

# Preliminary Geotechnical Data Report

**Emergency Bridge Package 3 –  
S-21-57 (North Old River Road) Bridge Replacement  
over Barfield Mill Creek  
Florence County, South Carolina**

November 13, 2015

Terracon Project No. 73155050F

Prepared for:

South Carolina Department of Transportation  
Columbia, South Carolina

Prepared by:

Terracon Consultants, Inc.  
Columbia, South Carolina

Offices Nationwide  
Employee-Owned

Established in 1965  
[terracon.com](http://terracon.com)

# Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

November 13, 2015



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: Preliminary Geotechnical Data Report  
Emergency Bridge Package 3 –  
S-21-57 (North Old River Road) Bridge Replacement over Barfield Mill Creek  
Florence County, South Carolina  
Terracon Project Number: 73155050F

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 dated November 5, 2015. 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 the subsurface exploration and laboratory testing for the Emergency Bridge Package 3 - S-21-57 (North Old River Road) Bridge Replacement over Barfield Mill Creek in Florence County, South Carolina. The purpose of this work is to develop information relative to subsurface soil and groundwater conditions at the bridge location. 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 borings and CPT soundings, the Site Location Map and the Exploration Plan are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during 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.



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Geotechnical



Environmental



Construction Materials



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## 2.0 PROJECT DESCRIPTION

The project site is located on S-21-57 (North Old River Road) in Florence County, SC. 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 the existing bridge structure and the replacement with a new bridge on the existing or similar horizontal alignment. The existing bridge is a 3-span structure apparently supported by wooden piles. It crosses Barfield Mill Creek. At the time of the field exploration, the surface of the stream flow was about 13 feet below the existing bridge deck.

## 3.0 GEOTECHNICAL TESTING

Between November 6 and November 9, 2015, two (2) soil test borings (designated STB-1 and STB-2) and two cone penetration test soundings (designated CPT-1 and CPT-2) were performed at the bridge location. Borings STB-1 and STB-2 were performed approximately 10 feet to the north and south of the ends of the existing bridge, respectively, as shown on Exhibit A-2 in Appendix A. The CPT soundings were performed slightly further away in the adjacent lanes to the soil borings.

### 3.1 Field Exploration

Our field exploration at the site consisted of two (2) Standard Penetration Test (SPT) Borings (STB-1 and STB-2) and two cone penetration test (CPT) soundings (CPT-1 and CPT-2) at the general test locations provided to Terracon 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. The test locations were established in the field by Terracon and surveyed by Construction Support Services, LLC, after completion. At the time of our field exploration, the roadway in the area of the bridge was closed due to a washout of each of the approaches. The set up at each boring is provided in the photographs below.



Photo 1. Drill rig at STB-1 (S-21-57)



Photo 2. Drill rig at STB-2 (S-21-57)

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### 3.2 Laboratory Testing

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

- Twelve (12) Natural Moisture Content Tests (ASTM D2216)
- Three (3) Atterberg Limits Tests (ASTM D4318)
- Twelve (12) Wash #200 Tests

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.**

Joseph D.M. Fredendall, E.I.T.  
Field Engineer

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

Attachments

Copies: Addressee (1 via email)  
File (1)

## **APPENDIX A - FIELD EXPLORATION**

**Exhibit A-1 – Site Location Map**

**Exhibit A-2 – Exploration Plan**

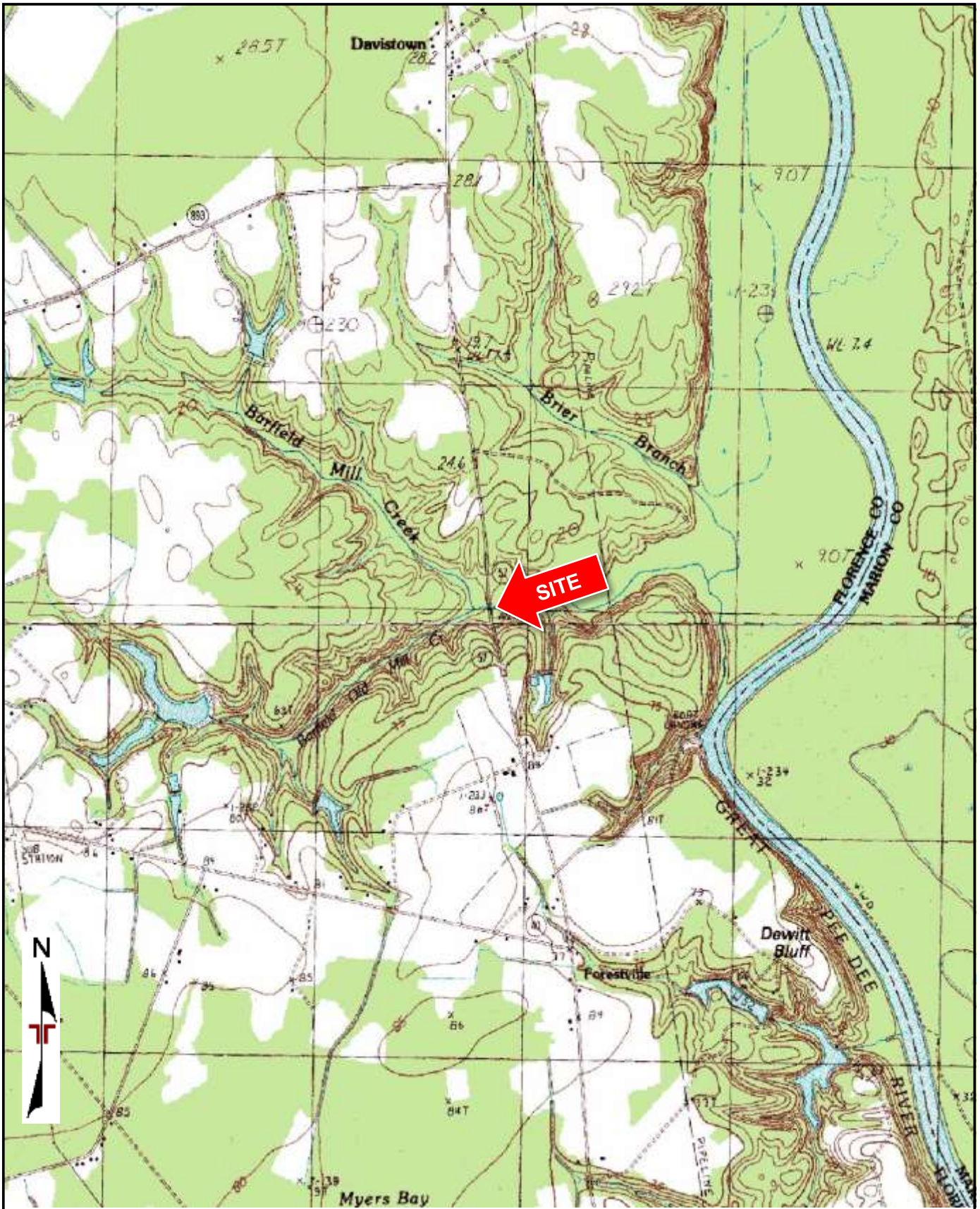
**Exhibit A-3 – Summary of Boring Data**

**Exhibit A-4 – Field Testing Description**

**Exhibit A-5 – Soil Description Terms**

**Exhibits A-6 and A-7 - Boring Logs**

**Exhibits A-8 to A-11 – CPT Sounding Logs**



Project Manager:	JDF
Drawn by:	PTK
Checked by:	PAM
Approved by:	PAM
Project No.:	73155050F
Scale:	1"=24,000 SF
File Name:	A-1 & A-2
Date:	Nov. 2015

**Terracon**

521 Clemson Road  
 Columbia, SC 29229

<b>SITE LOCATION</b>
S-21-57 over Barfield Mill Creek Florence County, South Carolina

Exhibit
<b>A-1</b>



bing

50 feet

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

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: JDF	Project No. 73155050F	<b>Terracon</b> 521 Clemson Road Columbia, SC 29229	<b>EXPLORATION PLAN</b>	Exhibit
Drawn by: PTK	Scale: AS SHOWN		S-21-57 over Barfield Mill Creek Florence County, South Carolina	<b>A-2</b>
Checked by: PAM	File Name: A-1 & A-2			
Approved by: PAM	Date: Nov. 2015			

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November 13, 2015 ■ Terracon Project No. 73155050F



### Summary of Boring Data

Boring No.	Ground Elevation (ft.)	Test Depth (ft.)	Northing	Easting	Latitude	Longitude
STB-1	43.5	100	791828.8	2445714.1	34.0009704	-79.5291347
STB-2	44.1	100	791754.1	2445714.0	34.0007651	-79.5291388
CPT-1	43.7	33.1	791841.0	2445702.7	34.0010045	-79.5291719
CPT-2	44.2	30.7	791742.5	2445724.4	34.0007331	-79.5291048



## **FIELD EXPLORATION DESCRIPTION**

### **Overview**

The testing locations were provided by the SCDOT and located in the field by Terracon by taking measurements from the existing bridge. The borings were surveyed by Construction Support Services, LLC after drilling was complete. The locations are shown on the Exploration Plan (Exhibit A-2).

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. 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 (24-inches in the upper 10 feet) 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 the three, 6-inch increments is recorded. A fourth reading was recorded in the upper 10 feet. 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). An explanation of the soil descriptions shown on the logs is provided on Exhibit A-5.

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Due to the drilling method, time-of-drilling water levels could not be recorded as it as well as the rock coring introduces water into the borehole. The 24-hour groundwater readings were collected from the borings, where possible. These are indicated on the boring logs. At the conclusion of the work, the boreholes were backfilled 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.

## SOIL DESCRIPTION TERMS

### Relative Density/Consistency Terms

<u>Relative Density</u> <sup>1</sup>			<u>Consistency</u> <sup>2</sup>		
Descriptive Term	Relative Density	SPT Blow Count	Descriptive Term	Unconfined Compression Strength (q <sub>u</sub> ) (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

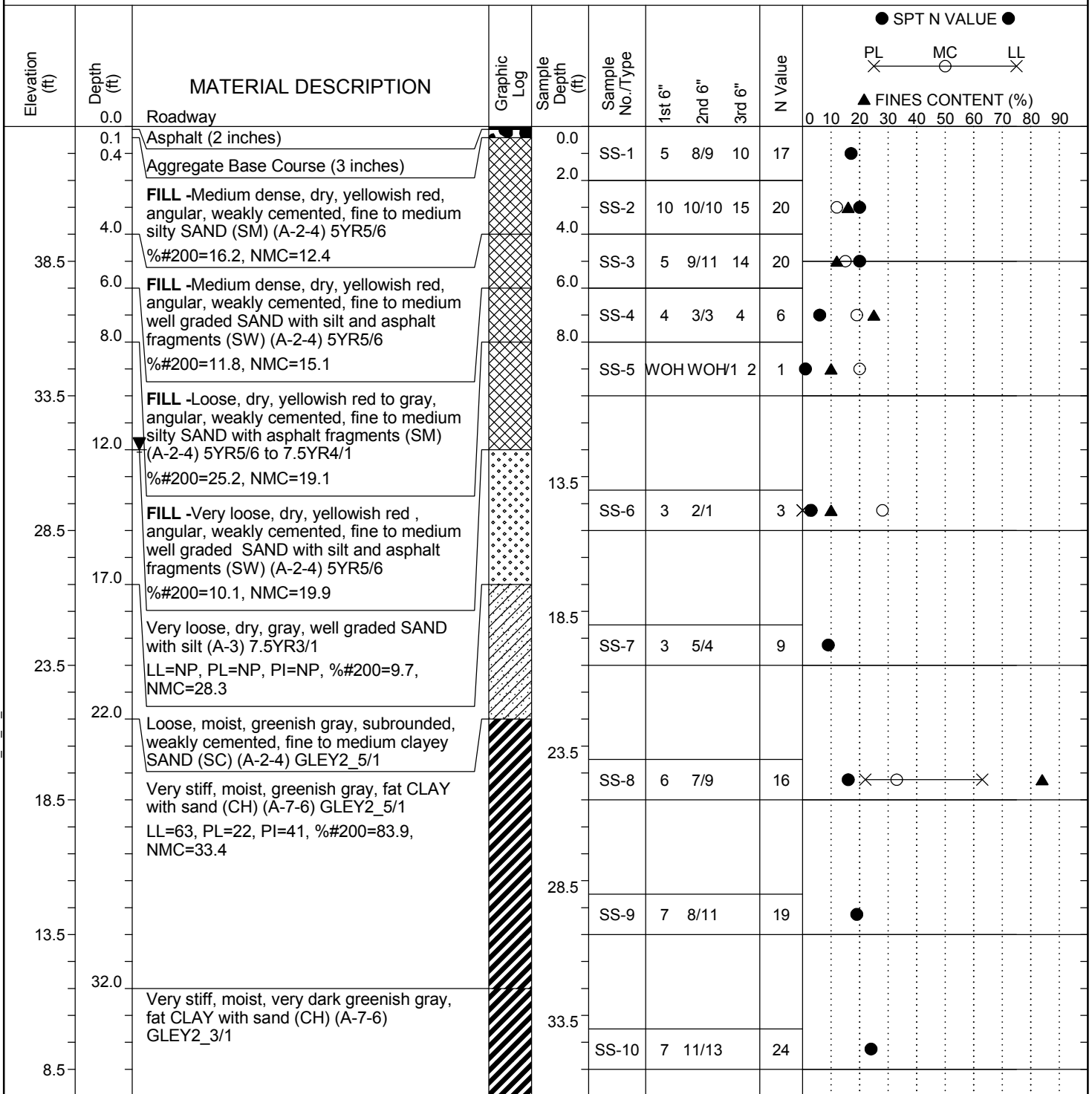
<sup>1</sup> Applies to coarse-grained soils (major portion retained on No. 200 sieve)

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

<sup>3</sup> Use as required

# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3	<b>County:</b>	Florence	<b>Boring No.:</b>	STB-1
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek			<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	NBL	<b>Offset:</b>	CENTER
<b>Alignment:</b>	Mainline				
<b>Elev.:</b>	43.5 ft	<b>Latitude:</b>	34.00097044	<b>Longitude:</b>	-79.52913474
<b>Date Started:</b>	11/9/2015				
<b>Total Depth:</b>	100 ft	<b>Soil Depth:</b>	100 ft	<b>Core Depth:</b>	N/A ft
<b>Date Completed:</b>	11/10/2015				
<b>Bore Hole Diameter (in):</b>	2.94"	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)				
<b>Drill Machine:</b>	CME-550X	<b>Drill Method:</b>	RW	<b>Hammer Type:</b>	Automatic
<b>Energy Ratio:</b>	74.2%				
<b>Core Size:</b>	N/A	<b>Driller:</b>	J. Pawless	<b>Groundwater:</b>	TOB N.A.
<b>24HR:</b>	12 ft				



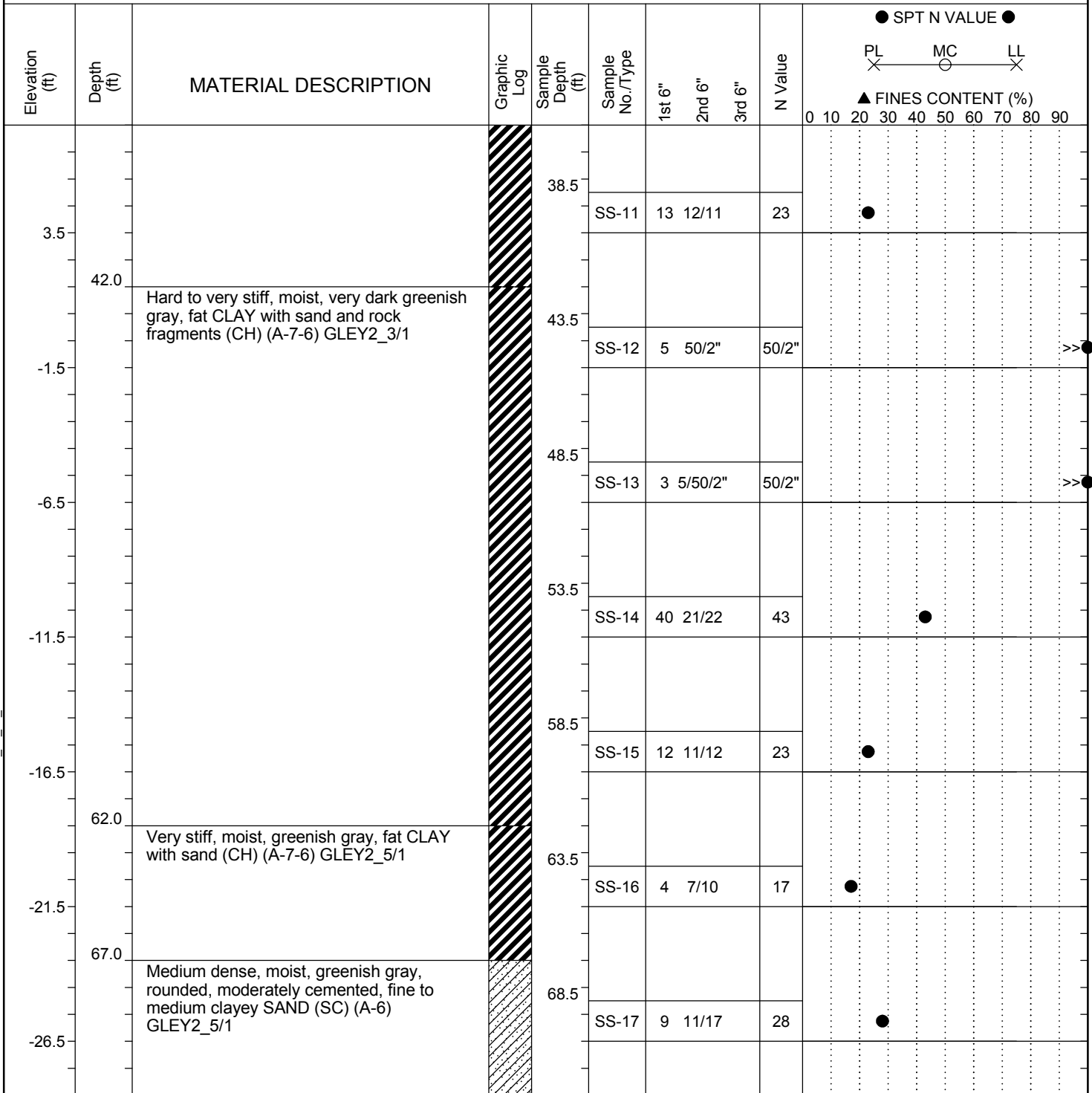
## LEGEND

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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	

# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3	<b>County:</b>	Florence	<b>Boring No.:</b>	STB-1
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek			<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	NBL	<b>Offset:</b>	CENTER
<b>Alignment:</b>	Mainline				
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<b>Bore Hole Diameter (in):</b>	2.94"	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)				
<b>Drill Machine:</b>	CME-550X	<b>Drill Method:</b>	RW	<b>Hammer Type:</b>	Automatic
<b>Energy Ratio:</b>	74.2%				
<b>Core Size:</b>	N/A	<b>Driller:</b>	J. Pawless	<b>Groundwater:</b>	TOB N.A.
<b>24HR</b>	12 ft				



**LEGEND**

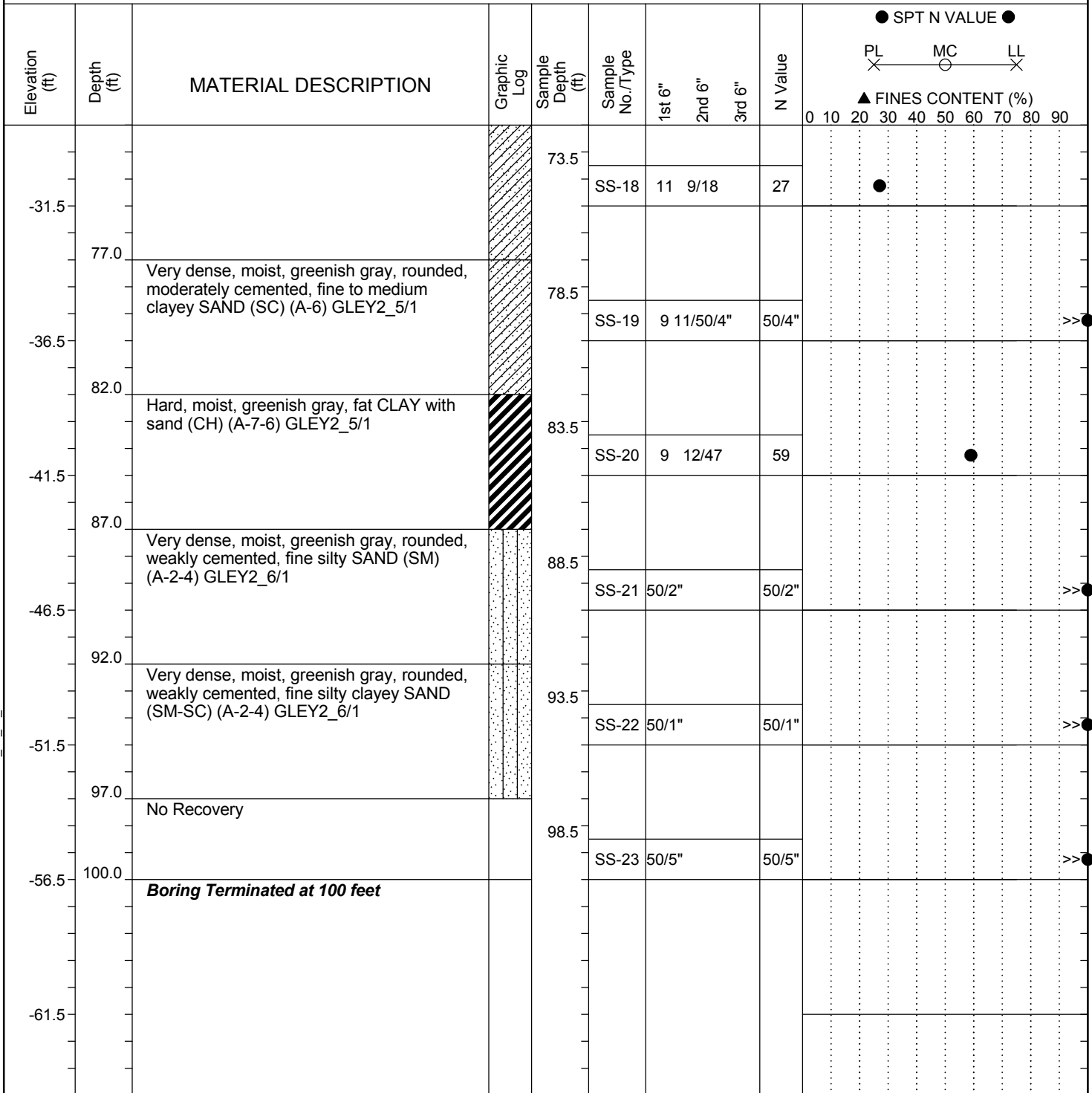
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<b>SAMPLER TYPE</b>		<b>DRILLING METHOD</b>	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
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AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC\_DOT 73155050F - S-21-57 - BORING LOGS.GPJ SCDOT DATA TEMPLATE\_12\_30\_2014.GDT 11/13/15

# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3			<b>County:</b>	Florence	<b>Boring No.:</b>	STB-1
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek					<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	NBL	<b>Offset:</b>	CENTER	<b>Alignment:</b>	Mainline
<b>Elev.:</b>	43.5 ft	<b>Latitude:</b>	34.00097044	<b>Longitude:</b>	-79.52913474	<b>Date Started:</b>	11/9/2015
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<b>Bore Hole Diameter (in):</b>	2.94"	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)	<b>Liner Used:</b>	Y (N)
<b>Drill Machine:</b>	CME-550X	<b>Drill Method:</b>	RW	<b>Hammer Type:</b>	Automatic	<b>Energy Ratio:</b>	74.2%
<b>Core Size:</b>	N/A	<b>Driller:</b>	J. Pawless	<b>Groundwater:</b>	TOB N.A.	<b>24HR</b>	12 ft



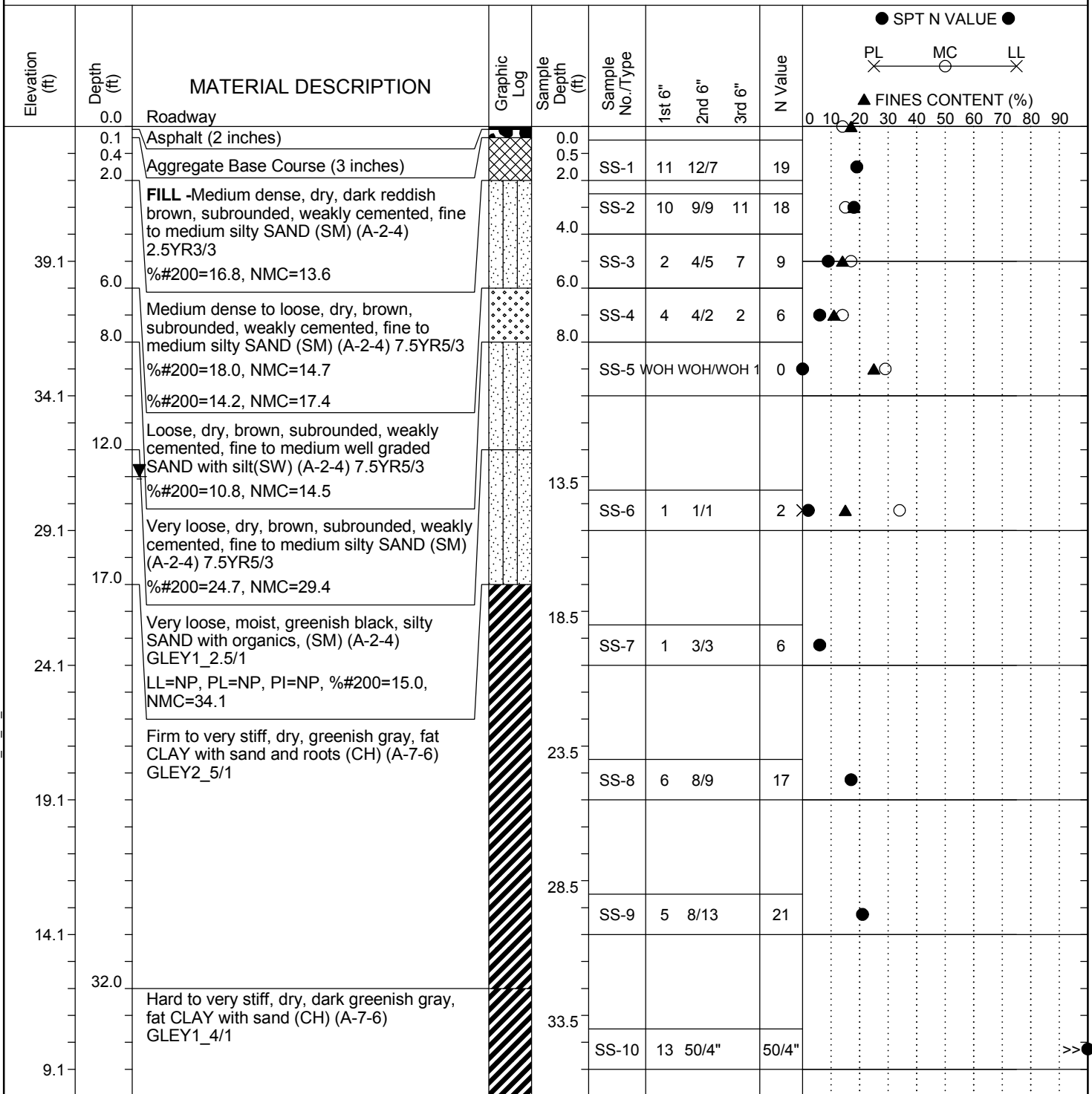
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# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3	<b>County:</b>	Florence	<b>Boring No.:</b>	STB-2
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek			<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	SBL	<b>Offset:</b>	CENTER
<b>Alignment:</b>	Mainline				
<b>Elev.:</b>	44.1 ft	<b>Latitude:</b>	34.00100445	<b>Longitude:</b>	-79.5291719
<b>Date Started:</b>	11/9/2015				
<b>Total Depth:</b>	100 ft	<b>Soil Depth:</b>	100 ft	<b>Core Depth:</b>	N/A ft
<b>Date Completed:</b>	11/10/2015				
<b>Bore Hole Diameter (in):</b>	2.94"	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)				
<b>Drill Machine:</b>	CME-550X	<b>Drill Method:</b>	RW	<b>Hammer Type:</b>	Automatic
<b>Energy Ratio:</b>	74.2%				
<b>Core Size:</b>	N/A	<b>Driller:</b>	J. Pawless	<b>Groundwater:</b>	TOB N.A.
<b>24HR</b>	13 ft				



LEGEND

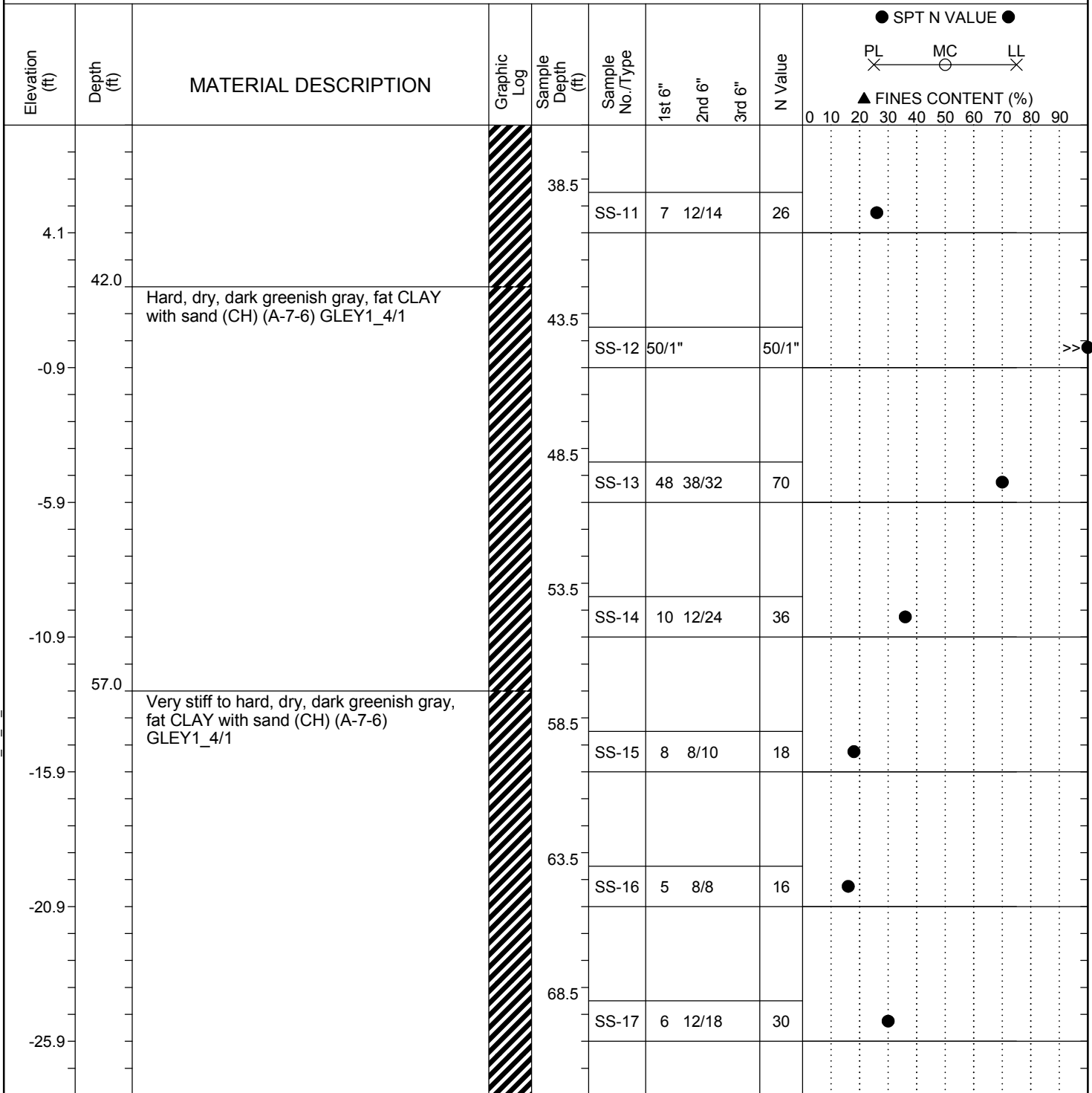
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SAMPLER TYPE		DRILLING METHOD	
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# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3	<b>County:</b>	Florence	<b>Boring No.:</b>	STB-2
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek			<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	SBL	<b>Offset:</b>	CENTER
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<b>24HR</b>	13 ft				



LEGEND

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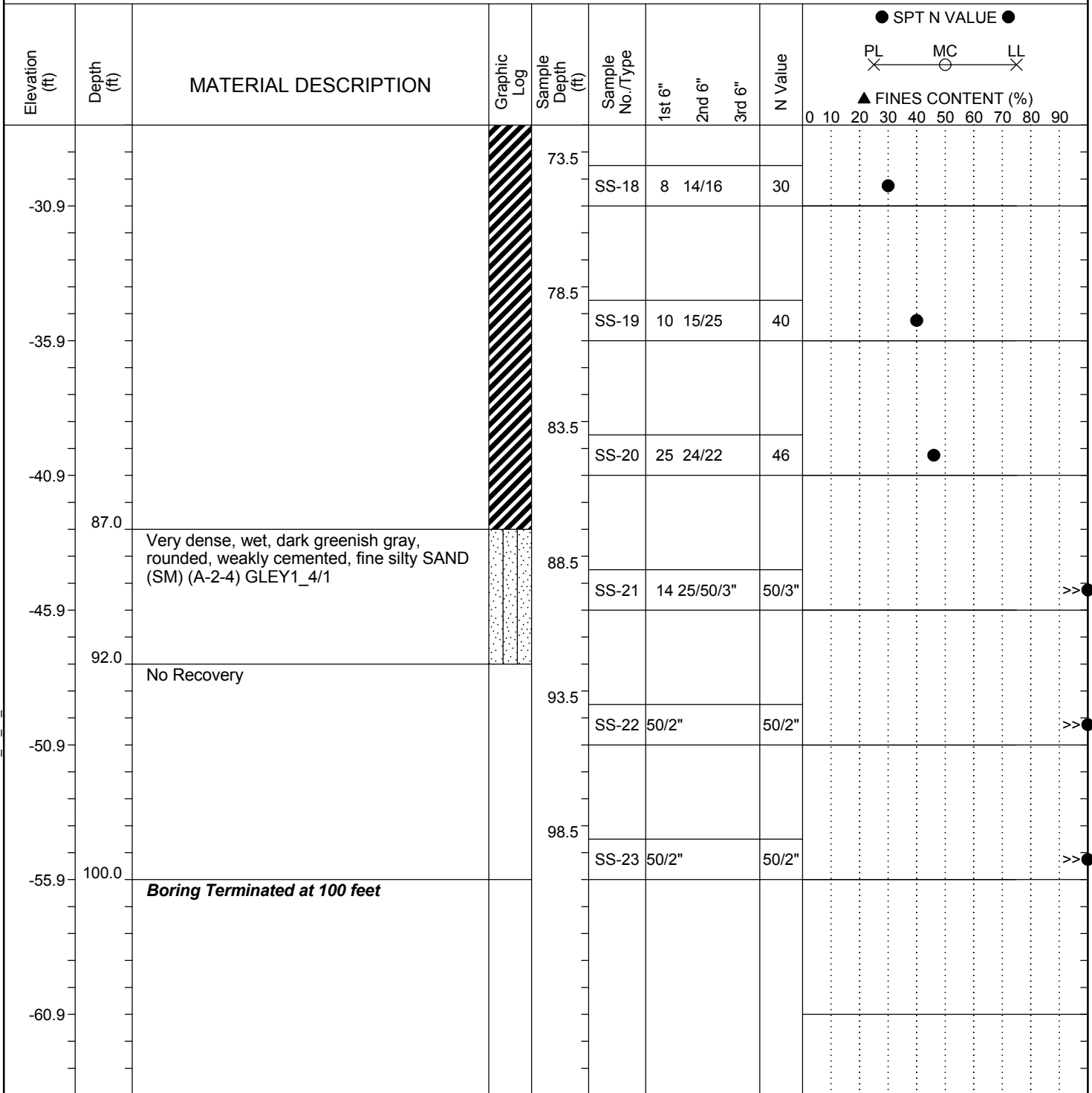
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SAMPLER TYPE		DRILLING METHOD	
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# SCDOT Soil Test Log

<b>Project ID:</b>	Emergency Bridge Package 3	<b>County:</b>	Florence	<b>Boring No.:</b>	STB-2
<b>Site Description:</b>	S-21-57 (North Old River Road) BRO Barfield Mill Creek			<b>Route:</b>	S-21-57
<b>Eng./Geo.:</b>	JDF	<b>Boring Location:</b>	SBL	<b>Offset:</b>	CENTER
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## LEGEND

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SC\_DOT 73155050F - S-21-57 - BORING LOGS.GPJ SCDOT DATA TEMPLATE\_12\_30\_2014.GDT 11/13/15

# CPT LOG NO. CPT-1

**PROJECT:** S-21-57 (North Old River Road) RBO  
Barfield Mill Creek

**CLIENT:** SCDOT  
Columbia, SC

**TEST LOCATION:** See Exhibit A-2

**SITE:** S-21-57  
Florence County, South Carolina

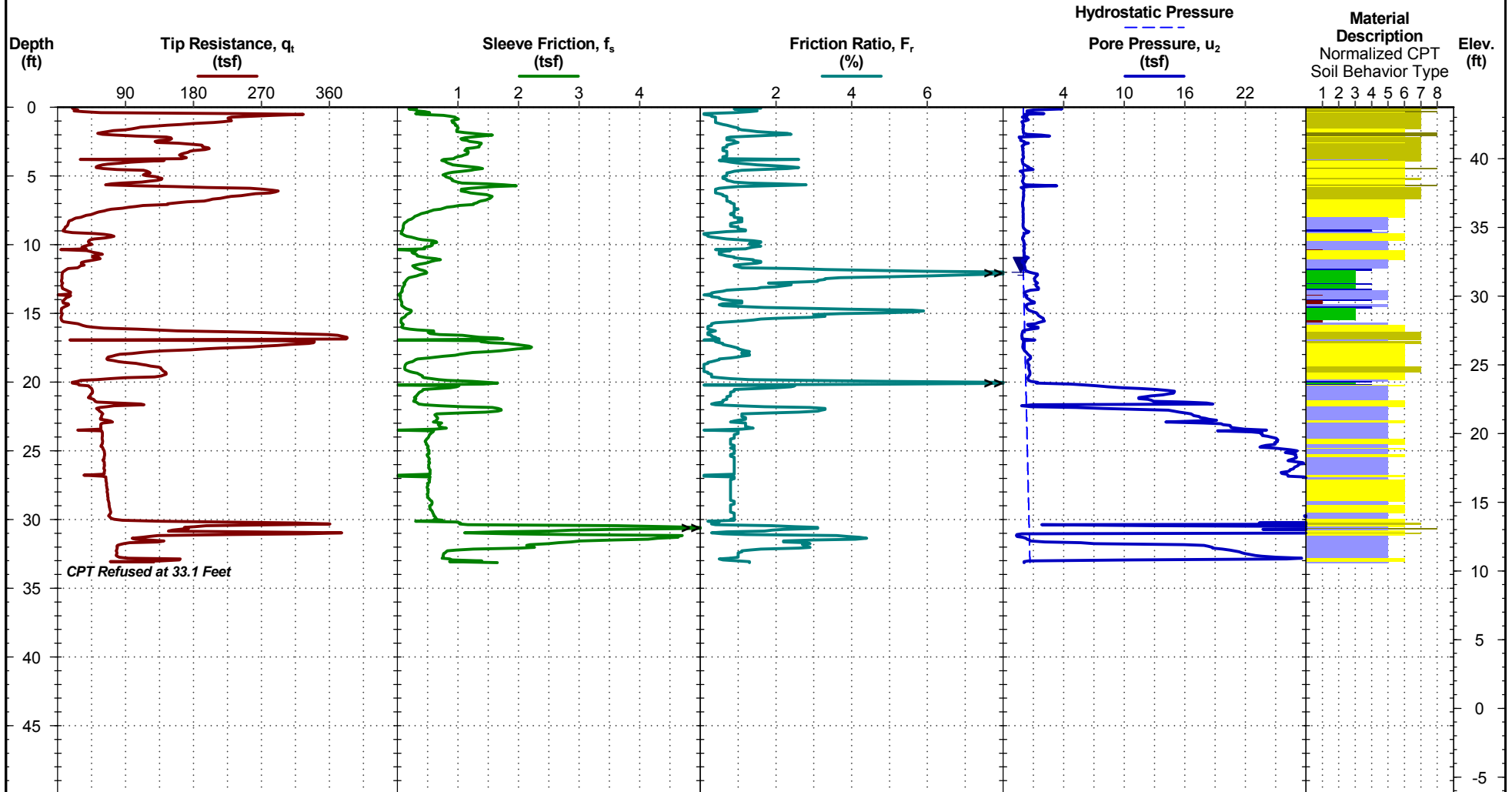
Surface Elev.: 43.7 ft

Latitude: 34.001°

Longitude: -79.52917°

Station: SBL

Offset: CENTER



See Exhibit A-3 for description of field procedures.  
See Appendix C for explanation of symbols and abbreviations.

CPT sensor calibration reports available upon request.

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT 73155050F - S-21-57 - CPT LOGS.GPJ TERRACON2015.GDT 11/13/15

**WATER LEVEL OBSERVATION**

12 ft estimated water depth  
(used in normalizations and correlations;  
see Appendix C)

Probe no. 4526 with net area ratio of 0.83  
U2 pore pressure transducer location  
Manufactured by Geotech A.B.; calibrated 11/12/2014  
Tip and sleeve areas of 10 cm<sup>2</sup> and 150 cm<sup>2</sup>  
Ring friction reducer with O.D. of 1.875 in



CPT Started: 11/7/2015

Rig: Pagani TG73-200

Project No.: 73155050F

CPT Completed: 11/7/2015

Operator: BR

Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT CORRELATIVE PARAMETERS REPORT. CPT CORRELATIVE PARAMETERS REPORT 73155050F - S-21-57 - CPT LOGS.GPJ TERRACON2015.GDT 11/13/15

# CPT CORRELATIVE PARAMETER LOG NO. CPT-1

SEE CPT LOG NO. CPT-1 FOR DETAILED TEST RESULTS

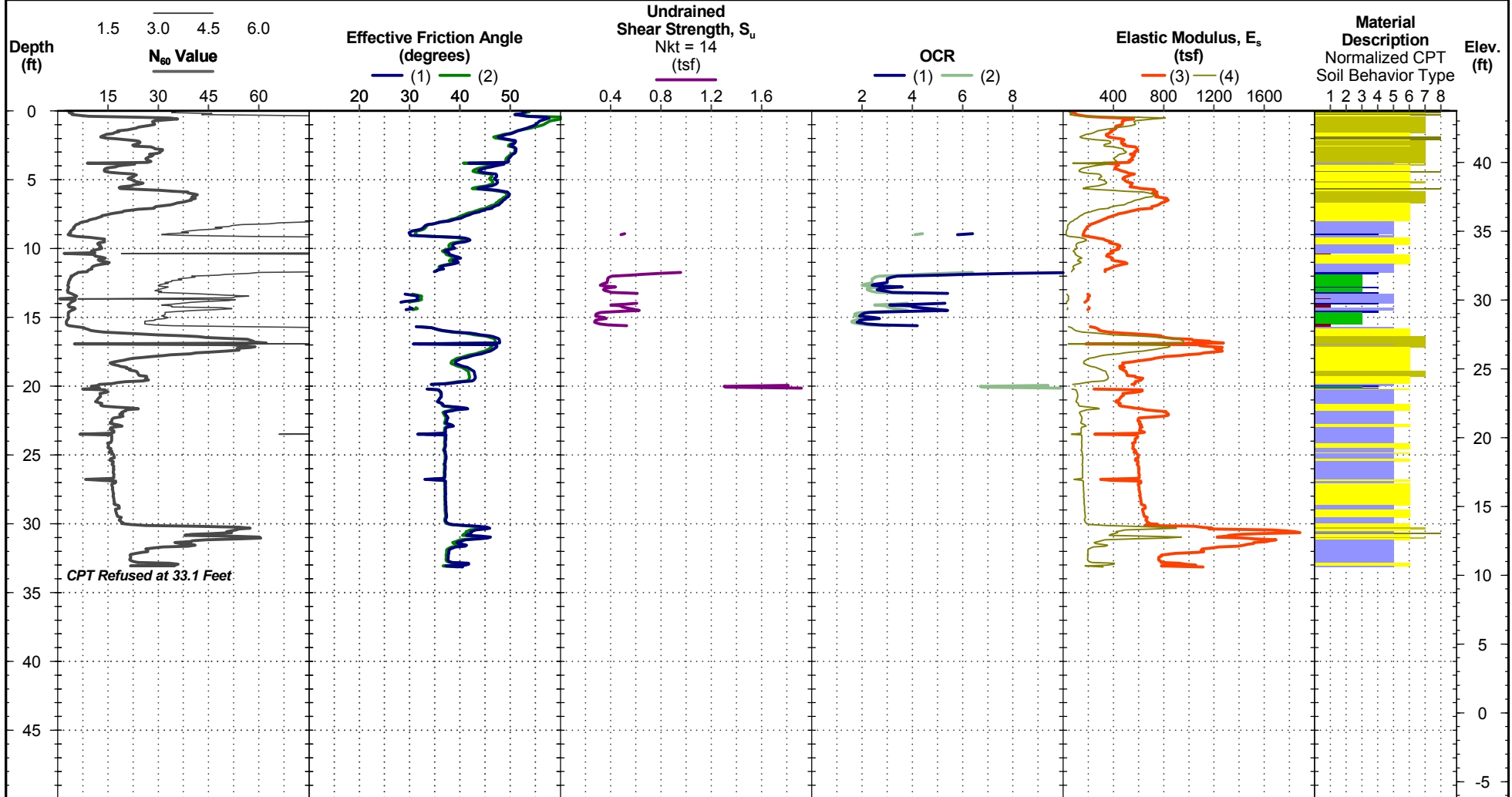
**PROJECT:** S-21-57 (North Old River Road) RBO  
Barfield Mill Creek

**CLIENT:** SCDOT  
Columbia, SC

**TEST LOCATION:** See Exhibit A-2

Surface Elev.: 43.7 ft  
Latitude: 34.00100445° Station: SBL  
Longitude: -79.5291719° Offset: CENTER

**SITE:** S-21-57  
Florence County, South Carolina



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix C provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

**WATER LEVEL OBSERVATION**

12 ft estimated water depth  
(used in normalizations and correlations; see Appendix C)

Notes:  
Probe no. 4526 with net area ratio of 0.83  
Manufactured by Geotech A.B.; calibrated 11/12/2014  
Tip and sleeve areas of 10 cm<sup>2</sup> and 150 cm<sup>2</sup>  
Ring friction reducer with O.D. of 1.875 in



CPT Started: 11/7/2015

Rig: Pagani TG73-200

Project No.: 73155050F

CPT Completed: 11/7/2015

Operator: BR

Exhibit: A-9

# CPT LOG NO. CPT-2

**PROJECT:** S-21-57 (North Old River Road) RBO  
Barfield Mill Creek

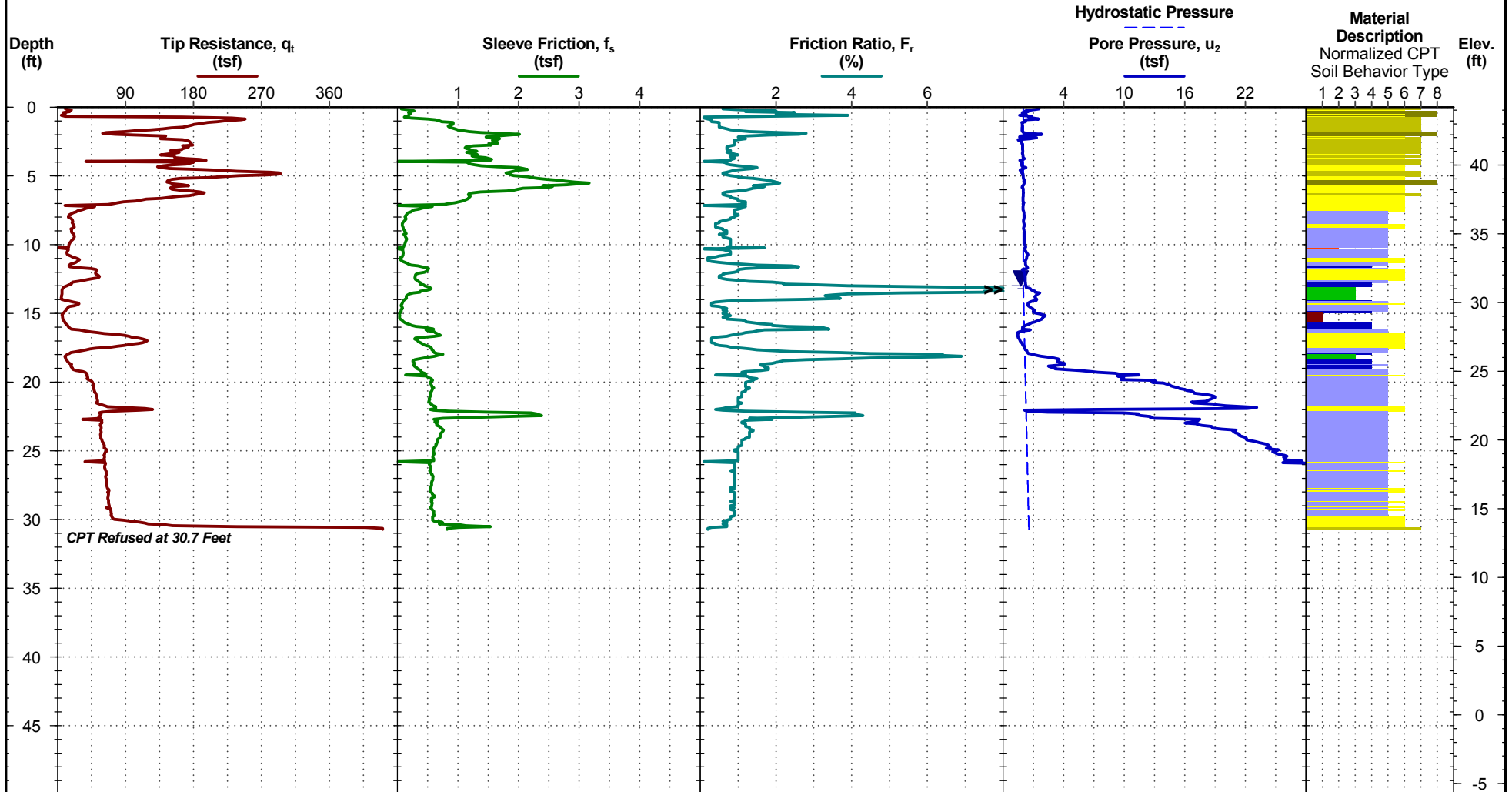
**CLIENT:** SCDOT  
Columbia, SC

**TEST LOCATION:** See Exhibit A-2

**SITE:** S-21-57  
Florence County, South Carolina

Surface Elev.: 44.2 ft  
Latitude: 34.00073°  
Longitude: -79.5291°

Station: NBL  
Offset: CENTER



See Exhibit A-3 for description of field procedures.  
See Appendix C for explanation of symbols and abbreviations.

CPT sensor calibration reports available upon request.

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT 73155050F - S-21-57 - CPT LOGS.GPJ TERRACON2015.GDT 11/13/15

**WATER LEVEL OBSERVATION**

13 ft estimated water depth  
(used in normalizations and correlations;  
see Appendix C)

Probe no. 4526 with net area ratio of 0.83  
U2 pore pressure transducer location  
Manufactured by Geotech A.B.; calibrated 11/12/2014  
Tip and sleeve areas of 10 cm<sup>2</sup> and 150 cm<sup>2</sup>  
Ring friction reducer with O.D. of 1.875 in



CPT Started: 11/7/2015

Rig: Pagani TG73-200

Project No.: 73155050F

CPT Completed: 11/7/2015

Operator: BR

Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT CORRELATIVE PARAMETERS REPORT. 73155050F - S-21-57 - CPT LOGS.GPJ TERRACON2015.GDT 11/13/15

# CPT CORRELATIVE PARAMETER LOG NO. CPT-2

SEE CPT LOG NO. CPT-2 FOR DETAILED TEST RESULTS

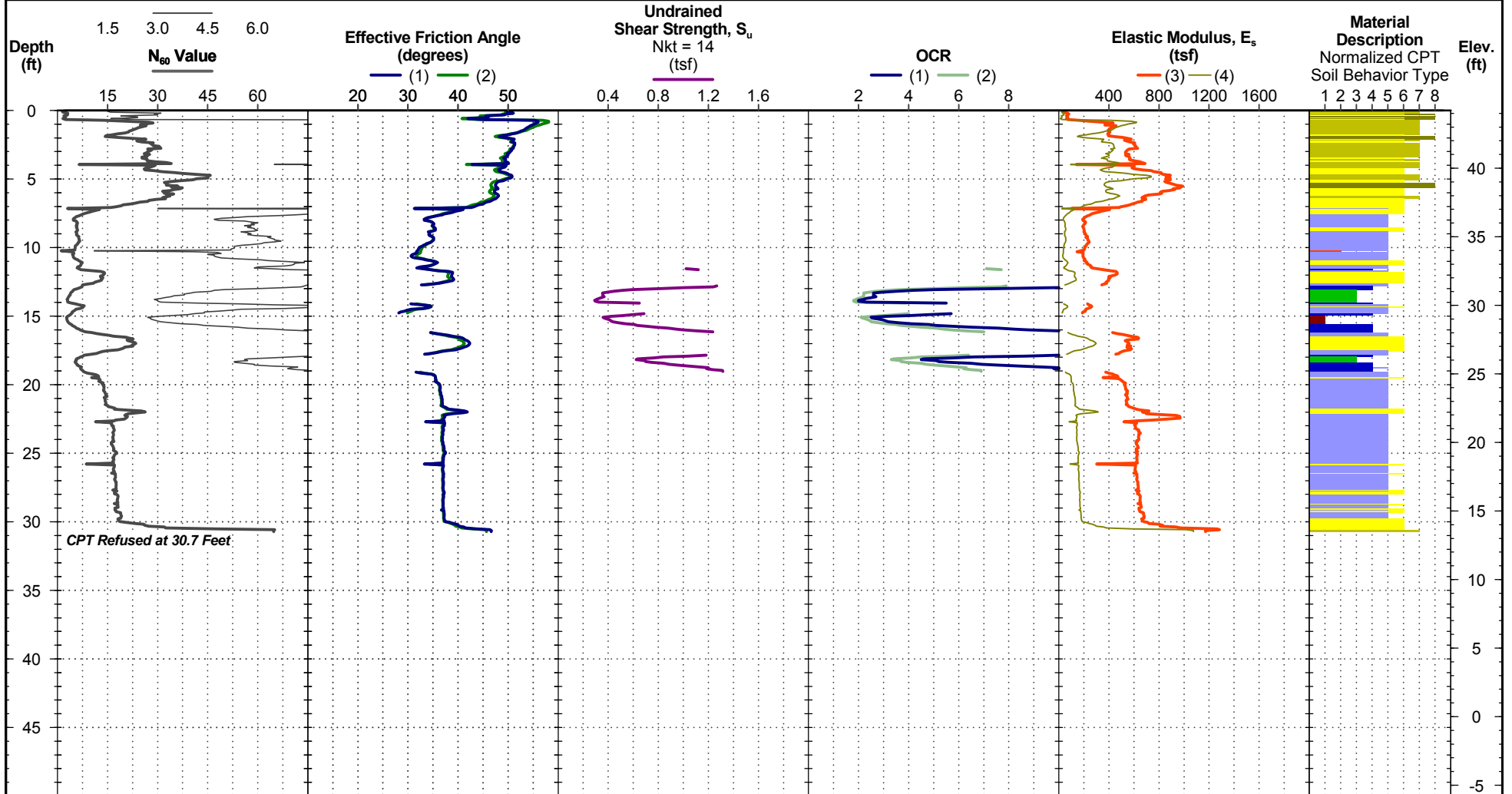
**PROJECT:** S-21-57 (North Old River Road) RBO  
Barfield Mill Creek

**CLIENT:** SCDOT  
Columbia, SC

**TEST LOCATION:** See Exhibit A-2

Surface Elev.: 44.2 ft  
Latitude: 34.00073308° Station: NBL  
Longitude: -79.5291048° Offset: CENTER

**SITE:** S-21-57  
Florence County, South Carolina



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix C provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

**WATER LEVEL OBSERVATION**

13 ft estimated water depth  
(used in normalizations and correlations; see Appendix C)

Notes:  
Probe no. 4526 with net area ratio of 0.83  
Manufactured by Geotech A.B.; calibrated 11/12/2014  
Tip and sleeve areas of 10 cm<sup>2</sup> and 150 cm<sup>2</sup>  
Ring friction reducer with O.D. of 1.875 in



CPT Started: 11/7/2015

Rig: Pagani TG73-200

Project No.: 73155050F

CPT Completed: 11/7/2015

Operator: BR

Exhibit: A-10

## **APPENDIX B - LABORATORY TESTING**

**Exhibit B-1 – Laboratory Testing Description**

**Exhibit B-2 – Summary of Laboratory Data**

**Laboratory Data Sheets**

**Preliminary Geotechnical Data Report**

EBP-3 - S-21-57 BRO Barfield Mill Creek ■ Florence County, SC  
November 13, 2015 ■ Terracon Project No. 73155050F



**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 and the bulk samples locations. 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:

- |   |                                |                            |
|---|--------------------------------|----------------------------|
| ■ | Percent Fines                  | AASHTO T11 (ASTM D1140)    |
| ■ | Atterberg Limits               | AASHTO T89/T90(ASTM D4318) |
| ■ | Moisture Content Determination | AASHTO T265/(ASTM D2216)   |

# Summary of Laboratory Results

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)
STB-1	2 - 4	SILTY SAND (SM)					16.2	0.0	0.0			12.4	
STB-1	4 - 6	SAND with silt (SW)					11.8	0.0	0.0			15.1	
STB-1	6 - 8	SILTY SAND (SM)					25.2	0.0	0.0			19.1	
STB-1	8 - 10	SAND with silt (SW)					10.1	0.0	0.0			19.9	
STB-1	13.5 - 15	SAND with silt (SW)		NP	NP	NP	9.7	0.0	0.0			28.3	
STB-1	23.5 - 25	FAT CLAY with SAND(CH)		63	22	41	83.9	0.0	0.0			33.4	
STB-2	0 - 2	SILTY SAND (SM)					16.8	0.0	0.0			13.6	
STB-2	2 - 4	SILTY SAND (SM)					18.0	0.0	0.0			14.7	
STB-2	4 - 6	SILTY SAND (SM)					14.2	0.0	0.0			17.4	
STB-2	6 - 8	SAND with silt (SW)					10.8	0.0	0.0			14.5	
STB-2	8 - 10	SILTY SAND (SM)					24.7	0.0	0.0			29.4	
STB-2	13.5 - 15	SILTY SAND(SM)		NP	NP	NP	15.0	0.0	0.0			34.1	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. OLD-LAB SUMMARY: USCS 73155050F - S-21-57 - LAB TESTING.GPJ TERRACON2012.GDT 11/13/15

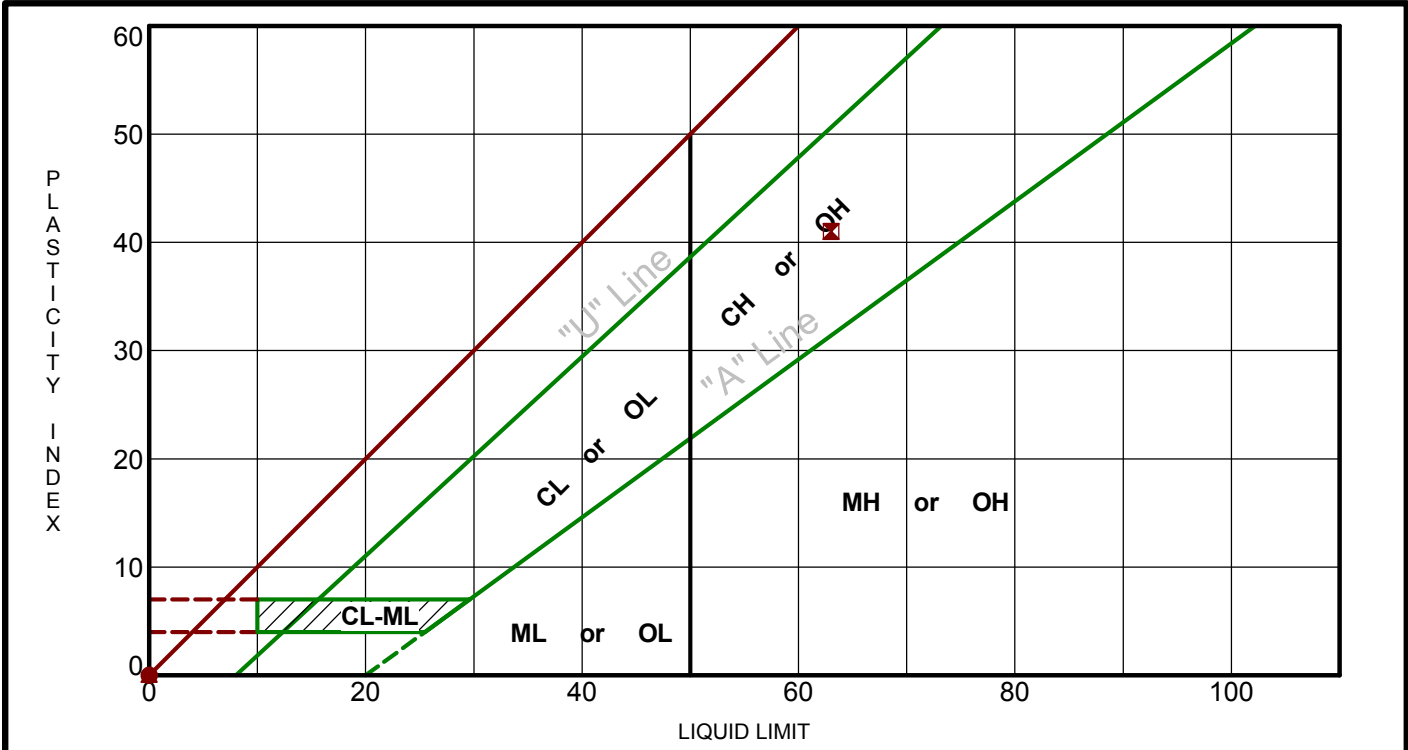
PROJECT: S-21-57 BRO Barfield Mill Creek	 521 Clemson Road Columbia, South Carolina	PROJECT NUMBER: 73155050F
SITE: S-21-57 Florence, South Carolina		CLIENT: SCDOT Columbia, South Carolina
		EXHIBIT: B-2



# ATTERBERG LIMITS RESULTS

ASTM D4318

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 73155050F - S-21-57 - LAB TESTING.GPJ TERRACON2015.GDT 11/13/15



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● STB-1	13.5 - 15	NP	NP	NP	10		SAND with silt (SW)
⊠ STB-1	23.5 - 25	63	22	41	84	CH	FAT CLAY with SAND
▲ STB-2	13.5 - 15	NP	NP	NP	15	SM	SILTY SAND

PROJECT: S-21-57 BRO Barfield Mill Creek	 521 Clemson Road Columbia, South Carolina	PROJECT NUMBER: 73155050F
SITE: S-21-57 Florence, South Carolina		CLIENT: SCDOT Columbia, South Carolina
		EXHIBIT: B-3












## **APPENDIX C - SUPPORTING DOCUMENTS**

Exhibit C-1 – General Notes

Exhibit C-2 – Unified Soil Classification System

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

<b>SAMPLING</b>			<b>WATER LEVEL</b>		Water Initially Encountered	<b>FIELD TESTS</b>	(HP) Hand Penetrometer	
	<b>Auger</b>	<b>Split Spoon</b>			Water Level After a Specified Period of Time		(T) Torvane	
					Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)	
	<b>Shelby Tube</b>	<b>Macro Core</b>		Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			(PID) Photo-Ionization Detector	
							(OVA) Organic Vapor Analyzer	
<b>Ring Sampler</b>	<b>Rock Core</b>							
								
<b>Grab Sample</b>	<b>No Recovery</b>							

## DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

## LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

<b>STRENGTH TERMS</b>	<b>RELATIVE DENSITY OF COARSE-GRAINED SOILS</b> (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			<b>CONSISTENCY OF FINE-GRAINED SOILS</b> (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

## RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 29
Modifier	> 30

## RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifier	> 12

## GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

## PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

# UNIFIED SOIL CLASSIFICATION SYSTEM

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

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> 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.

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

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

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

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

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

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

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup>  $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup>  $PI < 4$  or plots below "A" line.

<sup>P</sup>  $PI$  plots on or above "A" line.

<sup>Q</sup>  $PI$  plots below "A" line.

