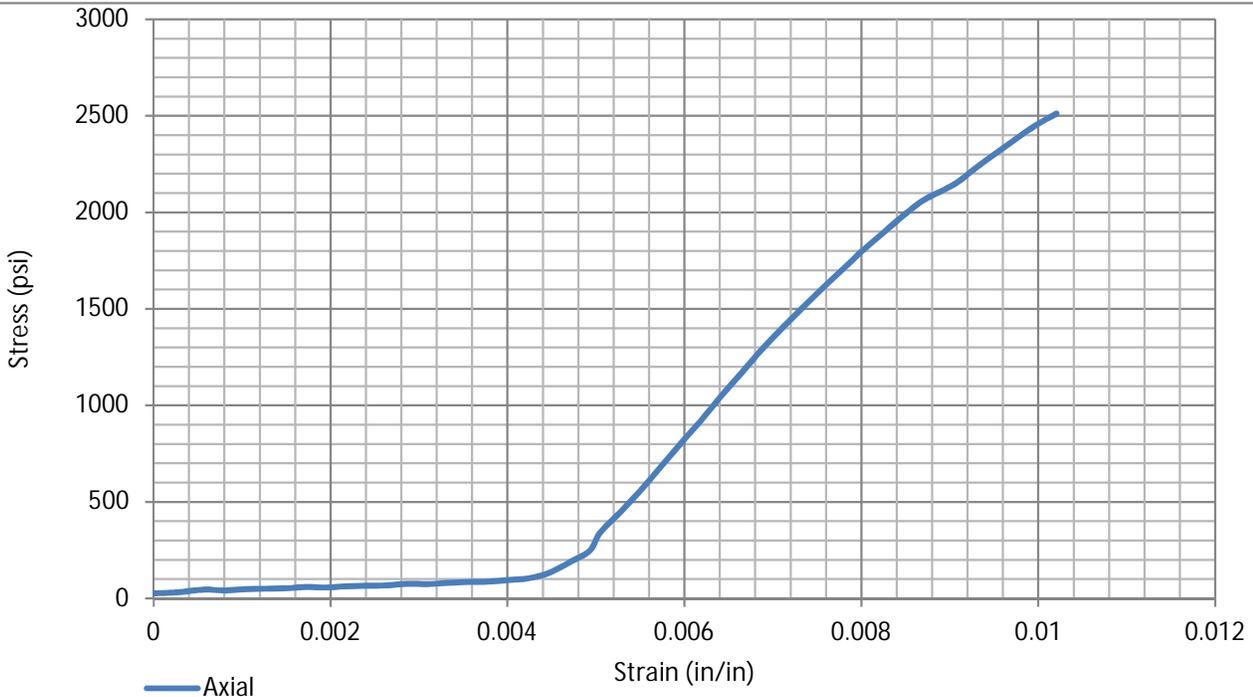
NOTES:

CLIENT: SCDOT  
 PROJECT: Emergency bridge Package  
 2018-2  
 PROJECT NO.: 7318119E



LAB NO.: 847  
 DATE TESTED: 2/5/2019  
 DATE REDUCED: 2/7/2019  
 EXHIBIT:

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



SAMPLE LOCATION			
Boring:	2-B-1	Depth (feet):	30.5-35.5

SPECIMEN INFORMATION			
Sample No.:	2	Mass (g):	495.10
Length (in.):	4.38	Diameter (in.):	1.83
L/D Ratio:	2.39	Density (pcf):	163.11

TEST RESULTS	
Failure Load (lbs):	6,629
Failure Strain (%):	1.02
Unconfined Compressive Strength (psi):	2,512
Elastic Modulus, E, (ksi):	
Poisson's Ratio, v:	

Description: GR SILTSTONE W/ PYRITE

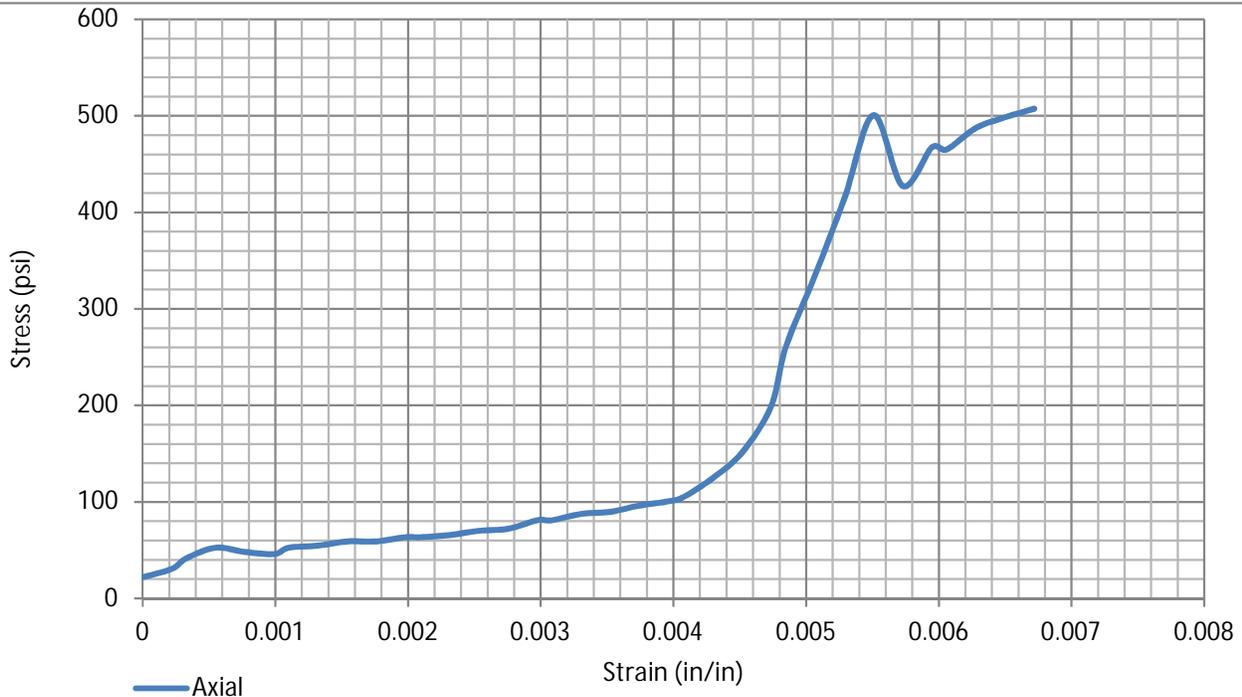
NOTES:

CLIENT: SCDOT  
 PROJECT: Emergency bridge Package  
 2018-2  
 PROJECT NO.: 7318119E



LAB NO.: 848  
 DATE TESTED: 2/5/2019  
 DATE REDUCED: 2/7/2019  
 EXHIBIT:

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



**SAMPLE LOCATION**

Boring:	3-B-1	Depth (feet):	35.5-40.6
---------	-------	---------------	-----------

**SPECIMEN INFORMATION**

Sample No.:	3	Mass (g):	515.75
Length (in.):	4.56	Diameter (in.):	1.83
L/D Ratio:	2.50	Density (pcf):	164.10

**TEST RESULTS**

Failure Load (lbs):	1,332
Failure Strain (%):	0.67
Unconfined Compressive Strength (psi):	507
Elastic Modulus, E, (ksi):	
Poisson's Ratio, v:	

Description: GR SILTSTONE W/ PYRITE

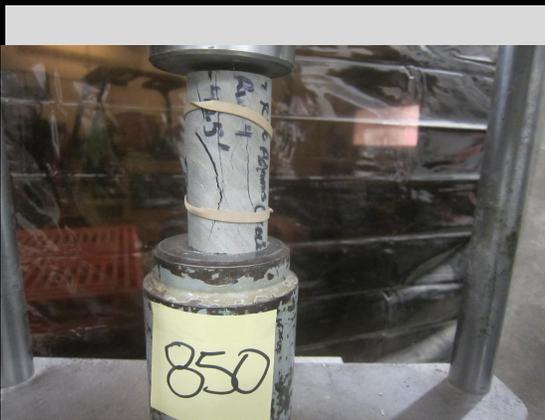
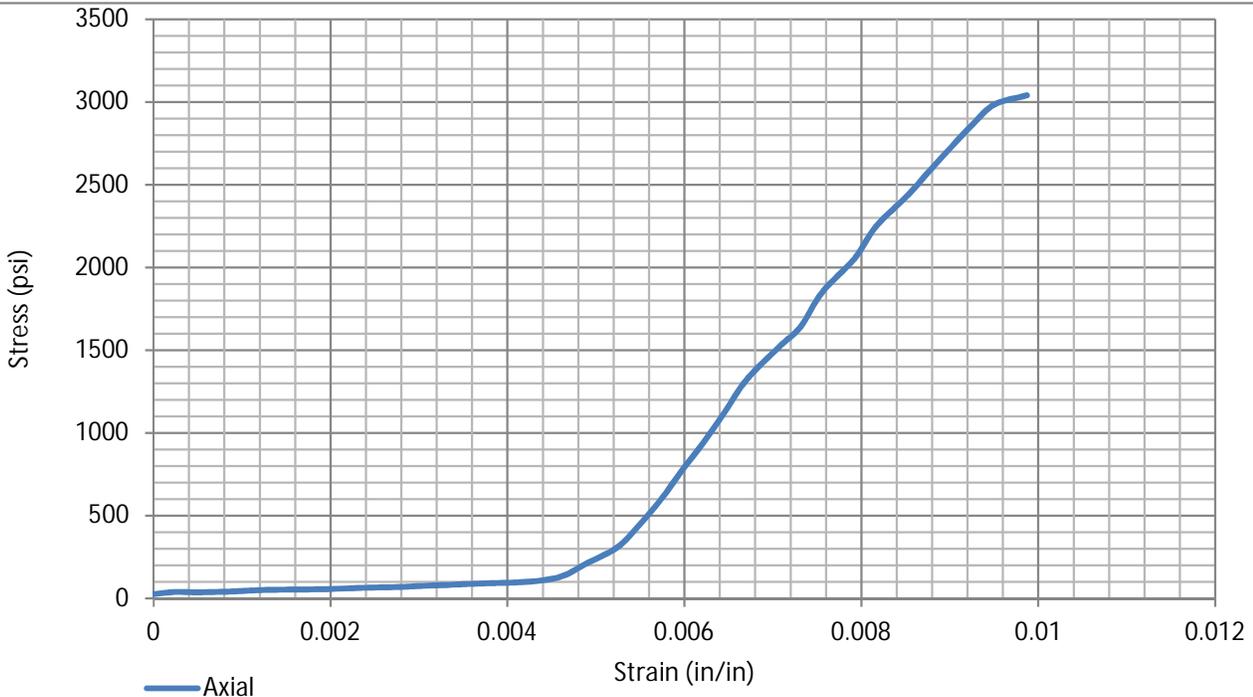
NOTES:

CLIENT: SCDOT  
PROJECT: Emergency bridge Package  
2018-2  
PROJECT NO.: 7318119E



LAB NO.: 849  
DATE TESTED: 2/5/2019  
DATE REDUCED: 2/7/2019  
EXHIBIT:

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



**SAMPLE LOCATION**

Boring:	4-B-1	Depth (feet):	40.6-45.5
---------	-------	---------------	-----------

**SPECIMEN INFORMATION**

Sample No.:	4	Mass (g):	477.10
Length (in.):	4.12	Diameter (in.):	1.84
L/D Ratio:	2.25	Density (pcf):	166.69

**TEST RESULTS**

Failure Load (lbs):	8,041
Failure Strain (%):	0.99
Unconfined Compressive Strength (psi):	3,041
Elastic Modulus, E, (ksi):	
Poisson's Ratio, v:	

Description: GR SILTSTONE W/ PYRITE

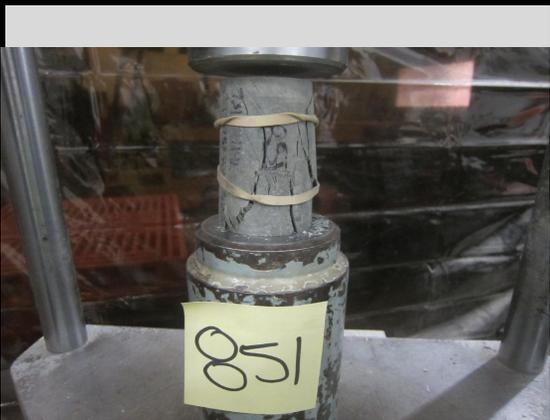
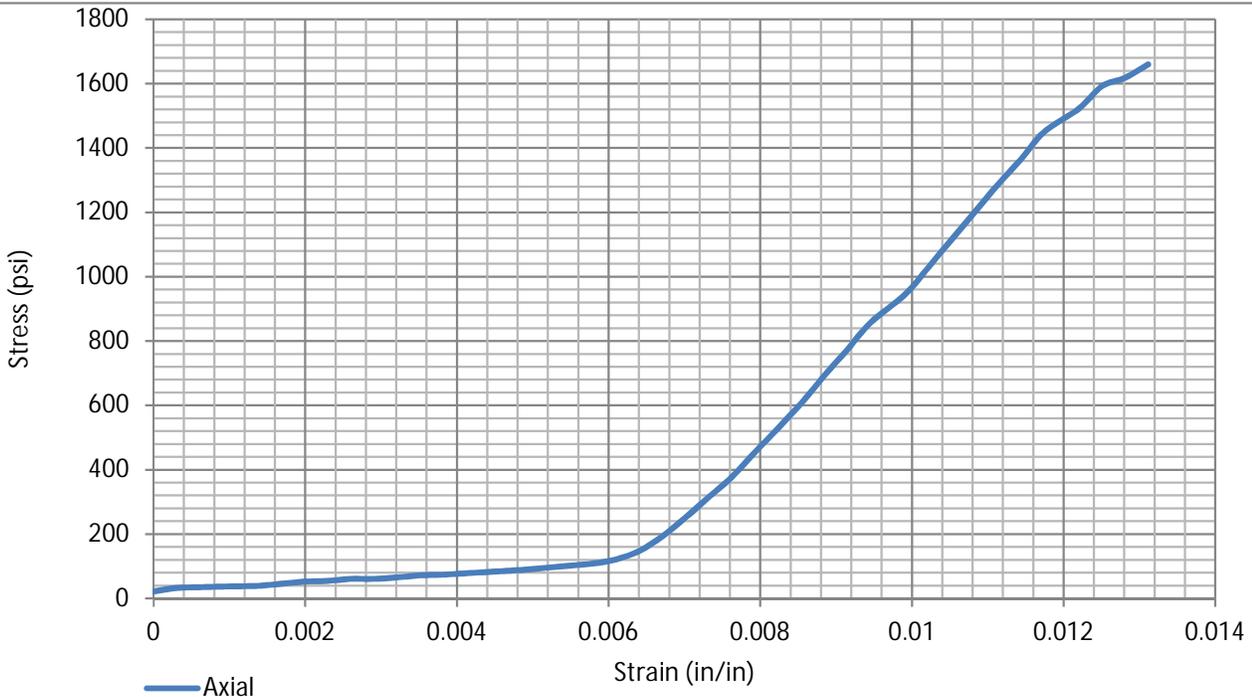
NOTES:

CLIENT: SCDOT  
PROJECT: Emergency bridge Package  
2018-2  
PROJECT NO.: 7318119E



LAB NO.: 850  
DATE TESTED: 2/5/2019  
DATE REDUCED: 2/7/2019  
EXHIBIT:

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



**SAMPLE LOCATION**

Boring:	5-B-2	Depth (feet):	19.3-24.9
---------	-------	---------------	-----------

**SPECIMEN INFORMATION**

Sample No.:	1	Mass (g):	362.17
Length (in.):	3.30	Diameter (in.):	1.84
L/D Ratio:	1.79	Density (pcf):	158.16

**TEST RESULTS**

Failure Load (lbs):	4,394
Failure Strain (%):	1.31
Unconfined Compressive Strength (psi):	1,660
Elastic Modulus, E, (ksi):	
Poisson's Ratio, v:	

Description: GR SILTSTONE W/ PYRITE

NOTES:

CLIENT: SCDOT

PROJECT: Emergency Bridge Package  
2018-2

PROJECT NO.: 7318119E



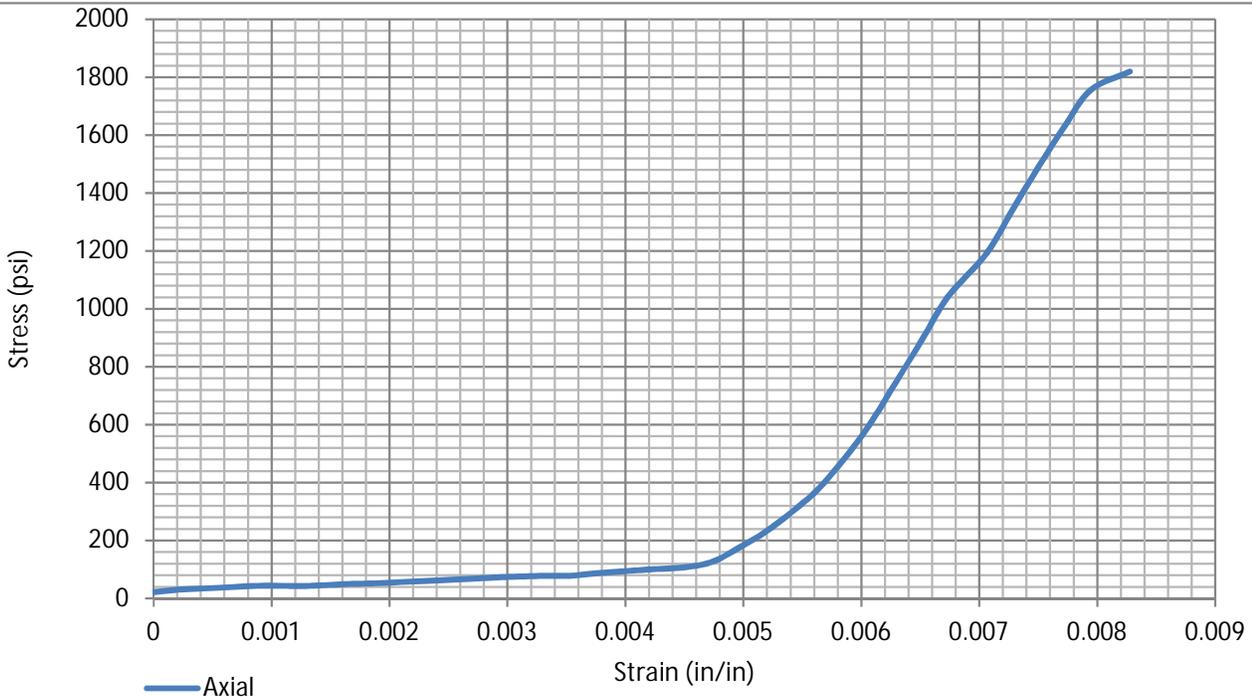
LAB NO.: 851

DATE TESTED: 2/5/2019

DATE REDUCED: 2/7/2019

EXHIBIT:

**COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF  
INTACT ROCK ASTM D7012**



	<b>SAMPLE LOCATION</b>			
	Boring:	6-B-2	Depth (feet):	34.8-39.6
	<b>SPECIMEN INFORMATION</b>			
	Sample No.:	4	Mass (g):	519.93
	Length (in.):	4.55	Diameter (in.):	1.84
	L/D Ratio:	2.48	Density (pcf):	163.57
	<b>TEST RESULTS</b>			
	Failure Load (lbs):	4,817		
	Failure Strain (%):	0.83		
	Unconfined Compressive Strength (psi):	1,819		
Elastic Modulus, E, (ksi):				
Poisson's Ratio, v:				
Description:	GR SILTSTONE W/ PYRITE			

NOTES:

CLIENT: SCDOT		LAB NO.: 852
PROJECT: Emergency Bridge Package 2018-2		DATE TESTED: 2/5/2019
PROJECT NO.: 7318119E		DATE REDUCED: 2/7/2019
		EXHIBIT:

**APPENDIX C**  
**SUPPORTING DOCUMENTS**

**Exhibit C-1 – Rig Calibration Documentation**

# DRILL RIG SPT HAMMER ENERGY CALIBRATION REPORT

Drill Rig Model CME-45C SN 406484  
 Terracon Drill Rig No. 543  
 Gaston Solar Facility  
 May 29, 2018  
 Project No. 73185061

Prepared for:  
 Terracon Consultants, Inc.  
 Columbia, SC

Prepared by:  
 Terracon Consultants, Inc.  
 North Charleston, South Carolina



## 1.0 PROJECT INFORMATION

ITEM	DESCRIPTION
Drill Rig Identification	CME-45C, SN 406484 (see photograph on cover page)
Drill Rig Owner	Terracon
Drill Rig Operator	Spencer Blair
Testing Date	May 24, 2018
Testing Location	Gaston Solar Facility
Terracon Project Number	73185061
Boring Identification	SB-2
Energy Measurement Depths	30.0 ft.; 35.0 ft.; 40.0 ft.; 45.0 ft.; 50.0 ft.
Hammer Type	Automatic
Boring Method	Hollow Stem Auger
Drill Rods	<ul style="list-style-type: none"> <li>■ AWJ</li> <li>■ 1½" outside diameter</li> <li>■ 3/16" wall thickness</li> </ul>
SPT Calibration Testing Equipment	<ul style="list-style-type: none"> <li>■ 2 foot AWJ rod instrumented w/ 2 strain gauges and 2 accelerometers</li> <li>■ Model PAX Pile Driving Analyzer™ (PDA)</li> </ul>
SPT Calibration Personnel	R. Wakeford & Z. McIntosh

## 2.0 TEST RESULTS

Table 1:  
 SPT Hammer Energy Calibration Testing Summary.

Boring	Start Depth <sup>1</sup> (ft)	Rod Length <sup>2</sup> (ft)	Rod Sections <sup>3</sup>				Measured Blow Counts (blows/6 inches)				SPT N <sub>meas</sub> (bpf)	Soil Type <sup>4</sup>
			2 ft	5 ft	10 ft	1 <sup>st</sup> Inc.	2 <sup>nd</sup> Inc.	3 <sup>rd</sup> Inc.	4 <sup>th</sup> Inc.			
SB-2	28.5	30.0	0	6	0	9	12	15	-	27	SM	
	33.5	35.0	0	7	0	6	5	9	-	14	SM	
	38.5	40.0	0	8	0	9	14	19	-	33	SM	
	43.5	45.0	0	9	0	8	12	12	-	24	SM	
	48.5	50.0	0	10	0	9	16	15	-	31	SM	

1. Depth from existing ground surface to start of SPT
2. Total rod length 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.

Offices Nationwide  
 Employee-Owned

Established in 1965  
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Responsive ■ Resourceful ■ Reliable

Table 2:  
 Energy Measurement and Analysis Summary.

Boring	Start Depth <sup>1</sup> (ft)	SPT N <sub>meas</sub> (bpf)	No. of Blows <sup>2</sup>	EMX <sup>3</sup> (kip-ft)				ETR <sup>3</sup> (%)	
				Max.	Min.	Ave.	Std. Dev.	Ave.	Std. Dev.
SB-2	28.5	27	27	0.37	0.31	0.34	0.016	97.9	4.464
	33.5	14	14	0.36	0.33	0.34	0.008	98.5	2.171
	38.5	33	33	0.35	0.34	0.34	0.003	97.1	0.776
	43.5	24	24	0.34	0.33	0.33	0.004	95.4	1.005
	48.5	31	31	0.36	0.33	0.34	0.006	96.7	1.763
<b>Average:</b>				<b>0.35</b>	<b>0.33</b>	<b>0.34</b>	<b>0.007</b>	<b>97.1</b>	<b>2.036</b>

1. Boring ID and depth from existing ground surface to start 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. EMX = Maximum Transferred Energy, ETR = Energy Transfer Ratio.

Table 3:  
 Hammer Blow Rate Summary.

Boring	Start Depth <sup>1</sup> (ft)	SPT N <sub>meas</sub> (bpf)	No. of Blows <sup>2</sup>	BPM <sup>3</sup>			
				Max.	Min.	Ave.	Std. Dev.
SB-2	28.5	27	27	55.4	54.8	55.1	0.183
	33.5	14	14	55.4	55.0	55.2	0.107
	38.5	33	33	55.0	54.5	54.7	0.123
	43.5	24	24	46.4	45.6	46.0	0.257
	48.5	31	31	55.2	54.7	55.0	0.128
<b>Average:</b>				<b>53.5</b>	<b>52.9</b>	<b>53.2</b>	<b>0.159</b>

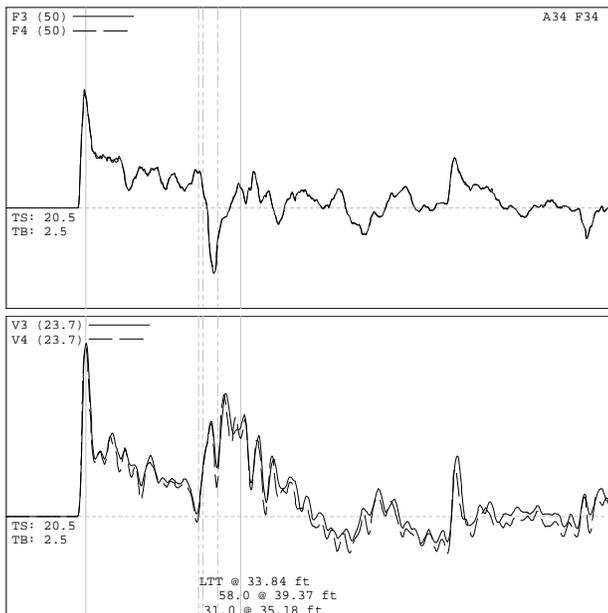
1. Boring ID and depth from existing ground surface to start of SPT.
2. Number of blows used in energy calibration analysis. Limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the 1st increment if refusal conditions were encountered.
3. BPM = Blows per minute

## 3.0 CONCLUSIONS

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

Based on our testing and subsequent analysis, drill rig CME-45C (No. 543) has an ETR of 97.1% ± 2.04%. Based on this ETR, the hammer efficiency correction (C<sub>e</sub>) is 1.62.

## Exhibit A-1 Representative Blow

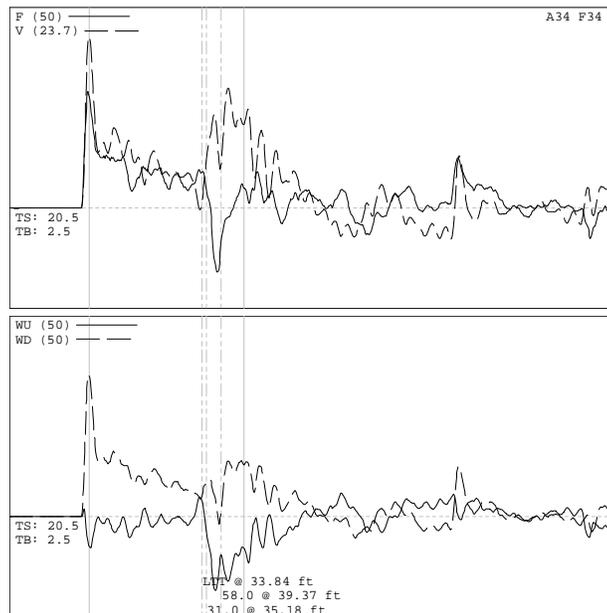


**Project Information**  
 PROJECT: GASTON 2 SOLAR FACILITY  
 PILE NAME: SPT CAL 38.5-40  
 DESCR: CME 45C 38.5-40  
 OPERATOR: ZM  
 FILE: SPT\_CAL\_38.5\_40\_Log  
 5/24/2018 11:54:19 AM  
 Blow Number 9

**Pile Properties**  
 LE 43.70 ft  
 AR 1.18 in<sup>2</sup>  
 EM 30000 ksi  
 SP 0.492 k/ft<sup>3</sup>  
 WS 16807.9 f/s  
 EA/C 2.1 ksec/ft  
 2L/C 5.22 ms  
 JC []  
 LP 37.50 ft

**Quantity Results**  
 ETR 98.2 (%)  
 CSX 24.6 ksi  
 CSB 0.0 ksi  
 BPM 55.1 bpm  
 EMX 0.344 k-ft  
 DMX 0.69 in  
 SFR kips  
 MEX 820 µE  
 VMX 20.3 f/s

**Sensors**  
 F3: [AWJ 1] 216.53 (1)  
 F4: [AWJ 2] 216.2 (1)  
 A3: [K5418] 382 mv/5000g's (1)  
 A4: [K0059] 317 mv/5000g's (1)  
 CLIP: OK



**Project Information**  
 PROJECT: GASTON 2 SOLAR FACILITY  
 PILE NAME: SPT CAL 38.5-40  
 DESCR: CME 45C 38.5-40  
 OPERATOR: ZM  
 FILE: SPT\_CAL\_38.5\_40\_Log  
 5/24/2018 11:54:19 AM  
 Blow Number 9

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 EM 30000 ksi  
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 WS 16807.9 f/s  
 EA/C 2.1 ksec/ft  
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 JC []  
 LP 37.50 ft

**Quantity Results**  
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 CSX 24.6 ksi  
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 A3: [K5418] 382 mv/5000g's (1)  
 A4: [K0059] 317 mv/5000g's (1)  
 CLIP: OK

Drill Rig SPT Hammer Energy Calibration Report  
 CME-45C (SN 406484) ■ Columbia, SC  
 May 29, 2018 ■ Terracon Project No. 73185061



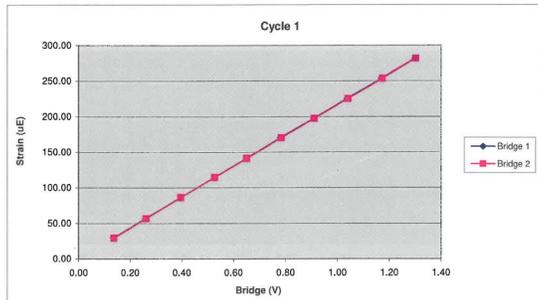
Exhibit A-2 PDA Equipment Calibrations



267AWJ		Cycle 1		
Sample	Force (lb)	Strain ( $\mu\text{E}$ )	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1034.65	29.80	0.14	0.14
3	1995.74	57.07	0.26	0.26
4	3021.54	86.56	0.40	0.40
5	4013.51	114.64	0.53	0.53
6	4945.09	141.59	0.65	0.65
7	5967.55	170.38	0.78	0.78
8	6935.72	197.78	0.91	0.91
9	7944.21	225.43	1.04	1.04
10	8835.59	253.69	1.17	1.17
11	9924.61	282.06	1.30	1.30

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7636.82	Force Calibration (lb/V)	7622.38
Offset	-7.82	Offset	-11.05
Correlation	0.999996	Correlation	0.999997
Strain Calibration ( $\mu\text{E/V}$ )	216.43	Strain Calibration ( $\mu\text{E/V}$ )	216.02
Offset	0.60	Offset	0.51
Correlation	0.999996	Correlation	0.999993

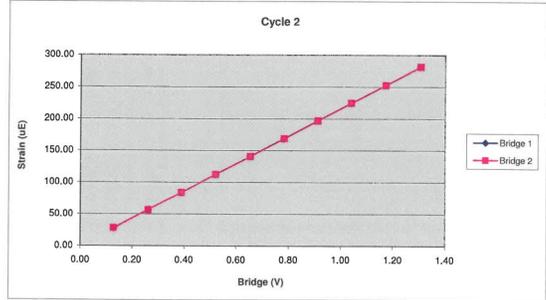
Force Strain Calibration	
EA (Kips)	35284.30
Offset	-29.01
Correlation	0.999989



267AWJ		Cycle 2		
Sample	Force (lb)	Strain ( $\mu\text{E}$ )	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	979.97	28.37	0.13	0.13
3	2002.82	57.00	0.26	0.26
4	2963.52	84.19	0.39	0.39
5	3965.12	112.62	0.52	0.52
6	4973.02	141.14	0.65	0.65
7	5964.01	169.13	0.78	0.78
8	6938.87	197.15	0.91	0.91
9	7932.41	224.93	1.04	1.04
10	8939.72	253.23	1.17	1.17
11	9962.18	281.86	1.30	1.31

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7634.65	Force Calibration (lb/V)	7626.42
Offset	-9.30	Offset	-6.45
Correlation	0.999997	Correlation	0.999997
Strain Calibration ( $\mu\text{E/V}$ )	215.81	Strain Calibration ( $\mu\text{E/V}$ )	215.58
Offset	0.30	Offset	0.38
Correlation	0.999997	Correlation	0.999996

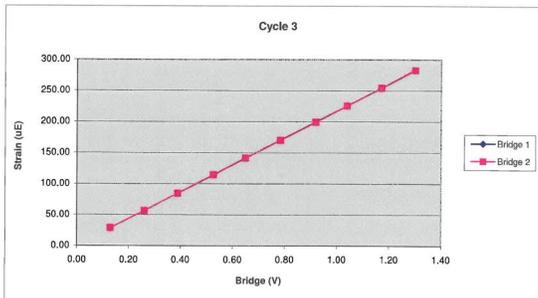
Force Strain Calibration	
EA (Kips)	35375.85
Offset	-19.88
Correlation	0.999997



267AWJ		Cycle 3		
Sample	Force (lb)	Strain ( $\mu\text{E}$ )	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	982.53	28.74	0.13	0.13
3	1993.97	56.89	0.26	0.26
4	2965.68	84.76	0.39	0.39
5	4014.49	114.61	0.53	0.53
6	4944.11	141.53	0.65	0.65
7	5962.04	170.43	0.78	0.78
8	6994.93	199.62	0.92	0.92
9	7922.38	225.92	1.04	1.04
10	8918.48	254.51	1.17	1.17
11	9909.26	283.02	1.30	1.30

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7625.63	Force Calibration (lb/V)	7613.58
Offset	-4.78	Offset	-1.05
Correlation	0.999999	Correlation	0.999998
Strain Calibration ( $\mu\text{E/V}$ )	217.34	Strain Calibration ( $\mu\text{E/V}$ )	217.00
Offset	0.23	Offset	0.33
Correlation	0.999995	Correlation	0.999998

Force Strain Calibration	
EA (Kips)	35085.96
Offset	-12.70
Correlation	0.999996



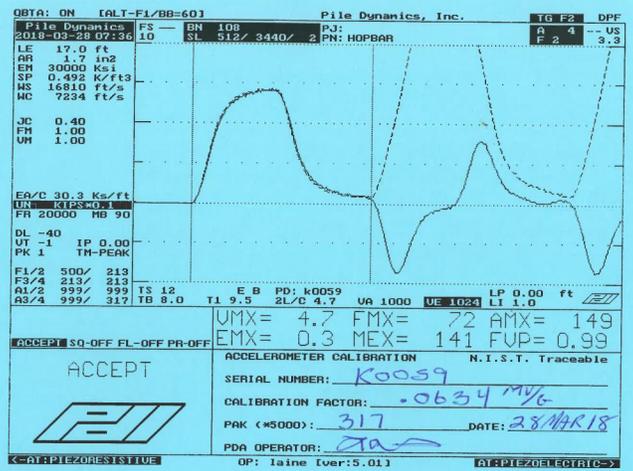
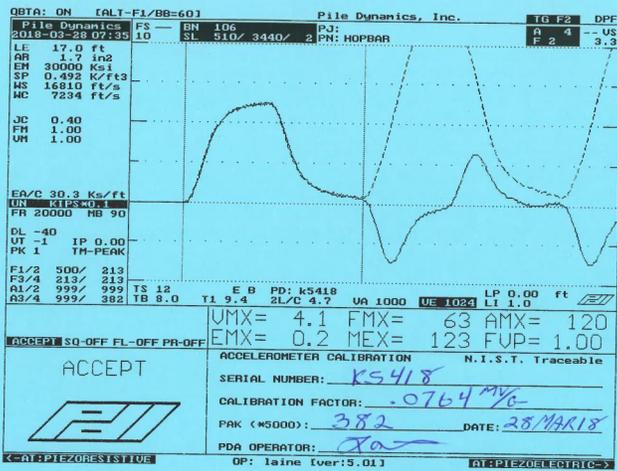
Bridge Excitation (V) 5  
Shunt Resistor (ohm) 60.4k

Calibration Factors	267AWJ	Bridge 2 ( $\mu\text{E/V}$ )	216.20
Bridge 1 ( $\mu\text{E/V}$ )	216.53	Area (in <sup>2</sup> )	1.17
EA Factor (Kips)	35248.70		

Calibrated by: *David Brull*  
Calibrated Date: 12/5/2016

Pile Dynamics Inc  
30725 Aurora Rd  
Solon, OH 44139

Traceable to N.I.S.T.



Smart Sensor

Smart Chip Programmed By J.W. on 28/MAR/18 CRC Value 63AE

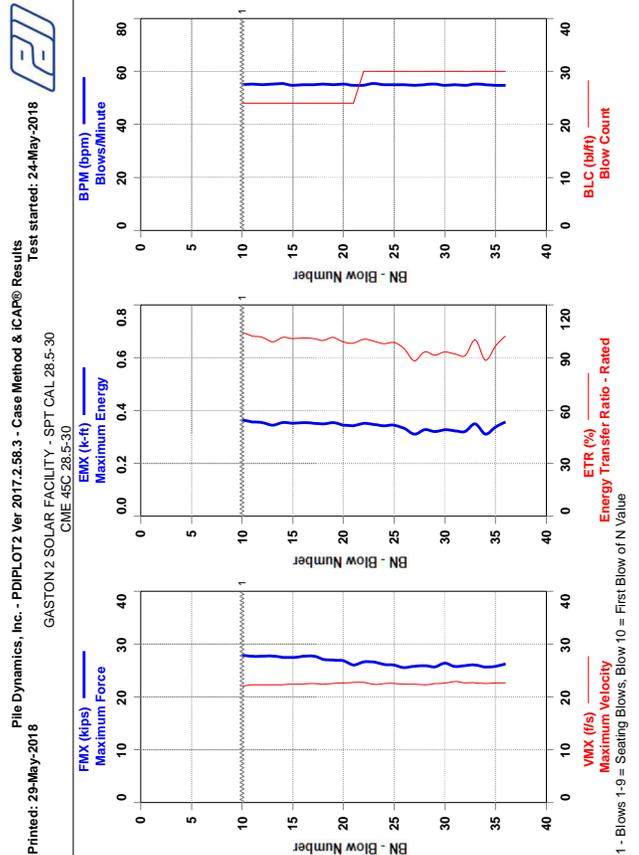
Smart Sensor

Smart Chip Programmed By J.W. on 28/MAR/18 CRC Value A7E0

Drill Rig SPT Hammer Energy Calibration Report  
 CME-45C (SN 406484) ■ Columbia, SC  
 May 29, 2018 ■ Terracon Project No. 73185061



Exhibit A-3 SPT Calibration Data Plots and Tables



GASTON 2 SOLAR FACILITY - SPT CAL 28.5-30

CME 45C 28.5-30

GASTON 2 SOLAR FACILITY - SPT CAL 28.5-30

CME 45C 28.5-30

OP: ZM Date: 24-May-2018  
 AR: 1.18 in<sup>2</sup> SP: 0.492 klf/ft  
 LE: 33.70 ft EM: 30,000 ksi  
 WS: 16,807.9 f/s JC: 0.00

OP: ZM Date: 24-May-2018

Time Summary

Drive 38 seconds 11:32 AM - 11:33 AM BN 1 - 36

FMX: Maximum Force  
 VMX: Maximum Velocity  
 EMX: Maximum Energy  
 ETR: Energy Transfer Ratio - Rated

BPM: Blows/Minute  
 DMX: Maximum Displacement  
 CSX: Compression Stress Maximum

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
10	29.04	24	28	22.0	0.366	104.5	55.1	0.93	23.6
11	29.08	24	28	22.3	0.359	102.5	55.2	0.85	23.4
12	29.13	24	28	22.3	0.356	101.7	55.1	0.76	23.4
13	29.17	24	28	22.2	0.347	99.1	55.3	0.67	23.5
14	29.21	24	28	22.3	0.356	101.6	55.4	0.74	23.3
15	29.25	24	27	22.4	0.353	101.0	54.8	0.68	23.3
16	29.29	24	28	22.5	0.355	101.4	55.1	0.70	23.4
17	29.33	24	28	22.5	0.354	101.0	55.0	0.64	23.5
18	29.38	24	27	22.4	0.350	100.0	55.2	0.62	23.0
19	29.42	24	27	22.6	0.356	101.6	55.0	0.64	22.8
20	29.46	24	27	22.6	0.347	99.1	55.2	0.64	22.7
21	29.50	24	26	22.7	0.344	98.4	54.8	0.60	22.1
22	29.53	30	27	22.7	0.352	100.6	54.9	0.63	22.5
23	29.57	30	27	22.4	0.349	99.6	55.4	0.60	22.5
24	29.60	30	26	22.5	0.343	98.0	55.0	0.56	22.2
25	29.63	30	26	22.6	0.346	98.8	55.1	0.59	22.0
26	29.67	30	26	22.4	0.333	95.1	55.0	0.53	21.6
27	29.70	30	26	22.4	0.310	88.5	54.8	0.48	21.9
28	29.73	30	26	22.3	0.327	93.5	55.1	0.50	21.9
29	29.77	30	26	22.5	0.321	91.6	55.2	0.49	21.8
30	29.80	30	26	22.6	0.327	93.3	54.8	0.49	22.4
31	29.83	30	26	22.9	0.323	92.3	55.1	0.49	21.8
32	29.87	30	26	22.6	0.320	91.3	54.8	0.48	21.9
33	29.90	30	26	22.7	0.351	100.2	55.2	0.63	22.1
34	29.93	30	26	22.5	0.311	88.8	55.1	0.47	21.7
35	29.97	30	26	22.6	0.338	96.7	54.8	0.52	21.8
36	30.00	30	26	22.7	0.359	102.5	54.9	0.69	22.2
Average		27	22.5	0.343	97.9	55.1	0.62		22.5
Std. Dev.		1	0.2	0.015	4.4	0.2	0.11		0.7
Maximum		28	22.9	0.366	104.5	55.4	0.93		23.6
Minimum		26	22.0	0.310	88.5	54.8	0.47		21.6

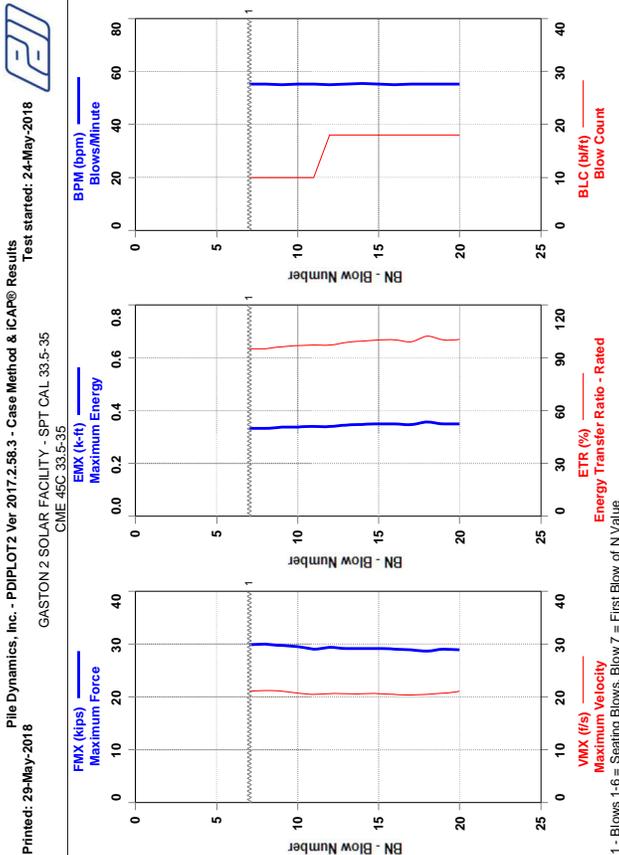
Total number of blows analyzed: 27

BL# Sensors

10-36 F3: [AWJ 1] 216.5 (1.00); F4: [AWJ 2] 216.2 (1.00); A3: [K5418] 382.0 (1.00);  
 A4: [K0059] 317.0 (1.00)

BL# Comments

10 Blows 1-9 = Seating Blows, Blow 10 = First Blow of N Value



GASTON 2 SOLAR FACILITY - SPT CAL 33.5-35

CME 45C 33.5-35

OP: ZM Date: 24-May-2018  
 AR: 1.18 in<sup>2</sup> SP: 0.492 klf/ft  
 LE: 38.70 ft EM: 30,000 ksi  
 WS: 16,807.9 f/s JC: 0.00

FMX: Maximum Force  
 VMX: Maximum Velocity  
 EMX: Maximum Energy  
 ETR: Energy Transfer Ratio - Rated

BPM: Blows/Minute  
 DMX: Maximum Displacement  
 CSX: Compression Stress Maximum

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
7	34.10	10	30	21.1	0.333	95.3	55.3	1.21	25.3
8	34.20	10	30	21.2	0.333	95.3	55.2	1.21	25.4
9	34.30	10	30	21.1	0.337	96.4	55.0	1.23	25.2
10	34.40	10	29	20.7	0.339	97.0	55.2	1.20	25.0
11	34.50	10	29	20.5	0.341	97.3	55.2	1.22	24.6
12	34.56	18	29	20.6	0.340	97.2	55.1	1.02	24.8
13	34.61	18	29	20.6	0.346	98.9	55.3	0.95	24.7
14	34.67	18	29	20.5	0.349	99.6	55.4	0.91	24.7
15	34.72	18	29	20.7	0.350	100.1	55.3	0.88	24.7
16	34.78	18	29	20.5	0.351	100.3	55.1	0.85	24.6
17	34.83	18	29	20.3	0.347	99.2	55.3	0.77	24.5
18	34.89	18	29	20.5	0.358	102.3	55.3	0.82	24.3
19	34.94	18	29	20.7	0.351	100.2	55.2	0.76	24.6
20	35.00	18	29	21.0	0.351	100.4	55.3	0.73	24.5
Average		29	20.7	0.345	98.5	55.2	0.98		24.8
Std. Dev.		0	0.3	0.007	2.1	0.1	0.19		0.3
Maximum		30	21.2	0.358	102.3	55.4	1.23		25.4
Minimum		29	20.3	0.333	95.3	55.0	0.73		24.3

Total number of blows analyzed: 14

BL# Sensors

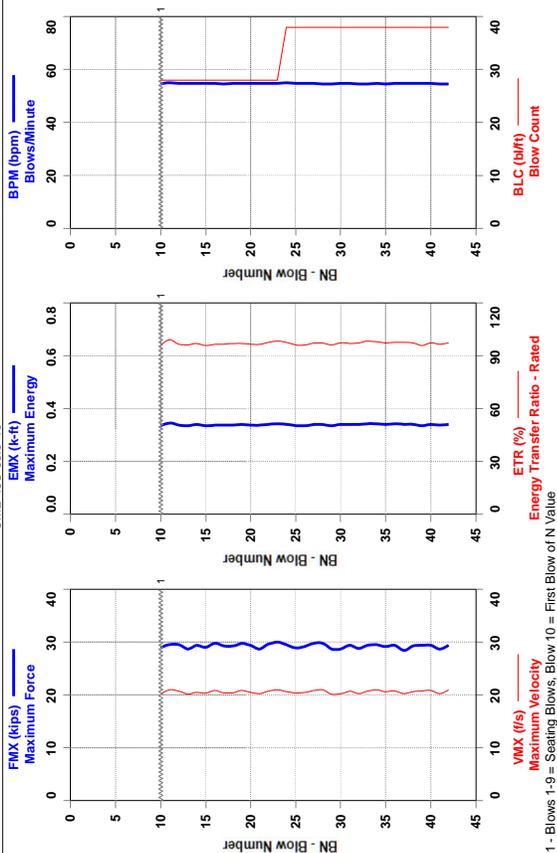
7-20 F3: [AWJ 1] 216.5 (1.00); F4: [AWJ 2] 216.2 (1.00); A3: [K5418] 382.0 (1.00);  
 A4: [K0059] 317.0 (1.00)

BL# Comments

7 Blows 1-6 = Seating Blows, Blow 7 = First Blow of N Value

Time Summary

Drive 20 seconds 11:48 AM - 11:48 AM BN 1 - 20



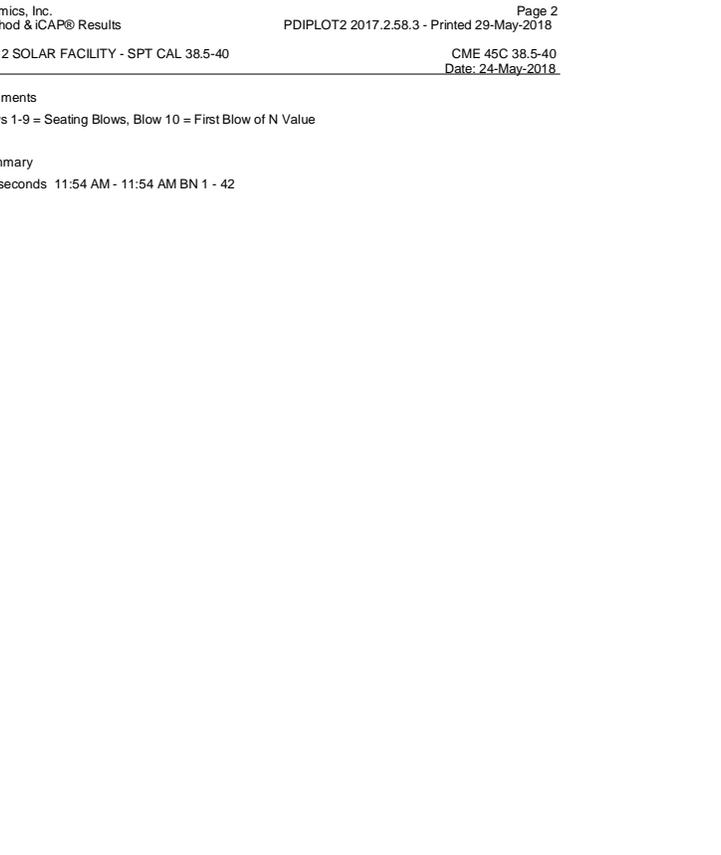
1 - Blows 1-9 = Seating Blows, Blow 10 = First Blow of N Value

BL# Comments

10 Blows 1-9 = Seating Blows, Blow 10 = First Blow of N Value

Time Summary

Drive 44 seconds 11:54 AM - 11:54 AM BN 1 - 42



1 - Blows 1-8 = Seating Blows, Blow 9 = First Blow of N Value

ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bi/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
10	37.54	28	29	20.2	0.336	96.1	54.6	0.58	24.5
11	37.57	28	30	20.9	0.347	99.1	55.0	0.59	25.0
12	37.61	28	30	20.7	0.339	96.7	54.8	0.57	25.0
13	37.64	28	29	20.2	0.337	96.1	54.8	0.56	24.3
14	37.68	28	29	20.5	0.340	97.1	54.8	0.56	24.9
15	37.71	28	29	20.3	0.335	95.9	54.7	0.56	24.6
16	37.75	28	30	20.9	0.338	96.5	54.8	0.55	25.2
17	37.79	28	29	20.4	0.339	96.7	54.5	0.56	24.8
18	37.82	28	29	20.4	0.339	96.9	54.8	0.56	24.8
19	37.86	28	30	20.8	0.340	97.1	54.7	0.55	25.2
20	37.89	28	29	20.4	0.339	96.7	54.7	0.56	24.8
21	37.93	28	29	20.2	0.338	96.5	54.8	0.55	24.3
22	37.96	28	30	20.7	0.342	97.7	54.9	0.56	25.1
23	38.00	28	30	21.0	0.344	98.3	54.8	0.56	25.4
24	38.03	38	29	20.6	0.342	97.7	55.0	0.56	25.0
25	38.05	38	29	20.3	0.337	96.3	54.8	0.55	24.5
26	38.08	38	29	20.4	0.337	96.2	54.7	0.54	24.7
27	38.11	38	30	20.8	0.340	97.1	54.8	0.54	25.2
28	38.13	38	30	20.9	0.340	97.2	54.6	0.53	25.2
29	38.16	38	29	20.2	0.336	96.1	54.6	0.53	24.3
30	38.18	38	29	20.2	0.341	97.5	54.7	0.53	24.3
31	38.21	38	29	20.7	0.340	97.1	54.7	0.52	24.9
32	38.24	38	29	20.3	0.341	97.4	54.6	0.51	24.4
33	38.26	38	29	20.7	0.344	98.4	54.5	0.51	24.9
34	38.29	38	29	20.9	0.343	98.0	54.7	0.51	25.0
35	38.32	38	29	20.6	0.341	97.5	54.5	0.50	24.7
36	38.34	38	29	20.8	0.342	97.8	54.7	0.50	24.9
37	38.37	38	28	20.2	0.342	97.7	54.7	0.50	24.0
38	38.39	38	29	20.6	0.341	97.5	54.7	0.49	24.8
39	38.42	38	29	20.7	0.335	95.8	54.7	0.48	24.9
40	38.45	38	29	20.8	0.341	97.5	54.7	0.49	24.9
41	38.47	38	29	20.3	0.339	96.7	54.6	0.48	24.3
42	38.50	38	29	20.9	0.341	97.5	54.6	0.49	24.8
Average	29	20.6	0.340	97.1	54.7	0.53	24.8		
Std. Dev.	0	0.3	0.003	0.8	0.1	0.03	0.3		
Maximum	30	21.0	0.347	99.1	55.0	0.59	25.4		
Minimum	28	20.2	0.335	95.8	54.5	0.48	24.0		

Total number of blows analyzed: 33

BL# Sensors

10-42 F3: [AWJ 1] 216.5 (1.00); F4: [AWJ 2] 216.2 (1.00); A3: [K5418] 382.0 (1.00);

A4: [K0056] 317.0 (1.00)

GASTON 2 SOLAR FACILITY - SPT CAL 43.5-45 CME 45C 43.5-45  
OP: ZM Date: 24-May-2018  
AR: 1.18 in<sup>2</sup> SP: 0.492 klf/ft  
LE: 48.70 ft EM: 30,000 ksi  
WS: 16,807.9 f/s JC: 0.00

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
9	44.04	24	27	20.2	0.330	94.2	46.4	0.67	23.0
10	44.08	24	27	20.4	0.335	95.8	46.3	0.65	23.2
11	44.13	24	27	20.4	0.336	95.9	46.3	0.65	23.0
12	44.17	24	27	20.3	0.339	96.8	46.3	0.69	23.1
13	44.21	24	27	20.3	0.342	97.7	46.4	0.75	23.2
14	44.25	24	27	20.2	0.330	94.4	46.3	0.64	23.1
15	44.29	24	27	20.1	0.331	94.6	46.2	0.63	23.2
16	44.33	24	28	20.3	0.334	95.4	46.1	0.65	23.3
17	44.38	24	28	20.5	0.330	94.2	46.0	0.63	23.5
18	44.42	24	28	20.6	0.333	95.0	46.2	0.62	23.5
19	44.46	24	28	20.5	0.329	94.0	46.0	0.62	23.6
20	44.50	24	28	20.7	0.332	94.9	46.0	0.62	23.9
21	44.54	24	28	20.8	0.337	96.2	45.9	0.62	23.9
22	44.58	24	28	20.7	0.332	94.8	45.9	0.62	23.7
23	44.63	24	28	21.2	0.335	95.7	45.9	0.62	24.0
24	44.67	24	28	21.1	0.331	94.5	45.9	0.61	24.1
25	44.71	24	29	21.1	0.339	96.7	45.8	0.60	24.3
26	44.75	24	28	21.4	0.339	96.9	45.8	0.78	24.0
27	44.79	24	28	21.4	0.334	95.5	45.7	0.61	23.9
28	44.83	24	28	21.5	0.335	95.7	45.7	0.60	23.9
29	44.88	24	28	21.3	0.335	95.6	45.7	0.59	23.8
30	44.92	24	28	21.0	0.334	95.4	45.8	0.63	23.5
31	44.96	24	28	20.8	0.332	94.9	45.6	0.60	23.3
32	45.00	24	27	20.7	0.329	93.9	45.6	0.57	23.0
Average		28	20.7	0.334	95.4	46.0	0.64		23.5
Std. Dev.		0	0.4	0.003	1.0	0.3	0.05		0.4
Maximum		29	21.5	0.342	97.7	46.4	0.78		24.3
Minimum		27	20.1	0.329	93.9	45.6	0.57		23.0

Total number of blows analyzed: 24

BL# Sensors

9-32 F3; [AWJ 1] 216.5 (1.00); F4; [AWJ 2] 216.2 (1.00); A3; [K5418] 382.0 (1.00);  
A4; [K0059] 317.0 (1.00)

BL# Comments

9 Blows 1-8 = Seating Blows, Blow 9 = First Blow of N Value

Time Summary

Drive 40 seconds 12:01 PM - 12:02 PM BN 1 - 32

GASTON 2 SOLAR FACILITY - SPT CAL 48.5-50 CME 45C 48.5-50  
OP: ZM Date: 24-May-2018  
AR: 1.18 in<sup>2</sup> SP: 0.492 klf/ft  
LE: 53.70 ft EM: 30,000 ksi  
WS: 16,807.9 f/s JC: 0.00

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
10	49.03	32	28	21.4	0.332	94.8	55.1	0.63	23.4
11	49.06	32	28	21.7	0.336	96.0	55.0	0.63	23.6
12	49.09	32	28	21.4	0.334	95.5	55.0	0.62	23.5
13	49.13	32	28	21.4	0.337	96.2	55.1	0.63	23.4
14	49.16	32	28	21.4	0.332	94.9	54.8	0.62	23.8
15	49.19	32	27	21.2	0.337	96.4	55.1	0.63	23.0
16	49.22	32	28	21.2	0.336	96.1	54.8	0.63	23.6
17	49.25	32	28	21.4	0.339	96.8	55.0	0.64	23.7
18	49.28	32	28	21.3	0.338	96.6	54.9	0.63	23.8
19	49.31	32	28	21.2	0.336	96.0	55.0	0.63	23.9
20	49.34	32	28	21.3	0.336	96.0	55.1	0.63	23.9
21	49.38	32	28	21.0	0.333	95.1	55.1	0.63	23.4
22	49.41	32	27	20.8	0.334	95.5	55.2	0.64	23.2
23	49.44	32	27	20.8	0.338	96.4	55.1	0.65	23.2
24	49.47	32	28	21.2	0.337	96.2	55.0	0.65	23.8
25	49.50	32	28	21.0	0.335	95.8	55.1	0.64	23.8
26	49.53	30	28	20.9	0.338	96.5	54.8	0.63	23.6
27	49.57	30	28	20.7	0.339	96.9	54.9	0.64	23.4
28	49.60	30	28	20.8	0.333	95.2	55.2	0.61	23.6
29	49.63	30	27	21.0	0.338	96.5	54.9	0.65	23.3
30	49.67	30	28	21.1	0.332	94.8	54.9	0.58	23.6
31	49.70	30	28	21.1	0.355	101.4	54.9	0.88	23.7
32	49.73	30	28	21.3	0.354	101.2	54.9	0.82	23.4
33	49.77	30	28	21.4	0.341	97.5	55.0	0.68	23.4
34	49.80	30	27	21.4	0.344	98.3	54.9	0.71	23.2
35	49.83	30	27	21.7	0.355	101.4	54.9	0.83	23.1
36	49.87	30	27	21.7	0.337	96.4	55.0	0.59	23.1
37	49.90	30	27	21.6	0.344	98.2	54.7	0.69	23.3
38	49.93	30	28	21.6	0.338	96.6	54.8	0.59	23.3
39	49.97	30	28	21.5	0.340	97.2	54.8	0.58	23.4
40	50.00	30	28	21.6	0.335	95.7	55.0	0.58	23.4
Average		28	21.3	0.339	96.7	55.0	0.65		23.5
Std. Dev.		0	0.3	0.006	1.7	0.1	0.07		0.3
Maximum		29	21.7	0.355	101.4	55.2	0.88		23.9
Minimum		27	20.7	0.332	94.8	54.7	0.58		23.0

Total number of blows analyzed: 31

BL# Sensors

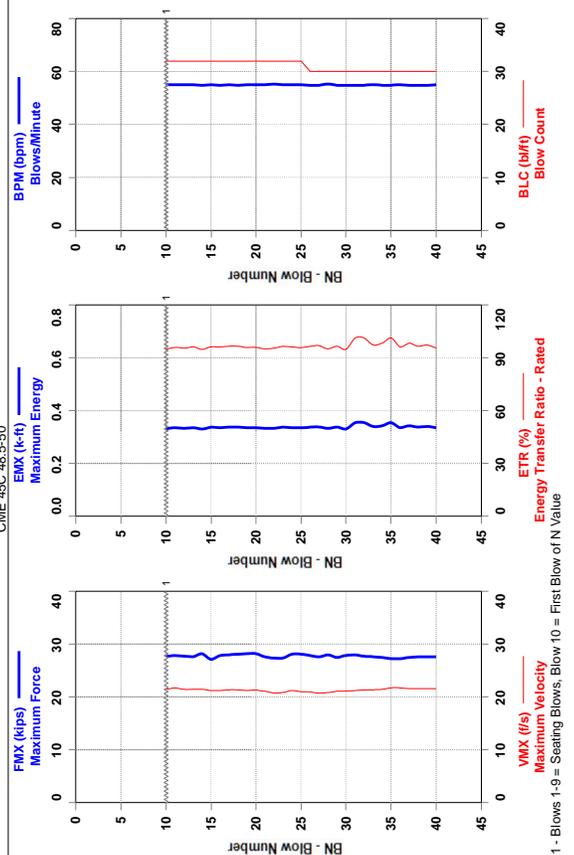
10-40 F3; [AWJ 1] 216.5 (1.00); F4; [AWJ 2] 216.2 (1.00); A3; [K5418] 382.0 (1.00);  
A4; [K0059] 317.0 (1.00)

BL# Comments

10 Blows 1-9 = Seating Blows, Blow 10 = First Blow of N Value



Pile Dynamics, Inc. - PDILOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results  
Test started: 24-May-2018  
Printed: 29-May-2018  
GASTON 2 SOLAR FACILITY - SPT CAL 48.5-50  
CME 45C 48.5-50



GASTON 2 SOLAR FACILITY - SPT CAL 48.5-50 CME 45C 48.5-50  
OP: ZM Date: 24-May-2018

Time Summary

Drive 42 seconds 12:10 PM - 12:11 PM BN 1 - 40

1 - Blows 1-9 = Seating Blows, Blow 10 = First Blow of N Value

# Terracon

## SPT HAMMER CALIBRATION FIELD WORKSHEET

ARRIVAL TIME: 10:30  
 DEPART TIME: 12:30  
 TOTAL TRAVEL: 3 hr  
 TOTAL TIME: 5 hr  
 CLIENT REP: \_\_\_\_\_  
 MILEAGE: \_\_\_\_\_

PROJECT NAME: Gaston Solar Facility  
 PROJECT NO.: 73185061  
 BORING NO.: B-18  
 CLIENT: \_\_\_\_\_

DATE: 5/24  
 TERRACON REP: Columbia  
 PDA MODEL/SN: DAK 7266  
 TERRACON RIG # DR#: 543

**DRILL RIG DATA**  
 Type/Transport: Truck  
 Manufacturer: CME-45C  
 Model No.: CME-45C  
 Serial No.: 406484  
 Year Built: 4-18  
 Modifications: N/A  
 Maint. Schedule: As Needed

**SPT HAMMER DATA**  
 Type: Auto  
 Manufacturer: \_\_\_\_\_  
 Lifting Mechanism: Chain w/ Hydraulic  
 Model No.: \_\_\_\_\_  
 Serial No.: \_\_\_\_\_  
 Hammer Weight: 140 lbs  
 Hammer Operator(s): Gregory and Brian

**PDA INPUT DATA**  
 Operator: OP ZM  
 Project No./Location: PJ Gaston  
 Rig Model & SN: PN CME-45C  
 Hammer Type, LM, Rods: PD Auto Chain, AWJ  
 Drill Rod Area (in<sup>2</sup>): AR 1.18

Elastic Modulus (ksi): EM 3000  
 Specific Weight (kips/ft<sup>3</sup>): SP 0.492  
 Wave Speed (ft/sec): WS 16808  
 Increment Length (ft): LI 0.5  
 Sampling Freq. (kHz): FR 50

Exhibit A-4 Field Log

**TRANSDUCER INFORMATION**  
 Gage SN Calibration  
 F1/F3: AWJ-1 246.53  
 F2/F4: AWJ-2 246.20  
 A1/A3: K5418 339  
 A2/A4: K0059 317

NOTES: Instrumentation to Bottom of Rod Length 25.85' ± 0.05'  
 \_\_\_\_\_ Inches \_\_\_\_\_ Feet  
 SPLIT SPOON SAMPLER LENGTH 0.55'  
 Gauge to Bottom of Cal. Rod length 08.7'  
 \* LE is Measured from the Center of the Strain Gauges to the bottom of Split Spoon Sampler

**SPT TESTING INFORMATION**

Start Time	Soil	Stick Up Length (ft)	Depth (ft)		'LE (ft)	Rods & Lengths	PDA Blows		SPT Blows						
			Start	End			Start	End	1st 6"	2nd 6"	3rd 6"	#Blows			
						2ft 5ft 10ft									
10:50		30"	22.5	25	28.7	5ft 2ft 5ft 10ft									
11:20		4.5'	24.5	26	30.7	1.2ft 5ft 10ft	1	10	5	5	8	13			
11:32	Sand	36"	28.5	30	32.7	2ft 2ft 5ft 10ft	1	37	9	12	15	27			
11:48	White Sand	36"	33.5	35	38.7	2ft 2ft 5ft 10ft	1	24	6	5	9	14			
11:53	Prager Sand	37"	38.5	40	42.7	2ft 2ft 5ft 10ft	1	43	7	14	19	33			
12:01	White Sand	36"	43.5	45	48.7	2ft 2ft 5ft 10ft	1	33	8	12	17	24			
12:10	Sand	36"	48.5	50	52.7	2ft 10ft 10ft	1	41	9	16	15	31			

Individual pairs of F or V signals versus time shall be very similar for good quality data.  
 If you see Force goes negative before 2/LC after impact, drill rod joints should be carefully tightened for good quality data

PICTURE NUMBERS AND INFO: Take Photo of Each Rigs, Boring Locations at the Site  
 Drilling Method: (ie. Hollow Stem Augers, Mud Rotary...)