

S-42-31 (Cannons Campground Road) over Peters Creek Emergency Bridge Replacement

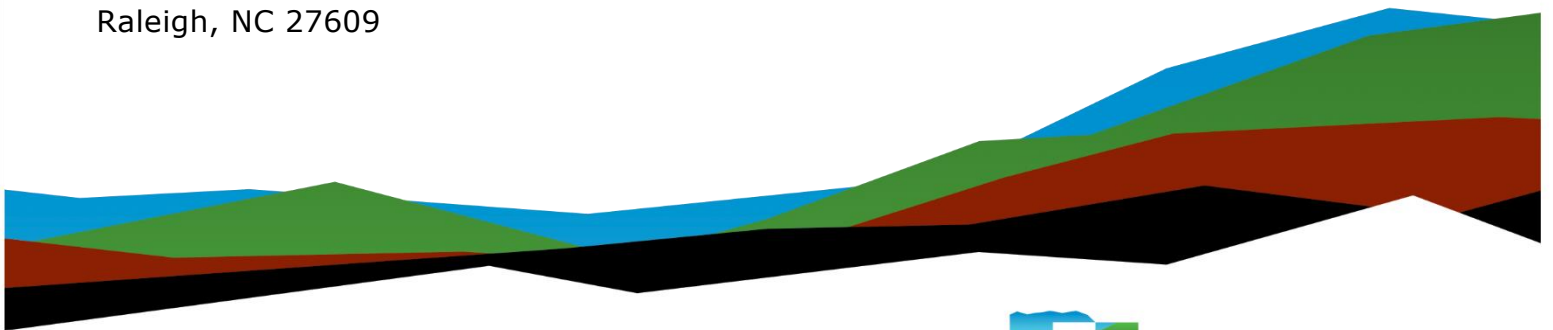
Spartanburg County, SC

Geotechnical Baseline Report

March 12, 2025 | SCDOT Project ID: P041165
Terracon Project No.: 8623P180

Prepared for:

HNTB Corporation
343 E. Six Forks Road, Suite 200
Raleigh, NC 27609



Nationwide
[Terracon.com](https://www.terracon.com)

- Facilities
- Environmental
- Geotechnical
- Materials



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March 12, 2025

HNTB Corporation
343 E. Forks Road, Suite 200
Raleigh, NC 27609

Attn: Mr. Spencer Franklin, PE, Senior Vice President
P: 919-546-8997

Re: Geotechnical Baseline Report
S-42-31 over Peters Creek Emergency Bridge Replacement
Spartanburg County, South Carolina
SCDOT Project ID.: P041165
Terracon Project No.: 8623P180

Dear Mr. Franklin:

Terracon Consultants Inc. (Terracon) has completed the exploration, testing and limited engineering analysis services for the above-referenced project. The services were conducted in general accordance with our Task Order Number 001, dated May 25, 2023.

Introduction

HNTB Corporation (HNTB) has contracted Terracon to perform subsurface exploration, laboratory testing and limited preliminary engineering recommendations for the replacement of the S-42-31 Bridge over Peters Creek in Spartanburg County, South Carolina. The results of the subsurface exploration and laboratory testing have been separately presented in a Geotechnical Subsurface Data Report (GSDR). For convenience, those data are also provided here in this Geotechnical Baseline Report (GBR) along with a characterization of the subsurface conditions for the project. Limited preliminary geotechnical design and construction considerations associated with the requested scope of work are included in this GBR. This GBR was prepared in general accordance with the 2022 SCDOT Geotechnical Design Manual (GDM).

Project Description

The project site is located at the S-42-31 (Cannons Campground Road) crossing over Peters Creek in Spartanburg County, South Carolina. Site location and exploration plans are presented in Appendix A of this report. Based on the conceptual plans by HNTB dated

2/17/2025, the replacement bridge will be constructed on the same alignment as the current bridge. The current plan indicates the new bridge will be a 170-ft long multi-span bridge constructed with AASHTO Type III Prestressed Concrete Beams.

Geotechnical Testing

The geotechnical exploration for this project was performed between January 13 and February 6, 2025. The results of our field work and our associated laboratory testing are included in Appendices A and B.

Field Exploration

Our field exploration consisted of the following:

- Two (2) Standard Penetration Test (SPT) Borings (S-42-31-1 and S-42-31-2)
- Two (2) offset auger probes near S-42-31-2 for bulk sample collection
- One (1) Downhole Shear Wave Velocity Test (DHT-1) performed in casing installed within Boring S-42-31-2
- Two (2) Cone Penetration Test soundings (S-42-31-1C and S-42-31-2C).

The tests were performed at the approximate locations as approved by 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 Thomas & Hutton after completion.

Laboratory Testing

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

- Twenty-seven (27) Natural Moisture Content Tests
- Eight (8) Atterberg Limits Tests
- Nine (9) Grain Size Tests
- Four (4) Grain Size Tests with Hydrometer
- One (1) Remolded, Consolidated-Undrained (CU) Triaxial Compression Test with Pore Pressure Readings
- One (1) Standard Proctor Test
- One (1) Corrosivity Suite (pH, chloride content, sulfate content, and resistivity tests)
- Seven (7) Compressive Strength of Rock Cores

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

Subsurface Conditions

Regional Geology

The bridge site is located on route S-42-31 in Spartanburg County, South Carolina. The site lies generally within the Piedmont Physiographic Province. More specifically, the site is located within the Six Mile Thrust Sheet. According to regional geologic mapping and published geologic reports, the project area is mapped in an area with biotite gneiss interlayered with mica sillimanite schist. The bridge end bents and approach embankments contain existing fill above alluvial and/or residual soils, very dense residual soils classified as Intermediate Geomaterials (IGM) and bedrock.

Soil and Rock Stratification

Borings S-42-31-1 and S-42-31-2 encountered 7 to 8 inches of asphalt followed by 1 ½ to 3 inches of gravel. Beneath the existing roadway section, embankment fill soil consisting of very loose to loose silty/clayey sand and very soft to very stiff sandy silt/clay was encountered to approximately 8 to 16 feet below the existing ground surface. Under the fill soils, both borings encountered a layer of alluvial soil consisting of very loose to loose clayey sand and soft to firm sandy silt/clay to a depth of around 22 to 34 feet below the existing ground surface. Below the alluvium, residual soils consisting of loose to very dense silty/clayey sand were encountered and continued to between 33.5 to 38.5 feet below ground surface, with some residual soils characterized as being intermediate geomaterials (IGM) exhibiting SPT N values of more than 100 blows per foot (bpf), followed by bedrock. Bedrock was present to the maximum depth explored of 58.5 feet and 53.5 feet at borings S-42-31-1 and S-42-31-2, respectively.

Borings performed by F&ME in June 2024 (B-1, B-2, and B-3) and conducted through the existing bridge deck show 4 to 5 inches of asphalt and 5 to 9 inches of concrete followed by a 20.6 to 34.8-foot air gap to the mudline. Boring log B-1 shows approximately 5-foot-thick concrete above the bedrock and Boring log B-3 shows approximately 5-foot-thick concrete and approximately 3-foot-thick wood above the residuum. The F&ME Boring logs show top of rock at depths of 33 ½ to approximately 47 feet. Boring log B-2 by F&ME shows the creek level at a depth of 35.6 feet below the existing bridge deck.

Geology ^{1, 4}	Approximate Elevation of Layer Bottom (ft, NAVD88)	USCS Soil Type	Measured Field N Value	Plasticity Index	Fines Content	REC / RQD
Ground Cover (Asphalt and Gravel)	716 to 720	--	--	--	--	--
Fill	705 to 709	SM, SC, ML, CL	0 to 19	NP ³ to 14	25 to 54	--
Alluvium	687 to 695	SC, ML, CL	1 to 6	NP ³ to 16	27 to 53	--
Residuum	682 to 683	SM, SC	7 to 100+	--	24	--
Rock	PMDE ²	--	--	--	--	18-100% / 0-68%

1. Geology is shown for Terracon Borings S-42-31-1 and S-42-31-2 only.
2. PMDE = Present to Maximum Depth Explored
3. NP = non-plastic
4. Concrete and wood debris were encountered in F&ME Borings B-1 and B-3 between Elevation 679 feet and 683 feet.

Seismic Conditions

According to SCDOT Seismic Design Specifications for Highway Bridges version 2.0, the proposed bridge will be an Operational Classification II (OC II). Per SCDOT GDM 2022, the proposed bridge shall be designed to meet the performance limits for an OC II bridge.

Acceleration Design Response Spectrum (ADRS)

The shear wave and compression wave velocity results, as measured at Boring S-42-31-2 using downhole seismic tests, were provided to SCDOT. SCDOT used these velocity measurements to develop Acceleration Design Response Spectrum (ADRS) curves by determining the seismic hazard and evaluating the local site effects on the response spectra.

SCDOT provided “3-Point Acceleration Design Response Spectrum” curves along with a table that included pseudo-spectral accelerations (PSA) for 5% critical damping and at selected frequencies, consistent with a Geologically Realistic (B-C Boundary) condition (shear wave velocity, $V_s = 2,500$ feet per second). PSA values were provided for the:

- Functional Evaluation Earthquake (FEE): 15% probability of exceedance in 75 years
- Safety Evaluation Earthquake (SEE): 3% probability of exceedance in 75 years

The table below provides the maximum considered earthquake peak ground acceleration (PGA), the short period acceleration (S_{DS}), and one-second period acceleration (S_{D1}) for the

FEE and SEE earthquakes at the ground surface. A copy of the “3-Point Acceleration Design Response Spectrum” provided by SCDOT is included in Appendix C.

Seismic Design Parameter	FEE	SEE
PGA	0.04	0.07
S _{DS}	0.08	0.15
S _{D1}	0.01	0.02

Soil Shear Strength Loss (SSL) Analysis

A few feet of alluvium (soft sandy silt/clay and very loose silty/clayey sand) were encountered below the existing fill at the boring locations. Although the groundwater level encountered was at a lower elevation than the bottom of the alluvium, groundwater fluctuations are likely. Therefore, soil shear strength loss (SSL) screening should be performed to assess potential for liquefaction related settlement and stability impacts on the planned bridge foundations and embankment slopes. Additional soil and groundwater evaluation may be required.

Design and Construction Considerations

Foundations

Driven steel H-piles driven to practical refusal on rock or within IGM materials (i.e., >20 blows per inch [bpi] with appropriately sized hammer) are expected to be feasible for the proposed bridge end bents.

The elevation to the top of very dense residual soils (IGM) at End Bent 1 (Begin Bridge) is 685 feet and at End Bent 4 (End Bridge) is 695 feet, NAVD88. The IGM is about 4 ½ feet thick at Bent 1 overlying bedrock with a minimum RQD of 13% and about 11 ½ feet thick at Bent 4 overlying bedrock with a minimum RQD of 0% at the top of rock. Per section 16.3.1 of the GDM, reinforced pile tips will be needed to minimize potential pile damage while penetrating through IGM to the top of rock. Pile drivability using the wave equation should be performed as part of subsequent detailed geotechnical evaluations. Appropriate group effect should be considered as necessary per GDM Chapter 16.

According to the conceptual bridge plans by HNTB dated 2/17/2025, minimal fill is expected at the end bent embankments. Foundations should typically be installed after the approach embankment construction to reduce potential downdrag settlement issues. The pile design should account for drag loads, should new fill be placed after installing foundation piles.

Drilled shafts are anticipated to be feasible for the proposed bridge interior Bents 2 and 3. Assuming redundant drilled shafts, Table 9-4 GDM 2022 allows using a resistance factor of

0.60 (both side resistance and end bearing) for a single redundant drilled shaft in rock. It is assumed that the drilled shaft will be cased to the top of rock and the side resistance along the casing length will not be considered in estimating axial resistance. Appropriate group effects should be considered as necessary per GDM Chapter 16.

We have observed variability in the top of rock and thickness of IGM, as seen in **Soil and Rock Stratification**. Therefore, we expect variability in tip elevations at each bent location. Resistance of piles driven to practical refusal in IGM or rock will be limited by their structural resistance. Therefore, likely reinforced pile tips will be required to penetrate to IGM and rock. Pile drivability using the wave equation should be performed along with estimating stresses during driving and, in general, verifying the ability of the Contractor’s selected hammer to drive the piles to the desired penetration while preventing overstressing.

Corrosion and Deterioration

Corrosion testing was performed on a composite sample obtained from split spoons in the upper 2 to 30 feet. Corrosion testing included pH, resistivity, chlorides, and sulfates content as summarized in Table below. Corrosion test results are included in Appendix B.

Corrosion Test	Results Bent 1, Boring S-42-31-1 Composite Sample from 2 to 30 feet	Indication of Corrosivity ¹
pH	5.5	Less than 5.5
Resistivity	2,814 ohm-cm	Less than 2,000 ohm-cm
Chloride	130 ppm	Greater than 500 ppm
Sulfate	95 ppm	Greater than 1,000 ppm

1. AASHTO LRFD bridge design specifications, Ninth Edition 2020, Section 10.7.5.

Based on the criteria for electro-chemical properties in the GDM Section 7.18, the electro-chemical classification of the project site is non-aggressive. Interpretation of these data should be communicated with the project’s structural engineer.

Embankment Construction

Based on the conceptual plans by HNTB, minimal fill will be placed to meet the proposed grade with some embankment cut below the bridge and relatively short 2H:1V riprap lined slopes shown at the end abutment positions. Bulk samples were obtained near End Bent 4 (End Bridge) from the top 5 feet of existing embankment material. Per our scope, a bulk sample was tested for soil classification and was also remolded to about 95% of the Standard-effort Proctor prior to being tested for shear strength envelopes under CU Triaxial Compression with pore pressure readings. Test results are presented in Appendix B and summarized in the table below.

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Sample No.	Station	Offset (ft)	Sample Depth (ft)	USCS Soil Type	Compaction		Shear Strength ¹	
					Optimum Moisture (%)	Max Dry Density (pcf)	Total	Effective
S-42-31-2 Offsets	180+32	7 R	1 - 5	SC	13.3	117.6	c=1.7 psi ø=26°	c'=1.3 psi ø'=33°

1. Based on a maximum deviator stress failure criterion

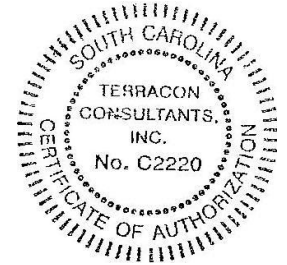
Closure

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.

Maggie McKenney, EIT
Senior Staff Engineer

Abdul Q. Fekrat, PhD, PE
Senior Engineer
SC Registration No. 38531

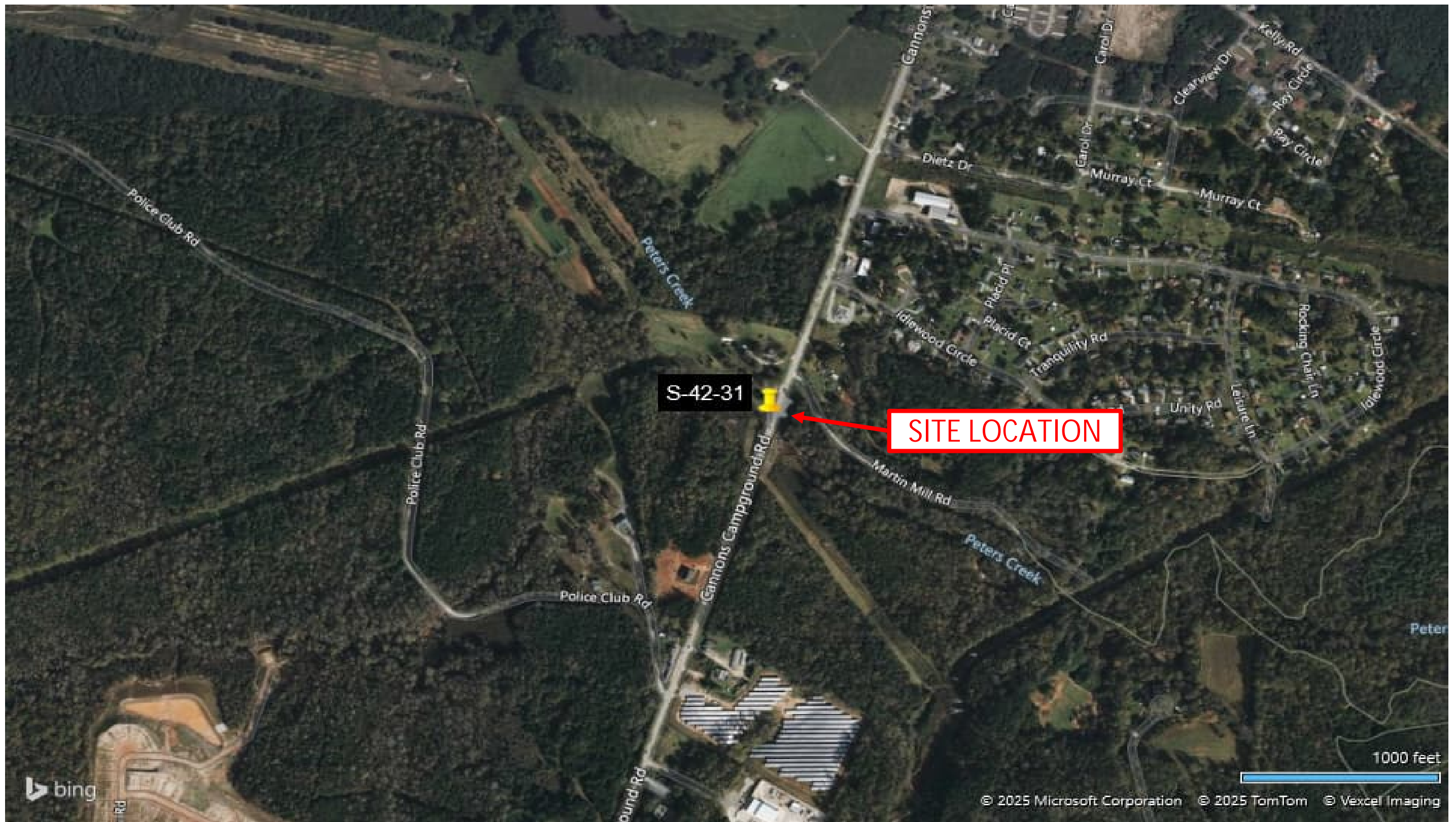


Appendix A

Field Exploration

- Exhibit A-1 – Site Location Map
- Exhibit A-2 – Aerial Exploration Plan
- Exhibit A-3 – Boring Location Diagram
- Exhibit A-4 – Field Testing Summary
- Exhibit A-5 – GeoScoping Form (2 Pages)
- Exhibit A-6 – Field Exploration Description (3 Pages)
- Exhibit A-7 – Soil Description Terms
- Exhibit A-8 – Soil/Rock Symbols
- Exhibit A-9 – Boring Logs (4 Pages)
- Exhibit A-10 – Grout Logs (4 Pages)
- Exhibit A-11 – Rock Core Photograph Logs (2 Pages)
- Exhibit A-12 – Geophysical Testing Results
- Exhibit A-13 – CPT Sounding Logs (2 Pages)
- Exhibit A-14 – Boring Logs Done by F&ME (4 Pages)
- Exhibit A-15 – Rock Core Photograph Logs Done by F&ME (3 Pages)

Note: All exhibits are one page unless noted above



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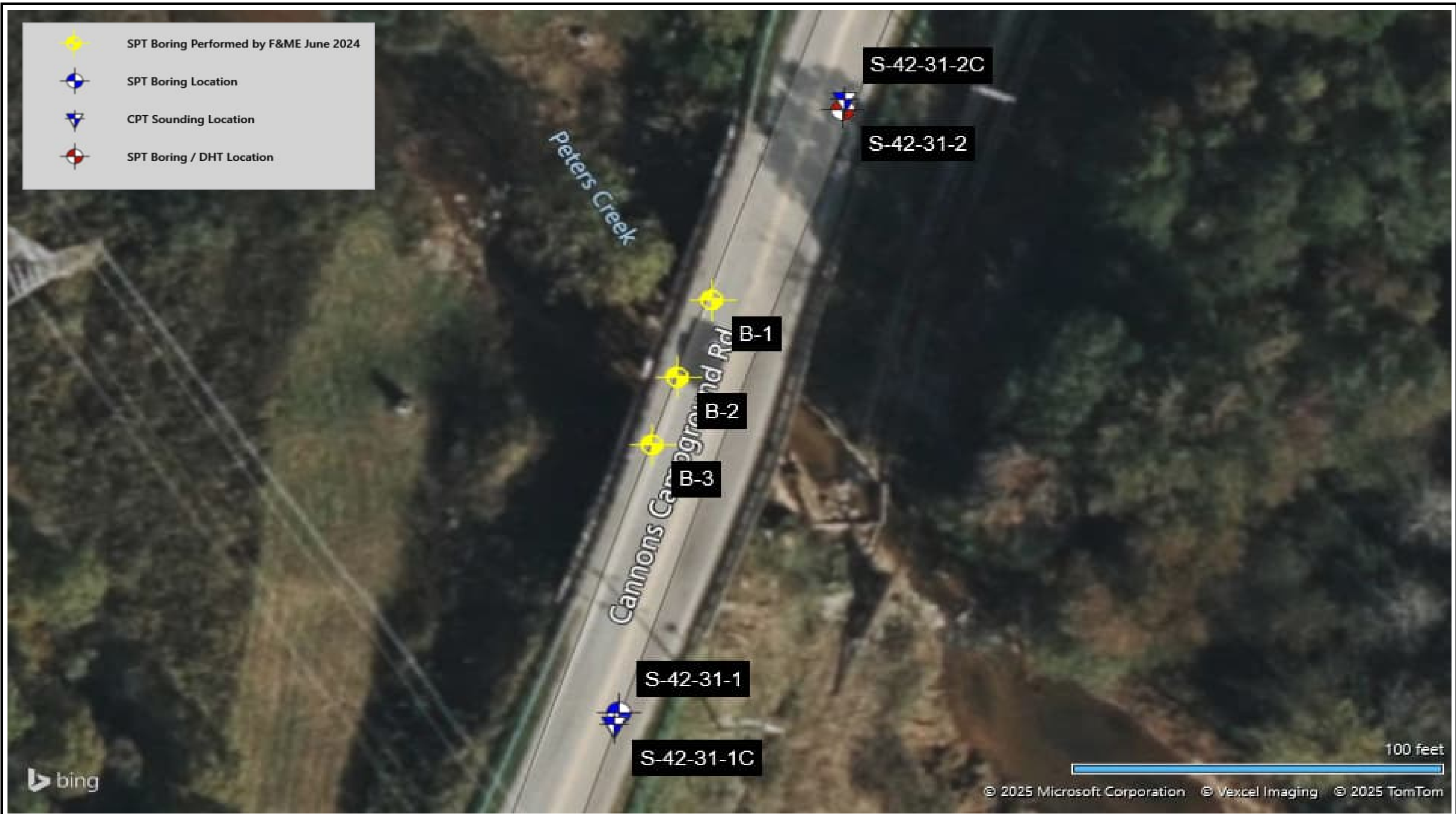
AERIAL PHOTOGRAPHY PROVIDED BY BING
 DIAGRAM IS FOR GENERAL LOCATION ONLY,
 AND IS NOT INTENDED FOR CONSTRUCTION
 PURPOSES

Project Mgr:	JA	Project No.	8623P180
Drawn by:	MM	Scale:	AS SHOWN
Checked by:	JA	Date:	2/27/2025
Approved by:	JA		

Terracon
 72 POINTE CIR
 GREENVILLE, SC 29615

SITE LOCATION MAP
**S-42-31 (Cannons Campground Road) over
 Peters Creek Emergency Bridge Replacement**
 Spartanburg County, SC P041165

EXHIBIT
A-1



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 PURPOSES

Project Mgr:	JA	Project No.	8623P180
Drawn by:	MM	Scale:	AS SHOWN
Checked by:	JA	Date:	2/27/2025
Approved by:	JA		

72 POINTE CIR
 GREENVILLE, SC 29615

AERIAL EXPLORATION PLAN

**S-42-31 (Cannons Campground Road) over
 Peters Creek Emergency Bridge Replacement**

Spartanburg County, SC P041165

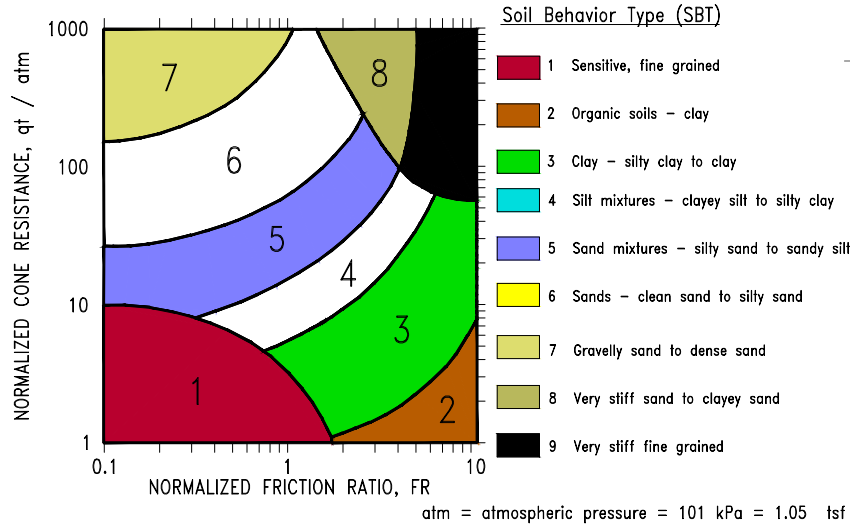
EXHIBIT

A-2

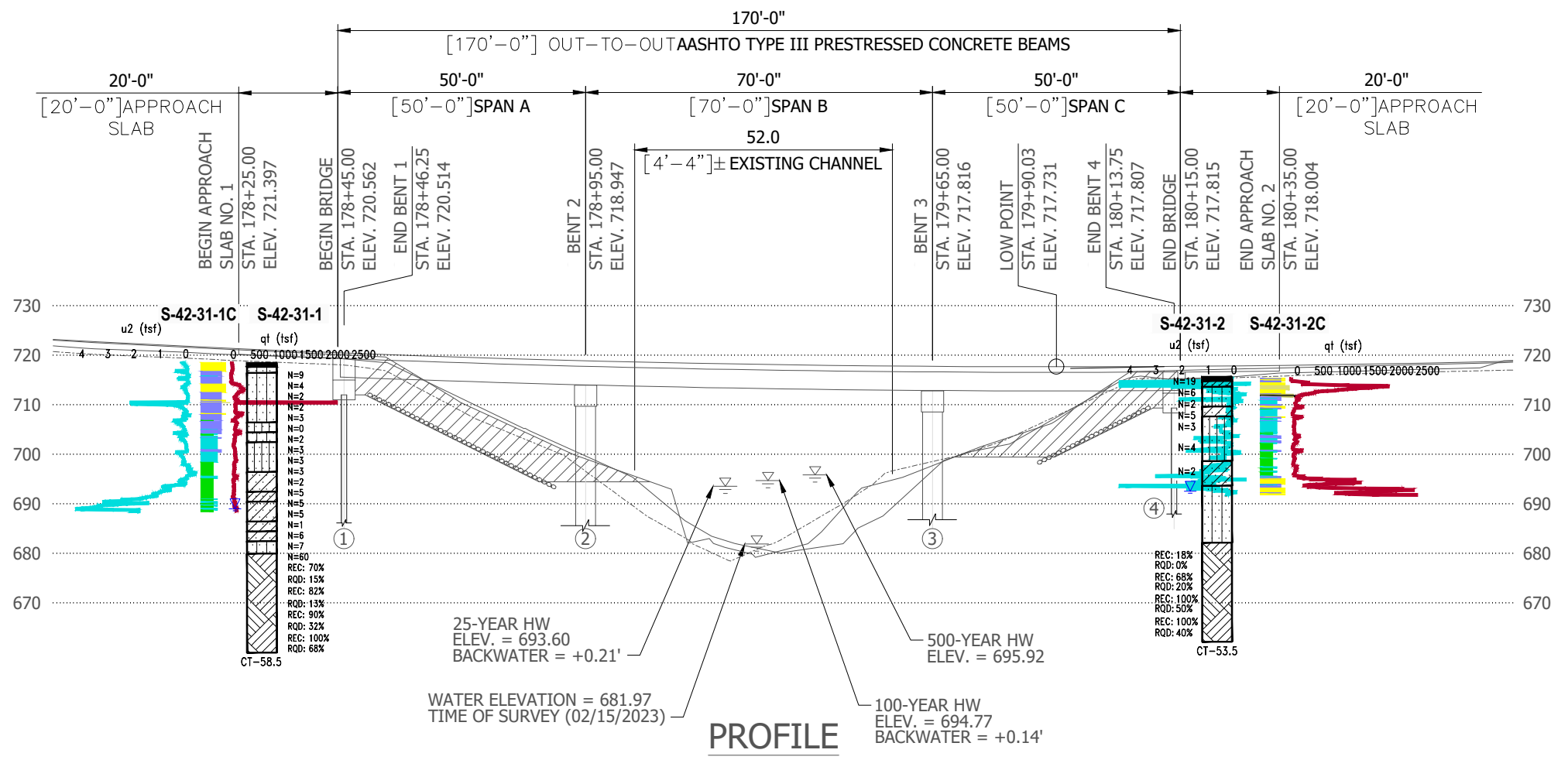
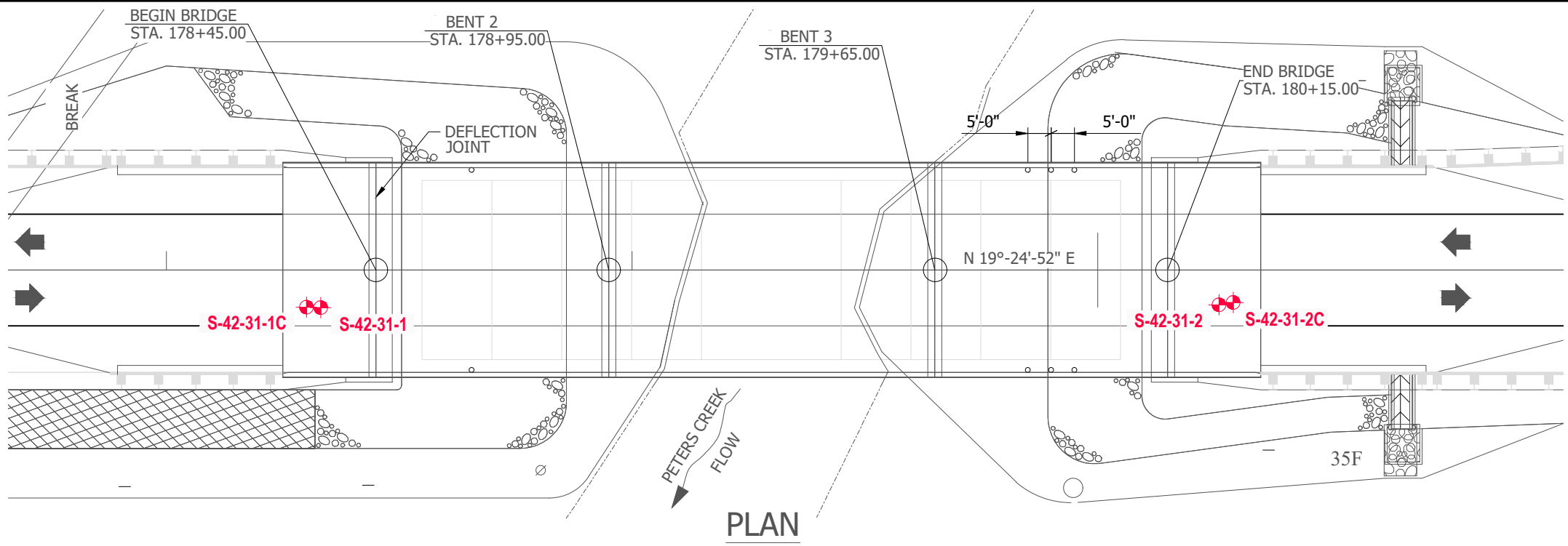
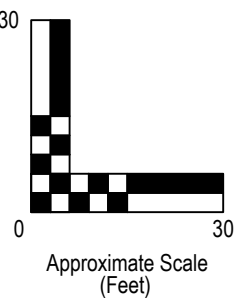
LEGEND

- APPROXIMATE BORING LOCATION
- SCDOT-ASPHALT
- SCDOT-GP
- SCDOT-FILL
- SCDOT-MLS
- SCDOT-SC
- SCDOT-CLS
- SCDOT-SM
- SCDOT-BEDROCK

CPT Soil Classification Graphic Symbols



- Water Level Reading at time of drilling.
- Water Level Reading after drilling.



Project Mngr:	MM
Drawn By:	RLW
Checked By:	MM/MRF
Approved By:	JNA

Project No.	8623P180
Scale:	AS SHOWN
File No.	8623P180 PC
Date:	FEBRUARY 2025

Terracon

72 Pointe Circle
Greenville, SC 29615
864-292-2901 864-292-6361

BORING LOCATION DIAGRAM

SCDOT PROJECT ID: P041165

S-42-31 (CANNONS CAMPGROUND ROAD) BRO PETERS CREEK

SPARTANBURG COUNTY

SOUTH CAROLINA

EXHIBIT

A-3

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

Soil Testing Location Table - Exhibit A-4

S-42-31 over Peters Creek Emergency Bridge Replacement | Spartanburg County, SC

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Test Number	Type	Test Hole Local	Northing	Easting	Latitude	Longitude	Station ¹	Offset ¹	Elevation ² (ft)	Depth (ft)
S-42-31-1	STB	Begin Bridge	1152580.06	1737390.87	34.99793	-81.87675	178+33	8.1-R	720.5	58.5
S-42-31-1C	CPT	Begin Bridge	1152576.65	1737389.59	34.99792	-81.87676	178+30	8-R	720.7	30.2
S-42-31-2	STB	End Bridge	1152762.25	1737452.90	34.99843	-81.87655	180+26	7.5-R	716.8	53.5
S-42-31-2C	CPT	End Bridge	1152765.44	1737453.40	34.99844	-81.87655	180+29	7-R	716.9	23.6

1. Stations and offsets were based on the state plane coordinates collected by Thomas & Hutton.

2. Elevations are based on NAVD 88.

3. A composite bulk sample was collected about 5.8 feet and 6.3 feet north of S-42-31-2.

Exhibit A-5 GeoScoping Form

PROJECT INFORMATION			
Project ID:	P041165	Date of Trip:	1/14/2025
County:	Spartanburg	Location:	Spartanburg
Rd/ Route:	S-42-31	Local Name:	Cannons
Attendees:	M. McKenney		Campground Rd

EXISTING BRIDGE INFORMATION			
Bridge Length:	150 ft	Bridge Width:	38.5 ft
Superstructure Type:	Concrete framing and decking	Substructure Type:	Timber Piles
Begin Bridge Sta ¹ :	178+45	End Bridge Sta ¹ :	180+15
Begin Bridge Embankment Sta ¹ :	177+45	End Bridge Embankment Sta ¹ :	181+15
Structure Number:	04212	Posted Weight Limit:	20 tons
Crossing:	Peters Creek	Skew:	N/A
Latitude:	34.99820°	Longitude:	-81.87667°
Existing Fill Height:	approx 8 to 16 ft	Approx Existing Slope Angle:	2H:1V
1. Begin & End Bridge Embankment 100 ft down Sta. or up Sta., respectively. Sta. estimated from overlay of bridge plan provided by HNTB.			

EXISTING ROADWAY EMBANKMENT INFORMATION			
Begin Project Sta:	177+00	Begin Bridge Embankment Sta:	177+45
Accessibility Issues:	None Observed		
Ground Cover:	Asphalt pavement and grassed shoulders		
Existing Fill Height:	16 feet, sloping	Approx Existing Slope Angle:	2H:1V
Local Development:	developed - residential		
Topography:	graded slope to creek		
Traffic Control Necessary:	No, bridge closed for construction		
Surface Soils:	silty sand	Muck:	No
Exposed Rock in Stream Bed:	Yes	Exposed Rock in banks:	Yes
Wetlands on Site:	Yes	Wetland Adjacent:	Yes
Depth FG to Water:	36 feet	Water Depth:	2 feet
Depth to Existing Ground:	approximately 38 feet at center of bridge		
Scour Condition at EB:	Critical	Scour Condition at IB:	Critical

End Bridge Embankment Sta:	181+15	End Project Sta:	182+00
Accessibility Issues:	None Observed		
Ground Cover:	Asphalt pavement and grassed shoulders		
Existing Fill Height:	8 feet, sloping	Approx Existing Slope Angle:	2H:1V
Local Development:	developed - residential		
Topography:	graded slope to creek		
Traffic Control Necessary:	No, bridge closed for construction		
Surface Soils:	clayey sand	Muck:	No
Exposed Rock in Stream Bed:	Yes	Exposed Rock in banks:	Yes
Wetlands on Site:	Yes	Wetland Adjacent:	Yes
Depth FG to Water:	36 feet	Water Depth:	2 feet
Depth to Existing Ground:	approximately 38 feet at center of bridge		
Scour Condition at EB:	Critical	Scour Condition at IB:	Critical

Exhibit A-5 GeoScoping Form

UTILITIES INFORMATION	
Attached:	A telephone conduit was observed to be attached along the west side of the bridge
Above Ground:	Overhead power with attached AT&T cable was observed along the east side of the bridge. A Duke Power easement was observed crossing diagonally over the south end of the bridge. A 16-inch waterline and 8-inch ductile iron sewer line was observed above ground along the east side of the bridge.
Underground:	A 42-inch underground waterline was observed along the west side of the bridge. An underground gas line was observed along the east side of the bridge. Underground sewer was observed crossing over the north end of the bridge.

Comments:

Field Exploration Description Overview

The testing locations were determined by Terracon and submitted to SCDOT for approval. Terracon located the test locations in the field using handheld GPS and measurements from existing structures shown on the provided drawings. The borings were surveyed by Thomas & Hutton after testing and drilling was complete. The locations, as shown in the Exploration Plans, are shown to the scale indicated.

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

Soil Test Borings (STB)

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

- SCDOT Geotechnical Design Manual 2022
- ASTM D5783, "Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geo-environmental Exploration"
- ASTM D6151, "Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling"
- ASTM D1586 "Test Method for Penetration Test and Split-Barrel Sampling of Soils"
- ASTM D4220 "Standard Practices for Preserving and Transporting Soil"
- ASTM D2113 "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration"
- ASTM D5079 "Standard Practices for Preserving and Transporting Rock Core Samples"

Each soil test boring was advanced using rotary wash drilling techniques. 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.

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

Exhibit A-6 – Subsurface Exploration Description

S-42-31 over Peters Creek Emergency Bridge Replacement | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165



consistency (based on standard penetration resistance). The designations shown on the logs are described in the 2022 SCDOT Geotechnical Design Manual, Chapter 6.

The borings were advanced either to the planned drilling depth at which they were terminated, or to refusal of the drilling equipment. Select borings were 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 description of the rock. An explanation of the rock descriptions shown on the logs is provided in the SCDOT GDM Chapter 6. Photos of the recovered rock core specimens are provided in the Rock Core Photograph Log.

Groundwater readings were collected from the soil test borings after 24 hours if site constraints allowed the borings to stay open. If collected, water levels are indicated on the boring logs. The borings were advanced using mud rotary drilling techniques, and time-of-drilling water levels may not be reliable. Due to active construction taking place on the bridge at the time of drilling, borings were immediately backfilled after completion.

At the conclusion of the work, the boreholes were backfilled with the drill cuttings and clean sand. The upper 20 feet of the tests in the existing roadways and embankments were grouted with a cement bentonite grout. Test locations performed in existing pavements were capped with cold-patch asphalt.

Cone Penetration Test (CPT) Soundings

Cone Penetration Test soundings were conducted in accordance with ASTM D5778 *Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils*.

Downhole Shear Wave Velocity Test (DHT)

One downhole seismic test was performed in a cased borehole drilled for this project. After the test boring was completed, the boring was filled with a fluid water/cement/bentonite grout and then a threaded PVC pipe casing (capped at the bottom end) was inserted into the borehole, providing a uniform bond between the soil and pipe exterior.

The downhole seismic test consisted of placing two downhole triaxial geophones at selected depth intervals in the borehole casing. The geophone was connected to a recording device (Seismic Source Daq Link 5 Seismograph) at the surface and clamped to the side of the casing at the selected test depth. The geophones are equipped with a spring-arm that is released at the bottom of the boring. The spring expands and forces the geophone against the casing wall. The interval between each geophone and each test depth was 3 feet for the entire depth of the cased borehole. An instrumented hammer was then used to strike a steel plate with cleats at the bottom (often called a shear wave golf shoe) that penetrated the ground and prevented sliding when struck. The steel plate was oriented to generate horizontal shear waves (SH) at the surface. An additional plate was also struck to better produce compression

Exhibit A-6 – Subsurface Exploration Description

S-42-31 over Peters Creek Emergency Bridge Replacement | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165



waves. The horizontal distance was measured, and the plate was set exactly 10 feet from the borehole. The recorder was set to record the arrival times of the shear waves at the geophone locations. At least 15 blows (5 in each direction on the golf shoe, and 5 on the steel plate) were struck for each test depth to electronically stack and polarize the observed data, and to increase the signal-to-noise ratio. The data was stored on computer disks for processing and computation. The geophone was raised to the next depth interval and the process was repeated.

Shear Wave Velocity Test Results shows the downhole shear wave velocity and compressive wave velocity test results. The data was evaluated using the Fixed Interval method. S-wave arrival times using the Interval method were picked based on the onset of the signal (first break) as observed in the software package TomTime by GeoTom.

SOIL DESCRIPTION TERMS

Relative Density/Consistency Terms

<u>Relative Density</u> ¹			<u>Consistency</u> ²		
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.

Angularity¹

<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 Reaction³

<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

Cementation³

<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 Range¹

<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^{1, 2}

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

USCS Soil Designation

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

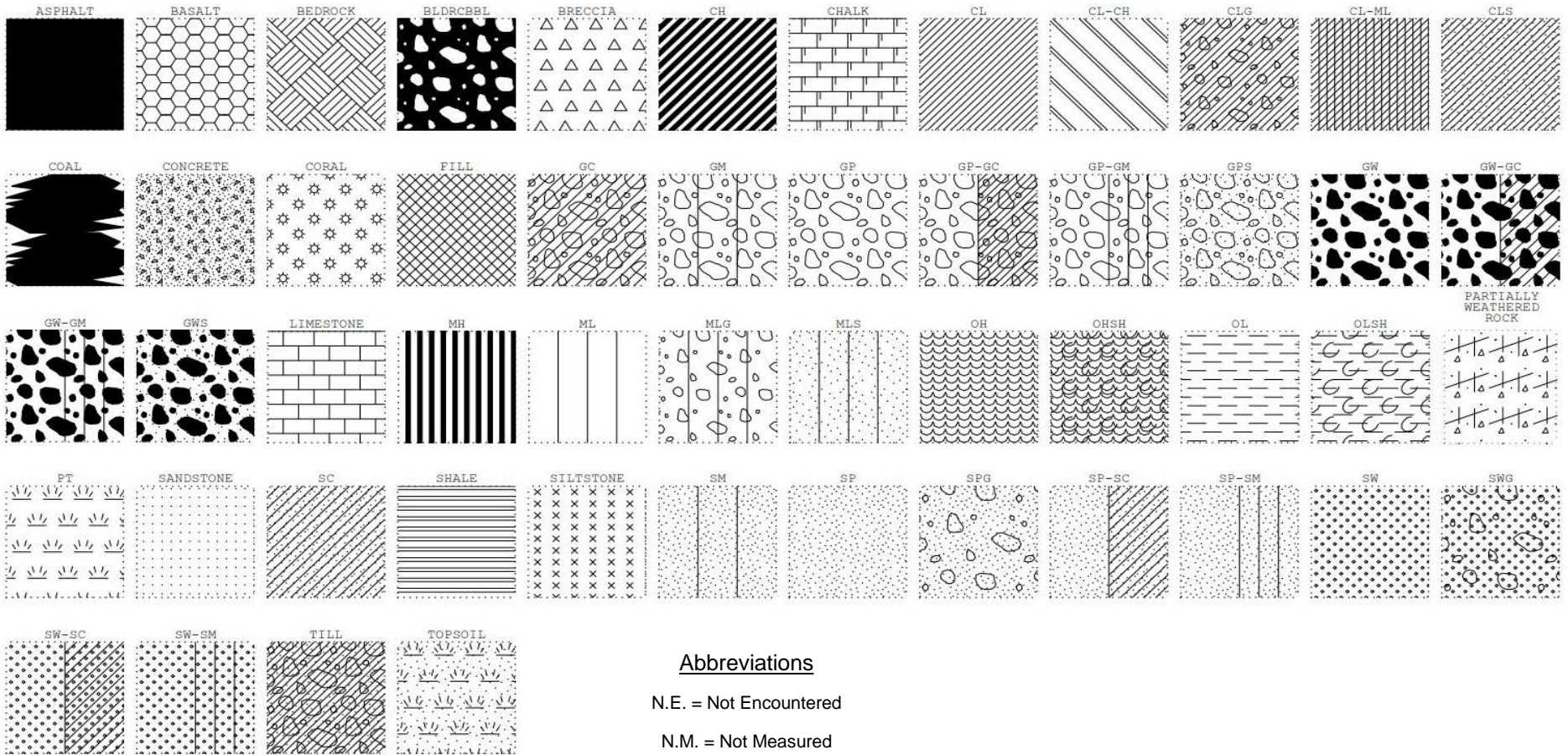
AASHTO Soil Designation

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

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

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

³Use as required




Abbreviations

N.E. = Not Encountered

N.M. = Not Measured

Project Manager:
MEM
Drawn by:
KJZ
Checked by:
SG
Approved by:
DJC

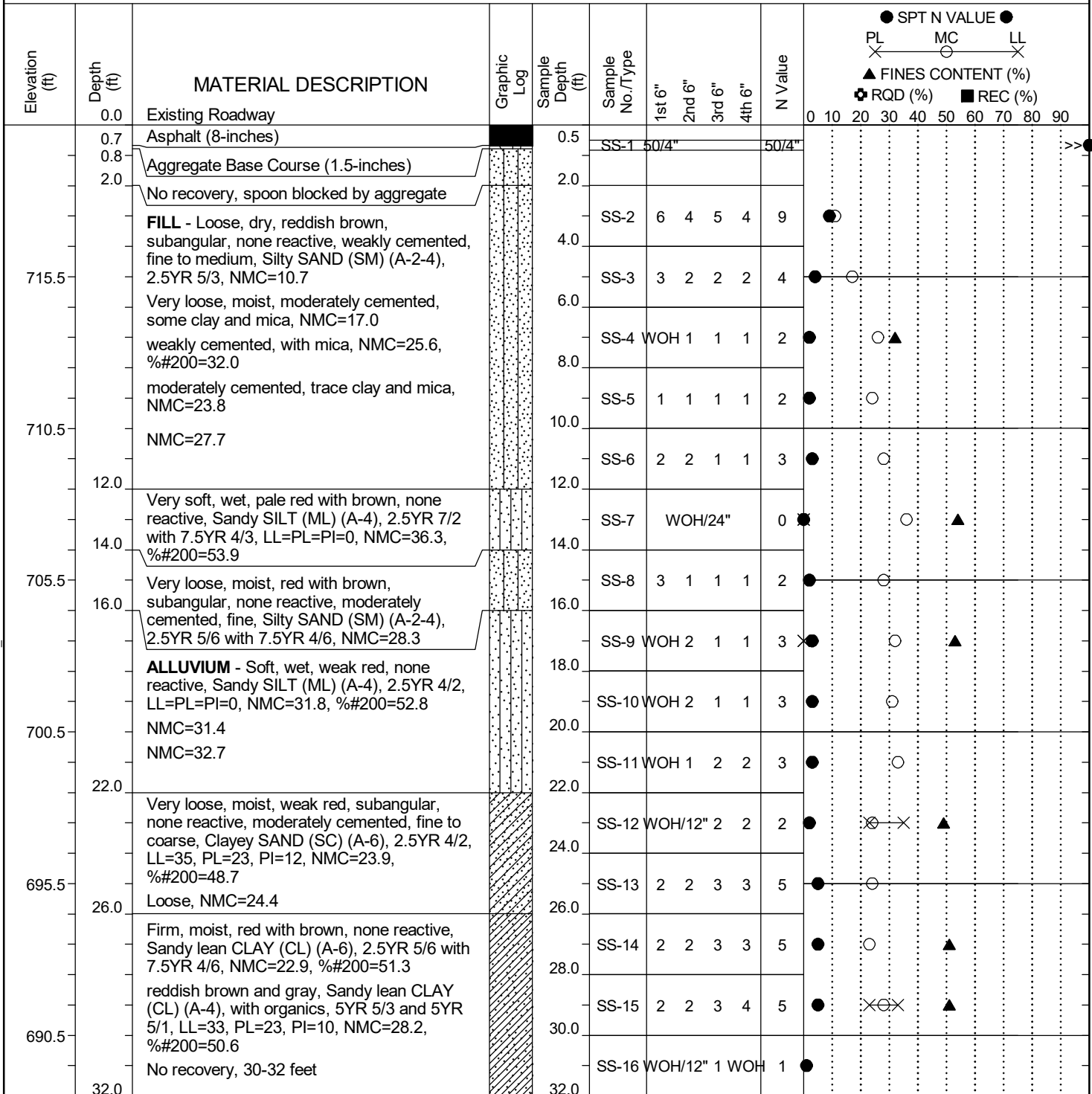
Project No.
8623P180
Scale:
N.T.S.
File Name:
Soil - Rock - Log
Date:
Jul 2023



72 Pointe Circle
Greenville, SC 29615
PH. (864) 292-2901 FAX. (864) 292-6361

SOIL AND ROCK SYMBOLS

Project ID: P041165	County: Spartanburg	Boring No.: S-42-31-1
Site Description: S-42-31 (Cannons Campground Road) BRO Peters Creek		Route: S-42-31
Eng./Geo.: S. Greaber	Boring Location: 178+33	Offset: 8.1R Alignment: Existing
Elev.: 720.5 ft	Latitude: 34.99793	Longitude: -81.87675 Date Started: 1/14/2025
Total Depth: 58.5 ft	Soil Depth: 38.5 ft	Core Depth: 20 ft Date Completed: 1/14/2025
Bore Hole Diameter (in): 4	Sampler Configuration	Liner Required: Y (N) Liner Used: Y (N)
Drill Machine: DR#1327	Drill Method: RW/RC	Hammer Type: Automatic Energy Ratio: 92.6%
Core Size: NQ2	Driller: B. Burnette	Groundwater: TOB N.M. 24HR: N.M.



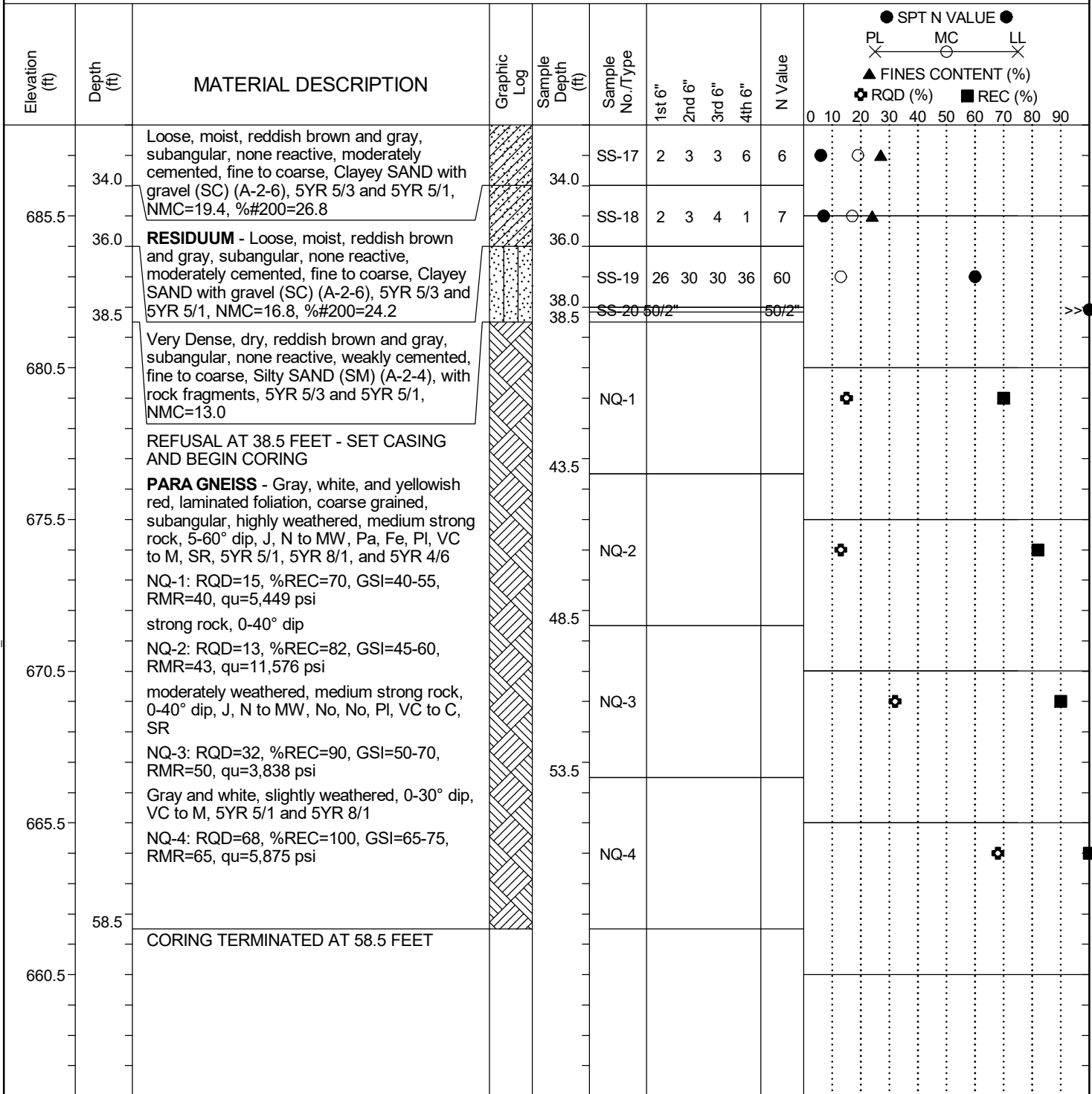
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SC.DOT 8623P180T SCDOT BRIDGE PACK 21 DOT S-42-31 OVER PETERS CREEK.GPJ SCDOT DATATEMPLATE.GDT 3/4/25

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	

Project ID: P041165	County: Spartanburg	Boring No.: S-42-31-1
Site Description: S-42-31 (Cannons Campground Road) BRO Peters Creek		Route: S-42-31
Eng./Geo.: S. Greaber	Boring Location: 178+33	Offset: 8.1R Alignment: Existing
Elev.: 720.5 ft	Latitude: 34.99793	Longitude: -81.87675 Date Started: 1/14/2025
Total Depth: 58.5 ft	Soil Depth: 38.5 ft	Core Depth: 20 ft Date Completed: 1/14/2025
Bore Hole Diameter (in): 4	Sampler Configuration	Liner Required: Y (N) Liner Used: Y (N)
Drill Machine: DR#1327	Drill Method: RW/RC	Hammer Type: Automatic Energy Ratio: 92.6%
Core Size: NQ2	Driller: B. Burnette	Groundwater: TOB N.M. 24HR: N.M.

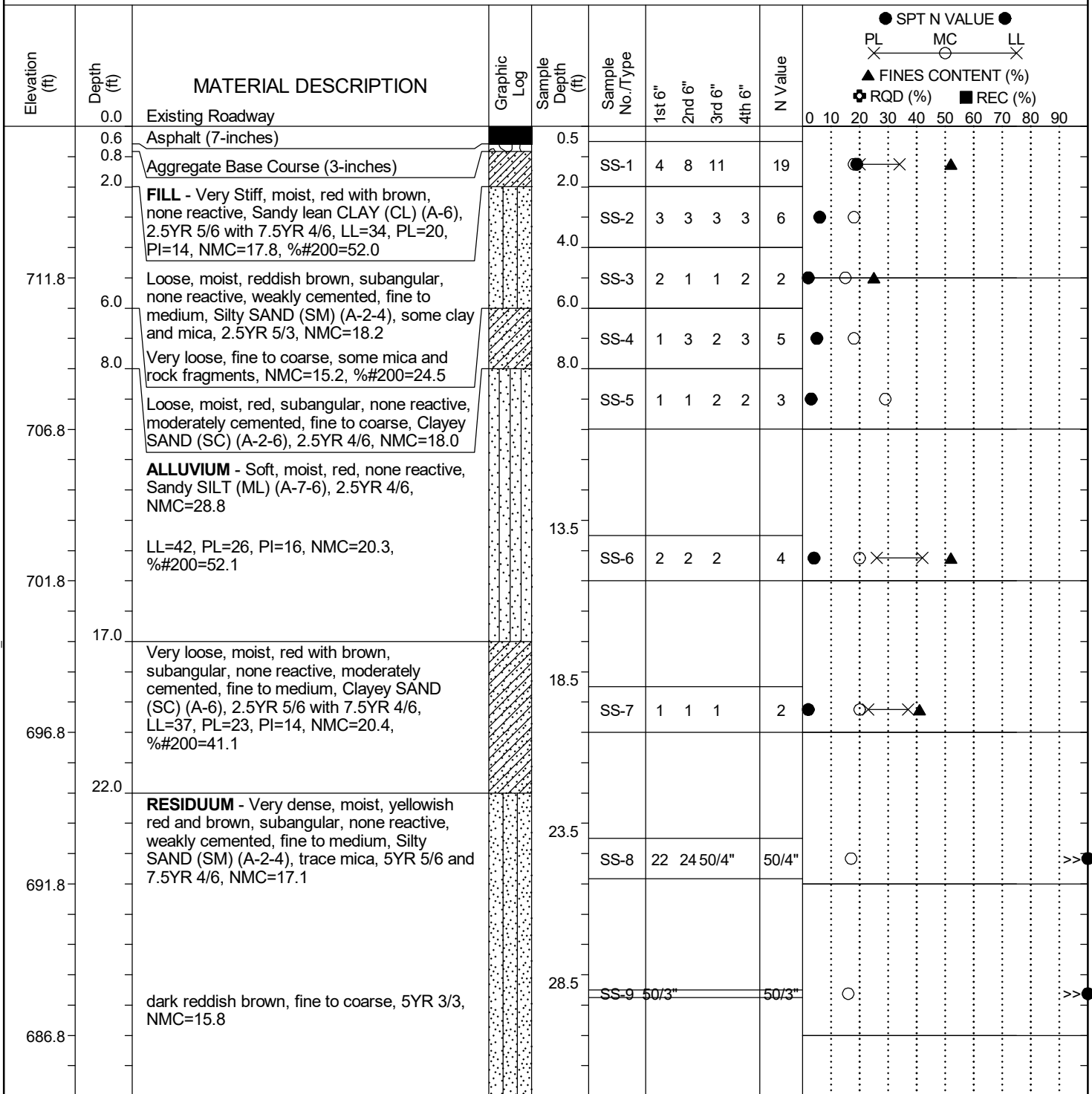


LEGEND

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 8623P180T SCDOT BRIDGE PACK 21 DOT S-42-31 OVER PETERS CREEK.GPJ SCDOT_DATATEMPLATE.GDT 3/4/25

Project ID: P041165	County: Spartanburg	Boring No.: S-42-31-2
Site Description: S-42-31 (Cannons Campground Road) BRO Peters Creek		Route: S-42-31
Eng./Geo.: S. Greaber	Boring Location: 180+26	Offset: 7.5R Alignment: Existing
Elev.: 716.8 ft	Latitude: 34.99843	Longitude: -81.87655 Date Started: 1/13/2025
Total Depth: 53.5 ft	Soil Depth: 33.5 ft	Core Depth: 20 ft Date Completed: 1/13/2025
Bore Hole Diameter (in): 4	Sampler Configuration	Liner Required: Y (N) Liner Used: Y (N)
Drill Machine: DR#1327	Drill Method: RW/RC	Hammer Type: Automatic Energy Ratio: 92.6%
Core Size: NQ2	Driller: B. Burnette	Groundwater: TOB N.M. 24HR: N.M.



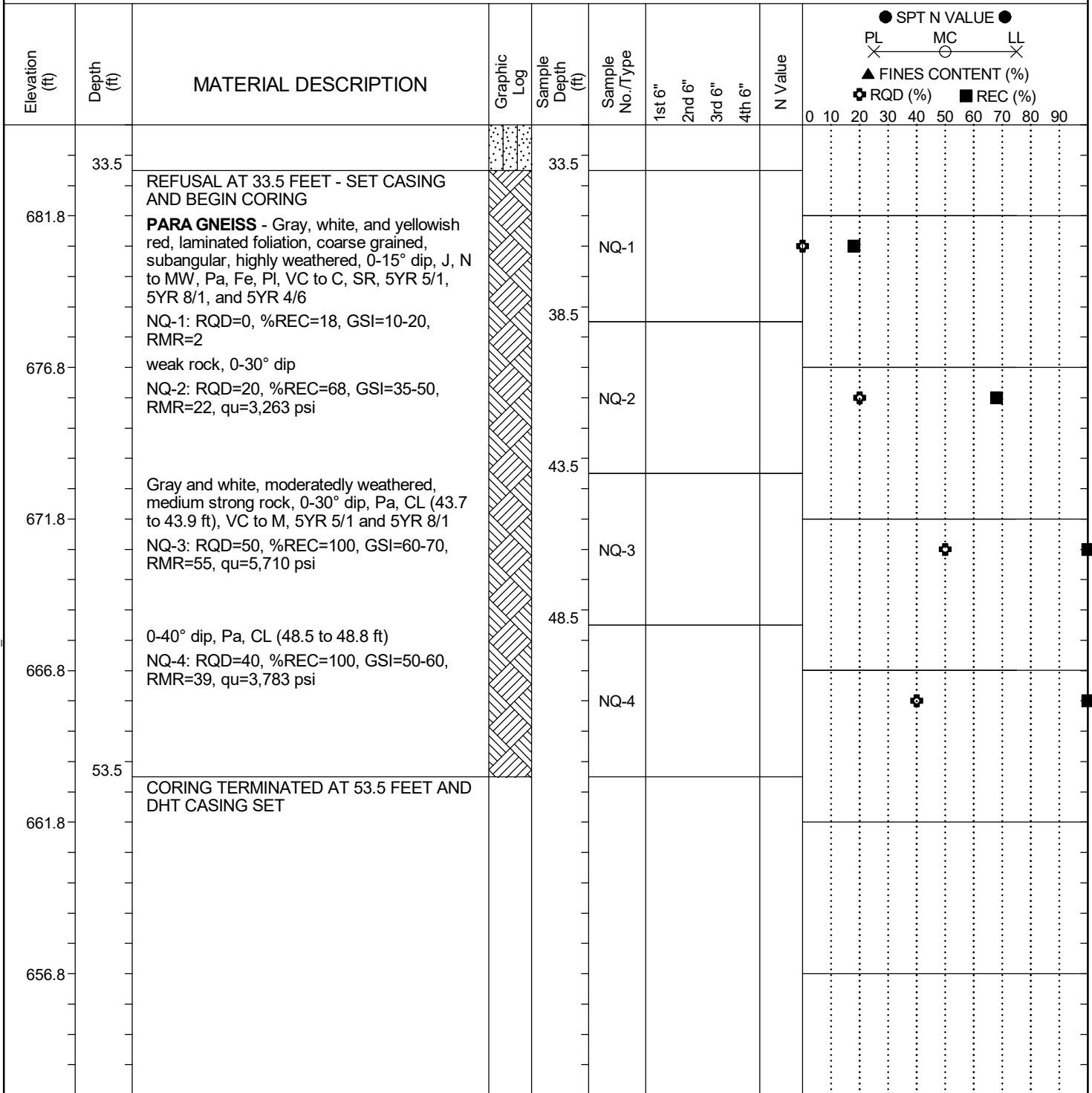
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SC.DOT 8623P180T SCDOT BRIDGE PACK 21 DOT S-42-31 OVER PETERS CREEK.GPJ SCDOT DATATEMPLATE.GDT 3/4/25

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	

Project ID: P041165	County: Spartanburg	Boring No.: S-42-31-2
Site Description: S-42-31 (Cannons Campground Road) BRO Peters Creek		Route: S-42-31
Eng./Geo.: S. Greaber	Boring Location: 180+26	Offset: 7.5R Alignment: Existing
Elev.: 716.8 ft	Latitude: 34.99843	Longitude: -81.87655 Date Started: 1/13/2025
Total Depth: 53.5 ft	Soil Depth: 33.5 ft	Core Depth: 20 ft Date Completed: 1/13/2025
Bore Hole Diameter (in): 4	Sampler Configuration	Liner Required: Y (N) Liner Used: Y (N)
Drill Machine: DR#1327	Drill Method: RW/RC	Hammer Type: Automatic Energy Ratio: 92.6%
Core Size: NQ2	Driller: B. Burnette	Groundwater: TOB N.M. 24HR: N.M.



LEGEND

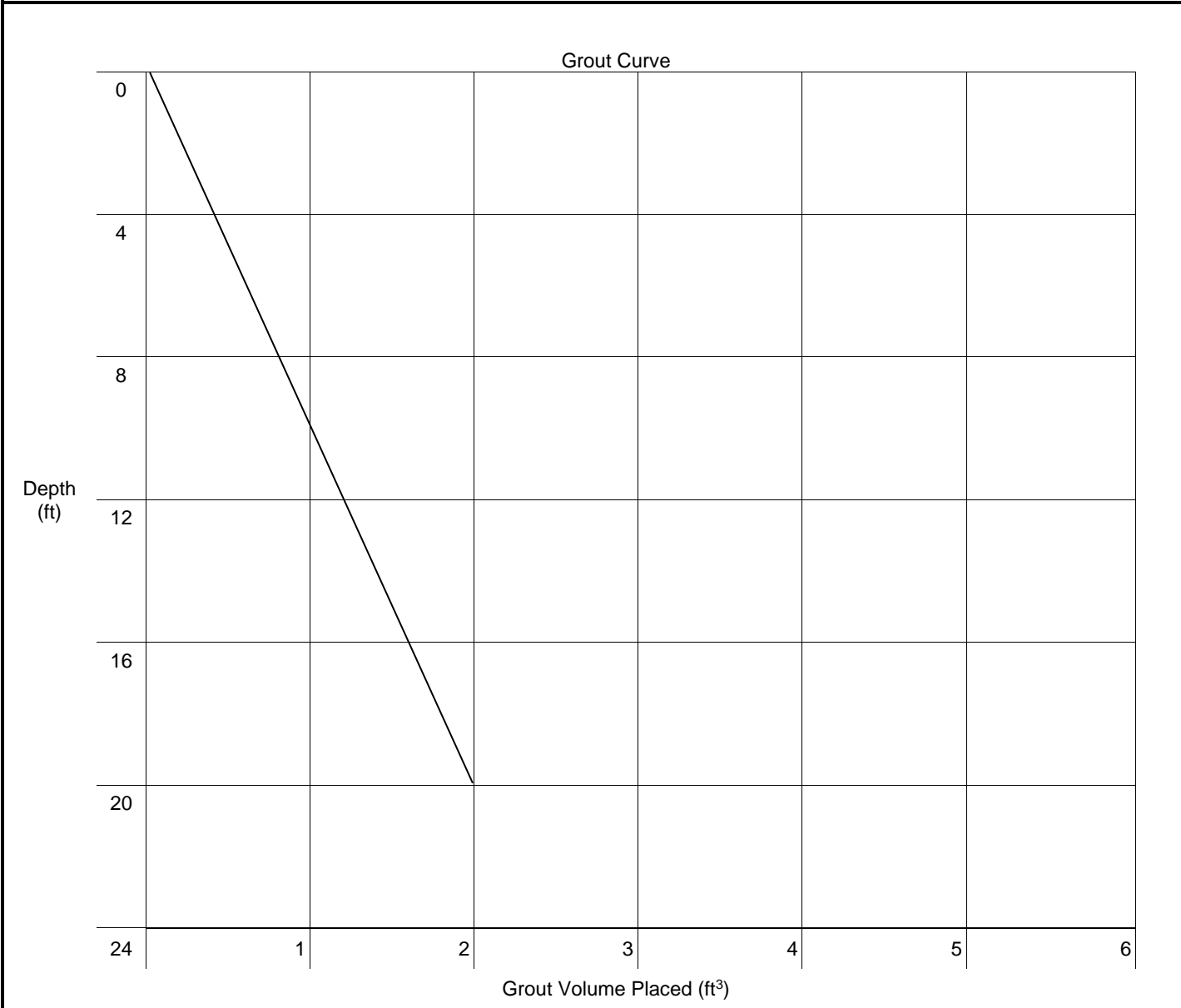
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC.DOT 8623P180T SCDOT BRIDGE PACK 21 DOT S-42-31 OVER PETERS CREEK.GPJ SCDOT DATATEMPLATE.GDT 3/4/25



Exhibit A-10 GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-42-31 BRO Peters Creek		Test Hole No.:	S-42-31-1
Project ID:	P041165		Station:	178+33
Consultant Firm:	Terracon Consultants, Inc.		Offset:	8.1R
Grouted By:	Burnette	Date	1/14/25	
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water			

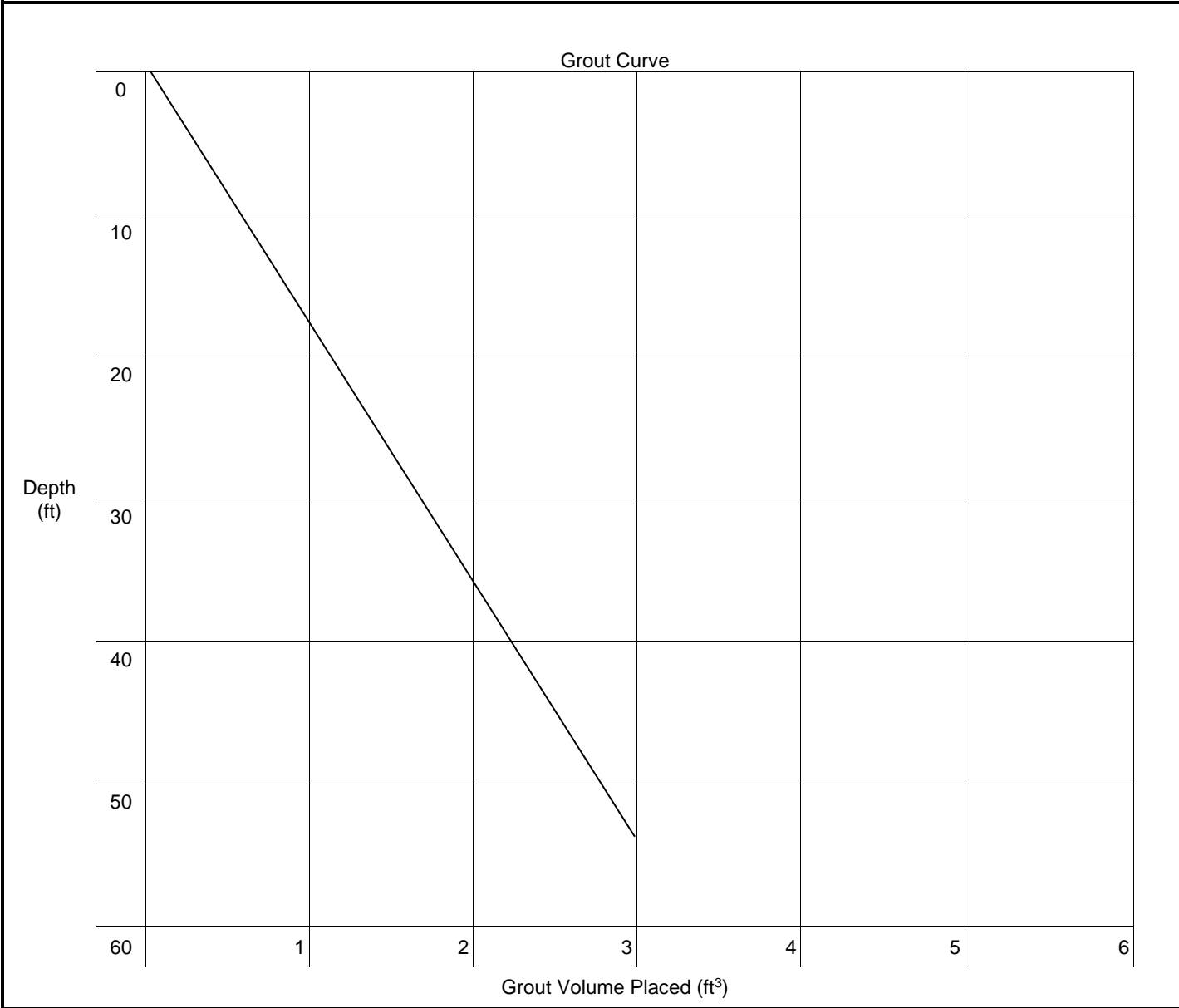


Number of Bags On-Site	<u>20</u>	ea.
Depth of Test Hole Grouted	<u>20</u>	ft.
Diameter of Test Hole	<u>0.33</u>	ft.
Area of Test Hole	<u>0.09</u>	ft ²
Volume of Test Hole	<u>1.74</u>	ft ³
Volume of Casing (If applicable)	<u>-</u>	ft ³
Theoretical Volume of Test Hole	<u>1.74</u>	ft ³
Number of Bags Used	<u>2.5</u>	ea.
Volume Placed	<u>2</u>	ft ³



Exhibit A-10 GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name: S-42-31 BRO Peters Creek
Project ID: P041165 Test Hole No.: S-42-31-2
Consultant Firm: Terracon Consultants, Inc. Station: 180+26
Grouted By: Burnette Date 1/13/2025 Offset: 7.5R
Notes: Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water

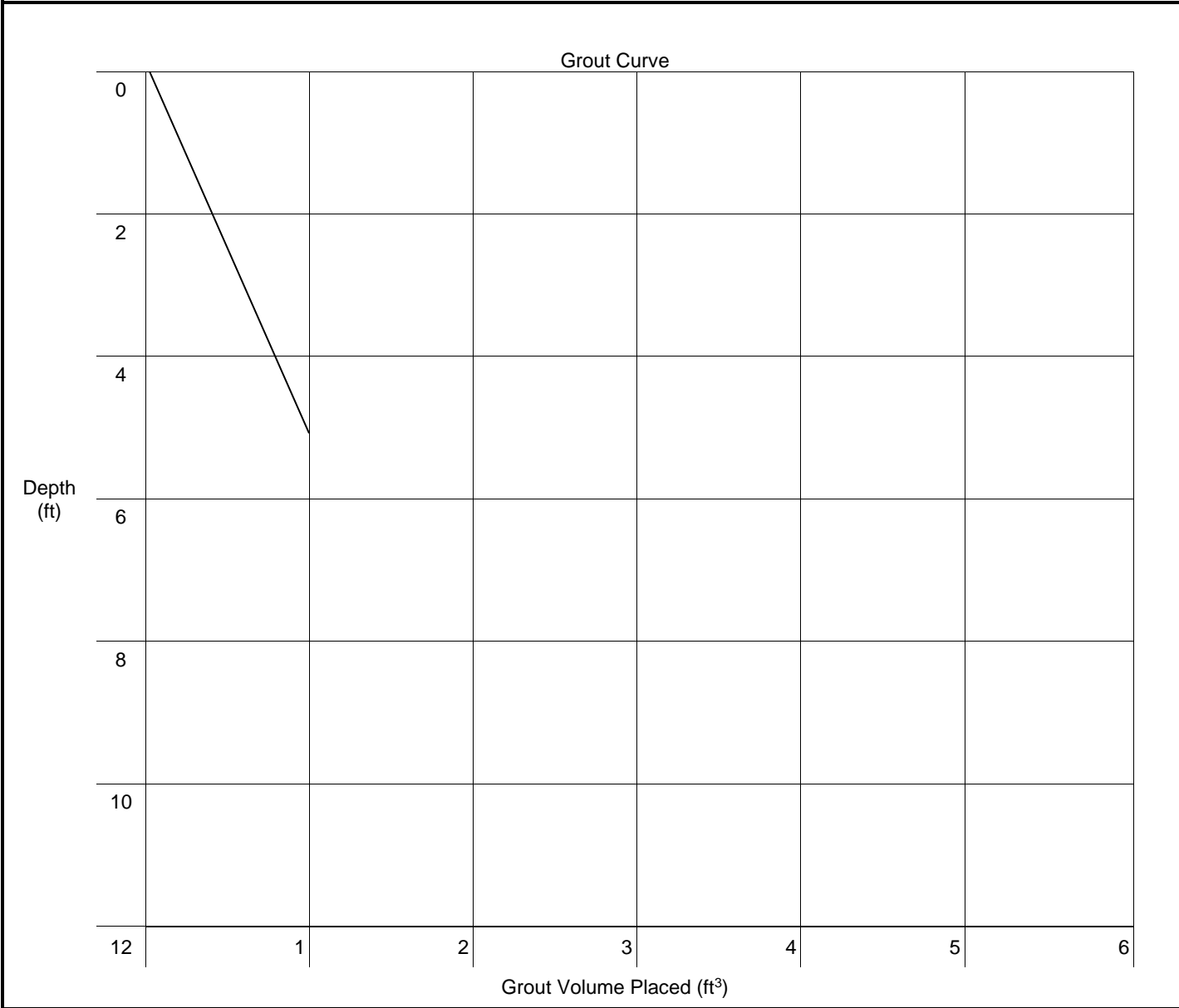


Number of Bags On-Site	<u>20</u>	ea.
Depth of Test Hole Grouted	<u>53.5</u>	ft.
Diameter of Test Hole	<u>0.33</u>	ft.
Area of Test Hole	<u>0.09</u>	ft ²
Volume of Test Hole	<u>4.6</u>	ft ³
Volume of Casing (If applicable)	<u>1.7</u>	ft ³
Theoretical Volume of Test Hole	<u>2.9</u>	ft ³
Number of Bags Used	<u>5</u>	ea.
Volume Placed	<u>3</u>	ft ³



Exhibit A-10 GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-42-31 BRO Peters Creek		S-42-31-2
Project ID:	P041165	Test Hole No.:	Bulk 1
Consultant Firm:	Terracon Consultants, Inc.	Station:	180+32
Grouted By:	Burnette	Date	1/13/2025
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water	Offset:	7R

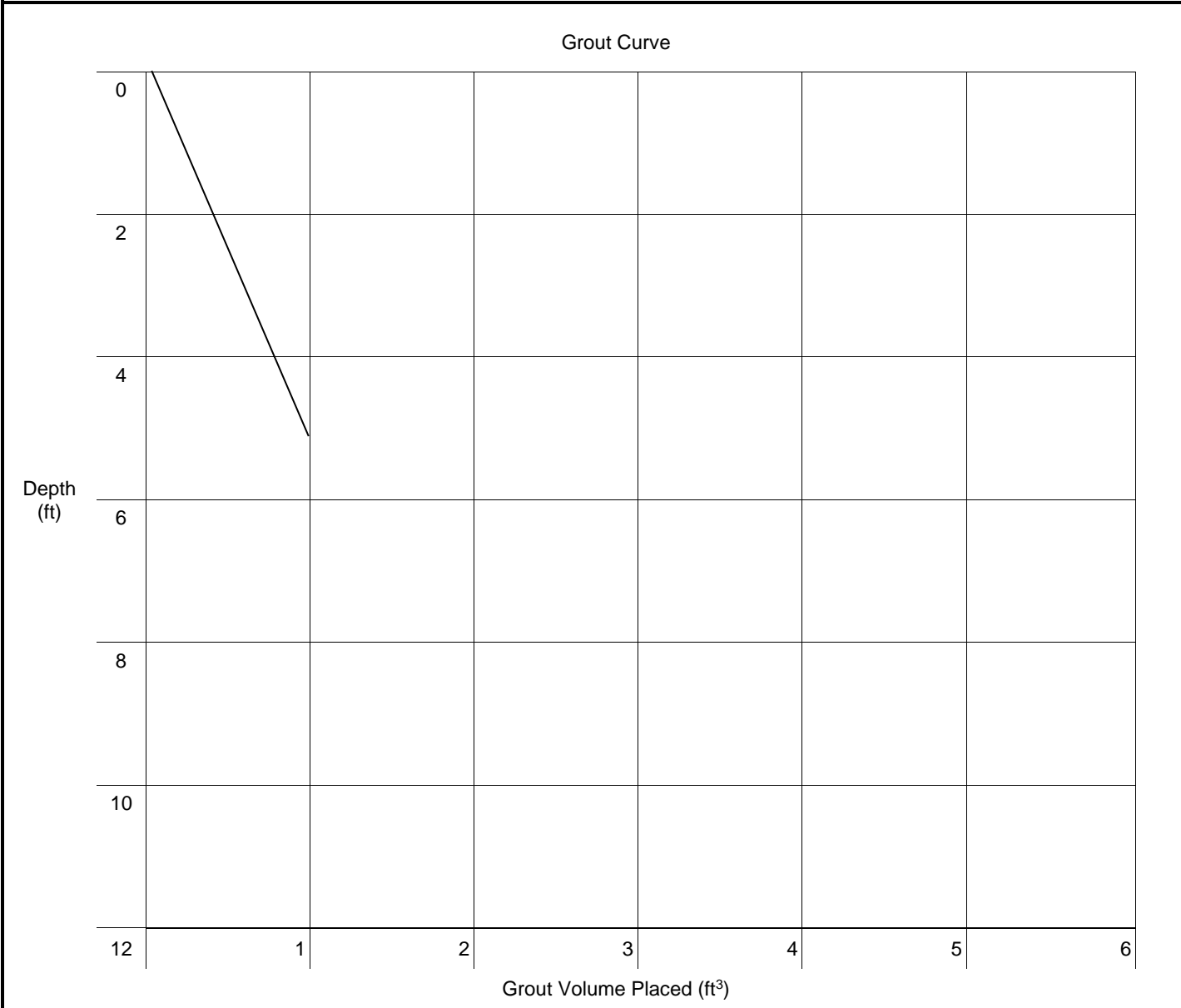


Number of Bags On-Site	20		ea.
Depth of Test Hole Grouted	5		ft.
Diameter of Test Hole	0.5		ft.
Area of Test Hole	0.20		ft ²
Volume of Test Hole	1.0		ft ³
Volume of Casing (If applicable)	-		ft ³
Theoretical Volume of Test Hole	1.0		ft ³
Number of Bags Used	2		ea.
Volume Placed	1.0		ft ³



Exhibit A-10 GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

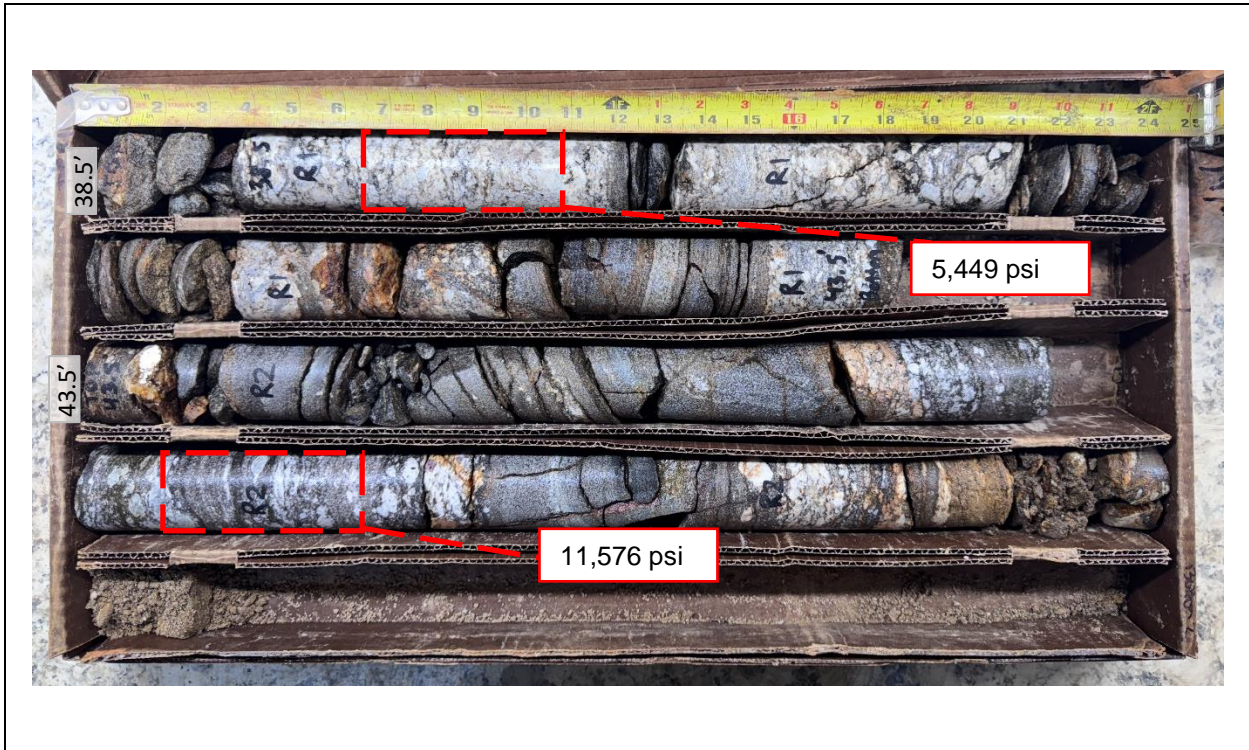
Project Name:	S-42-31 BRO Peters Creek		
Project ID:	P041165	Test Hole No.:	Bulk 2
Consultant Firm:	Terracon Consultants, Inc.	Station:	180+32
Grouted By:	Burnette	Date	1/13/2025
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water		
		Offset:	7R



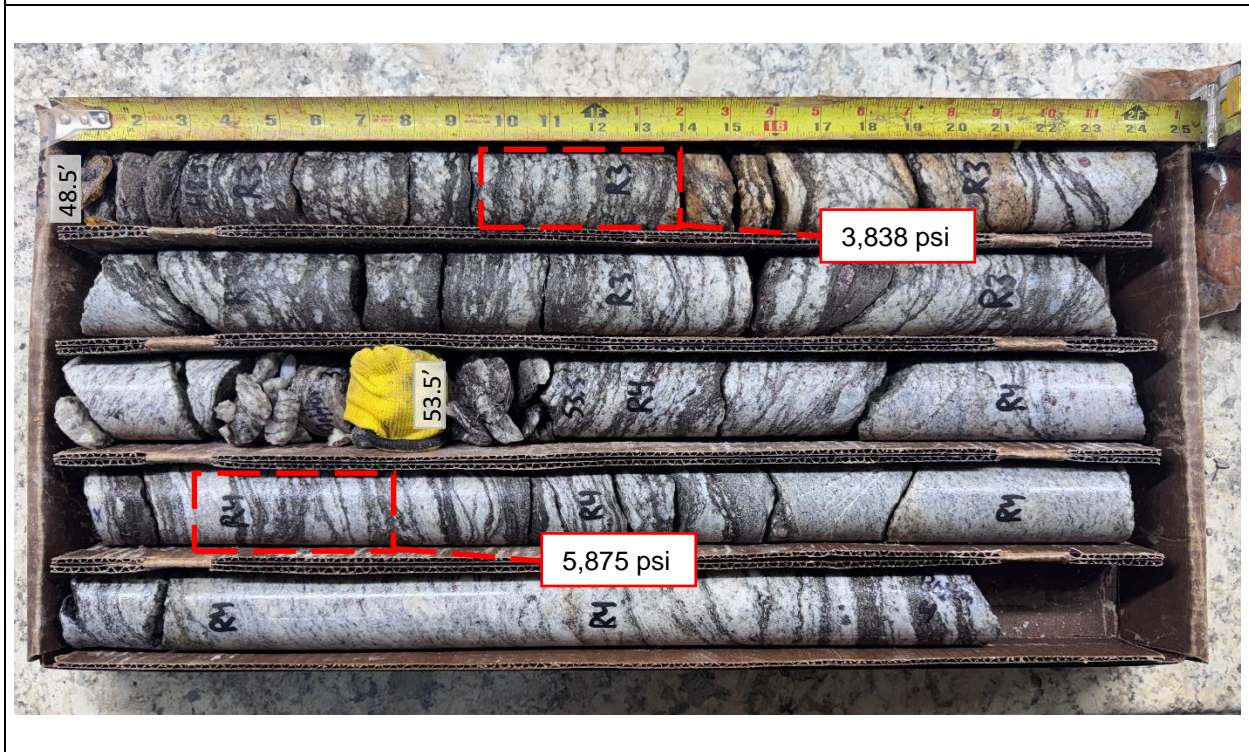
Number of Bags On-Site	20		ea.
Depth of Test Hole Grouted	5		ft.
Diameter of Test Hole	0.5		ft.
Area of Test Hole	0.20		ft ²
Volume of Test Hole	1.0		ft ³
Volume of Casing (If applicable)	-		ft ³
Theoretical Volume of Test Hole	1.0		ft ³
Number of Bags Used	2		ea.
Volume Placed	1.0		ft ³

Rock Core Photograph Logs – Exhibit A-11

S-42-31 BRO over Peters Creek | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165



S-42-31-1, NQ-1 and NQ-2 (38.5 to 48.5 feet)



S-42-31-1, NQ-3 and NQ-4 (48.5 to 58.5 feet)

Rock Core Photograph Logs – Exhibit A-11

S-42-31 BRO over Peters Creek | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165

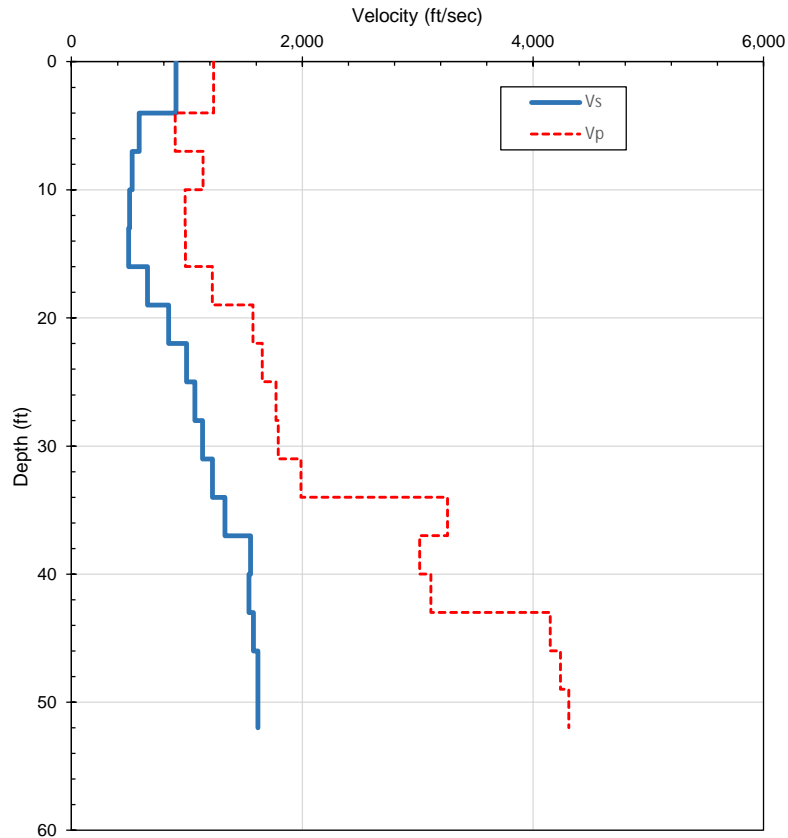


S-42-31-2, NQ-1, NQ-2, and NQ-3 (33.5 to 48.5 feet)



S-42-31-2, NQ-4 (48.5 to 53.5 feet)

Downhole Seismic Velocity Fixed Interval Method



Depth (ft)	Vp (ft/sec)	Vs (ft/sec)	Δt (ft)	Δt (sec)	Est. In-Situ Unit Wt (pcf)
3	1233	904	3	0.00332	100
6	900	585	3	0.00513	
9	1140	524	3	0.00573	
12	985	502	3	0.00598	
15	989	496	3	0.00605	
18	1221	659	3	0.00455	
21	1573	840	3	0.00357	130
24	1654	997	3	0.00301	
27	1772	1068	3	0.00281	
30	1792	1134	3	0.00265	
33	1989	1221	3	0.00246	165
36	3260	1329	3	0.00226	
39	3019	1550	3	0.00194	
42	3117	1536	3	0.00195	
45	4151	1576	3	0.00190	
48	4240	1615	3	0.00186	
51	4312	1616	3	0.00186	
Unit Weight of Soil estimated from SPT results					
Unit Weight of Rock based on average results from compression tests					
Sum of Data Over Profile			51	0.05700	
Weighted Average Shear Wave Velocity Over Profile				895 ft/sec	

Project Mgr:	MM	Project No.	8623P180
Prepared by:	MM	Scale:	NA
Checked by:	SG	Date:	3/4/2025
Approved by:			



terracon
Consulting Engineers and Scientists

72 Pointe Circle
Ph: (864) 292-2901

Greenville, South Carolina
Fax: (864) 292-6361

GEOPHYSICAL TESTING RESULTS

DOWNHOLE SEISMIC TEST

S-42-31 (Cannons Campground Road) Bridge Replacement over Peters Creek

SPARTANBURG COUNTY, SOUTH CAROLINA

P041165

TEST NO.
S-42-31-2

EXHIBIT
A-12

CPT Sounding ID S-42-31-1C

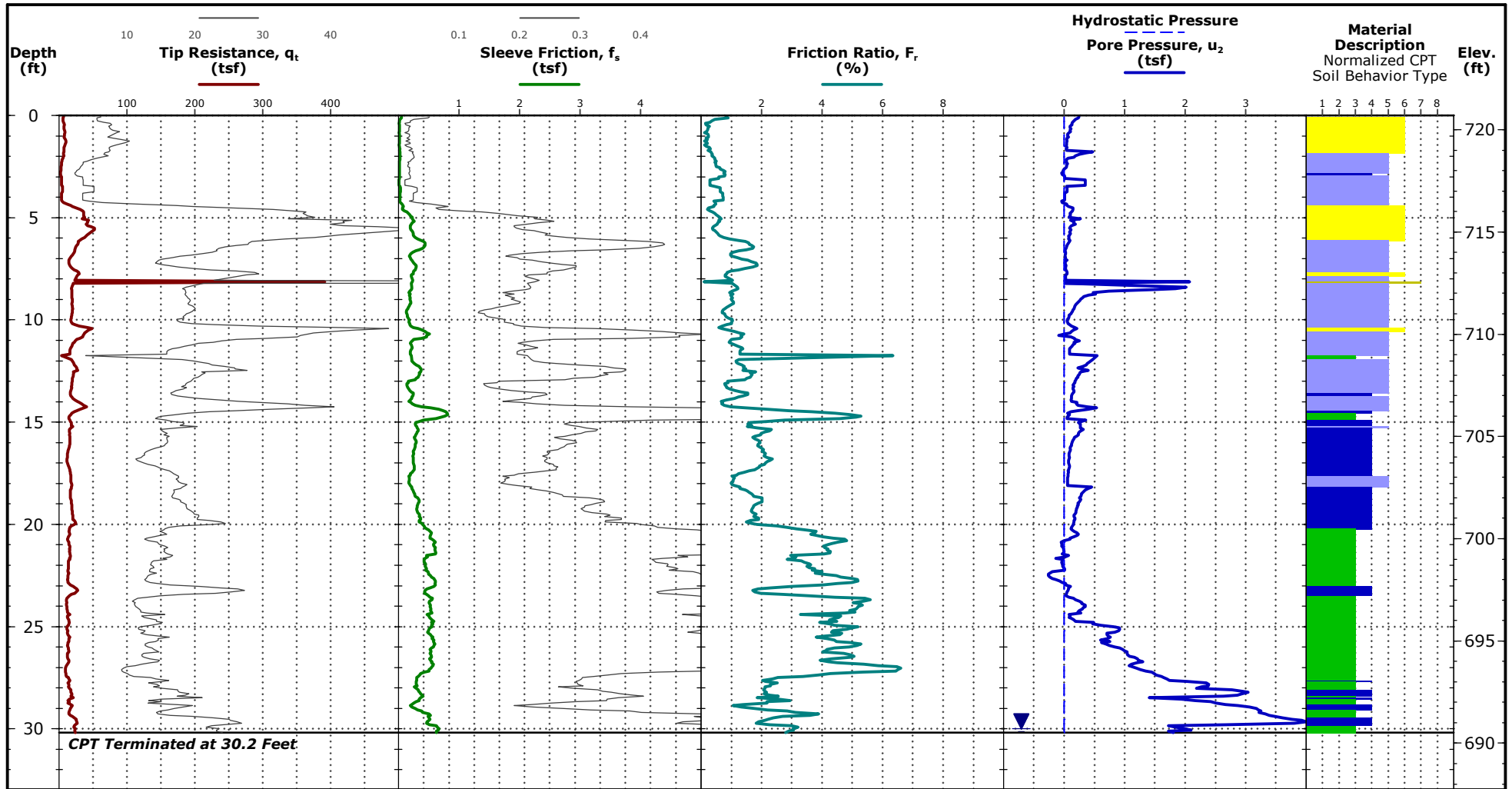


72 Pointe Cir
 Greenville, SC

CPT Started: 2/6/2025
 CPT Completed: 2/6/2025

Elevation: 720.7 (ft)
 Elevation Reference: Elevations were provided by others.

Latitude: 34.99792° Longitude: -81.87676°
 North: 1152576.65 East: 1737389.59
 Station: 178+30 Offset: 8R



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)

CPT Equipment

CPT Rig: CR#CPT03
 Operator: BJ/LB
 CPT sensor calibration reports available upon request
 Probe No. 5851 with net area ratio of .86
 u_2 pore pressure transducer location
 Manufactured by Geoprobe Systems- Calibrated 2/16/2024
 Tip and sleeve areas of 10 cm² and 150 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 30 ft estimated water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 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

CPT Sounding ID S-42-31-2C

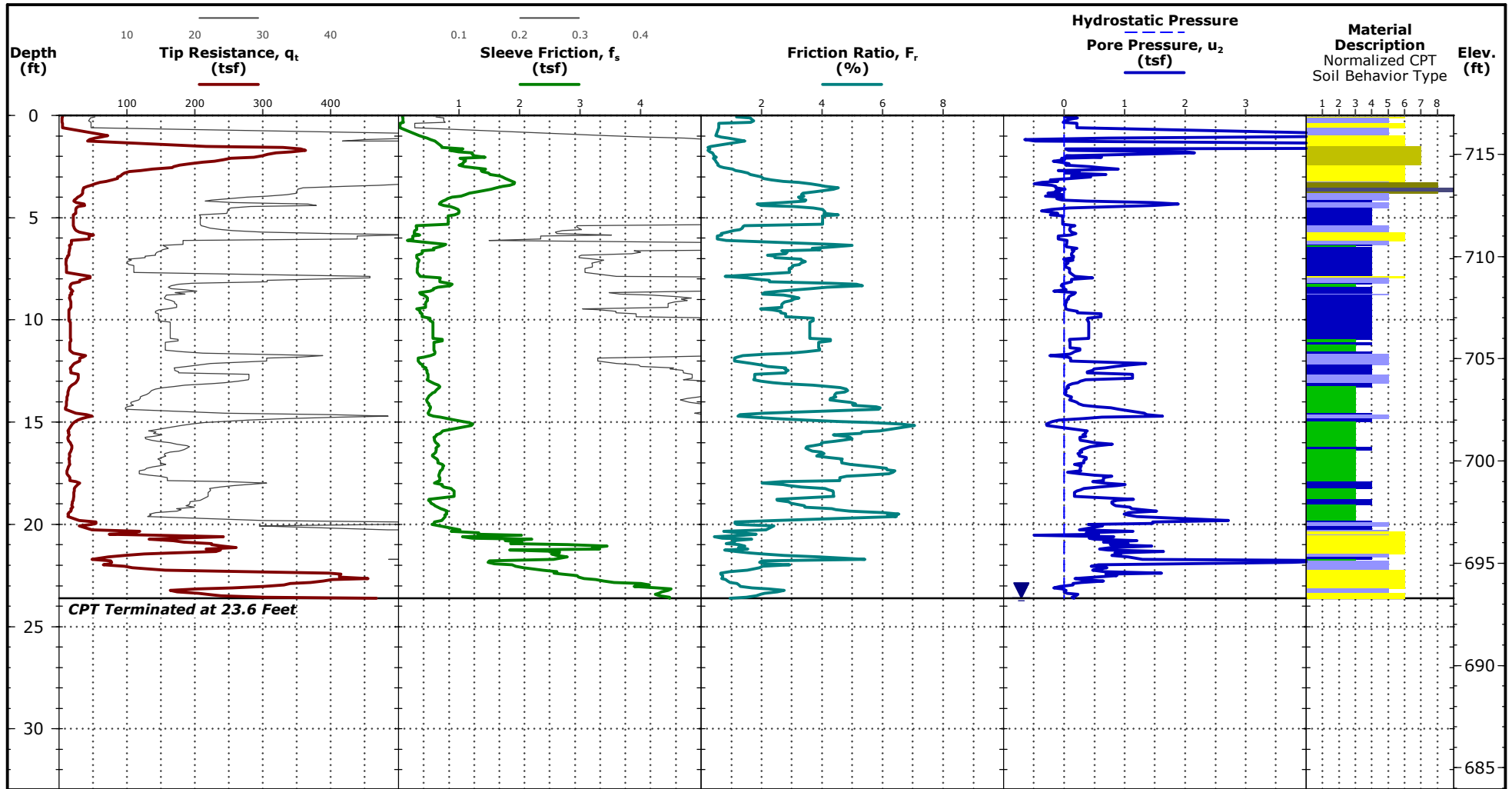


72 Pointe Cir
 Greenville, SC

Elevation: 716.9 (ft)
 Elevation Reference: Elevations were provided by others.

Latitude: 34.99844° Longitude: -81.87655°
 North: 1152765.44 East: 1737453.4
 Station: 180+29 Offset: 7R

CPT Started: 1/17/2025
 CPT Completed: 1/17/2025



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)

CPT Equipment

CPT Rig: CR#CPT03
 Operator: AM/LB
 CPT sensor calibration reports available upon request
 Probe No. 5851 with net area ratio of .86
 U₂ pore pressure transducer location
 Manufactured by Geoprobe Systems- Calibrated 2/16/2024
 Tip and sleeve areas of 10 cm² and 150 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

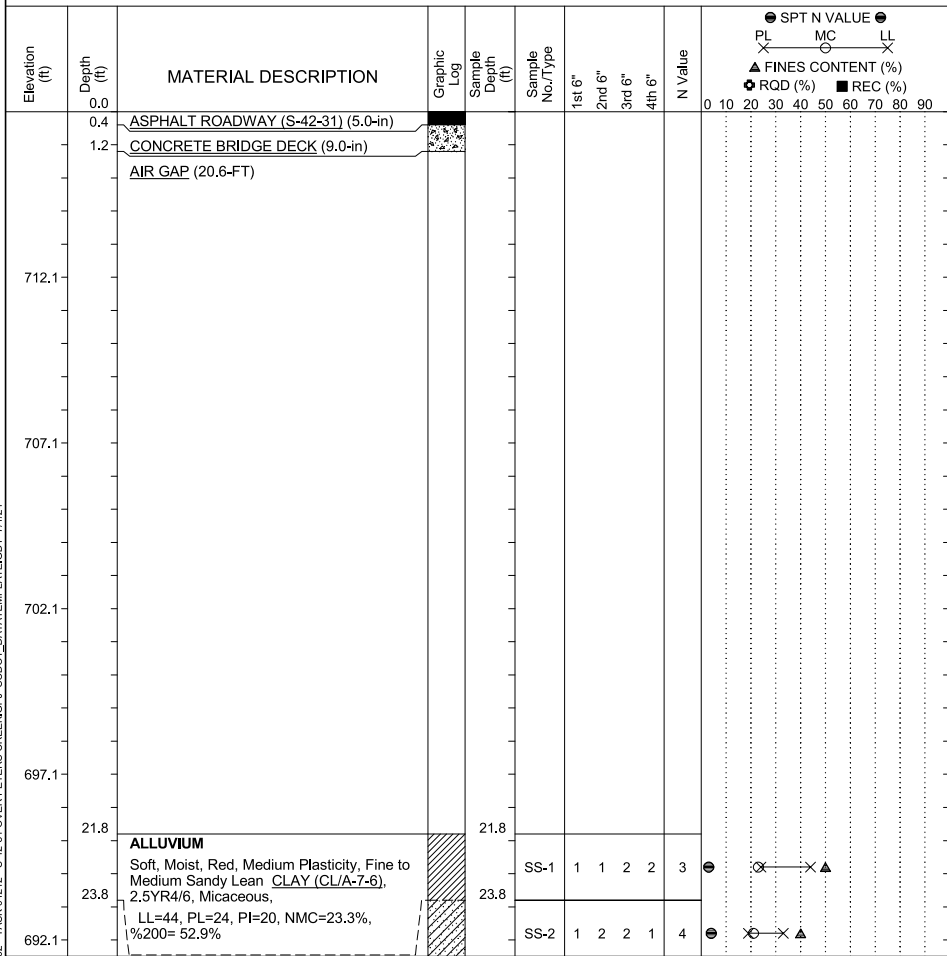
▼ 23.6 ft estimated water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 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

SCDOT Soil Test Log

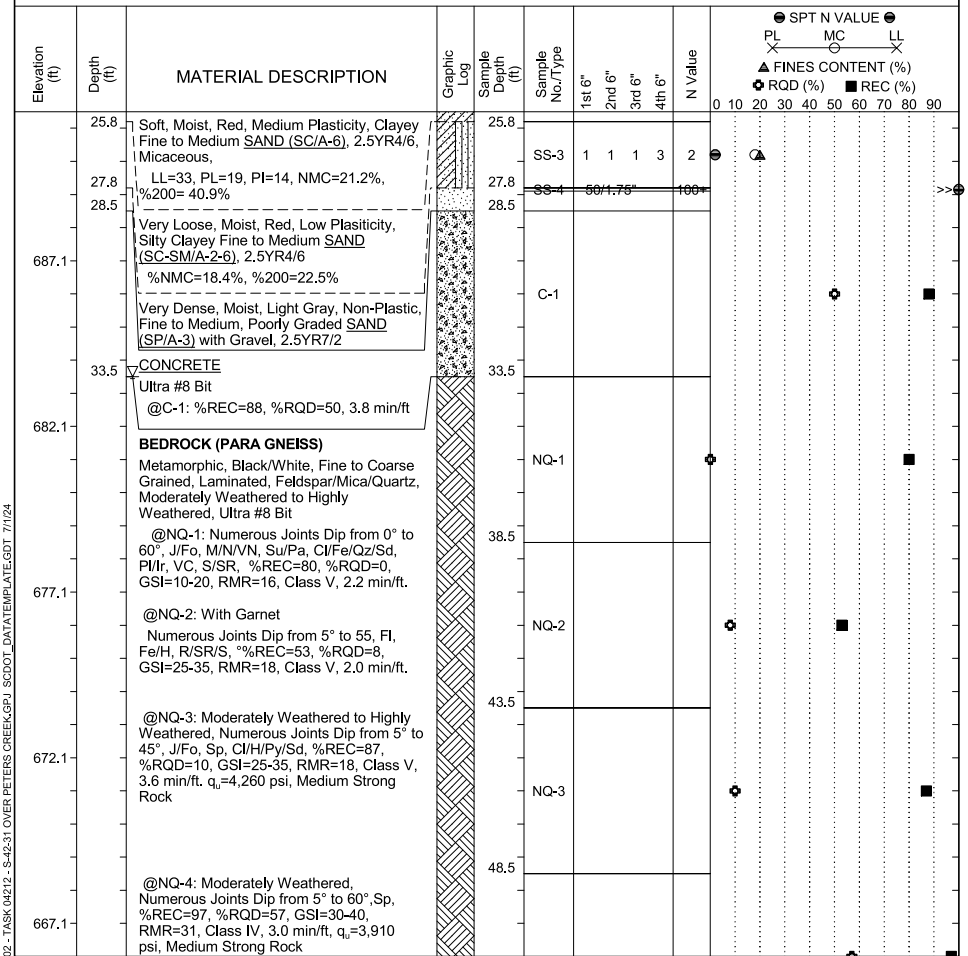
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Site Description:	S-42-31 over Peters Creek	Route:	S-42-31		
Eng./Geo.:	T. Peterson	Boring Location:	Offset:	Alignment:	
Elev.:	717.1 ft	Latitude:	34.99827268	Longitude:	-81.87666846
Date Started:	6/5/2024				
Total Depth:	58.5 ft	Soil Depth:	6.7 ft	Core Depth:	25 ft
Date Completed:	6/5/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration:	Liner Required:	Y (N)	Liner Used:
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	D. Harris	Groundwater:	TOB Not Measured
				24HR	33.3 (Cave at 59.2)



Continued Next Page

SCDOT Soil Test Log

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-1
Site Description:	S-42-31 over Peters Creek	Route:	S-42-31		
Eng./Geo.:	T. Peterson	Boring Location:	Offset:	Alignment:	
Elev.:	717.1 ft	Latitude:	34.99827268	Longitude:	-81.87666846
Date Started:	6/5/2024				
Total Depth:	58.5 ft	Soil Depth:	6.7 ft	Core Depth:	25 ft
Date Completed:	6/5/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration:	Liner Required:	Y (N)	Liner Used:
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	D. Harris	Groundwater:	TOB Not Measured
				24HR	33.3 (Cave at 59.2)



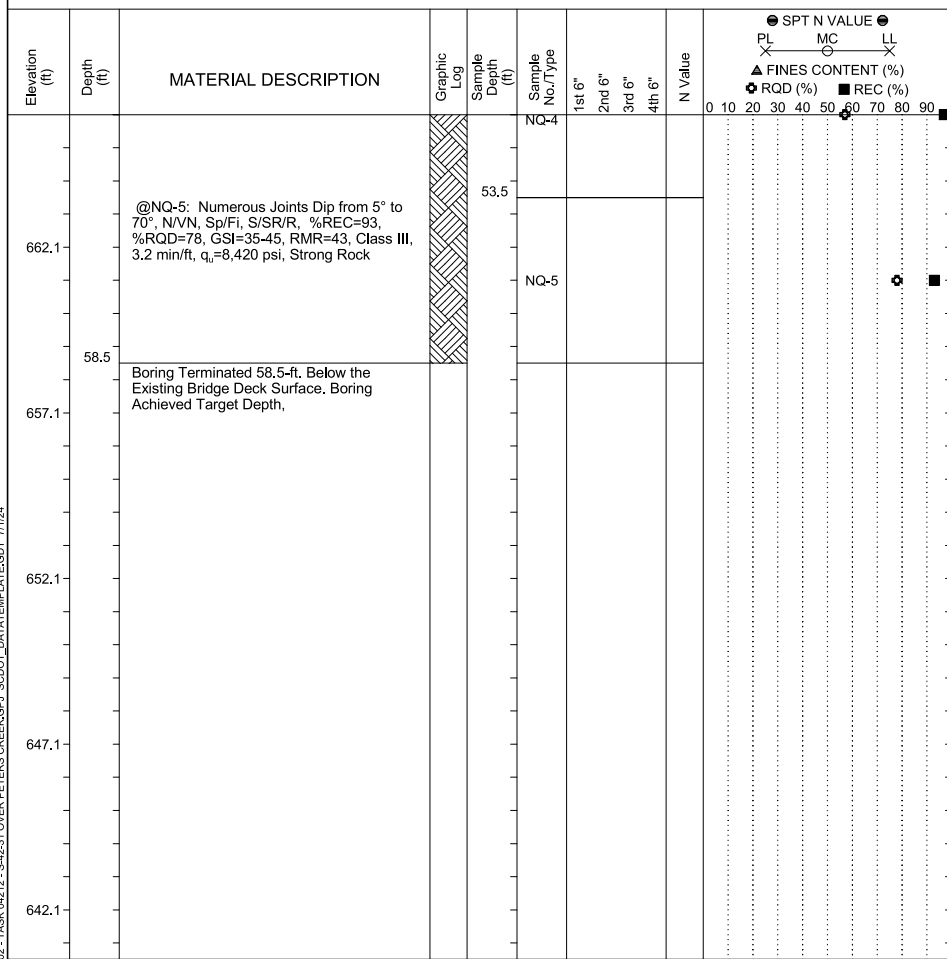
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SCDOT E6950.002 - TASK 04212 - S-42-31 OVER PETERS CREEK.GPJ SCDOT_DATATEMPLATE.GDT 7/1/24

SCDOT E6950.002 - TASK 04212 - S-42-31 OVER PETERS CREEK.GPJ SCDOT_DATATEMPLATE.GDT 7/1/24

SCDOT Soil Test Log

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-1
Site Description:	S-42-31 over Peters Creek			Route:	S-42-31
Eng./Geo.:	T. Peterson	Boring Location:	34.99827268	Offset:	-81.87666846
Elev.:	717.1 ft	Latitude:	34.99827268	Longitude:	-81.87666846
Date Started:	6/5/2024				
Total Depth:	58.5 ft	Soil Depth:	6.7 ft	Core Depth:	25 ft
Date Completed:	6/5/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration:		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	D. Harris	Groundwater:	TOB
				Not Measured	24HR

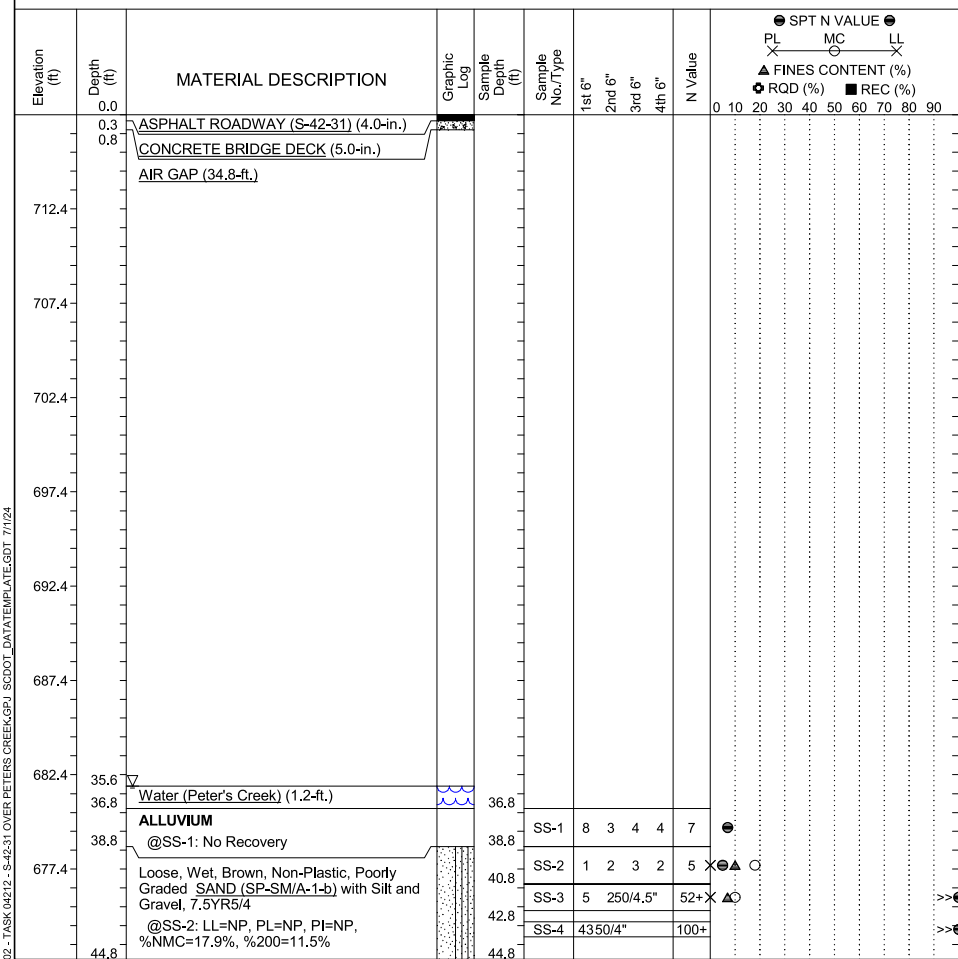


LEGEND

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	

SCDOT Soil Test Log

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-2
Site Description:	S-42-31 over Peters Creek			Route:	S-42-31
Eng./Geo.:	T. Peterson	Boring Location:	34.99820842	Offset:	-81.87669914
Elev.:	717.4 ft	Latitude:	34.99820842	Longitude:	-81.87669914
Date Started:	6/6/2024				
Total Depth:	66.4 ft	Soil Depth:	10.1 ft	Core Depth:	20 ft
Date Completed:	6/6/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration:		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	D. Harris	Groundwater:	TOB
				35.6 ft	24HR



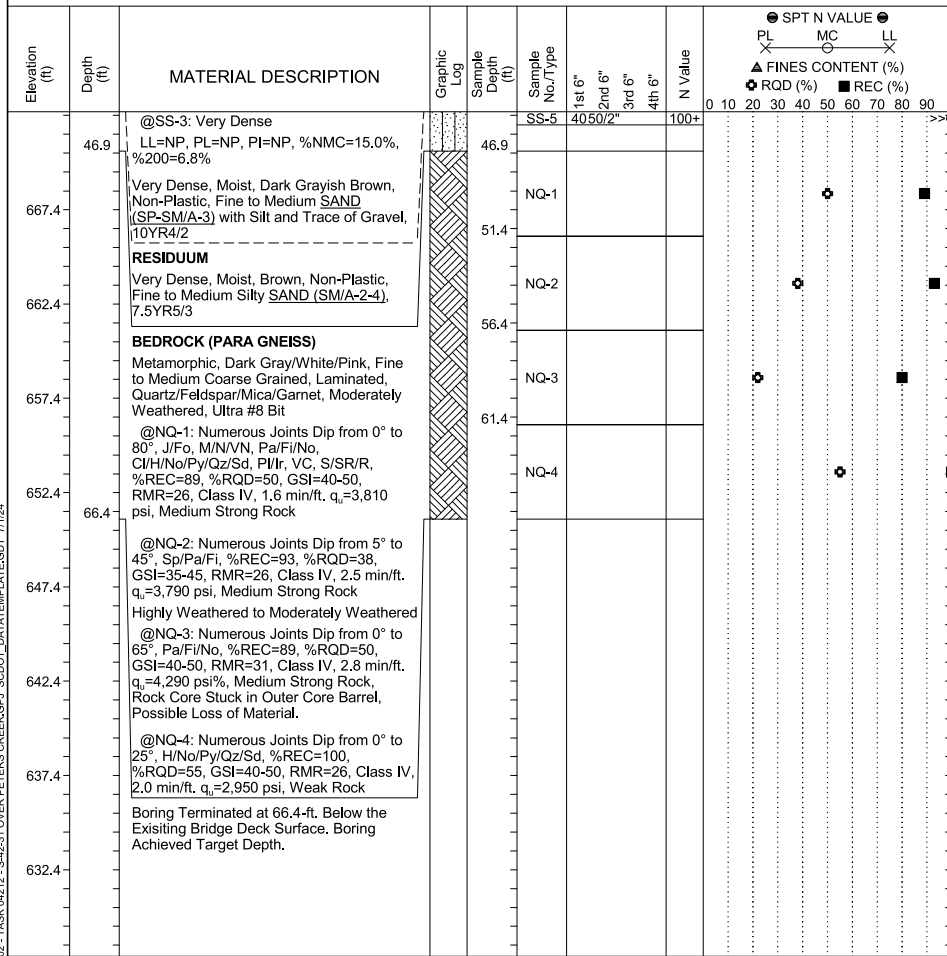
LEGEND

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	

Continued Next Page

SCDOT Soil Test Log

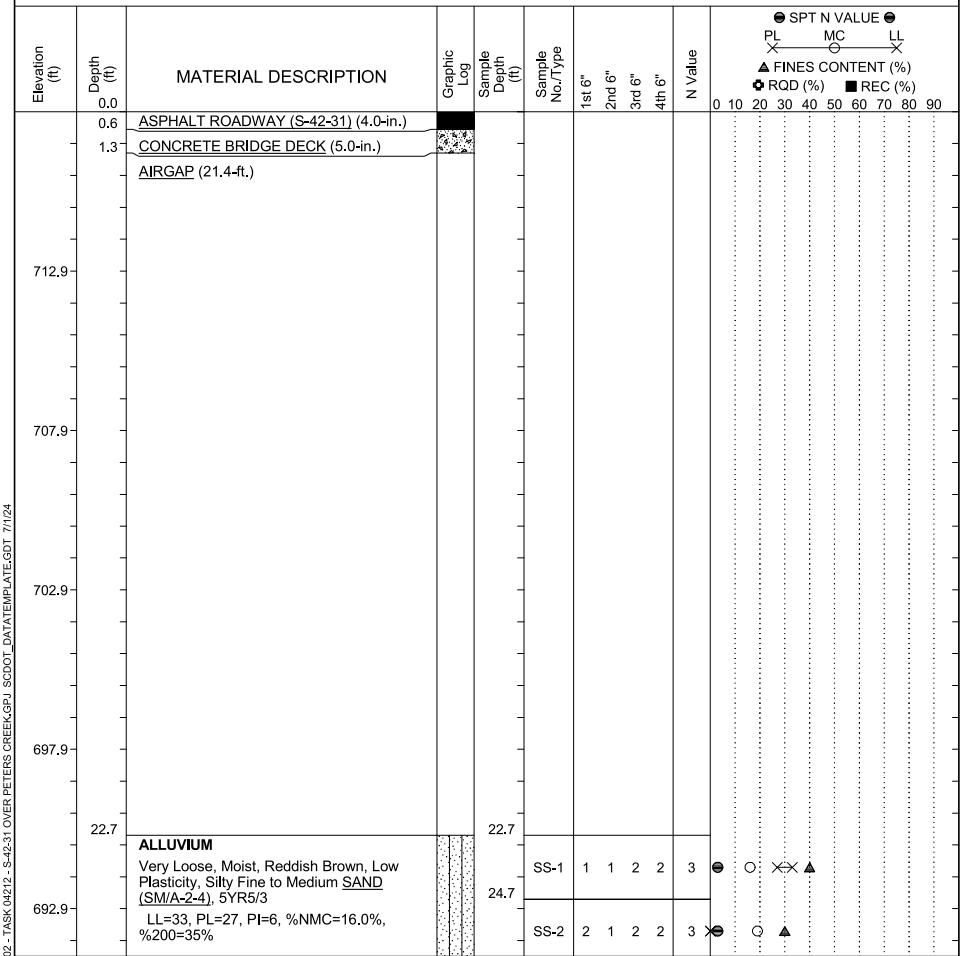
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Site Description:	S-42-31 over Peters Creek	Route:	S-42-31		
Eng./Geo.:	T. Peterson	Boring Location:	Offset:	Alignment:	
Elev.:	717.4 ft	Latitude:	34.99820842	Longitude:	-81.87669914
Date Started:	6/6/2024				
Total Depth:	66.4 ft	Soil Depth:	10.1 ft	Core Depth:	20 ft
Date Completed:	6/6/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration	Liner Required:	Y (N)	Liner Used:
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	D. Harris	Groundwater:	TOB 35.6 ft
					24HR 35.6 ft



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

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-3
Site Description:	S-42-31 over Peters Creek	Route:	S-42-31		
Eng./Geo.:	Trey Peterson	Boring Location:	Offset:	Alignment:	
Elev.:	717.9 ft	Latitude:	34.99815213	Longitude:	-81.87672185
Date Started:	6/6/2024				
Total Depth:	62.8 ft	Soil Depth:	8.2 ft	Core Depth:	31.9 ft
Date Completed:	6/7/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration	Liner Required:	Y (N)	Liner Used:
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	Don Harris	Groundwater:	TOB 36.7 (Cave at 52)
					24HR Not Measured



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	

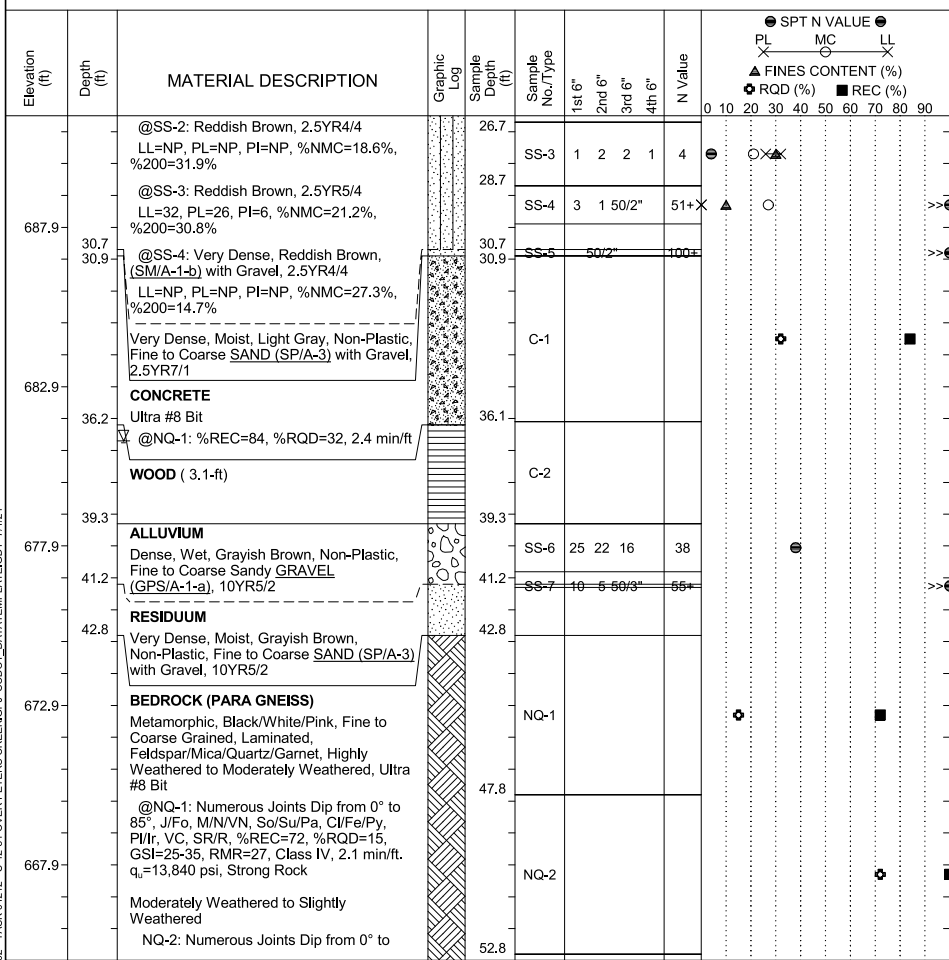
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SCDOT E6950.002 - TASK 04212 - S-42-31 OVER PETERS CREEK.GPJ SCDOT_DATATEMPLATE.GDT 7/1/24

SCDOT E6950.002 - TASK 04212 - S-42-31 OVER PETERS CREEK.GPJ SCDOT_DATATEMPLATE.GDT 7/1/24

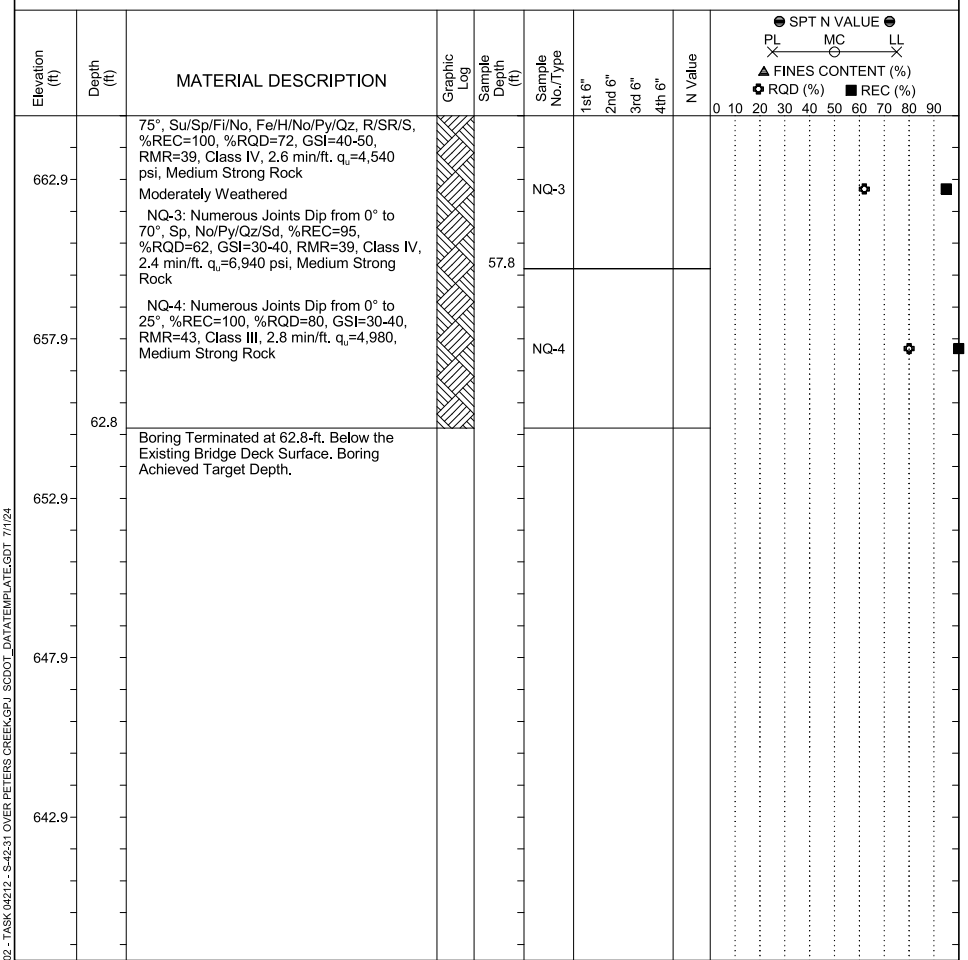
SCDOT Soil Test Log

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-3
Site Description:	S-42-31 over Peters Creek			Route:	S-42-31
Eng./Geo.:	Trey Peterson	Boring Location:	34.99815213	Offset:	-81.87672185
Elev.:	717.9 ft	Latitude:	34.99815213	Longitude:	-81.87672185
Date Started:	6/6/2024				
Total Depth:	62.8 ft	Soil Depth:	8.2 ft	Core Depth:	31.9 ft
Date Completed:	6/7/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	Don Harris	Groundwater:	TOB 36.7 (Cave at 52) 24HR Not Measured



SCDOT Soil Test Log

Project ID:	E6950.002 - Task 04212	County:	Spartanburg	Boring No.:	B-3
Site Description:	S-42-31 over Peters Creek			Route:	S-42-31
Eng./Geo.:	Trey Peterson	Boring Location:	34.99815213	Offset:	-81.87672185
Elev.:	717.9 ft	Latitude:	34.99815213	Longitude:	-81.87672185
Date Started:	6/6/2024				
Total Depth:	62.8 ft	Soil Depth:	8.2 ft	Core Depth:	31.9 ft
Date Completed:	6/7/2024				
Bore Hole Diameter (in):	3.0	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 45B	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	86.4%				
Core Size:	NQ	Driller:	Don Harris	Groundwater:	TOB 36.7 (Cave at 52) 24HR Not Measured



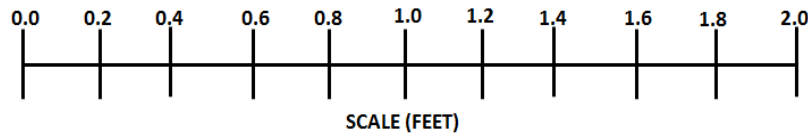
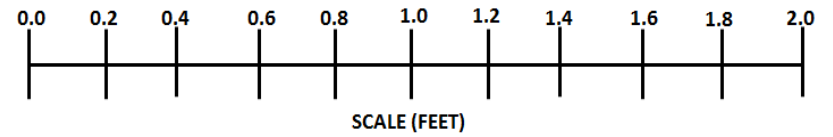
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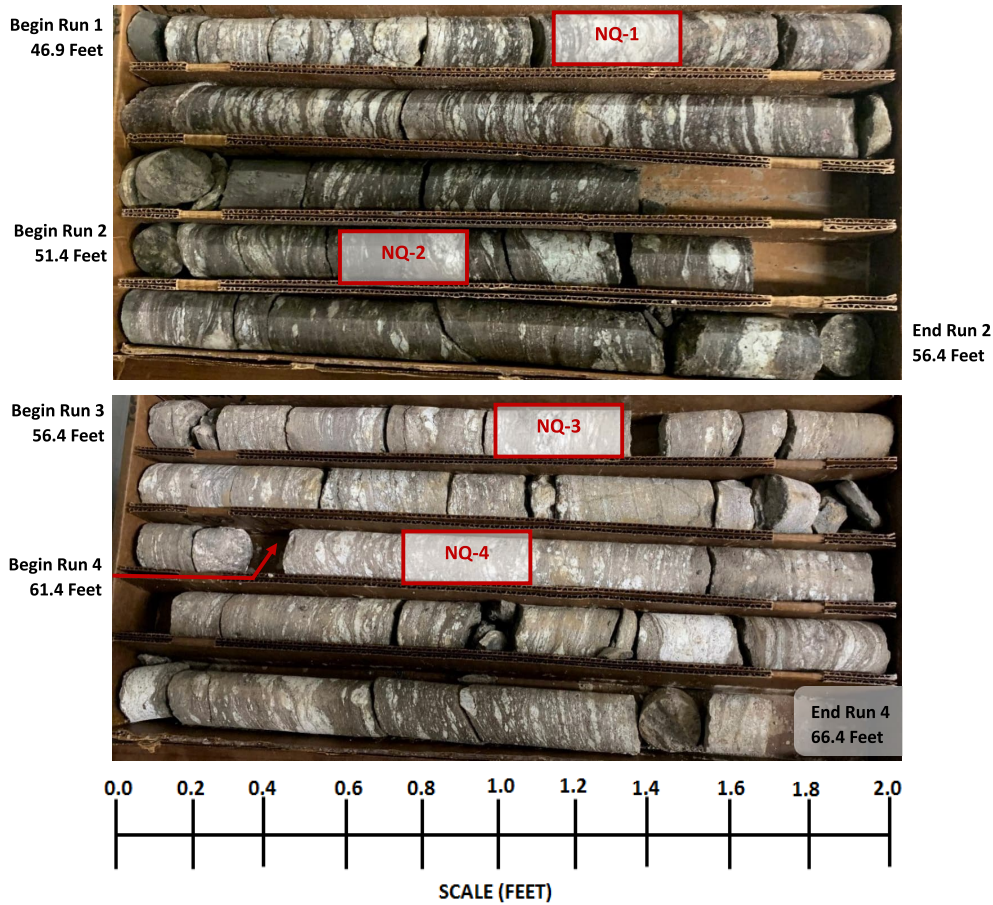
B-1

B-1

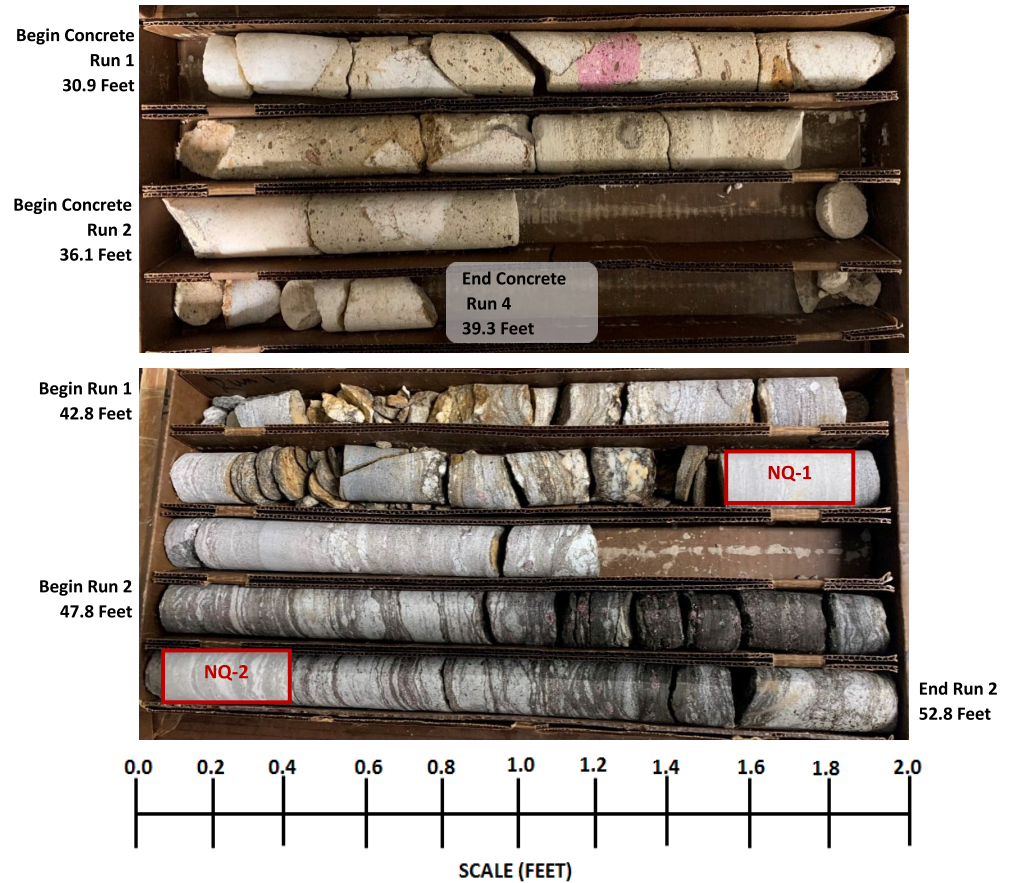


Rock Core Photos by F&ME

B-2

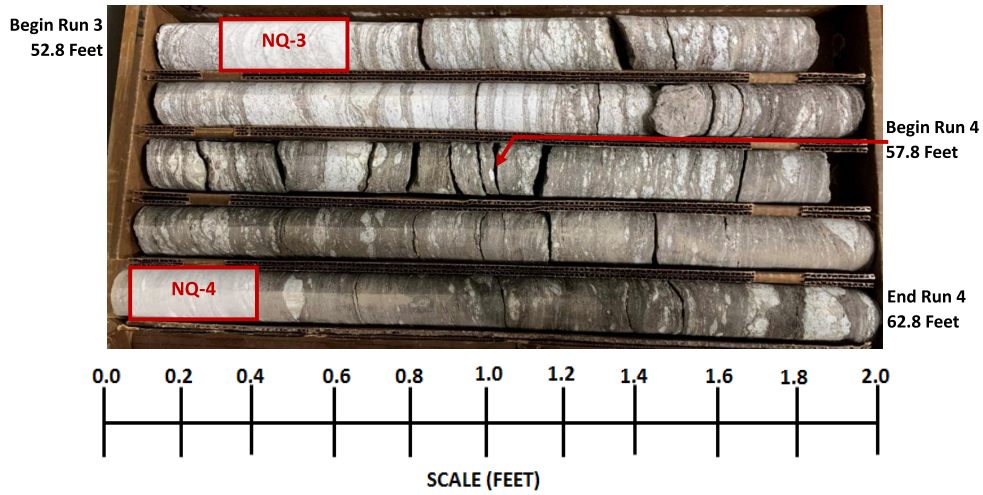


B-3



Rock Core Photos by F&ME

B-3



Appendix B – Laboratory Testing

S-42-31 BRO Peters Creek | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165



Appendix B

Laboratory Testing

Exhibit B-1 – Laboratory Testing Description
Summary of Laboratory Data (2 Pages)
Laboratory Data Sheets (25 Pages)

Note: All exhibits are one page unless noted above.

Laboratory Testing Description

The samples collected during the field exploration were taken to our laboratory for additional testing. The laboratory testing scope was developed by the SCDOT and laboratory assignment was performed by Terracon. The laboratory tests were conducted on selected soil samples from the borings and the bulk sample 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:

- | | |
|--------------------------------------|----------------------------|
| ■ Moisture Content | AASHTO T265/(ASTM D2216) |
| ■ Atterberg Limits | AASHTO T89/T90(ASTM D4318) |
| ■ Proctor (Standard effort) | AASHTO T99/ (ASTM D698) |
| ■ Triaxial Shear CU w/ PP | AASHTO T297/(ASTM D4767) |
| ■ Grain Size Distribution | ASTM D6913 |
| ■ Hydrometer | ASTM D7928 |
| ■ Compressive Strength of Rock Cores | ASTM D7012 |
| ■ Corrosion Series | AASHTO D422 |
| | AASHTO T289/ASTM G51 |
| | AASHTO T290/ASTM C1580 |
| | AASHTO T291 |

Summary of Laboratory Results

Boring ID	Depth (Ft.)	Soil Classification USCS & AASHTO	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	% Fines	% Silt	% Clay	Water Content (%)	Proctor Dry Density (pcf)/Opt. Moisture (%)
S-42-31-1	2-4	SILTY SAND(SM) / A-2-4 **									10.7	
S-42-31-1	4-6	SILTY SAND(SM) / A-2-4 **									17.0	
S-42-31-1	6-8	SILTY SAND(SM) / A-2-4 **				1.6	66.4	32.0			25.6	
S-42-31-1	8-10	SILTY SAND(SM) / A-2-4 **									23.8	
S-42-31-1	10-12	SILTY SAND(SM) / A-2-4 **									27.7	
S-42-31-1	12-14	SANDY SILT(ML) / A-4 (0)	NP	NP	NP	1.1	45.0	53.9			36.3	
S-42-31-1	14-16	SILTY SAND(SM) / A-2-4 **									28.3	
S-42-31-1	16-18	SANDY SILT(ML) / A-4 (0)	NP	NP	NP	3.5	43.7	52.8			31.8	
S-42-31-1	18-20	SANDY SILT(ML) / A-4 **									31.4	
S-42-31-1	20-22	SANDY SILT(ML) / A-4 **									32.7	
S-42-31-1	22-24	CLAYEY SAND(SC) / A-6 (3)	35	23	12	4.9	46.4	48.7	48.4	0.3	23.9	
S-42-31-1	24-26	CLAYEY SAND(SC) / A-6 **									24.4	
S-42-31-1	26-28	SANDY LEAN CLAY(CL) / A-6 **				5.5	43.2	51.3			22.9	
S-42-31-1	28-30	SANDY LEAN CLAY(CL) / A-4 (3)	33	23	10	7.0	42.4	50.6	32.9	17.7	28.2	
S-42-31-1	32-34	CLAYEY SAND WITH GRAVEL(SC) / A-2-6 **				28.3	44.9	26.8	19.3	7.4	19.4	
S-42-31-1	34-36	CLAYEY SAND WITH GRAVEL(SC) / A-2-6 **				34.0	41.8	24.2			16.8	
S-42-31-1	36-38	SILTY SAND(SM) / A-2-4 **									13.0	
S-42-31-2	0.5-2	SANDY LEAN CLAY(CL) / A-6 (4)	34	20	14	2.2	45.8	52.0			17.8	
S-42-31-2	2-4	SILTY SAND(SM) / A-2-4 **									18.2	

** Where index test was not conclusive, soil was classified per ASTM D2488 - Visual-Manual Procedure

Summary of Laboratory Results

Boring ID	Depth (Ft.)	Soil Classification USCS & AASHTO	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	% Fines	% Silt	% Clay	Water Content (%)	Proctor Dry Density (pcf)/Opt. Moisture (%)
S-42-31-2	4-6	SILTY SAND(SM) / A-2-4 **				14.5	61.0	24.5			15.2	
S-42-31-2	6-8	CLAYEY SAND(SC) / A-2-6 **									18.0	
S-42-31-2	8-10	SANDY SILT(ML) / A-7-6 **									28.8	
S-42-31-2	13.5-15	SANDY SILT(ML) / A-7-6 (6)	42	26	16	1.8	46.1	52.1			20.3	
S-42-31-2	18.5-20	CLAYEY SAND(SC) / A-6 (2)	37	23	14	6.8	52.1	41.1	41.1	0.0	20.4	
S-42-31-2	23.5-24.83	SILTY SAND(SM) / A-2-4 **									17.1	
S-42-31-2	28.5-28.75	SILTY SAND(SM) / A-2-4 **									15.8	
S-42-31-2 Bulk	1-5	CLAYEY SAND(SC) / A-6 (1)	29	18	11	3.6	53.9	42.5			13.7	117.6 / 13.3

** Where index test was not conclusive, soil was classified per ASTM D2488 - Visual-Manual Procedure



INDEX PROPERTIES VERSUS DEPTH

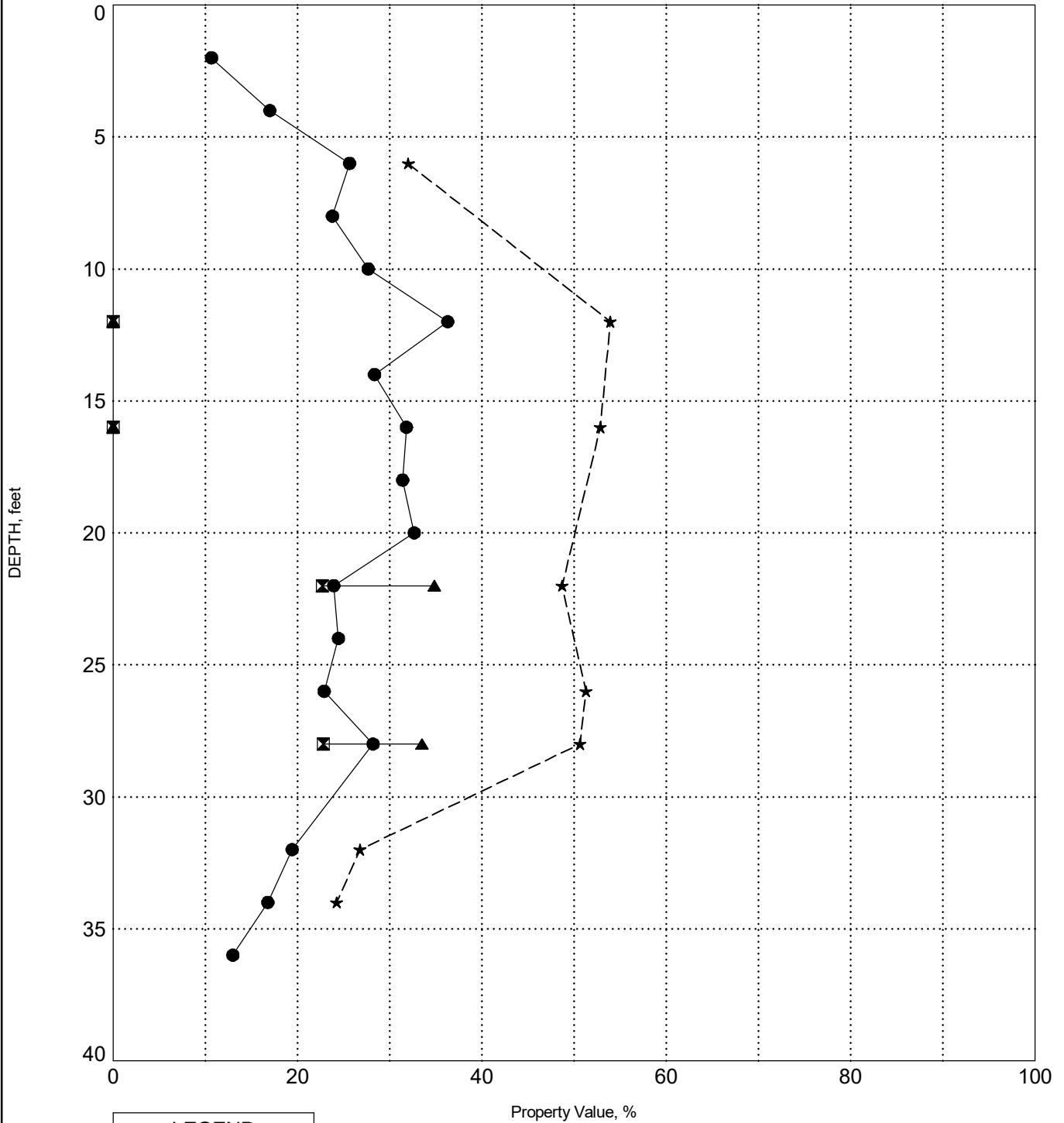
PROJECT ID P041165

PROJECT NAME S-42-31 (Cannons Campground Road) BRO Peters Creek

PROJECT COUNTY Spartanburg

SURFACE ELEVATION: 720.5

BORING S-42-31-1



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

INDEX PROPS 8623P180T SCDOT BRIDGE PACK 21 DOT S-42-31 OVER PETERS CREEK.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/3/25



INDEX PROPERTIES VERSUS DEPTH

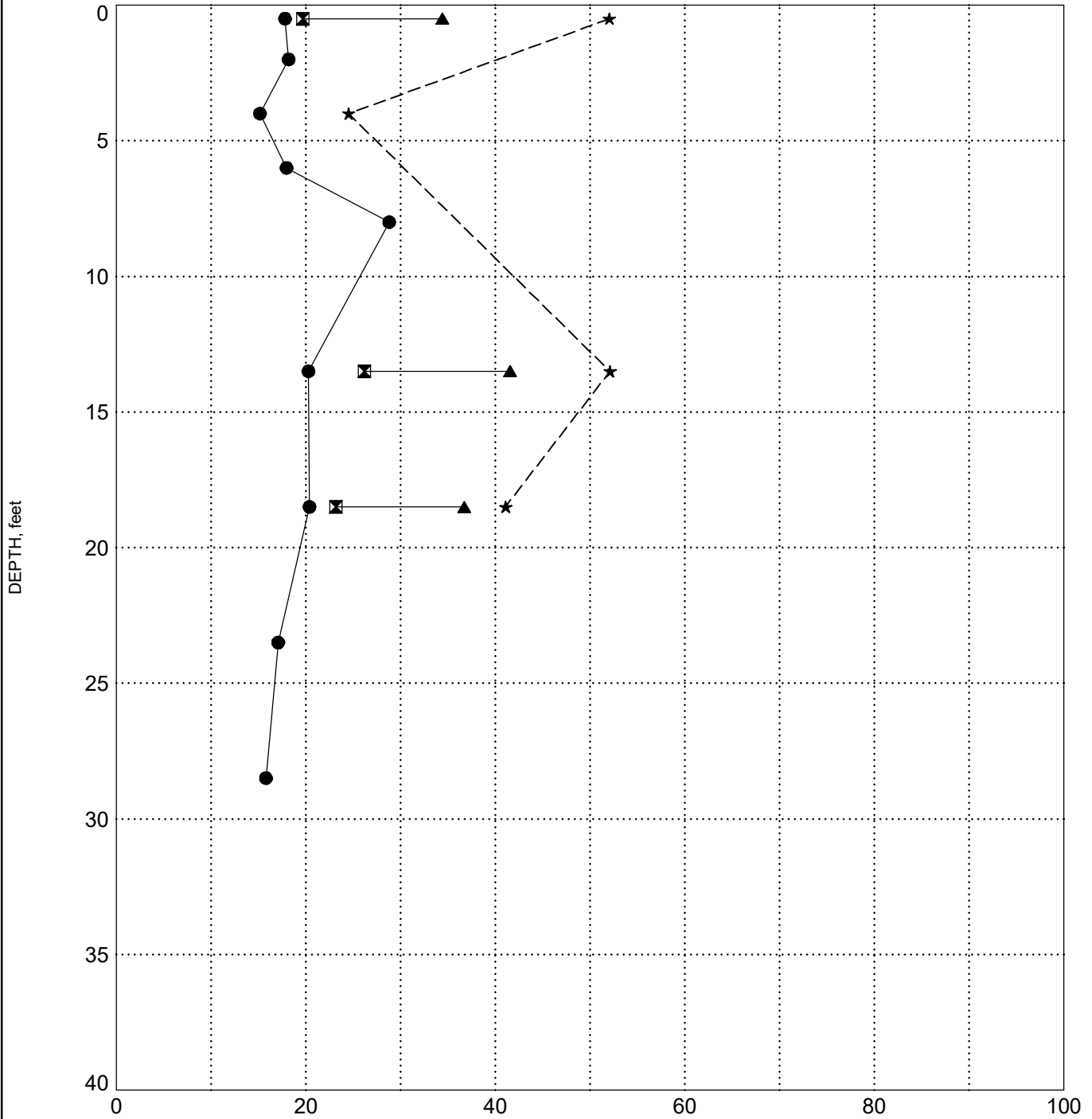
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PROJECT NAME S-42-31 (Cannons Campground Road) BRO Peters Creek

PROJECT COUNTY Spartanburg

SURFACE ELEVATION: 716.8

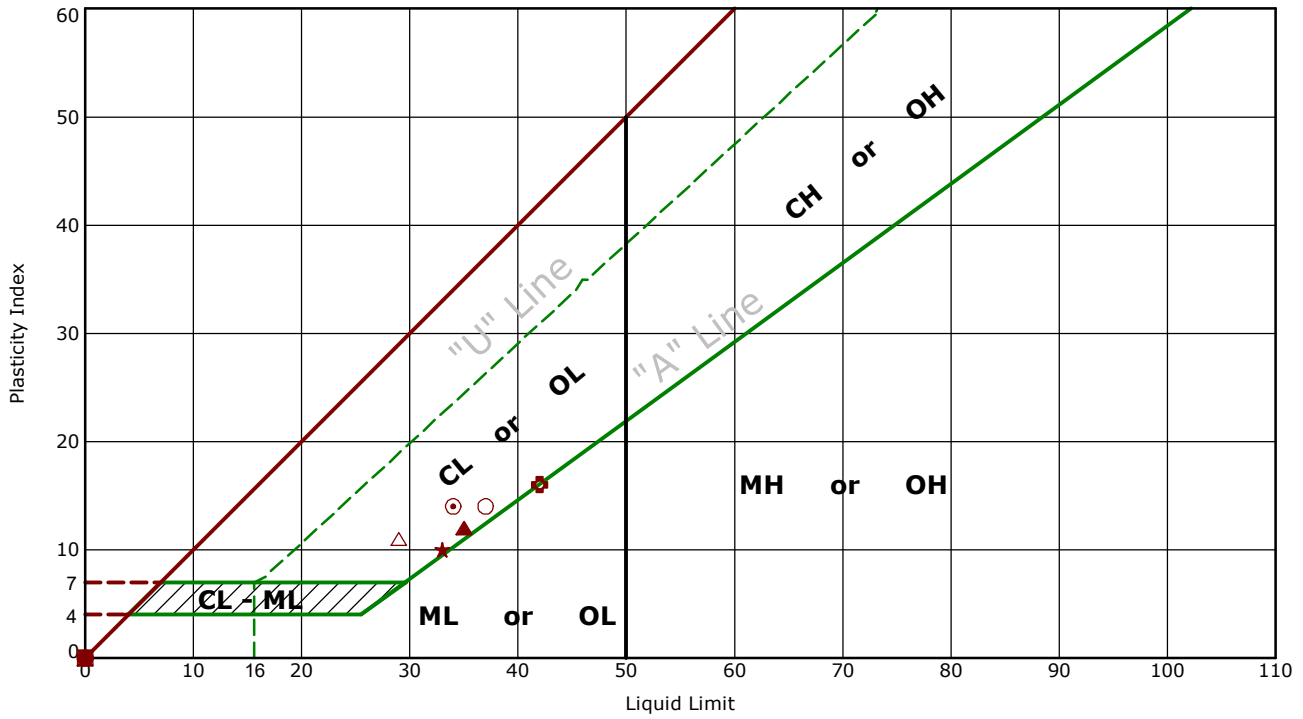
BORING S-42-31-2



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

Atterberg Limit Results

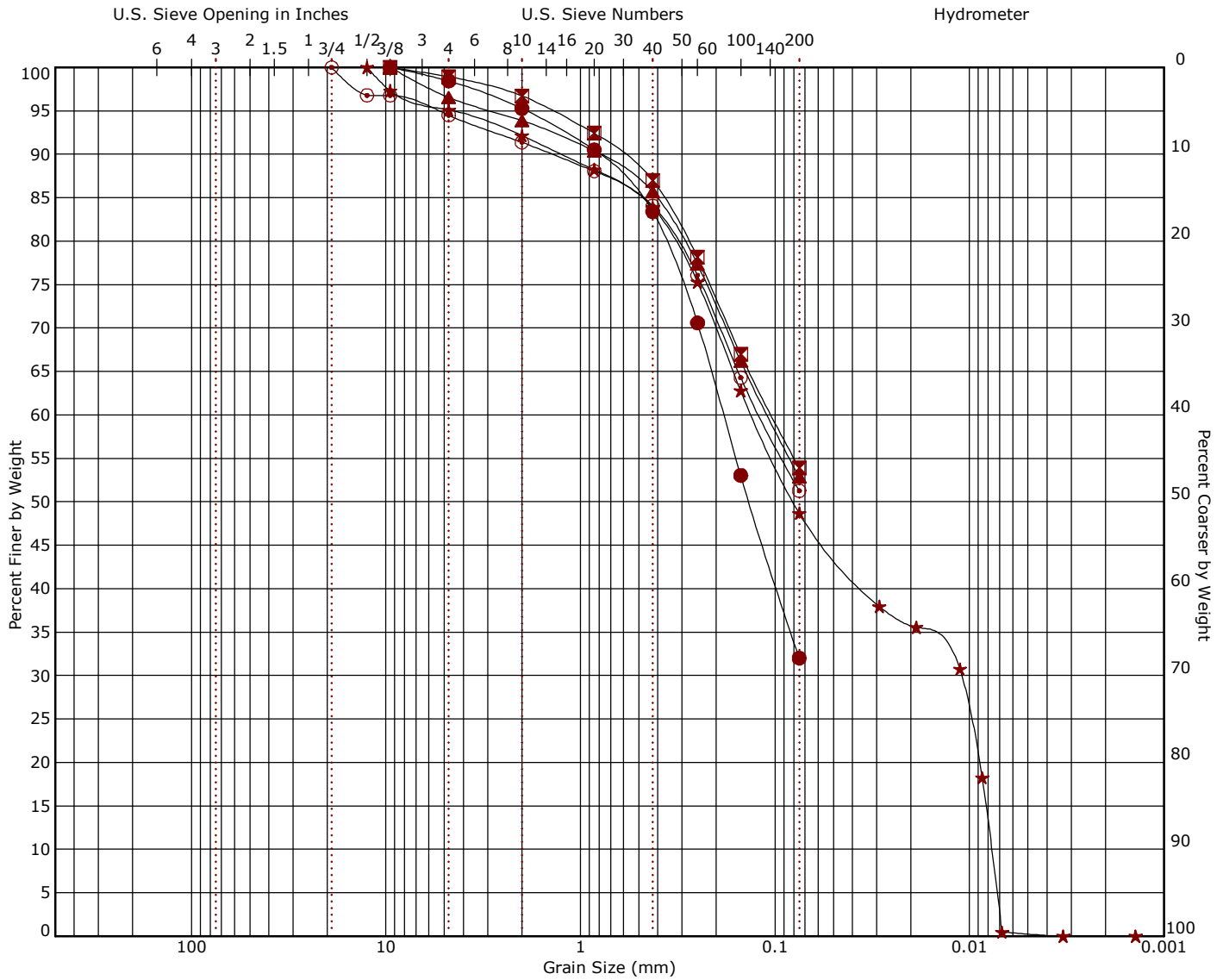
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	AASHTO	Description
●	S-42-31-1	12 - 14	NP	NP	NP	53.9	A-4 (0)	SANDY SILT
⊠	S-42-31-1	16 - 18	NP	NP	NP	52.8	A-4 (0)	SANDY SILT
▲	S-42-31-1	22 - 24	35	23	12	48.7	A-6 (3)	CLAYEY SAND
★	S-42-31-1	28 - 30	33	23	10	50.6	A-4 (3)	SANDY LEAN CLAY
⊙	S-42-31-2	0.5 - 2	34	20	14	52.0	A-6 (4)	SANDY LEAN CLAY
⊕	S-42-31-2	13.5 - 15	42	26	16	52.1	A-7-6 (6)	SANDY SILT
○	S-42-31-2	18.5 - 20	37	23	14	41.1	A-6 (2)	CLAYEY SAND
△	S-42-31-2 Bulk	1 - 5	29	18	11	42.5	A-6 (1)	CLAYEY SAND

Grain Size Distribution

ASTM D422 / ASTM C136



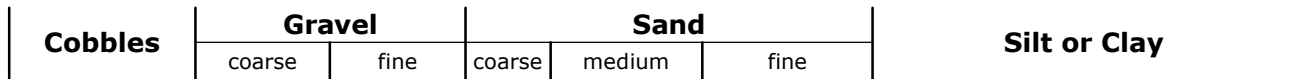
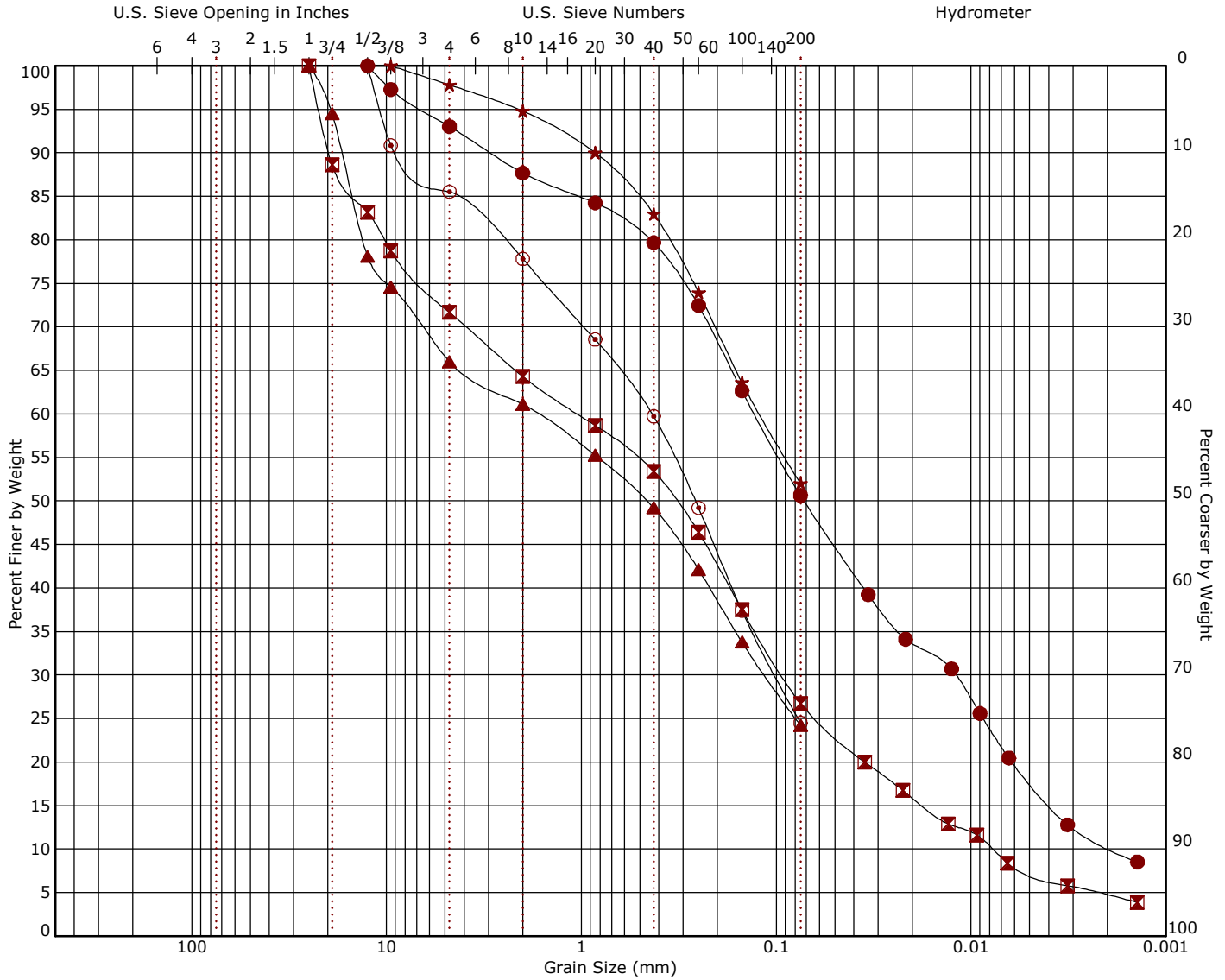
Cobbles	Gravel					Sand			Silt or Clay	
	coarse	fine	coarse	medium	fine					

Boring ID	Depth (Ft)	USCS Classification		USCS	AASHTO	LL	PL	PI	Cc	Cu
● S-42-31-1	6 - 8	SILTY SAND		SM	A-2-4					
☒ S-42-31-1	12 - 14	SANDY SILT		ML	A-4 (0)	NP	NP	NP		
▲ S-42-31-1	16 - 18	SANDY SILT		ML	A-4 (0)	NP	NP	NP		
★ S-42-31-1	22 - 24	CLAYEY SAND		SC	A-6 (3)	35	23	12	0.12	16.96
⊙ S-42-31-1	26 - 28	SANDY LEAN CLAY		CL	A-6					

Boring ID	Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● S-42-31-1	6 - 8	9.5	0.184			0.0	1.6	66.4	32.0		
☒ S-42-31-1	12 - 14	9.5	0.104			0.0	1.1	45.0	53.9		
▲ S-42-31-1	16 - 18	9.5	0.109			0.0	3.5	43.7	52.8		
★ S-42-31-1	22 - 24	12.5	0.131	0.011	0.008	0.0	4.9	46.4		48.4	0.3
⊙ S-42-31-1	26 - 28	19	0.119			0.0	5.5	43.2	51.3		

Grain Size Distribution

ASTM D422 / ASTM C136

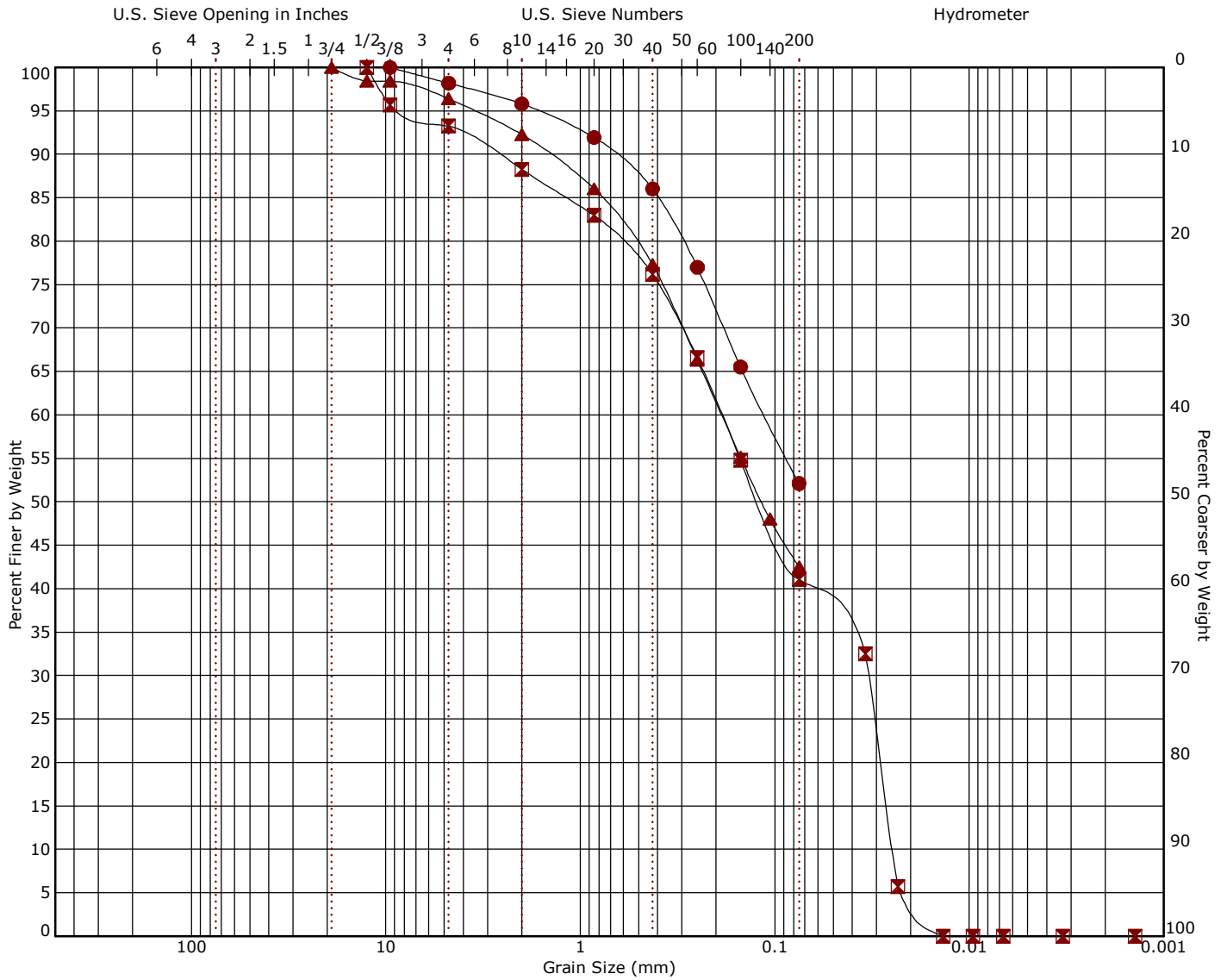


Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● S-42-31-1	28 - 30	SANDY LEAN CLAY	CL	A-4 (3)	33	23	10	0.60	69.09
☒ S-42-31-1	32 - 34	CLAYEY SAND WITH GRAVEL	SC	A-2-6				1.06	133.35
▲ S-42-31-1	34 - 36	CLAYEY SAND WITH GRAVEL	SC	A-2-6					
★ S-42-31-2	0.5 - 2	SANDY LEAN CLAY	CL	A-6 (4)	34	20	14		
⊙ S-42-31-2	4 - 6	SILTY SAND	SM	A-2-4					

Boring ID	Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● S-42-31-1	28 - 30	12.5	0.129	0.012	0.002	0.0	7.0	42.4		32.9	17.7
☒ S-42-31-1	32 - 34	25	1.039	0.092	0.008	0.0	28.3	44.9		19.3	7.4
▲ S-42-31-1	34 - 36	25	1.701	0.114		0.0	34.0	41.8	24.2		
★ S-42-31-2	0.5 - 2	9.5	0.121			0.0	2.2	45.8	52.0		
⊙ S-42-31-2	4 - 6	12.5	0.434	0.101		0.0	14.5	61.0	24.5		

Grain Size Distribution

ASTM D422 / ASTM C136



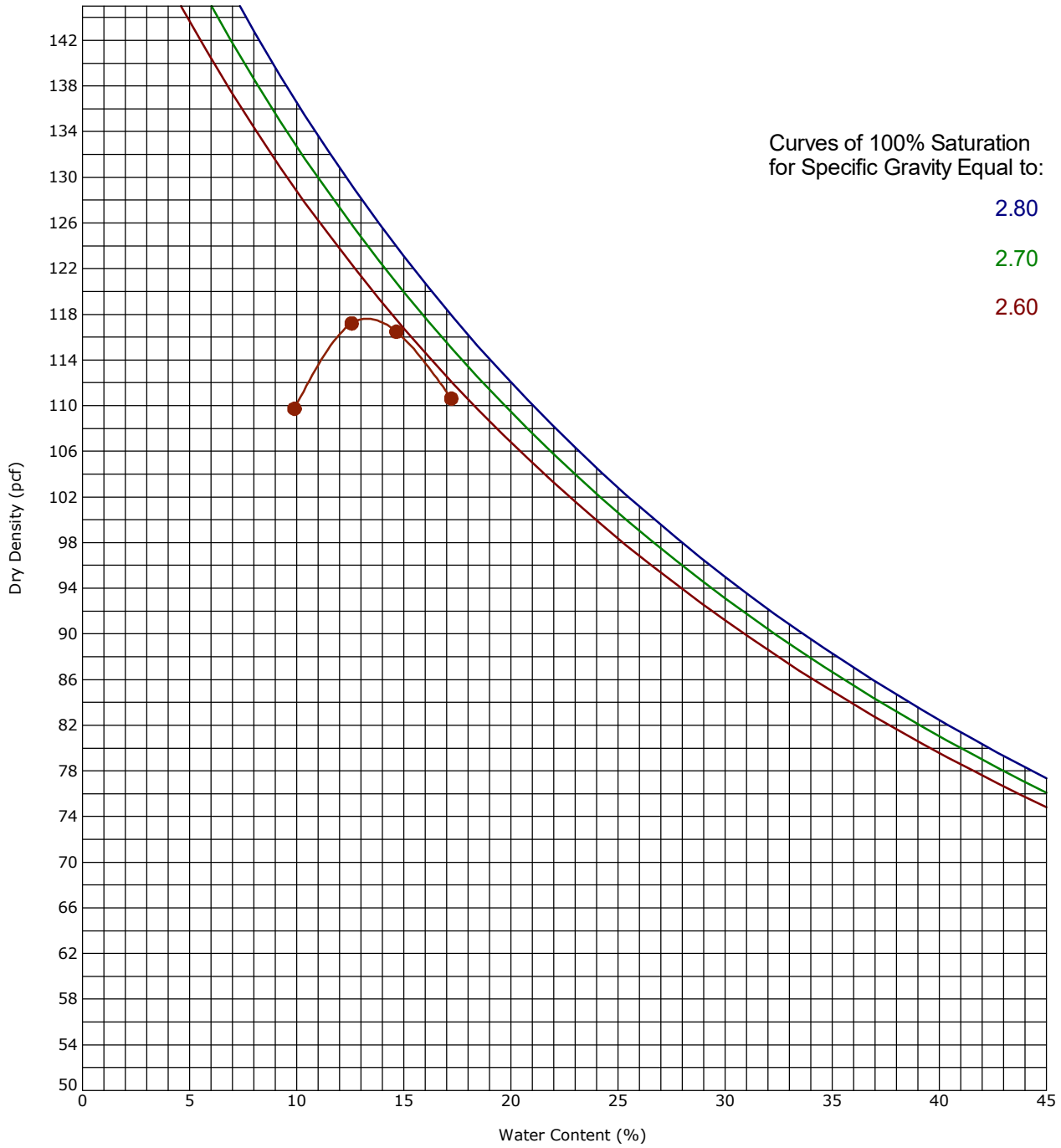
Cobbles	Gravel					Sand			Silt or Clay		
	coarse	fine	coarse	medium	fine						

Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● S-42-31-2	13.5 - 15	SANDY SILT	ML	A-7-6 (6)	42	26	16		
☒ S-42-31-2	18.5 - 20	CLAYEY SAND	SC	A-6 (2)	37	23	14	0.23	7.60
● S-42-31-2 Bulk	1 - 5	CLAYEY SAND	SC	A-6 (1)	29	18	11		

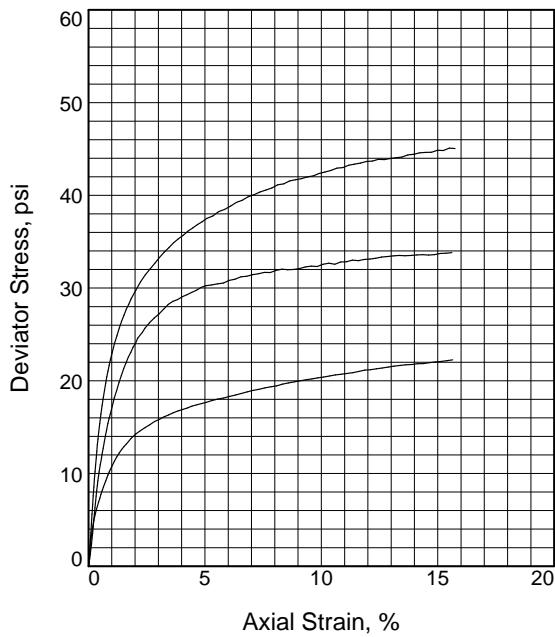
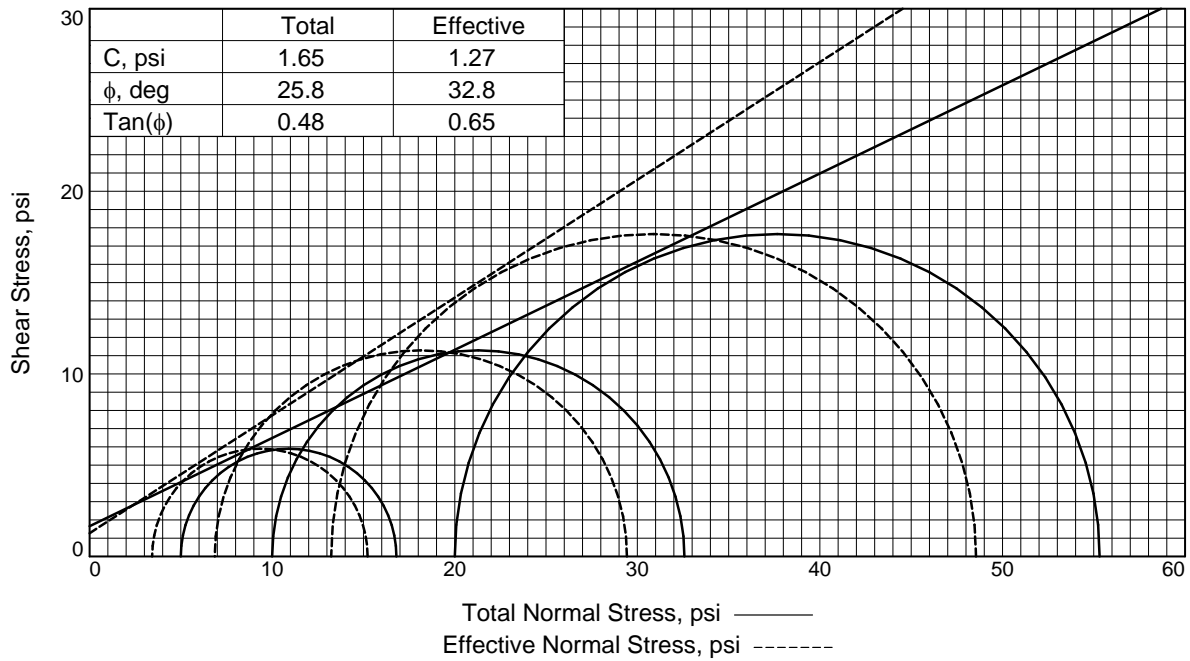
Boring ID	Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● S-42-31-2	13.5 - 15	9.5	0.113			0.0	1.8	46.1	52.1		
☒ S-42-31-2	18.5 - 20	12.5	0.188	0.033	0.025	0.0	6.8	52.1		41.1	0.0
● S-42-31-2 Bulk	1 - 5	19	0.187			0.0	3.6	53.9	42.5		

Moisture-Density Relationship

ASTM D698-Method B



Boring ID		Depth (Ft)		Description of Materials				
S-42-31-2 Bulk		1 - 5		CLAYEY SAND(SC)				
Fines (%)	Fraction > mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)	
43	0.0	29	18	11	ASTM D698-Method B	117.6	13.3	



Sample No.	1	2	3	
Initial	Water Content, %	13.3	13.4	13.2
	Dry Density, pcf	112.0	112.1	112.3
	Saturation, %	71.1	71.9	71.3
	Void Ratio	0.5044	0.5030	0.5013
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.62	5.62	5.62
At Test	Water Content, %	18.2	19.4	18.4
	Dry Density, pcf	113.0	110.6	112.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.4910	0.5237	0.4964
	Diameter, in.	2.80	2.82	2.81
	Height, in.	5.57	5.58	5.53
Strain rate, in./min.	0.001	0.001	0.001	
Back Pressure, psi	50.0	50.0	50.0	
Cell Pressure, psi	55.0	60.0	70.0	
Fail. Stress, psi	11.8	22.6	35.3	
Excess Pore Pr., psi	1.6	3.1	6.8	
Ult. Stress, psi	22.1	33.7	44.9	
Excess Pore Pr., psi	-2.8	-2.9	2.7	
$\bar{\sigma}_1$ Failure, psi	15.2	29.4	48.6	
$\bar{\sigma}_3$ Failure, psi	3.4	6.9	13.2	

Type of Test:

CU with Pore Pressures

Sample Type: Remolded

Description: Clayey Sand (SC)

LL= 29

PL= 18

PI= 11

Specific Gravity= 2.7

Remarks: Specimens were remolded to approximately 95% MDD at optimum water content.

Figure _____

Client: HNTB North Carolina PC

Project: S-42-31 (Cannons Campground Road) BRO Peters Creek

Source of Sample: S-42-31-2

Depth: 1-3'

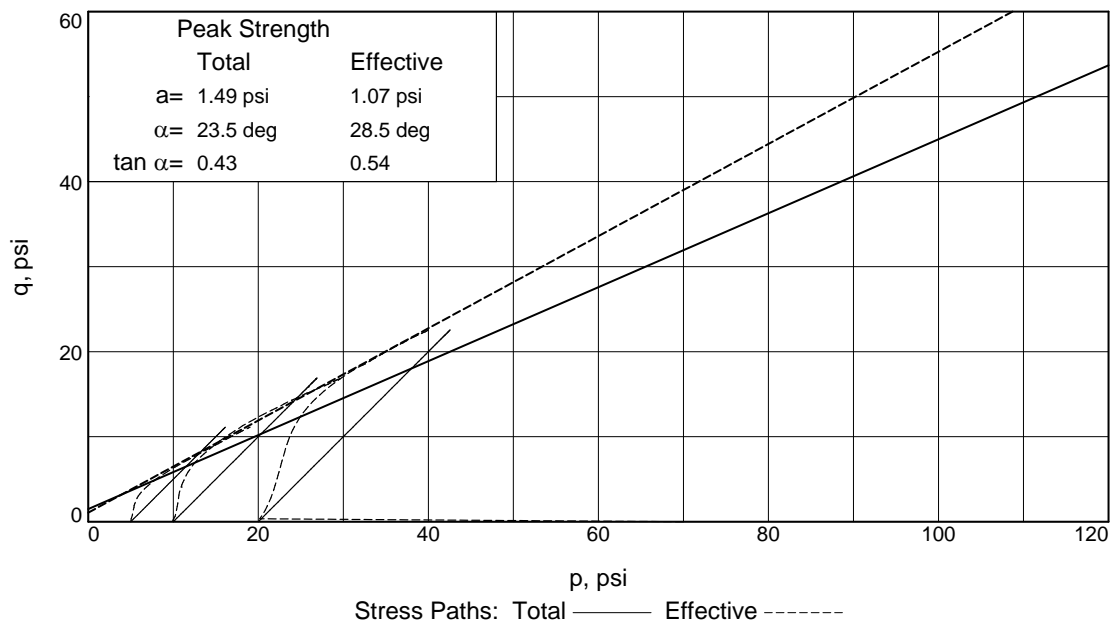
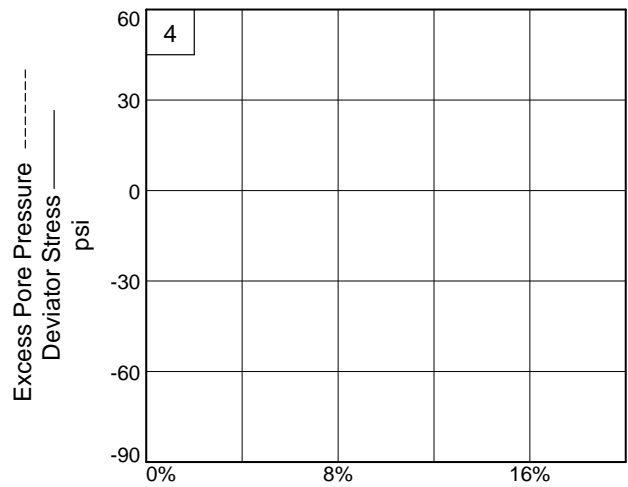
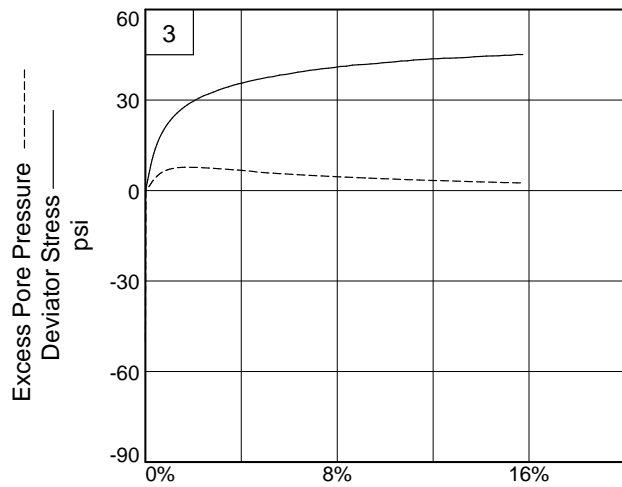
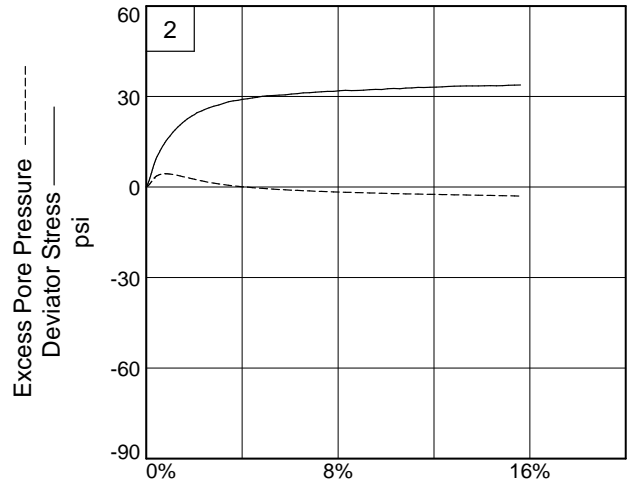
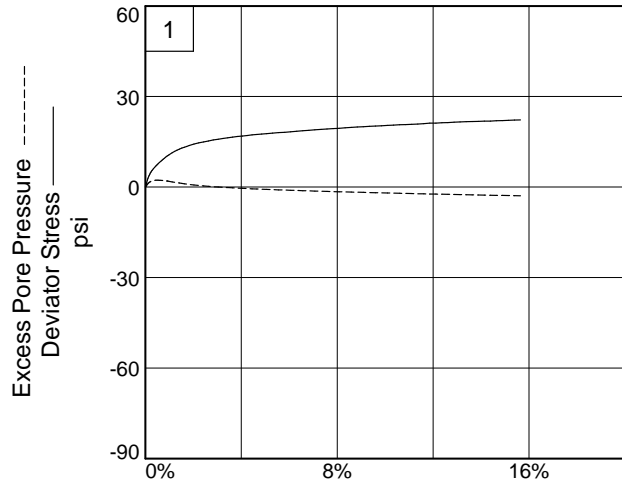
Proj. No.: 8623P180

Date Sampled: 1/13/2025

TRIAxIAL SHEAR TEST REPORT

Terracon Consultants, Inc.

Chattanooga, TN



Client: HNTB North Carolina PC

Project: S-42-31 (Cannons Campground Road) BRO Peters Creek

Source of Sample: S-42-31-2

Depth: 1-3'

Project No.: 8623P180

Figure _____

Terracon Consultants, Inc.

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393



Client

HNTB North Carolina PC

Project

SCDOT Bridge Package 19 - Peters Creek

Sample Submitted By: Terracon (86)

Date Received: 2/7/2025

Lab No.: 25-0052

Results of Corrosion Analysis

Sample Number	--
Sample Location	S-42-31-1
Sample Depth (ft.)	2.0-30.0
pH Analysis, AASHTO T289	5.45
Water Soluble Sulfate (SO4), AASHTO T290 (mg/kg)	95
Sulfides, ASTM D4658, (ppm)	Nil
Red-Ox, ASTM G200, (mV)	+733
Chlorides, AASHTO T291, (mg/kg)	130
Saturated Minimum Resistivity, ASTM G-57, (ohm cm)	2814

A handwritten signature in black ink, appearing to read "N. Campo".

Analyzed By _____

Nathan Campo
Laboratory Coordinator

The tests were performed in general accordance with applicable ASTM and AWWA test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.



Rock Coring Summary

PROJECT ID P041165

PROJECT NAME S-42-31 (Cannons Campground Road) BRO Peters Creek

PROJECT COUNTY Spartanburg

Borehole	Core Run Number	Core Run Top Depth	REC (%)	RQD (%)	q _u (psi)	Poisson's Ratio	Secant Modulus (ksi)	Unit Weight (pcf)	RMR	GSI
S-42-31-1	NQ-1	38.5	70	15	5449	0.29	718	162	40	48
S-42-31-1	NQ-2	43.5	82	13	11576	0.22	1449	172	43	53
S-42-31-1	NQ-3	48.5	90	32	3838	0.04	376	165	50	60
S-42-31-1	NQ-4	53.5	100	68	5875	0.03	636	170	65	70
S-42-31-2	NQ-1	33.5	18	0					2	15
S-42-31-2	NQ-2	38.5	68	20	3263	0.10	132	163	22	43
S-42-31-2	NQ-3	43.5	100	50	5710	0.03	616	168	55	65
S-42-31-2	NQ-4	48.5	100	40	3783	0.05	280	165	39	55

Client

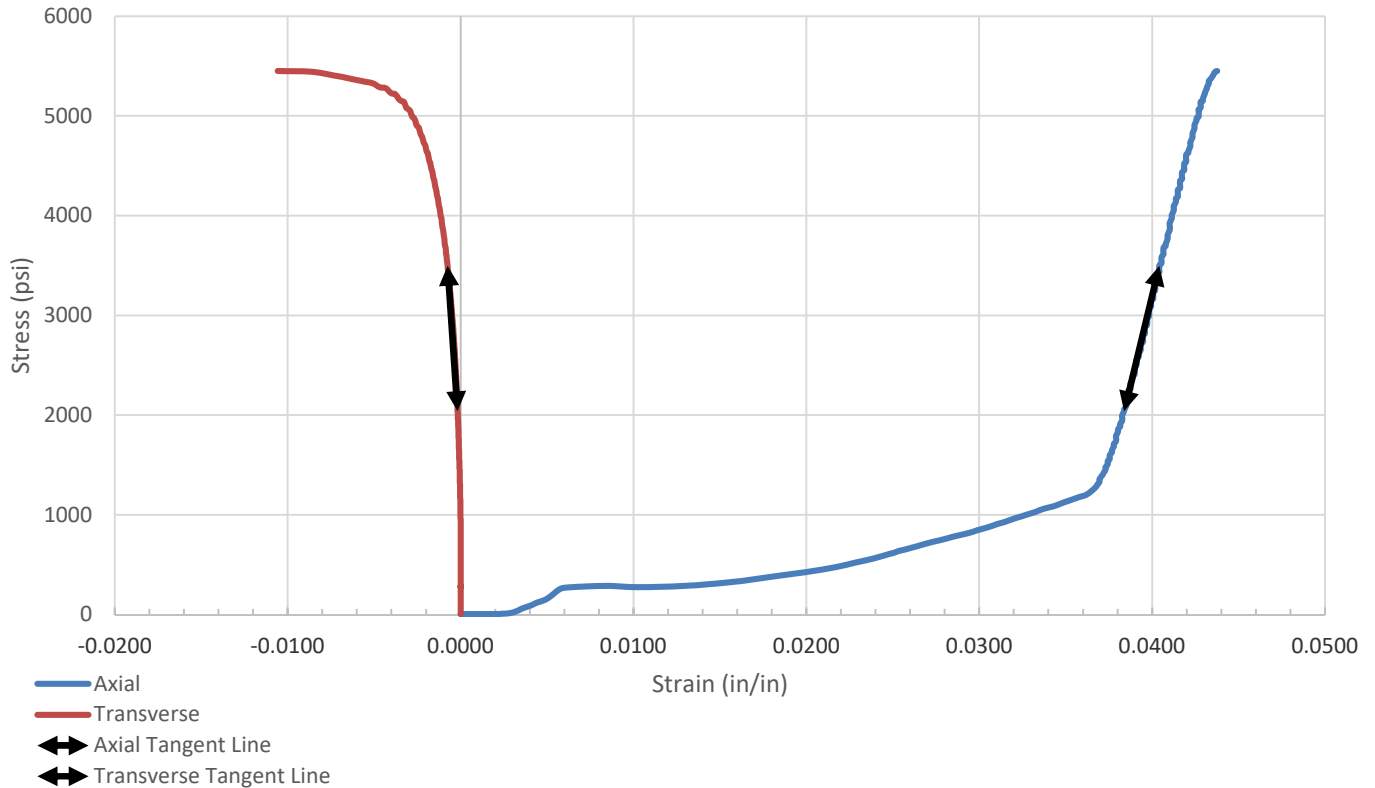
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - over Peters Creek		
Rock Type:	Granite		
Boring:	S-42-31-1	Depth (feet):	38.8-39.5

SPECIMEN INFORMATION

Sample No.:	R1	Mass (g):	530.78
Length (in.):	4.19	Diameter (in.):	1.95
L/D Ratio:	2.1	Density (pcf):	161.59

TEST RESULTS

Failure Load (lbs):	16266
Failure Strain (%):	4.38
Unconfined Compressive Strength (psi):	5,449
Elastic Modulus, E, (ksi):	718
Poisson's Ratio, u:	0.285
Time of Failure (min):	00:39
Rate of Loading (psi/sec):	141.17
Moisture Content Post-break:	0.3%

Client

HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0079
Perpendicularity Deviation:	
Diameter 1a:	0.0017
Diameter 1b:	0.0034
Diameter 2a:	0.0018
Diameter 2b:	0.0028
Max Deviation from Flatness:	0.0014
Parallelism Deviation:	
Diameter a:	0.02
Diameter b:	0.04

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches. According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client

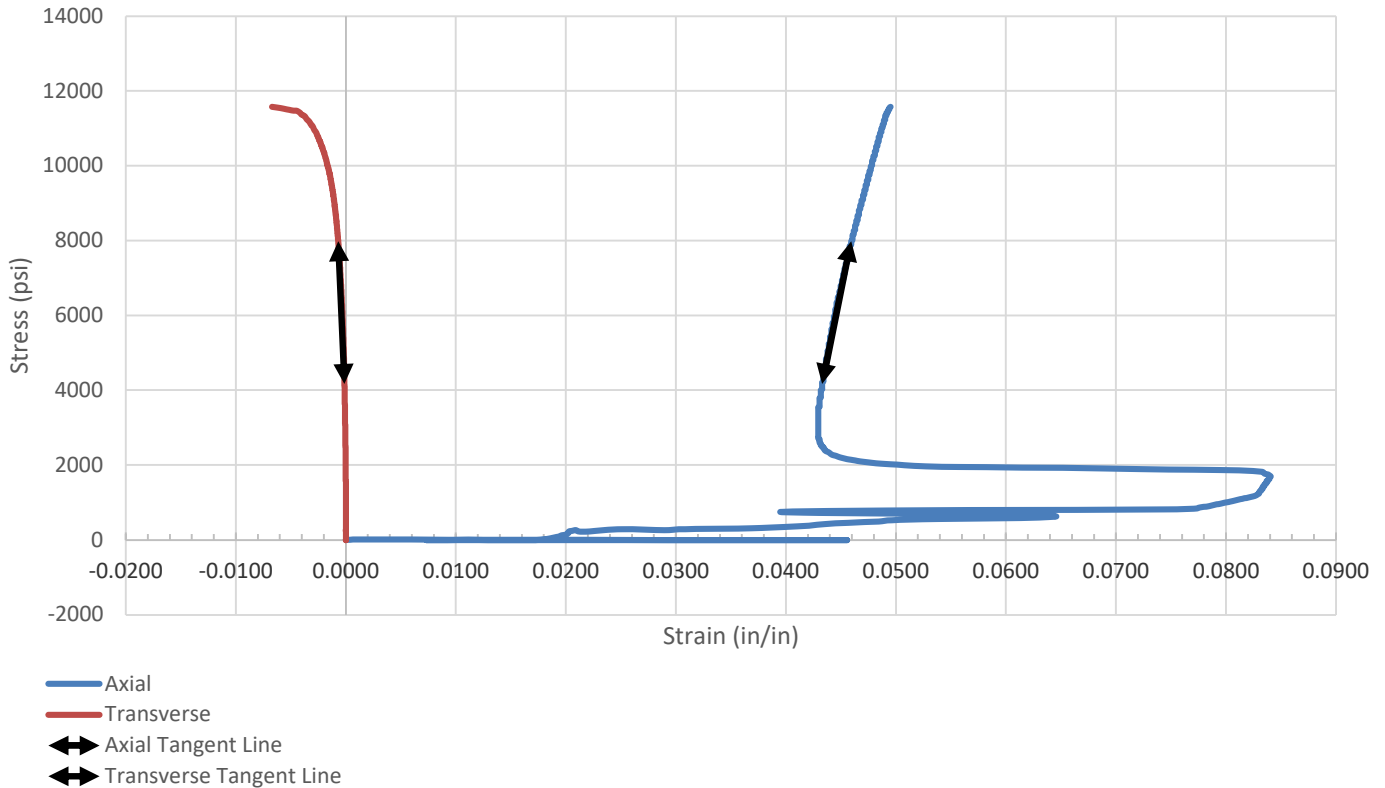
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Gneiss		
Boring:	S-42-31-1	Depth (feet):	45.3-46.0

SPECIMEN INFORMATION

Sample No.:	R2	Mass (g):	563.36
Length (in.):	4.19	Diameter (in.):	1.95
L/D Ratio:	2.1	Density (pcf):	171.51

TEST RESULTS

Failure Load (lbs):	34572
Failure Strain (%):	8.40
Unconfined Compressive Strength (psi):	11,576
Elastic Modulus, E, (ksi):	1449
Poisson's Ratio, u:	0.216
Time of Failure (min):	01:55
Rate of Loading (psi/sec):	100.315
Moisture Content Post-break:	0.3%

Client

HNTB North Carolina PC
4922 O'Hear Avenue Suite 203
North Charleston, SC 29402

Project

SCDOT Bridge Package 19
Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0042
Perpendicularity Deviation:	
Diameter 1a:	0.0048
Diameter 1b:	0.0019
Diameter 2a:	0.0025
Diameter 2b:	0.0033
Max Deviation from Flatness:	0.0019
Parallelism Deviation:	
Diameter a:	0.14
Diameter b:	0.28

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

The inconsistencies on the graph are due to the settling of the chain and movement of the sample during testing. As the testing proceeded, the chain settled into a more stable state. The Elastic Modulus and Poisson's ratio were taken from the stable state. These results may differ from results from a test specimen that does not fluctuate as much.

Client

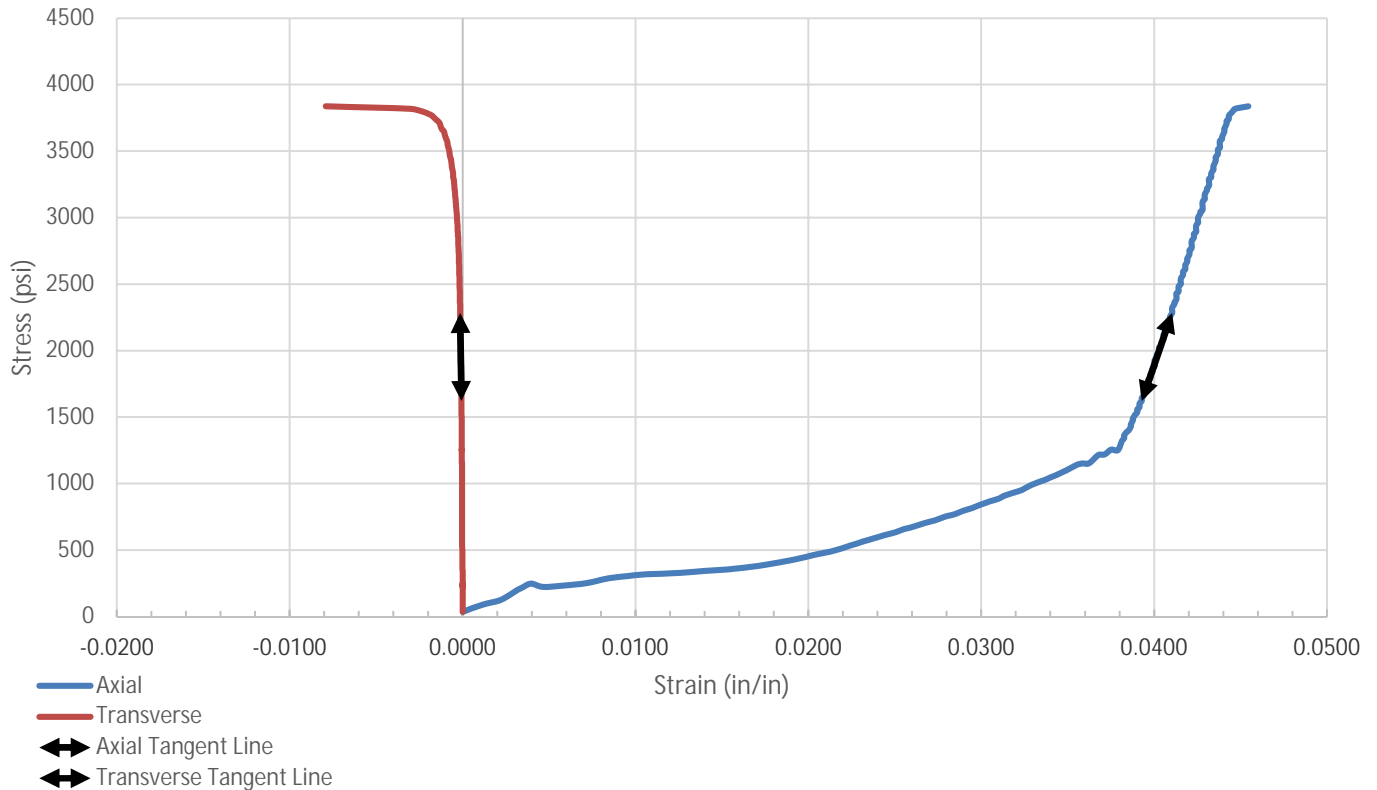
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Schist		
Boring:	S-42-31-1	Depth (feet):	49.3-50.4

SPECIMEN INFORMATION

Sample No.:	R3	Mass (g):	519.42
Length (in.):	3.98	Diameter (in.):	1.96
L/D Ratio:	2.03	Density (pcf):	164.78

TEST RESULTS

Failure Load (lbs):	11580
Failure Strain (%):	4.54
Unconfined Compressive Strength (psi):	3,838
Elastic Modulus, E, (ksi):	376
Poisson's Ratio, u:	0.041
Time of Failure (min):	00:34
Rate of Loading (psi/sec):	112.884
Moisture Content Post-break:	0.5%

Client

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4922 O'Hear Avenue Suite 203
North Charleston, SC 29402

Project

SCDOT Bridge Package 19
Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0068
Perpendicularity Deviation:	
Diameter 1a:	0.0049
Diameter 1b:	0.0068
Diameter 2a:	0.0099
Diameter 2b:	0.0081
Max Deviation from Flatness:	0.0070
Parallelism Deviation:	
Diameter a:	0.35
Diameter b:	0.82

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25°.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client

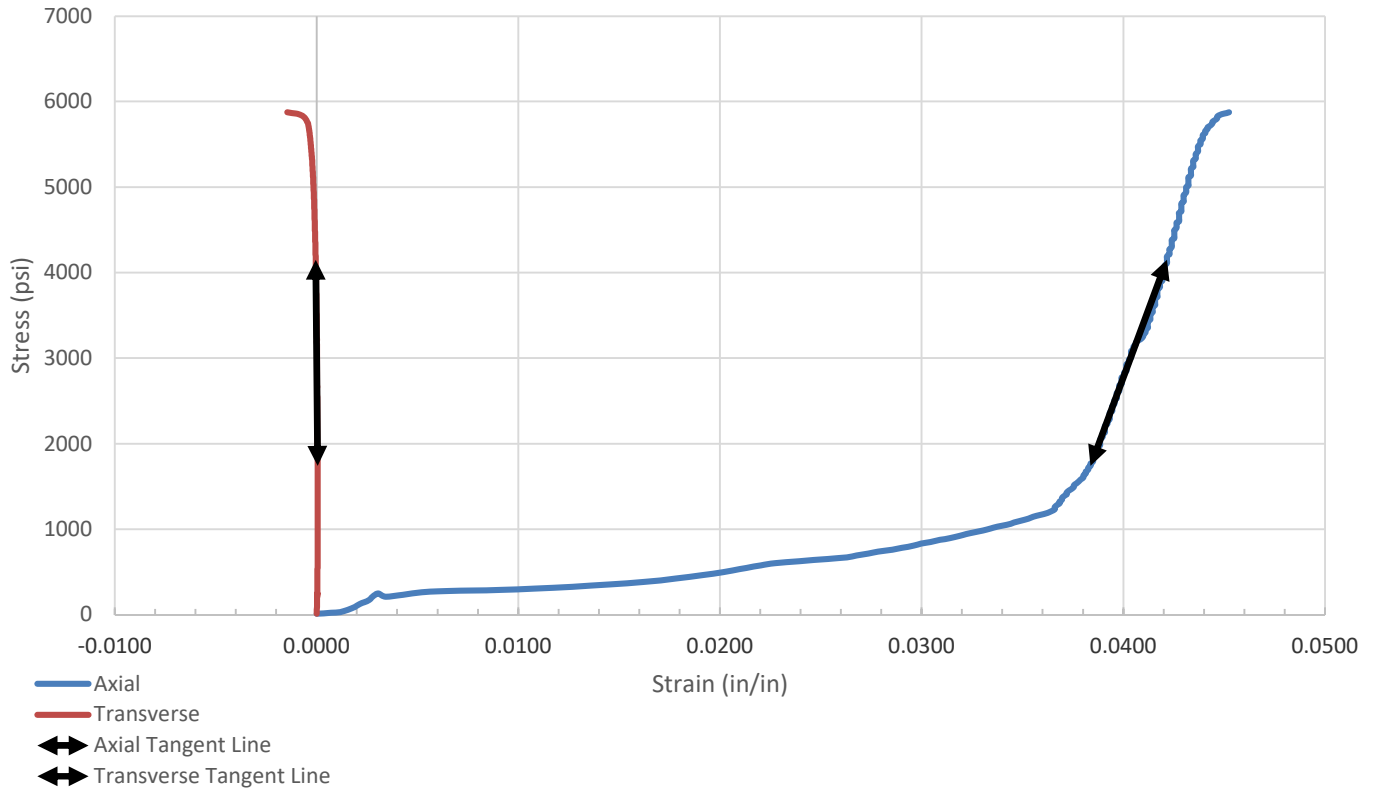
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Gneiss		
Boring:	S-42-31-1	Depth (feet):	54.9-55.6

SPECIMEN INFORMATION

Sample No.:	R4	Mass (g):	556.32
Length (in.):	4.23	Diameter (in.):	1.94
L/D Ratio:	2.2	Density (pcf):	169.50

TEST RESULTS

Failure Load (lbs):	17357
Failure Strain (%):	4.52
Unconfined Compressive Strength (psi):	5,875
Elastic Modulus, E, (ksi):	636
Poisson's Ratio, u:	0.025
Time of Failure (min):	00:54
Rate of Loading (psi/sec):	109.20
Moisture Content Post-break:	0.7%



Client

HNTB North Carolina PC
4922 O'Hear Avenue Suite 203
North Charleston, SC 29402

Project

SCDOT Bridge Package 19
Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0087
Perpendicularity Deviation:	
Diameter 1a:	0.0032
Diameter 1b:	0.0069
Diameter 2a:	0.0020
Diameter 2b:	0.0073
Max Deviation from Flatness:	0.0029
Parallelism Deviation:	
Diameter a:	0.05
Diameter b:	0.80

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25°.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client

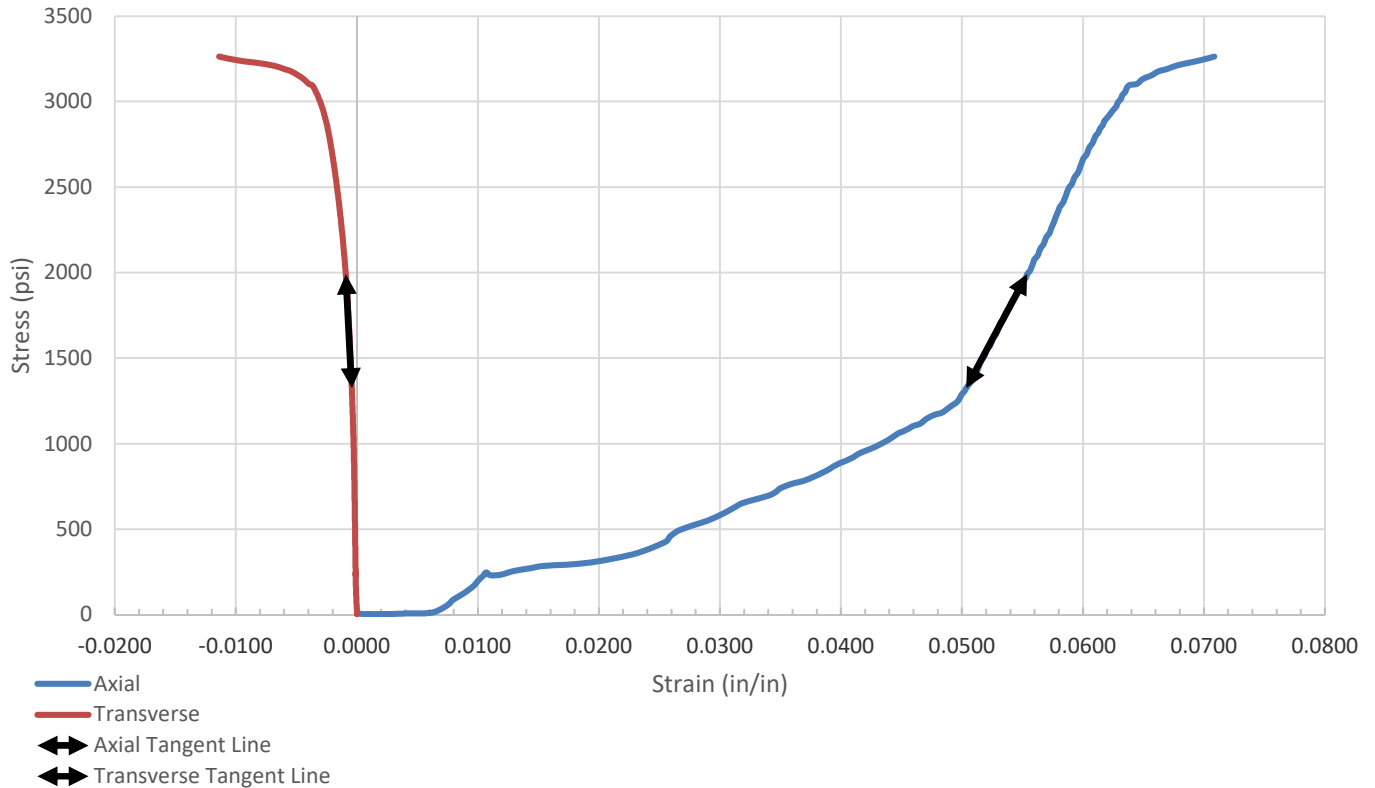
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Schist		
Boring:	S-42-31-2	Depth (feet):	40.4-41

SPECIMEN INFORMATION

Sample No.:	R2	Mass (g):	517.09
Length (in.):	4.08	Diameter (in.):	1.94
L/D Ratio:	2.10	Density (pcf):	163.34

TEST RESULTS

Failure Load (lbs):	9642
Failure Strain (%):	7.08
Unconfined Compressive Strength (psi):	3,263
Elastic Modulus, E, (ksi):	132
Poisson's Ratio, u:	0.098
Time of Failure (min):	00:33
Rate of Loading (psi/sec):	99.49
Moisture Content Post-break:	1.7%

Client

HNTB North Carolina PC
4922 O'Hear Avenue Suite 203
North Charleston, SC 29402

Project

SCDOT Bridge Package 19
Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0182
Perpendicularity Deviation:	
Diameter 1a:	0.0085
Diameter 1b:	0.0137
Diameter 2a:	0.0043
Diameter 2b:	0.0155
Max Deviation from Flatness:	0.0064
Parallelism Deviation:	
Diameter a:	0.19
Diameter b:	1.70

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

Per ASTM D4543, this specimen has not met the requirements for parallelism, by exceeding 0.25°.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client

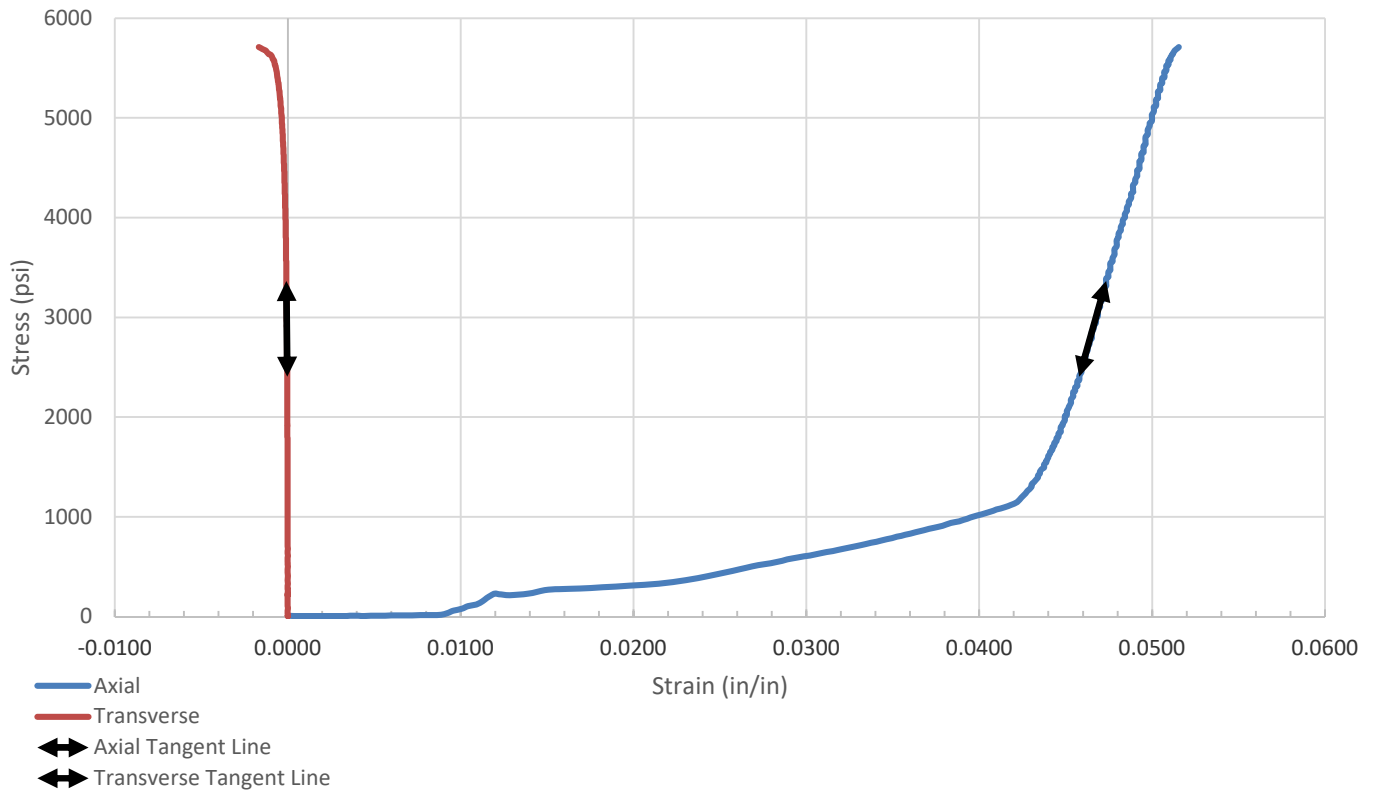
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Gneiss		
Boring:	S-42-31-2	Depth (feet):	46.7-47.5

SPECIMEN INFORMATION

Sample No.:	R3	Mass (g):	551.12
Length (in.):	4.18	Diameter (in.):	1.95
L/D Ratio:	2.14	Density (pcf):	168.19

TEST RESULTS

Failure Load (lbs):	17043
Failure Strain (%):	5.15
Unconfined Compressive Strength (psi):	5,710
Elastic Modulus, E, (ksi):	616
Poisson's Ratio, u:	0.029
Time of Failure (min):	00:56
Rate of Loading (psi/sec):	101.59
Moisture Content Post-break:	1.2%

Client

HNTB North Carolina PC
4922 O'Hear Avenue Suite 203
North Charleston, SC 29402

Project

SCDOT Bridge Package 19
Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0049
Perpendicularity Deviation:	
Diameter 1a:	0.0022
Diameter 1b:	0.0015
Diameter 2a:	0.0008
Diameter 2b:	0.0014
Max Deviation from Flatness:	0.0018
Parallelism Deviation:	
Diameter a:	0.08
Diameter b:	0.03

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Client

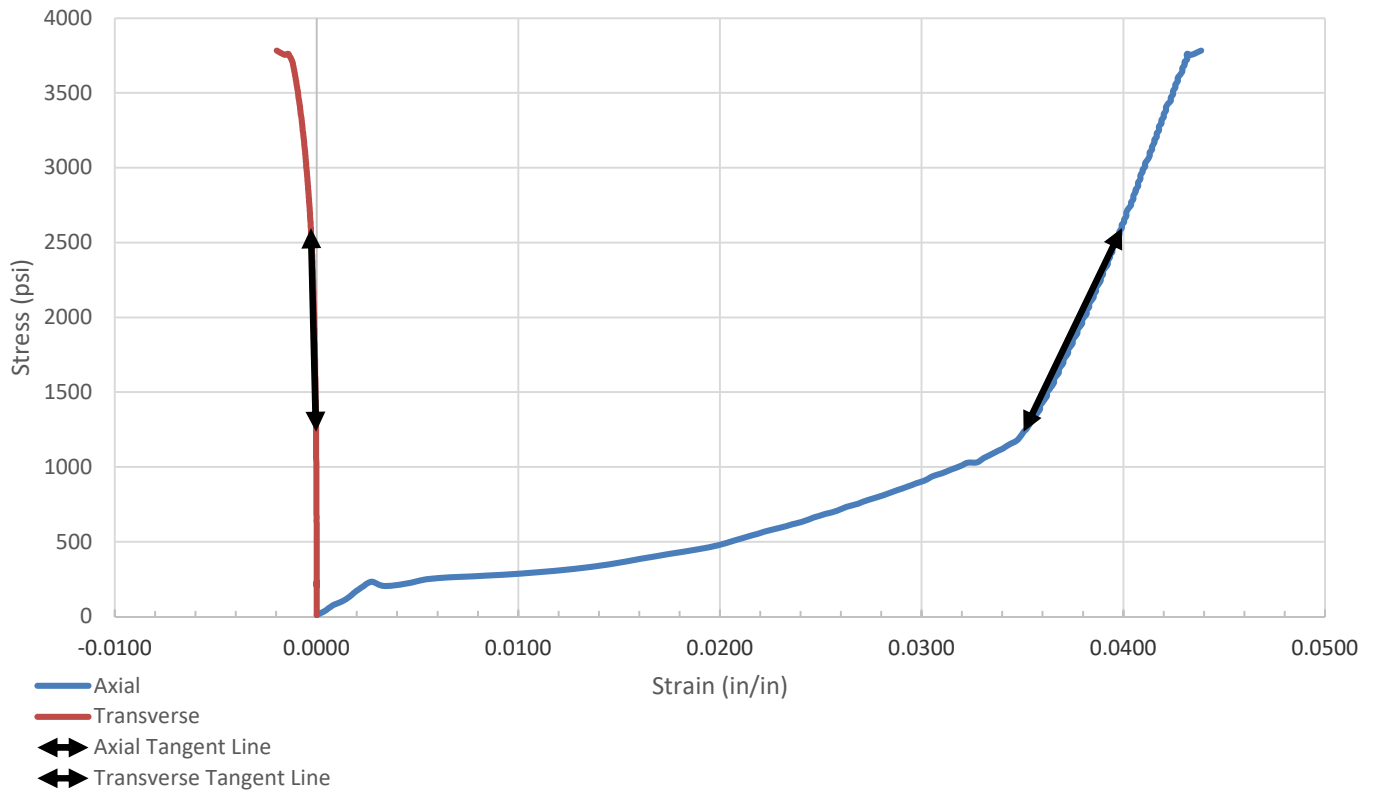
HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D7012 Stress/ Strain Curve



SAMPLE LOCATION

Site:	SCDOT Bridge Package 19 - Over Peters Creek		
Rock Type:	Schist		
Boring:	S-42-31-2	Depth (feet):	51.4-52

SPECIMEN INFORMATION

Sample No.:	R4	Mass (g):	559.94
Length (in.):	4.33	Diameter (in.):	1.95
L/D Ratio:	2.22	Density (pcf):	164.96

TEST RESULTS

Failure Load (lbs):	11291
Failure Strain (%):	4.38
Unconfined Compressive Strength (psi):	3,783
Elastic Modulus, E, (ksi):	280
Poisson's Ratio, u:	0.053
Time of Failure (min):	00:35
Rate of Loading (psi/sec):	109.33
Moisture Content Post-break:	1.3%

Client

HNTB North Carolina PC
 4922 O'Hear Avenue Suite 203
 North Charleston, SC 29402

Project

SCDOT Bridge Package 19
 Multiple Sites

Project No. 8623P180

ASTM D4543 Test Results:

<u>Parameter</u>	<u>Data</u>
Side Straightness:	0.0038
Perpendicularity Deviation:	
Diameter 1a:	0.0089
Diameter 1b:	0.0025
Diameter 2a:	0.0088
Diameter 2b:	0.0040
Max Deviation from Flatness:	0.0096
Parallelism Deviation:	
Diameter a:	0.10
Diameter b:	0.15

Equipment:

	TICCS ID:
Calipers:	W-54522
Scale:	B-71466
Dial Indicator:	C-70608
Compression (spherically seated):	C-48999

Samples were prepared and tested in accordance with ASTM D4543 and D7012. Deviations, if any, are noted below:

Notes:

Per ASTM D4543, this specimen has not met the requirements for perpendicularity, by exceeding 0.250°.

Per ASTM D4543, this specimen has not met the requirements for flatness, by exceeding 0.001 inches.

According to ASTM D7012 Section 8.2.1, this specimen, although not meeting all requirements of ASTM D4543 is acceptable for testing. However, the results reported may differ from results obtained from a test specimen that meets the requirements of D4543.

Appendix C – Supporting Documents

S-42-31 over Peters Creek Emergency Bridge Replacement | Spartanburg County, SC
Terracon Project No. 8623P180 | SCDOT Project ID: P041165



Appendix C

Supporting Documents

3-Point Acceleration Design Response Spectrum by SCDOT
Rig Calibration Report – DR#1327 (8 Pages)

Note: All exhibits are one page unless noted above.

3-Point Acceleration Design Response Spectrum

SCDOT v3.2 - 06/01/2023

Project ID: P041165	Latitude: 34.9982
Route: S-42-31	County: 42 - Spartanburg
Project: Cannons Campground Road over Peters Creek	Longitude: 81.8767

Designer: D. Sapkota - Support
Date: 2/5/2025

Design EQ	PGA	S _{DS}	S _{D1}	M _W	R	PGV	D _{a5-95}	T' _o
	g	g	g	-	km	inches/sec	sec	sec
FEE	0.04	0.08	0.01	7.30	236.43	0.29	54.72	0.17
SEE	0.07	0.15	0.02	6.46	159.77	0.61	34.02	0.13

Damping: 5%
Geologic Condition: Geologically Realistic (Q = 100)*
ADRS Location within Soil Column: At Ground Surface

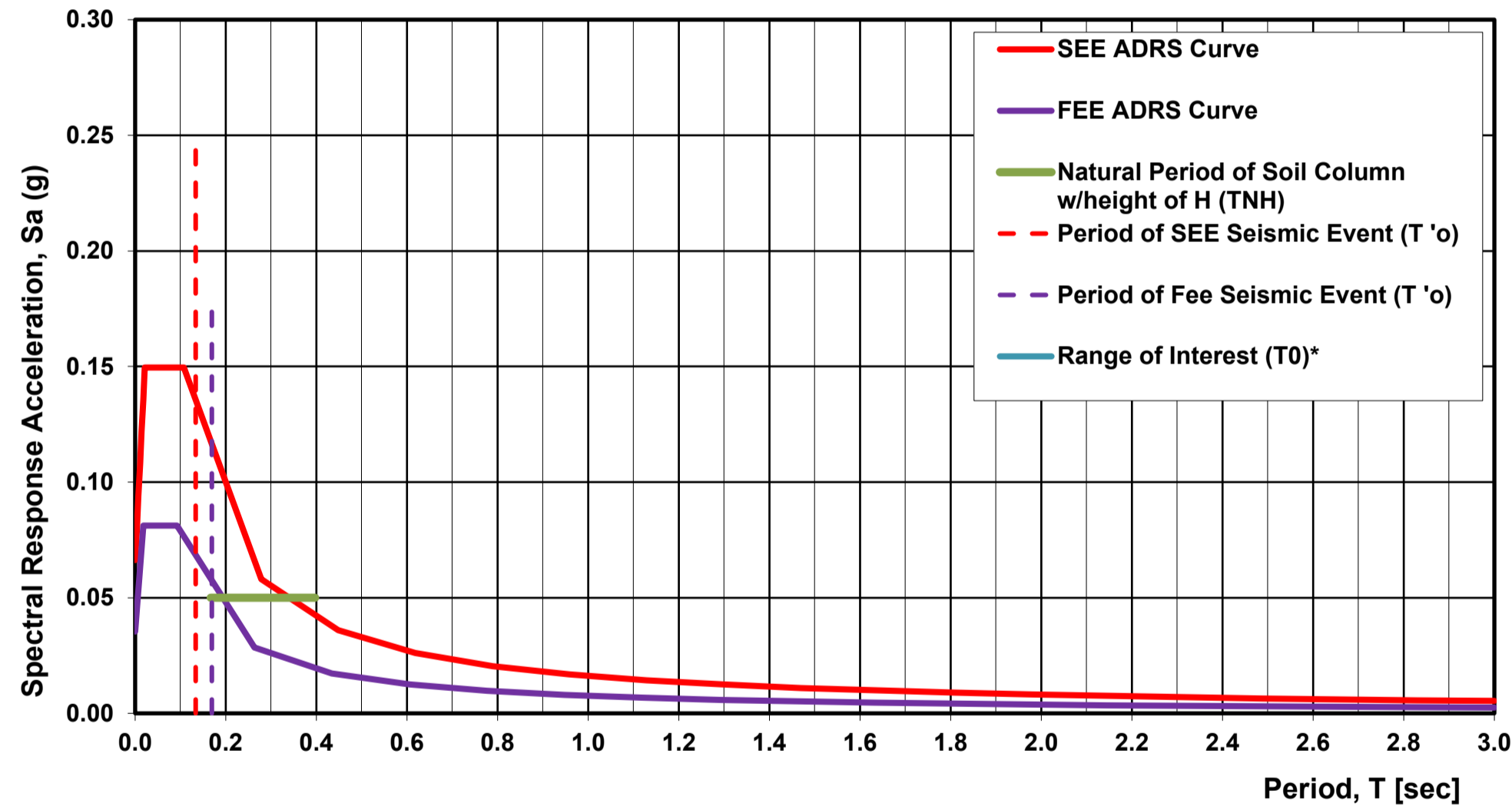
South Carolina Piedmont
*Same Geologic Condition as used in SCENARIO_PC (2006)

Fundamental Period of Structure, T ₀	Range of Interest		V* _{s,H}	H	T _{NH}	
	sec				sec	
sec	0.5*T ₀	2.0*T ₀	ft/sec	ft	(4*H)/V* _{s,H}	(6*H)/V* _{s,H}
0.00	0.00	0.00	1117.75	74.00	0.17	0.40
0.00	0.00	0.00				

H = B-C Boundary

FEE Data		SEE Data	
T	S _a	T	S _a
0.00	0.035	0.00	0.066
0.00	0.043	0.00	0.080
0.01	0.051	0.01	0.094
0.01	0.058	0.01	0.108
0.01	0.066	0.01	0.122
0.02	0.074	0.02	0.136
0.02	0.081	0.02	0.150
0.02	0.081	0.03	0.150
0.03	0.081	0.04	0.150
0.04	0.081	0.04	0.150
0.04	0.081	0.05	0.150
0.05	0.081	0.06	0.150
0.06	0.081	0.06	0.150
0.06	0.081	0.07	0.150
0.07	0.081	0.08	0.150
0.07	0.081	0.09	0.150
0.08	0.081	0.09	0.150
0.09	0.081	0.10	0.150
0.09	0.081	0.11	0.150
0.26	0.029	0.28	0.058
0.43	0.017	0.45	0.036
0.61	0.012	0.62	0.026
0.78	0.010	0.79	0.020
0.95	0.008	0.96	0.017
1.12	0.007	1.13	0.014
1.29	0.006	1.30	0.012
1.46	0.005	1.47	0.011
1.63	0.005	1.64	0.010
1.80	0.004	1.81	0.009
1.97	0.004	1.98	0.008
2.14	0.004	2.15	0.008
2.32	0.003	2.32	0.007
2.49	0.003	2.49	0.006
2.66	0.003	2.66	0.006
2.83	0.003	2.83	0.006
3.00	0.003	3.00	0.005

SC Seismic ADRS Curve



SPT Automatic Hammer Energy Measurement Report

Drill Rig Model: Geoprobe 3126GT
 Drill Rig Serial Number: 3126S5V224106
 Asset Number: DR#1327

September 13, 2024

September 13, 2024

Terracon Consultants Inc.
 72 Pointe Circle
 Greenville, SC 29615

Attn: Nitin Dudani
 E: nitin.dudani@terracon.com

Re: SPT Automatic Hammer Energy Measurement Report
 Rig No: 1327
 Terracon Project Number: 73245115

Dear Mr. Dudani:

This report provides the Energy Transfer Ratio (ETR) for the Standard Penetration Testing (SPT) automatic hammer as summarized below:

Table 1: Hammer Efficiency Summary

Drill Rig Make/Model	Drill Rig Serial Number	Drill Rig Year	Asset Number	Energy Transfer Ratio (ETR)	Hammer Efficiency Correction (C _e)
Geoprobe	3126S5V224106	2024	DR#1327	92.6% ± 1.75%	1.54

*Please Note: according to ASTM standard, a minimum of three recordings should be collected at five-foot intervals no shallower than twenty feet below current ground surface (bgs). The sample intervals were obtained between 30 and 50 feet bgs.

If you have any questions concerning this summary, or if we may be of further service, please contact us.

Ryan C. Wakeford, P.E.
 Geotechnical Engineer

Susheel R. Kolwalkar, Ph.D., P.E.
 Regional Services Manager

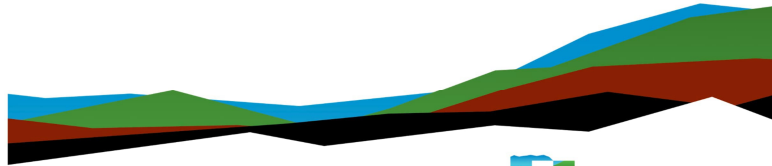


Micah Hatch, P.E.
 Geotechnical Department Manager



Attachments:

- Exhibit A: SPT Representative Blow
- Exhibit B: SPT Analyzer Literature and Equipment Calibrations
- Exhibit C: SPT Analyzer Results
- Exhibit D: Field Log
- Exhibit E: Copy of Certificate of Proficiency



Prepared for:
 Terracon Consultants, Inc.
 Greenville, South Carolina



1.0 MEASUREMENT SUMMARY

ITEM	DESCRIPTION
Drill Rig Owner	Terracon Consultant, Inc. – Greenville, SC
Drill Rig Operator	Brett Burnett: Terracon Exploration
Testing Date	9/5/2024
Testing Location	Sumter County, SC
Boring Identification	B-3
Energy Measurement Depths	30 ft, 40 ft, 45 ft, 50 ft
Subsurface Soils	Poorly graded sands (SP) to clayey sands (SC)
Hammer Type/Height	140 pounds (automatic) with 2.5-foot drop height
Boring Method	Mud rotary
Drill Rods	<ul style="list-style-type: none"> AWJ 1-3/4" outside diameter 1-1/4" inside diameter 1.15 in² cross sectional area 1/4" wall thickness
Calibration Testing Equipment	<ul style="list-style-type: none"> 2-foot AWJ rod instrumented w/ two strain gauges and two accelerometers manufactured by Pile Dynamics Inc. (PDI) SN: 746AWJ Model SPT Analyzer™ (PDA) SN: 4621 TB
ASTM Methods Used	ASTM D1586, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils ASTM D4633-16, Standard Method for Energy Measurement for Dynamic Penetrometers
SPT Calibration Personnel	Ryan Wakeford – Intermediate PDA Proficiency, Terracon Consultants, Inc.

2.0 PURPOSE AND SCOPE OF WORK

The North Charleston office of Terracon Consultants, Inc. conducted SPT energy measurements in accordance with ASTM D4633-16 at a site off Panola Road in Sumter County, South Carolina. Energy measurements on the rig were taken during eight samples events.

3.0 TEST RESULTS

Table 2: SPT Hammer Energy Calibration Testing Summary

Boring	Start Depth ¹ (ft)	Rod Length ² (ft)	Rod Sections ³					Measured Blow Counts (blows/6 inches)				SPT N _{meas} (bpf)	Soil Type ⁴
			2 ft	5 ft	10 ft	1 st Inc.	2 nd Inc.	3 rd Inc.	4 th Inc.				
B-3	28.5	33.7	0	6	0	4	5	6	-	11	SP		
	38.5	43.7	0	8	0	7	10	10	-	20	SP		
	43.5	48.7	0	9	0	4	5	7	-	12	SP		
	48.5	53.7	0	10	0	4	4	7	-	11	SP		

- Depth from existing ground surface to start of SPT
- Total rod length from instrumentation to bottom of sampler
- Two-foot section is instrumented and is located at top of drill rods
- Soil type visually classified by Terracon

Table 3: Energy Measurement and Analysis Summary

Boring	Start Depth ¹ (ft)	SPT N _m (bpf)	No. of Blows ²	EMX ³ (ft-lbs)			ETR ³ (%)		
				Max.	Min.	Ave.	Std. Dev.	Ave.	Std. Dev.
B-3	28.5	11	11	340	313	327	8.8	93.4	2.5
	38.5	20	20	334	309	318	5.6	90.9	1.6
	43.5	12	12	330	309	323	5.5	92.4	1.6
	48.5	11	11	334	320	328	4.5	93.7	1.3
Average:				335	313	334	6.1	92.6	1.75

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

Table 4: Hammer Blow Rate Summary

Boring	Start Depth ¹ (ft)	SPT N _{meas} (bpf)	No. of Blows ²	BPM ³			
				Max.	Min.	Ave.	Std. Dev.
B-3	28.5	11	11	53.8	53.1	53.5	0.2
	38.5	20	20	53.7	53.0	53.4	0.1
	43.5	12	12	53.6	53.2	53.4	0.1
	48.5	11	11	53.8	53.1	53.4	0.2
Average:				53.7	53.1	53.4	0.2

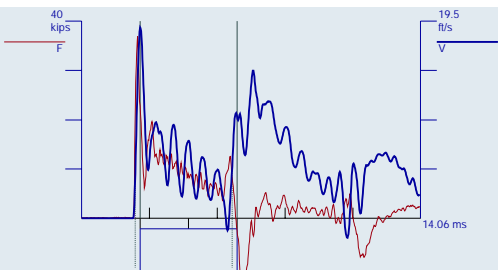
1. Boring ID and depth from existing ground surface to start of SPT.
2. Number of blows used in energy calibration analysis. Limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the 1st increment if refusal conditions were encountered.
3. BPM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

Exhibit A

SPT Representative Blow

GRL Engineers, Inc.
 GEOPROBE 3126GT
 28.5-30
 B3
 PDA Operator: RW

Pile Driving Analyzer ® (PDA)
 Version: 2022.35.2



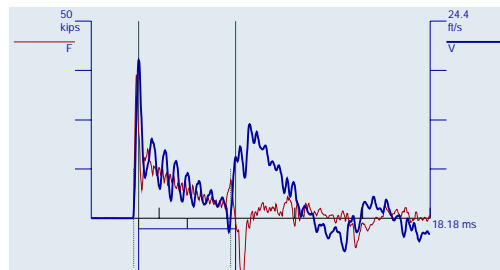
BN 13
 05Sep2024 10:07:23 AM

CSX	32.1 ksi
DMX	1.11 in
EFV	331 ft/lb
ETR	94.7 %
BPM	53.8 bpm
RAT	1.0
VMX	18.9 ft/s
FMX	37 kips
DFN	1.00 in
MEX	1070 µE
AMX	3001 g/s
FVP	0.6

F1: [746AWJ1]	222.05 PDICAL (1) FF1
F2: [746AWJ2]	222.19 PDICAL (1) FF1
A3 (PR): [K14007]	407.233 mv/6.4v/5000g (1) VF1
A4 (PR): [K14006]	375.226 mv/6.4v/5000g (1) VF1

GRL Engineers, Inc.
 GEOPROBE 3126GT
 38.5-40
 B3
 PDA Operator: RW

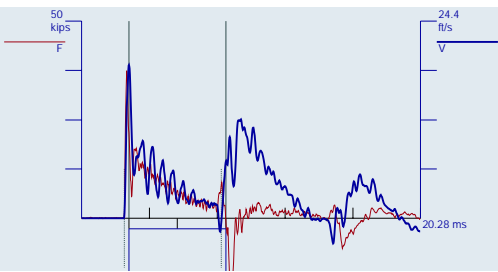
Pile Driving Analyzer ® (PDA)
 Version: 2022.35.2



BN 25
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CSX	31.7 ksi
DMX	0.66 in
EFV	324 ft/lb
ETR	92.6 %
BPM	53.4 bpm
RAT	1.1
VMX	19.6 ft/s
FMX	36 kips
DFN	0.60 in
MEX	1056 µE
AMX	3358 g/s

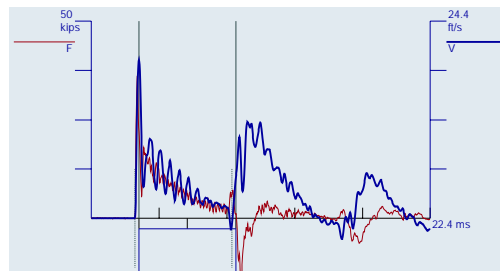
F1: [746AWJ1]	222.05 PDICAL (1) FF1
F2: [746AWJ2]	222.19 PDICAL (1) FF1
A3 (PR): [K14007]	407.233 mv/6.4v/5000g (1) VF1
A4 (PR): [K14006]	375.226 mv/6.4v/5000g (1) VF1



BN 14
 05Sep2024 10:32:57 AM

CSX	32.6 ksi
DMX	0.91 in
EFV	325 ft-lb
ETR	92.8 %
BPM	53.4 bpm
RAT	1.0
VMX	19.0 ft/s
FMX	37 kips
DFN	0.86 in
MEX	1086 µE
AMX	3426 g's
LE	48.70 ft
AR	1.15 in ²
EM	30000 ksi
SP	0.492 k/ft ³
WS	16807.9 ft/s
WC	16793.1 ft/s
JC	0.90
JF	1.00

F1: [746AWJ1] 222.05 PDICAL (1) FF1
 F2: [746AWJ2] 222.19 PDICAL (1) FF1
 A3 (PR): [K14007] 407.233 mv/6.4v/5000g (1) VF1
 A4 (PR): [K14006] 375.226 mv/6.4v/5000g (1) VF1



BN 13
 05Sep2024 10:42:13 AM

CSX	31.5 ksi
DMX	1.01 in
EFV	320 ft-lb
ETR	91.4 %
BPM	53.7 bpm
RAT	1.1
VMX	19.6 ft/s
FMX	36 kips
DFN	0.86 in
MEX	1049 µE
AMX	4077 g's
LE	53.70 ft
AR	1.15 in ²
EM	30000 ksi
SP	0.492 k/ft ³
WS	16807.9 ft/s
WC	16781.3 ft/s
JC	0.90
JF	1.00

F1: [746AWJ1] 222.05 PDICAL (1) FF1
 F2: [746AWJ2] 222.19 PDICAL (1) FF1
 A3 (PR): [K14007] 407.233 mv/6.4v/5000g (1) VF1
 A4 (PR): [K14006] 375.226 mv/6.4v/5000g (1) VF1

Exhibit B

SPT Analyzer Literature and Equipment Calibrations



PI SPT Analyzer

SPT Analyzer

Measures the energy transferred into an instrumented SPT rod during a Standard Penetration Test (SPT)

Reliable. Simplified. Rugged.

The SPT Analyzer determines the energy transferred by SPT hammers using force and velocity measurements, for improved reliability of SPT N-values.

What is SPT?

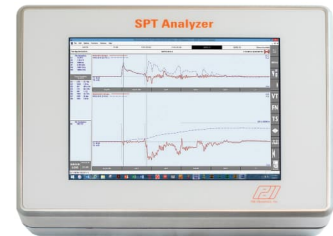
The Standard Penetration Test (SPT) is a widely-employed soil exploration tool that involves using an SPT hammer to drive a split sampler at the bottom of a drill string to obtain soil samples. The number of blows required to penetrate the last 300mm (1ft) is the "N value" which is related to soil strength.

Why measure the energy transferred by the SPT hammer?

Several different types of SPT hammers are used to conduct Standard Penetration Tests. Their varying efficiencies influence the N value. The measured N value is normalized by multiplying it by the ratio of the measured energy transferred to the rod to 60% of the theoretical potential energy. The normalization compensates for the variability of the efficiencies of different SPT hammer types, and improves the reliability of soil strength estimates used in geotechnical applications.

The SPT Analyzer is furnished with a 0.6m sub assembly (or section) of an SPT rod (AW, NW or other type) instrumented with two strain gage bridges, and calibrated by Pile Dynamics. Once in the field, two accelerometers are bolted to the rod section. The instrumented section is inserted at the top of the drill string between the hammer and the existing sampling rod. The sensors on the rod are connected to the SPT Analyzer.

Smart Sensor technology allows the SPT Analyzer to read the rod instrumentation, obtaining the sensor calibration and rod cross sectional area.



- Calculates energy transferred by SPT hammers using force and velocity measurements
- Determines N value to help improve reliability of soil strength estimates
- Offers simplified reporting and analysis option to speed testing results
- Operates in English, SI, or Metric units



EN ISO 22486-3:2005/ASTM Compliant

The SPT Analyzer is compliant with EN ISO 22476-3:2005. ASTM D1586 recommends normalizing results from any SPT test using energy measurements. When these tests are performed to determine the liquefaction potential of sands, ASTM D6066 not only recommends but mandates the normalization. ASTM D4633 states that the only acceptable method of determining energy for normalization of N values is by force and velocity measurements.

These quantities are input to the SPT Analyzer automatically. This significantly simplifies the initial test setup.

The strain gages and accelerometers obtain the force and velocity signals necessary for the calculation of transferred energy to the drill string for each hammer blow. The energy is displayed in real time on the SPT Analyzer screen.

Output

SPT Analyzer data is stored and transferred to a computer via USB memory stick. The software furnished with the SPT Analyzer has a Report Creation Option that makes it quick and easy to summarize results and create output graphs of Force, Velocity, Energy and Displacement versus Time, as well as numerical, statistical, and graphical results for each data set. The software is fully customizable.



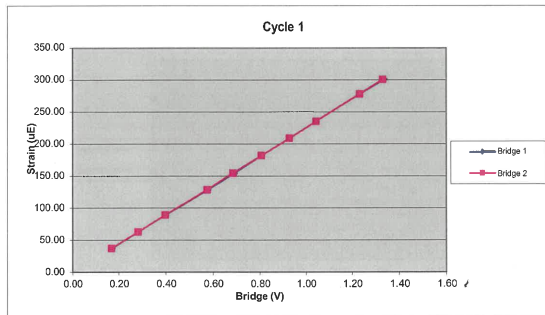
Pile Dynamics, Inc. (PDI) is the world leader in developing, manufacturing and supplying state of the art QA/QC products and systems for the deep foundations industry. The company is headquartered in Cleveland, Ohio, USA, with offices and representatives worldwide. For additional information visit us at www.pile.com or contact info@pile.com.

www.pile.com | +1 (216) 831-6131 | info@pile.com

746AWJ		Cycle 1		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1296.93	37.22	0.17	0.17
3	2135.32	62.74	0.28	0.28
4	3028.79	89.39	0.40	0.40
5	4377.09	128.61	0.58	0.57
6	5243.07	154.57	0.69	0.68
7	6143.17	181.90	0.81	0.81
8	7067.05	208.93	0.93	0.93
9	7958.18	235.42	1.04	1.05
10	9380.66	278.02	1.23	1.23
11	10161.74	300.76	1.34	1.33

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7605.07	Force Calibration (lb/V)	7606.74
Offset	-0.16	Offset	12.66
Correlation	0.999997	Correlation	0.999990
Strain Calibration (µE/V)	225.99	Strain Calibration (µE/V)	226.04
Offset	-1.01	Offset	-0.63
Correlation	0.999989	Correlation	0.999992

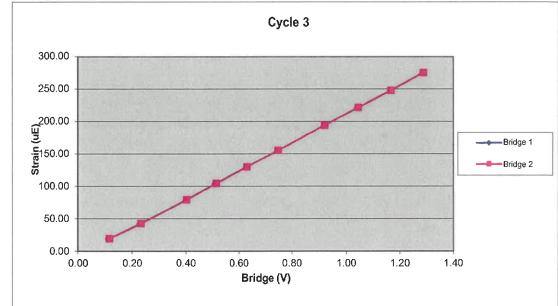
Force Strain Calibration	
EA (Kips)	33651.50
Offset	33.98
Correlation	0.999994



746AWJ		Cycle 3		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	898.16	19.27	0.11	0.12
3	1786.75	42.28	0.23	0.23
4	3083.67	79.12	0.40	0.40
5	3943.80	104.13	0.51	0.51
6	4839.52	129.87	0.63	0.63
7	5750.14	155.24	0.75	0.75
8	7079.92	194.22	0.92	0.92
9	8007.70	221.43	1.04	1.05
10	8943.28	247.95	1.17	1.17
11	9871.55	275.44	1.29	1.29

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7659.96	Force Calibration (lb/V)	7667.39
Offset	13.76	Offset	-1.59
Correlation	0.999999	Correlation	0.999998
Strain Calibration (µE/V)	219.43	Strain Calibration (µE/V)	219.64
Offset	-7.95	Offset	-8.39
Correlation	0.999934	Correlation	0.999939

Force Strain Calibration	
EA (Kips)	34904.41
Offset	291.93
Correlation	0.999935



Accelerometer Calibration Certificate Pile Dynamics, Inc.



Calibrated by Pile Dynamics, Inc.
Calibration performed on **MAY 16 2024**

Serial No: K14006 Temperature: 24.0 °C
Model: PR Humidity: 42%
Calibrated on: Channel 3 on 8G 5161 LE

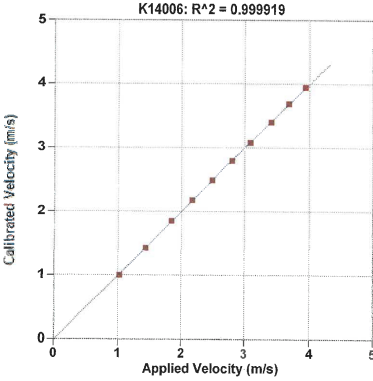
PDA CALIBRATION FACTOR
375.2 mv/5000g
(75.0 μ v/g)
R²: 0.999919 [Chip programmed]

Operator: William Johnson

Signed

Ref Acc 1: 78268! Cal on: 11Jan2024
986 g/s/volt
Ref Acc 2: 78270! Cal on: 11Jan2024
971 g/s/volt

Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).



Reference Velocity	S/N K14006 Velocity
m/s	m/s
1.015	1.001
1.426	1.425
1.839	1.850
2.171	2.177
2.489	2.491
2.800	2.796
3.087	3.078
3.408	3.397
3.681	3.688
3.938	3.946

Maximum Acceleration: 848 g/s

Version: 2020.30.170 -0.17

Accelerometer Calibration Certificate Pile Dynamics, Inc.



Calibrated by Pile Dynamics, Inc.
Calibration performed on **MAY 16 2024**

Serial No: K14007 Temperature: 23.8 °C
Model: PR Humidity: 42%
Calibrated on: Channel 4 on 8G 5161 LE

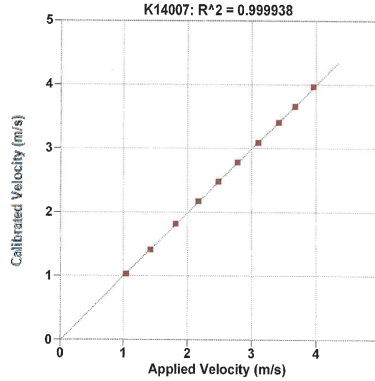
PDA CALIBRATION FACTOR
407.2 mv/5000g
(81.4 μ v/g)
R²: 0.999938 [Chip programmed]

Operator: William Johnson

Signed

Ref Acc 1: 78268! Cal on: 11Jan2024
986 g/s/volt
Ref Acc 2: 78270! Cal on: 11Jan2024
971 g/s/volt

Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).



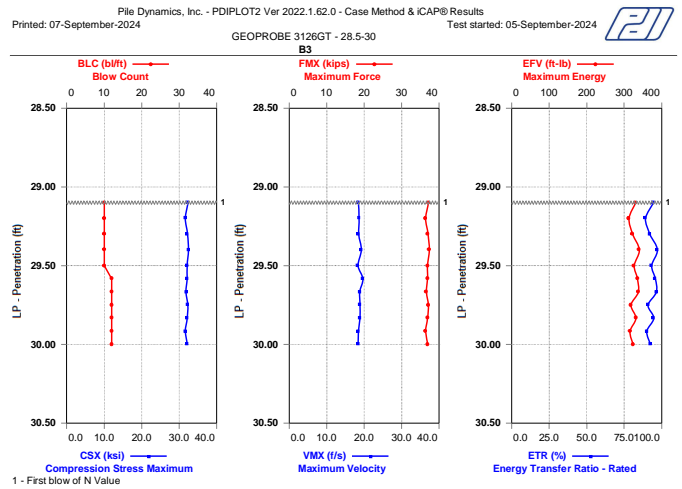
Reference Velocity	S/N K14007 Velocity
m/s	m/s
1.042	1.032
1.417	1.411
1.812	1.817
2.168	2.173
2.478	2.483
2.777	2.783
3.098	3.090
3.411	3.406
3.666	3.657
3.955	3.967

Maximum Acceleration: 852 g/s

Version: 2020.30.170 -0.28



Exhibit C
SPT Analyzer Results





Case Method & iCAP® Results

GEOPROBE 3126GT - 28.5-30
OP: RW
Date: 05-September-2024
B3

AR: 1.15 in² SP: 0.492 klf²
LE: 33.70 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

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

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

BL#	Depth ft	BLC b/ft	FMX kips	VMX f/s	EMX ft-lb	EFV ft-lb	ETR (%)	BPM bpm	DMX in	DFN in	CSX ksi
5	29.10	10	37	18.4	331.0	331.0	94.6	53.1	1.58	1.20	32.3
6	29.20	10	36	18.7	312.7	312.7	89.3	53.4	1.47	1.20	31.7
7	29.30	10	37	18.5	323.0	323.0	92.3	53.6	1.54	1.20	32.2
8	29.40	10	37	19.2	340.4	340.4	97.3	53.4	1.57	1.20	32.5
9	29.50	10	37	18.4	326.6	326.6	93.3	53.5	1.48	1.20	32.1
10	29.58	12	37	19.6	335.5	335.5	95.9	53.3	1.41	1.00	32.1
11	29.67	12	37	18.8	338.0	338.0	96.6	53.7	1.58	1.00	31.8
12	29.75	12	37	18.9	318.3	318.3	90.9	53.5	1.37	1.00	32.3
13	29.83	12	37	18.9	331.4	331.4	94.7	53.8	1.11	1.00	32.1
14	29.92	12	36	18.5	315.2	315.2	90.1	53.8	1.09	1.00	31.7
15	30.00	12	37	18.4	324.1	324.1	92.6	53.6	1.07	1.00	32.1
Average			37	18.8	326.9	326.9	93.4	53.5	1.39	1.09	32.1
Std. Dev.			0	0.4	8.8	8.8	2.5	0.2	0.19	0.10	0.3
Maximum			37	19.6	340.4	340.4	97.3	53.8	1.58	1.20	32.5
Minimum			36	18.4	312.7	312.7	89.3	53.1	1.07	1.00	31.7

Total number of blows analyzed: 11

BL# Sensors

5-15 F1: [746AWJ1] 222.1 (1.00); F2: [746AWJ2] 222.2 (1.00); A3: [K14007] 407.2 (1.00); A4: [K14006] 375.2 (1.00)

BL# Comments

5 First blow of N Value

Time Summary

Drive 15 seconds 10:07 AM - 10:07 AM BN 1 - 15



Case Method & iCAP® Results

GEOPROBE 3126GT - 38.5-40
OP: RW
Date: 05-September-2024
B3

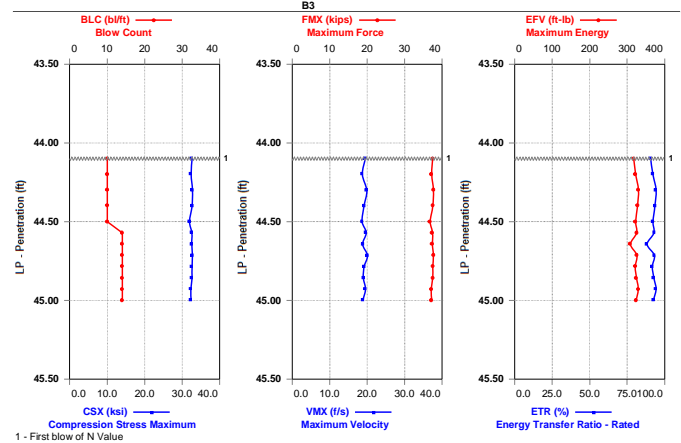
AR: 1.15 in² SP: 0.492 klf²
LE: 43.70 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

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

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

BL#	Depth ft	BLC b/ft	FMX kips	VMX f/s	EMX ft-lb	EFV ft-lb	ETR (%)	BPM bpm	DMX in	DFN in	CSX ksi
7	39.05	20	36	18.7	320.4	320.4	91.5	53.3	0.91	0.60	31.6
8	39.10	20	36	18.5	313.6	313.6	89.6	53.2	0.65	0.60	31.6
9	39.15	20	37	18.9	318.4	318.4	91.0	53.4	0.66	0.60	32.1
10	39.20	20	37	18.9	309.8	309.8	88.5	53.5	0.64	0.60	31.9
11	39.25	20	37	19.1	321.4	321.4	91.8	53.2	0.93	0.60	31.9
12	39.30	20	36	18.5	309.3	309.3	88.4	53.5	0.64	0.60	31.5
13	39.35	20	37	19.5	320.6	320.6	91.6	53.0	0.69	0.60	31.9
14	39.40	20	36	18.4	314.3	314.3	89.8	53.3	0.80	0.60	30.9
15	39.45	20	37	19.5	326.5	326.5	93.3	53.5	0.92	0.60	32.0
16	39.50	20	36	18.6	320.6	320.6	91.6	53.5	1.02	0.60	31.7
17	39.55	20	37	19.1	316.4	316.4	90.4	53.7	0.68	0.60	31.8
18	39.60	20	36	19.0	312.4	312.4	89.2	53.3	0.66	0.60	31.7
19	39.65	20	36	18.8	315.8	315.8	90.2	53.5	0.70	0.60	31.1
20	39.70	20	36	19.2	320.1	320.1	91.5	53.4	0.78	0.60	31.1
21	39.75	20	36	19.5	320.9	320.9	91.7	53.3	0.63	0.60	31.0
22	39.80	20	37	19.2	317.1	317.1	90.6	53.5	0.74	0.60	31.7
23	39.85	20	36	18.8	315.1	315.1	90.0	53.5	0.61	0.60	31.1
24	39.90	20	36	19.7	333.6	333.6	95.3	53.5	0.83	0.60	31.3
25	39.95	20	36	19.6	323.9	323.9	92.6	53.4	0.66	0.60	31.7
26	40.00	20	35	18.9	313.5	313.5	89.6	53.5	0.60	0.60	30.6
Average			36	19.0	318.2	318.2	90.9	53.4	0.74	0.60	31.5
Std. Dev.			0	0.4	5.6	5.6	1.6	0.1	0.12	0.00	0.4
Maximum			37	19.7	333.6	333.6	95.3	53.7	1.02	0.60	32.1
Minimum			35	18.4	309.3	309.3	88.4	53.0	0.60	0.60	30.6

Total number of blows analyzed: 20



BL# Sensors

7-26 F1: [746AWJ1] 222.1 (1.00); F2: [746AWJ2] 222.2 (1.00); A3: [K14007] 407.2 (1.00); A4: [K14006] 375.2 (1.00)

BL# Comments

7 First blow of N Value

Time Summary

Drive 28 seconds 10:24 AM - 10:24 AM BN 1 - 26



Case Method & iCAP® Results

GEOPROBE 3126GT - 43.5-45
OP: RW
Date: 05-September-2024

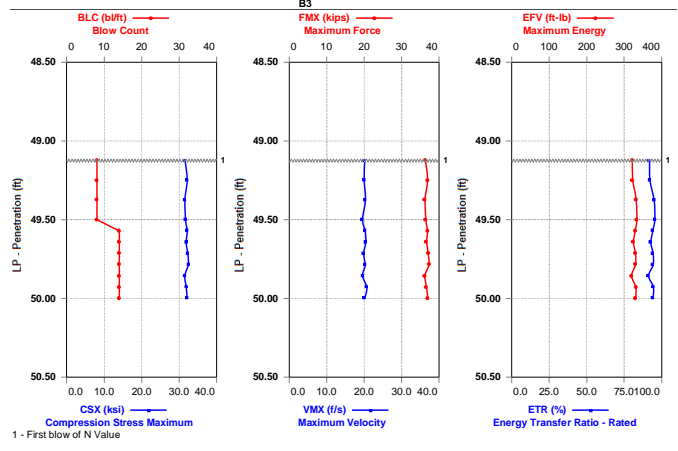
AR: 1.15 in² SP: 0.492 k/ft²
LE: 48.70 ft EM: 30,000 ksi
WS: 16.807 g f/s JC: 0.00

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

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

BL#	Depth ft	BLC b/ft	FMX kips	VMX f/s	EMX ft-lb	EFV ft-lb	ETR (%)	BPM bpm	DMX in	DFN in	CSX ksi
5	44.10	10	37	19.5	317.4	317.4	90.7	53.2	1.23	1.19	32.6
6	44.20	10	37	18.7	322.7	322.7	92.2	53.3	1.22	1.20	32.4
7	44.30	10	38	19.9	330.1	330.1	94.3	53.4	1.30	1.20	32.8
8	44.40	10	38	19.2	327.2	327.2	93.5	53.5	1.22	1.20	32.6
9	44.50	10	37	18.6	323.0	323.0	92.3	53.5	1.21	1.20	32.0
10	44.57	14	37	19.7	325.2	325.2	92.9	53.4	0.95	0.85	32.6
11	44.64	14	37	18.8	309.1	309.1	88.3	53.6	0.90	0.85	32.5
12	44.71	14	38	20.1	326.0	326.0	93.2	53.5	1.06	0.86	32.8
13	44.79	14	37	19.2	321.1	321.1	91.8	53.4	1.05	0.86	32.6
14	44.86	14	37	19.0	324.7	324.7	92.8	53.4	0.91	0.86	32.6
15	44.93	14	37	19.5	329.6	329.6	94.2	53.5	0.99	0.86	32.3
16	45.00	14	37	18.8	323.5	323.5	92.4	53.4	0.89	0.86	32.3
Average			37	19.3	323.3	323.3	92.4	53.4	1.08	1.00	32.5
Std. Dev.			0	0.5	5.5	5.5	1.6	0.1	0.15	0.17	0.2
Maximum			38	20.1	330.1	330.1	94.3	53.6	1.30	1.20	32.8
Minimum			37	18.6	309.1	309.1	88.3	53.2	0.89	0.85	32.0

Total number of blows analyzed: 12



BL# Sensors

5-16 F1: [746AWJ1] 222.1 (1.00); F2: [746AWJ2] 222.2 (1.00); A3: [K14007] 407.2 (1.00);
A4: [K14006] 375.2 (1.00)

BL# Comments

5 First blow of N Value

Time Summary

Drive 16 seconds 10:32 AM - 10:33 AM BN 1 - 16



Case Method & iCAP® Results

GEOPROBE 3126GT - 48.5-50
OP: RW
Date: 05-September-2024

AR: 1.15 in² SP: 0.492 k/ft²
LE: 53.70 ft EM: 30,000 ksi
WS: 16.807 g f/s JC: 0.00

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

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

BL#	Depth ft	BLC b/ft	FMX kips	VMX f/s	EMX ft-lb	EFV ft-lb	ETR (%)	BPM bpm	DMX in	DFN in	CSX ksi
5	49.13	8	36	20.1	321.6	321.6	91.9	53.3	1.81	1.50	31.6
6	49.25	8	37	20.1	323.0	323.0	92.3	53.4	1.81	1.50	32.1
7	49.38	8	36	20.3	332.2	332.2	94.9	53.5	1.50	1.50	31.5
8	49.50	8	36	19.6	334.0	334.0	95.4	53.3	1.50	1.50	31.7
9	49.57	14	37	20.3	329.3	329.3	94.1	53.8	0.87	0.86	32.1
10	49.64	14	37	20.4	324.8	324.8	92.8	53.4	1.00	0.86	31.9
11	49.71	14	37	19.9	329.7	329.7	94.2	53.2	0.89	0.86	32.2
12	49.79	14	37	20.2	330.1	330.1	94.3	53.7	0.89	0.86	32.4
13	49.86	14	36	19.6	319.8	319.8	91.4	53.7	1.01	0.86	31.5
14	49.93	14	37	20.7	331.0	331.0	94.6	53.1	0.91	0.86	31.9
15	50.00	14	37	20.1	330.2	330.2	94.4	53.2	1.03	0.86	32.1
Average			37	20.1	327.8	327.8	93.7	53.4	1.20	1.09	31.9
Std. Dev.			0	0.3	4.5	4.5	1.3	0.2	0.36	0.31	0.3
Maximum			37	20.7	334.0	334.0	95.4	53.8	1.81	1.50	32.4
Minimum			36	19.6	319.8	319.8	91.4	53.1	0.87	0.86	31.5

Total number of blows analyzed: 11

Exhibit D
Field Log

BL# Sensors

5-15 F1: [746AWJ1] 222.1 (1.00); F2: [746AWJ2] 222.2 (1.00); A3: [K14007] 407.2 (1.00);
A4: [K14006] 375.2 (1.00)

BL# Comments

5 First blow of N Value

Time Summary

Drive 15 seconds 10:42 AM - 10:42 AM BN 1 - 15



SPT HAMMER CALIBRATION FIELD WORKSHEET

PROJECT NAME: 7324515
PROJECT NO.: Terracon Assets Site
BORING NO.: 8-3
CLIENT:

ARRIVAL TIME:
DEPART TIME:
TOTAL TRAVEL:
TOTAL TIME:
CLIENT REP:
MILEAGE:

DATE: 9/5/24
TERRACON REP: RW
PDA MODEL/SN: SPT 402 TR
TERRACON RIG #: 1327

DRILL RIG DATA

Type/Transport: Truck
Manufacturer: Goode
Model No.: 3126 GS
Serial No.: 31265V224106
Year Built: 2024
Modifications: N/A
Maint. Schedule: 50 hrs

SPT HAMMER DATA

Type: A10
Manufacturer: Goode
Lifting Mechanism: Chain
Model No.: AD131
Serial No.: 10001
Hammer Weight: 140
Hammer Operator(s): B. Bennett

PDA INPUT DATA

Operator: OP RW
Project No./Location: PJ 7324515/
Rig Model & SN: PN Goode/3126 GS
Hammer Type, LM, Rods: PD A10/AWJ
Drill Rod Area (in²): AR 115
Elastic Modulus (ksi): EM 3000
Specific Weight (kips/ft³): SP 0.492
Wave Speed (ft/sec): WS 16808
Increment Length (ft): LI 0.5
Sampling Freq. (kHz): FR 50

TRANSDUCER INFORMATION

Gage SN Calibration
F1/F3: 746 AWJ1 222.05
F2/F4: 746 AWJ2 222.19
A1/A3: K14002 407.23
A2/A4: K14006 375.23
NOTES: 286 + 25 + .875 = 288.7
34 3/8 + 25 + 10.5 = 28.7
SPLIT SPOON SAMPLER LENGTH 288 + 0.88 = 3.5
LE is measured from the center of the strain gauges to the bottom of split spoon sampler

SPT TESTING INFORMATION

Table with columns: Start Time, Soil, Stick Up Length (ft), Depth (ft) Start/End, LE (ft), Rods & Lengths, PDA Blows Start/End, SPT Blows 1st 6"/2nd 6"/3rd 6"/4th 6".

Individual pairs of F or V signals versus time shall be very similar for good quality data.
If you see Force goes negative before 2L/C 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

Exhibit E

Copy of Certificate of Proficiency



This documents that
Susheel R. Kolwalker
Terracon Consultants
has on March 11, 2016 achieved the rank of
EXPERT

on the Dynamic Measurement and Analysis Proficiency Test.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations.

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc.

Steven A. Hall, Executive Director
Pile Driving Contractors Association

Gardner Likins, Senior Partner
Pile Dynamics, Inc.

No. 2005



This documents that
Ryan Wakeford
Terracon Consultants, Inc.
has on March 15, 2019 achieved the rank of
INTERMEDIATE

on the Dynamic Measurement and Analysis Proficiency Test.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. It is recommended that individuals at the Intermediate level seek Advanced, Master or Expert levels through additional study within four years of the date of this document.

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc.

Frank T. Peters, Executive Director
Pile Driving Contractors Association

Gardner Likins, Senior Partner
Pile Dynamics, Inc.

No. 2898