

REVISED

GEOTECHNICAL BASE LINE REPORT

Route S-30-110 Replacement Bridge over North Lick Creek
Laurens County, South Carolina



PREPARED FOR

SCDOT

955 Park Street

Columbia, South Carolina 29201

PREPARED BY

F&ME Consultants, Inc.

1825 Blanding Street

Columbia, South Carolina 29201

SCDOT Project ID: P038300

F&ME Project #: G6100.05.04

October 23, 2019

October 23, 2019

Trapp Harris, P.E.
Design-Build Group Geotechnical Engineer
South Carolina Department of Transportation
955 Park Street
Columbia, South Carolina 29201

Re: Closed and Load-Restricted Bridge Package 2020-1
REVISED Geotechnical Base Line Report
Route S-30-110 Bridge over North Lick Creek
Laurens County, South Carolina
SCDOT Project ID: P038300
F&ME Project No.: G6100.050.04

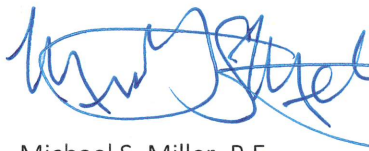
Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc. (FME) revised Geotechnical Base Line Report (GBLR) for the Route S-30-110 Replacement Bridge over North Lick Creek. Revisions to our previously submitted report include the corrosion series laboratory test results. This report contains findings from our subsurface field exploration, results from the laboratory testing program, and conceptual geotechnical assessment of approach embankments and bridge foundation systems.

It has been a pleasure working with you on this project and we appreciate the opportunity to be of service. Please notify us if there are any questions or if we may be of further assistance.

Sincerely,

F&ME Consultants, Inc.

A handwritten signature in blue ink, appearing to read 'Michael S. Miller', written over a circular professional engineer stamp.

Michael S. Miller, P.E.
Senior Geotechnical Engineer



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1.0 INTRODUCTION

FME performed geotechnical soil test borings and laboratory testing for the Route S-30-110 Replacement Bridge over North Lick Creek located in Laurens County, South Carolina. A Site Location Plan is presented as Figure 1 in Section 1 in the Appendix of this report. The South Carolina Department of Transportation (SCDOT) Scope of Services Work Request for the geotechnical subsurface exploration and laboratory testing was issued on March 1, 2019.

The field investigation consisted of performing soil test borings (STB's) with associated Standard Penetration Testing (SPT) and rock core sampling. Laboratory testing was performed on selected soil and rock core samples collected from the test borings. The exploration methods and laboratory procedures were conducted in general accordance with the current American Association of State Highway and Transportation Officials (AASHTO), American Society of Testing and Materials (ASTM) Standards, and the SCDOT Geotechnical Design Manual (GDM). This Geotechnical Base Line Report was prepared in general accordance with the 2019 SCDOT Geotechnical Design Manual (GDM), Version 2.0. along with PCDM-11 Supplemental Design Criteria for Low Volume Bridge Replacement Projects.

2.0 FIELD EXPLORATION SUMMARY

On June 3 and 4, 2019, F&ME performed two (2) soil test borings (STB's). The test boring locations were performed in proximity to the existing bridge end bent locations. The intent of the subsurface investigation was to provide a broad indication of the subsurface conditions at the site.

The STB's were advanced using a CME 45B trailer mounted drill rig with an automatic standard penetration test (SPT) hammer system. Rotary wash drilling techniques were used during drilling to maintain a stable borehole. Standard split-spoon sampling was performed continuously over the first ten (10) feet of the boring depth and at five (5) foot intervals thereafter. Soil test borings were advanced to a drilling refusal condition and subsequently advanced into rock using NQ rock coring techniques. Details of each STB are included on the individual Soil Test Boring Logs in Section 4 in the Appendix of this report.

2.1 Soil Test Borings (STB's)

The following table is a summary of the STB designations, exploration depths, locations, and ground surface elevations of the test boring locations.

Table 1 – Soil Test Boring Summary Table

SOIL TEST BORINGS (STB)							
Test Hole No.	Surface Condition	Soil Depth (ft.)	Rock Core Depth (ft.)	Total Boring Depth (ft.)	Latitude	Longitude	Elev. (ft.-MSL)
B-601	Paved Roadway	51.2	9.9	61.1	34.543195	-82.110723	579.5
B-602	Paved Roadway	45.3	10.0	55.3	34.543236	-82.110841	579.3
Totals	-	96.5	19.9	116.4			

2.2 Groundwater

Groundwater depths were recorded at the time of boring (TOB) for soil test borings B-601 and B-602, with the recorded measurements noted on the individual Soil Test Boring Logs in Section 4 of the Appendix to this report. Soil test borings B-601 and B-602 was backfilled following TOB groundwater measurements. The following table is a summary of the groundwater measurements for the soil test borings at time of boring and at twenty-four (24) hours following boring, where recorded.

Table 2 – Groundwater Depth Summary Table

GROUNDWATER DEPTH			
Boring No.	Date of TOB Groundwater Measurement	TOB Groundwater Depth (ft.)	24-hr. Groundwater Depth (ft.)
B-601	6/3/2019	6.2	Backfilled
B-602	6/4/2019	7.0	Backfilled

3.0 LABORATORY TESTING

Following completion of F&ME's field investigation, select split-spoon samples were tested in FME's AASHTO accredited laboratory to determine applicable physical and engineering properties. Four (4) rock core specimens were sent to Geotechnical Testing Services, Inc. and tested for unconfined compressive strength testing and Young's Modulus determinations. One (1) split-spoon sample was sent to an off-site AASHTO accredited laboratory for corrosion series testing. All laboratory testing was performed in general accordance with procedures set forth in the most current AASHTO and ASTM standards.

The laboratory testing performed for the split-spoon samples and rock cores are detailed in the table below. Data sheets containing the results of the laboratory testing program are provided in Section 7 of the Appendix.

Table 3 – Laboratory Testing Summary Table

LABORATORY AND ROCK TESTING		
Type of Test	Quantity	Procedure
Grain Size Analysis with Hydrometer	5	AASHTO T88
Grain Size Analyses with Wash 200	3	AASHTO T11
Atterberg Limits	3	AASHTO T89/T90
Natural Moisture Content	7	ASTM D2216
pH	1	AASHTO T289
Resistivity	1	AASHTO T288
Chloride Content	1	AASHTO T291
Sulfate Content	1	AASHTO T290
Rock Core Compressive Strength and Young's Modulus	4	ASTM D7012 Methods C and D

4.0 SUBSURFACE STRATIGRAPHY

The following table summarizes the soil and rock stratigraphy based on conditions as encountered in the soil test borings performed during this geotechnical subsurface investigation.

Table 4 – Stratigraphy Summary Table

SOIL AND ROCK STRATIGRAPHY					
Strata	Elevation of Top Layer (ft-MSL)	Depth to Top of Layer (ft.)	USCS Soil Type	Avg. SPT N Value (bpf)	Comments
Fill	579	0	GW	13	3'-4' Aggregate Fill
Alluvium	575	4	SP-SM, SM, ML	4	-
Residuum	551	28	SM	38	-
PWR	533	46	SM	100+	-
Bed Rock	531	48	N/A	N/A	Gneiss/Meta-Granite

5.0 CONCEPTUAL GEOTECHNICAL ASSESSMENT

Relative to the SCDOT's Supplemental Design Criteria for Low Volume Bridge Replacement Projects, the soil subgrade below the new embankment areas are anticipated to be adequate for embankment construction.

We anticipate that pile foundations will be preferred for support of the bridge abutments. The Strength Case axial loadings will likely govern the geotechnical driven pile design. We anticipate that the soil thickness above weathered rock and bedrock is sufficient to resist the assumed lateral loading conditions, and drilled pile will not be likely. We anticipate that the piles will be driven to a practical refusal driving condition on weathered rock or sound bedrock. To avoid excessive pile driving stresses, we anticipate that pile driving termination criteria will be based on encountering a pile driving practical refusal condition. Shallow foundation concepts are likely not feasible due to the estimated bearing depth and the presence of groundwater at that depth.

If a multi-span concept is pursued, the selection of the interior bent foundation type will be predicated on the scour depth relative to the bent location(s). For an assumed scour depth and channel geometry, FME anticipates that driven pile concepts may or may not be feasible based on the soil thickness above rock to resist the lateral loads. We anticipate that drilled shafts will be the most feasible foundation type for the interior bent(s). The drilled shafts will consist of construction casing and rock sockets below the casing tip elevation. We expect the Strength Case axial loadings will govern the drilled shaft design. Based on the performed borings, the rock strengths range on the order from about 15,500 psi to 31,200 psi.

S-30-110 Replacement Bridge over North Lick Creek

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APPENDIX

SECTION 1	SITE LOCATION PLAN
SECTION 2	BORING LOCATION PLAN
SECTION 3	DRILL RIG PHOTOS
SECTION 4	TEST BORING LOGS
SECTION 5	GENERALIZED SOIL PROFILE
SECTION 6	ROCK CORE PHOTOS
SECTION 7	LABORATORY TEST RESULTS

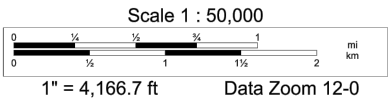
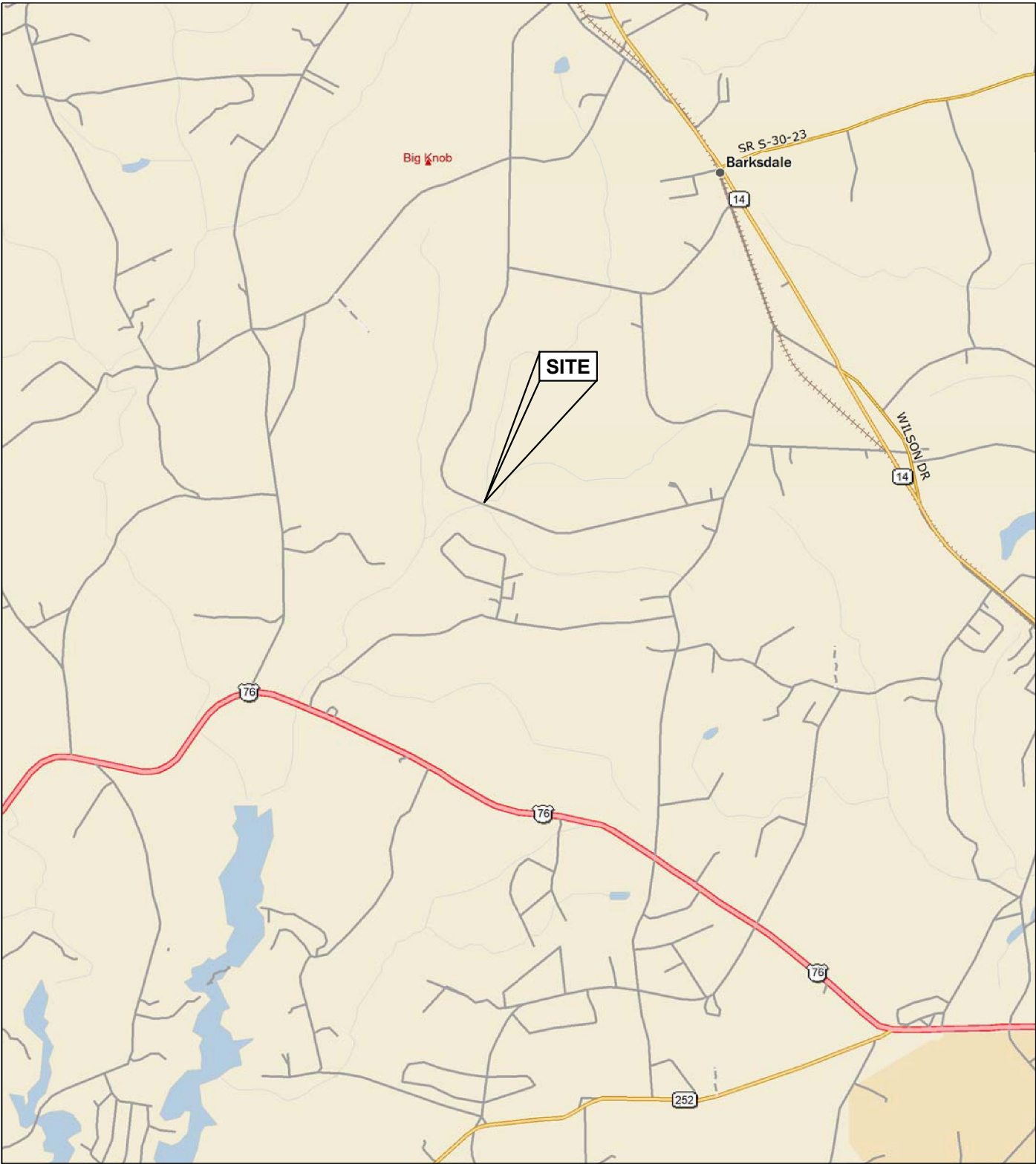
S-30-110 Replacement Bridge over North Lick Creek

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SECTION 1 SITE LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	LAURENS	P038300	S-30-110	



F&ME CONSULTANTS, INC.
COLUMBIA, SC

4			
3			
2			
1			
REV.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	CTC	DATE 6.3.19	GROUP - -
R/W		DATE	

NORTH LICK CREEK
LAURENS COUNTY, SOUTH CAROLINA

SITE LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: AS NOTED

FIGURE 1

S-30-110 Replacement Bridge over North Lick Creek

Geotechnical Base Line Report

APPENDIX

SECTION 2 BORING LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD/ROUTE NO.	SHEET NO.
3	SC	LAURENS	P038300	S-30-110	



LEGEND:

SOIL TEST BORING LOCATION

4			
3			
2			
1			
REV.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	CTC	DATE 6.3.19	GROUP -- --
R/W		DATE	

F&ME CONSULTANTS, INC.

COLUMBIA, SC

NORTH LICK CREEK LAURENS COUNTY, SOUTH CAROLINA	
BORING LOCATION PLAN	
F&ME JOB NO. G6100.050	
SCALE: 1"=30'	FIGURE 2

S-30-110 Replacement Bridge over North Lick Creek

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APPENDIX

SECTION 3 DRILL RIG PHOTOS

Drill Rig Setup Photographs

B-601



Drill Rig Setup Photographs

B-602



S-30-110 Replacement Bridge over North Lick Creek

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APPENDIX

SECTION 4 TEST BORING LOGS

Soil Test Boring Log Descriptors

Correlation of Penetration Resistance with Relative Density and Consistency














Coarse Grained Soils (Sands/Gravel)		Fine Grained Soils (Silt/Clay)	
SPT Blow Count	Relative Density	SPT Blow Count	Consistency
≤ 4	Very Loose	≤ 2	Very Soft
5 – 10	Loose	3 – 4	Spft
11 – 30	Medium Dense	5 – 8	Firm
31 – 50	Dense	9 – 15	Stiff
≥ 51	Very Dense	16 – 30	Very Stiff
		≥ 31	Hard

Particle Size Identification

















Gravel	Sieve Size
Fine	#4 to ¾ inch
Coarse	¾ inch to 3 inch

Sand	Sieve Size
Fine	#200 to #40
Medium	#40 to #10
Coarse	#10 to #4

Gravel	Sieve Size
Fines Content	< #200

SYMBOL	PRINT CODE*	TYPICAL DESCRIPTION
	SCCT	CONCRETE
	SCAT	ASPHALT
	SCTS	TOPSOIL/PEAT
	SCSAND	SAND
	SCSTSAND	SILTY SAND/SANDY SILT
	SCCLSAND	CLAYEY SAND/SANDY CLAY
	SCCLAY	CLAY
	SCSILT	SILT
	SCSTCLAY	SILTY CLAY/CLAYEY SILT
	SCSAP	SAPROLITE
	SCLS	LIMESTONE
	SCBR	GRANITE (BEDROCK)
	SCMARL	MARL

SOIL CLASSIFICATION CHART

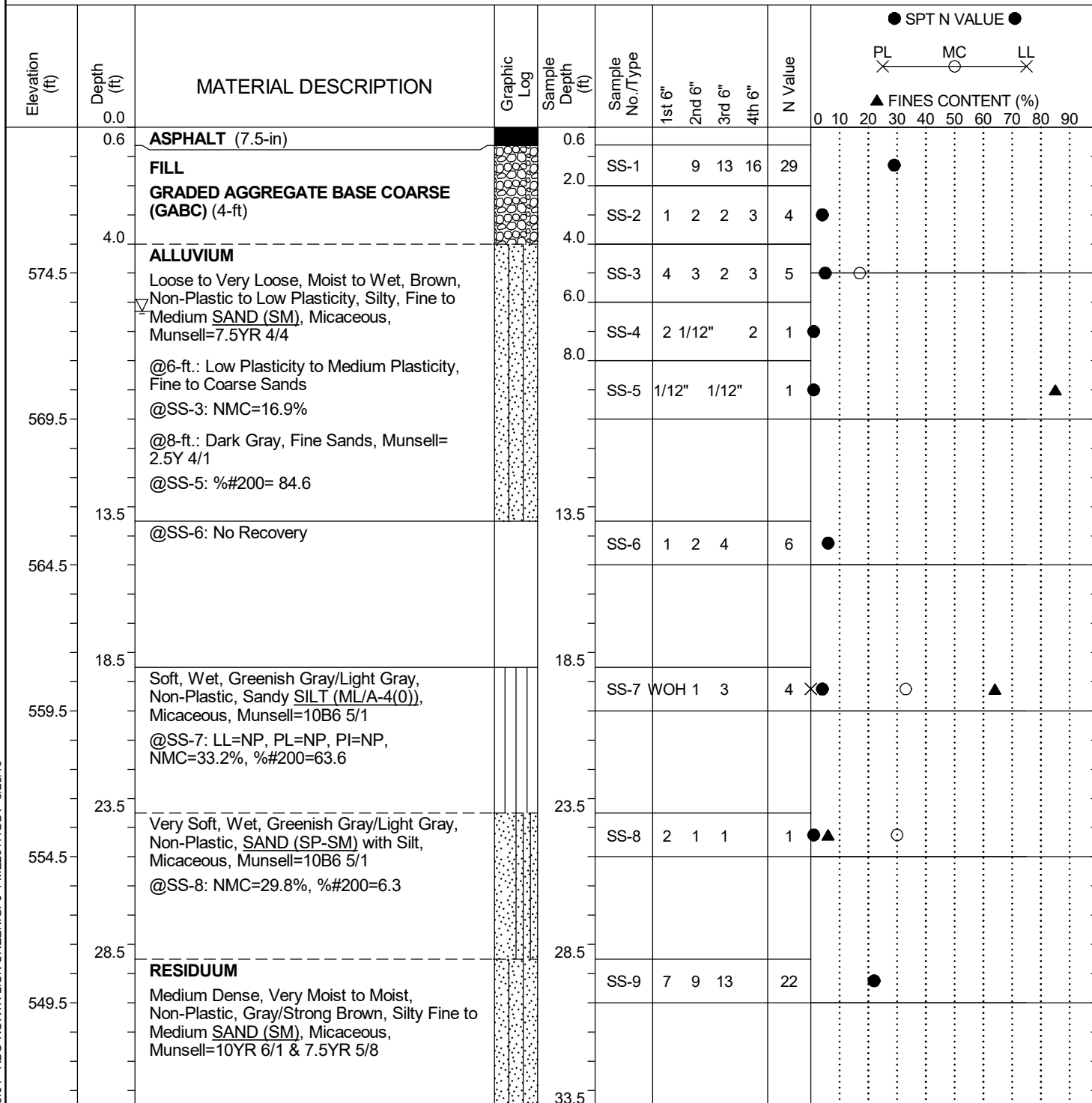
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
FINE GRAINED SOILS	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
HIGHLY ORGANIC SOILS	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		CH	INORGANIC CLAYS OF HIGH PLASTICITY
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
	SANDS AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



SCDOT Soil Test Log

Project ID:	P038300	County:	Laurens	Boring No.:	B-601
Site Description:	S-30-110 Replacement Bridge over North Lick Creek			Route:	S-30-110
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	579.5 ft	Latitude:	34.543195	Longitude:	-82.110723
Date Started:	6/3/2019				
Total Depth:	61.1 ft	Soil Depth:	51.2 ft	Core Depth:	9.9 ft
Date Completed:	6/3/2019				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 45B	Drill Method:	RW/RC
Hammer Type:	Automatic	Energy Ratio:	92%	Core Size:	NQ/8
Driller:	L. Guempel	Groundwater:	TOB	6.3 ft	24HR
					Backfilled



LEGEND

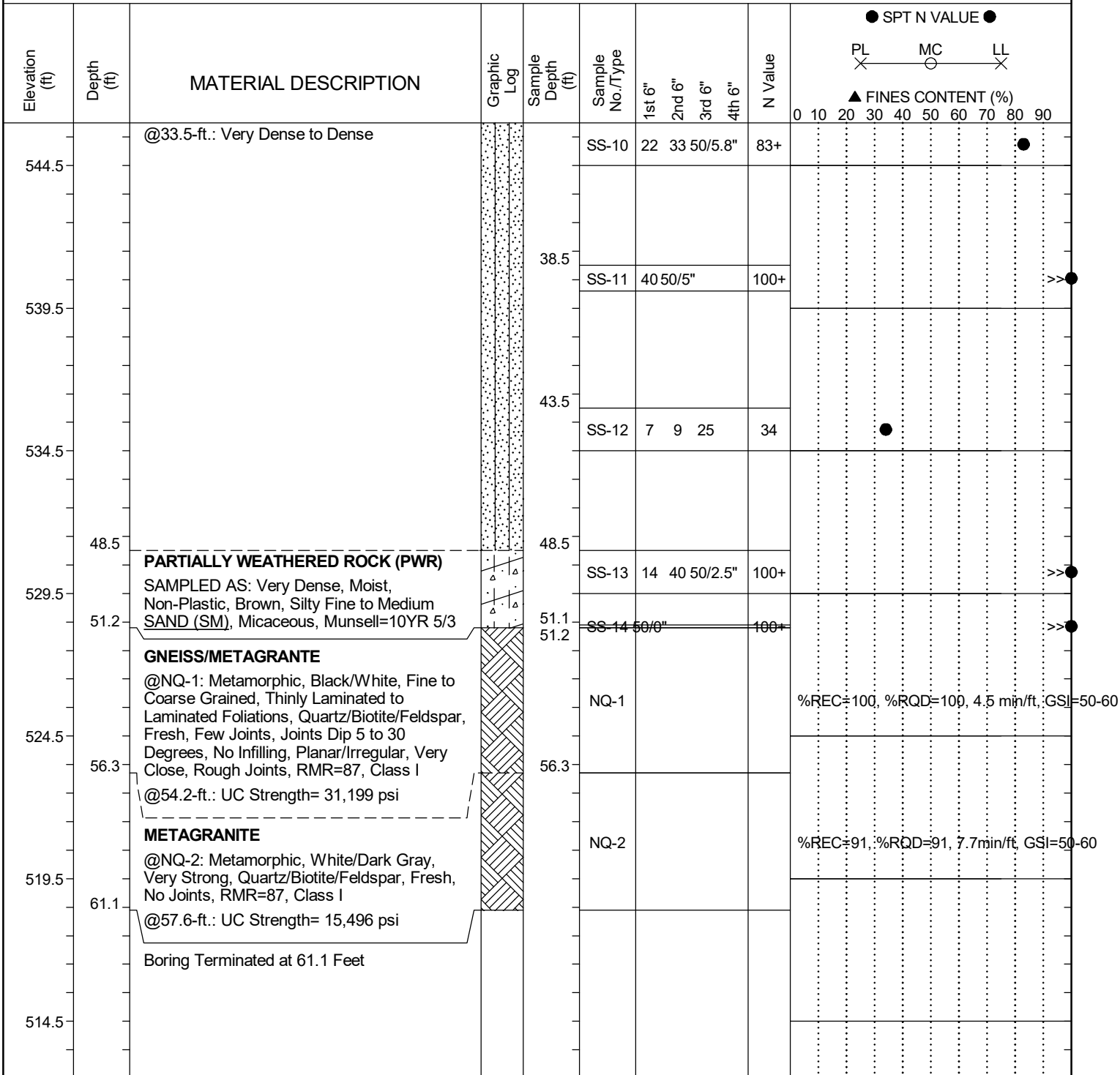
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SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD	
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P038300	County:	Laurens	Boring No.:	B-601
Site Description:	S-30-110 Replacement Bridge over North Lick Creek			Route:	S-30-110
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	579.5 ft	Latitude:	34.543195	Longitude:	-82.110723
Date Started:	6/3/2019				
Total Depth:	61.1 ft	Soil Depth:	51.2 ft	Core Depth:	9.9 ft
Date Completed:	6/3/2019				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 45B	Drill Method:	RW/RC
Hammer Type:	Automatic	Energy Ratio:	92%	Core Size:	NQ/8
Driller:	L. Guempel	Groundwater:	TOB	6.3 ft	24HR
					Backfilled



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:	P038300	County:	Laurens	Boring No.:	B-602
Site Description:	S-30-110 Replacement Bridge over North Lick Creek			Route:	S-30-110
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	579.3 ft	Latitude:	34.543236	Longitude:	-82.110841
Date Started:	6/4/2019				
Total Depth:	55.3 ft	Soil Depth:	45.3 ft	Core Depth:	10 ft
Date Completed:	6/4/2019				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 45B	Drill Method:	RW/RC
Hammer Type:	Automatic	Energy Ratio:	92%	Core Size:	NQ/8
Driller:	L. Guempel	Groundwater:	TOB	7 ft	24HR
					Backfilled

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ●	PL X MC X LL X	▲ FINES CONTENT (%)
	0.0												
	0.4	ASPHALT(4.5-in)		0.4									
		FILL											
	2.0	GRADED AGGREGATE BASE COARSE (GABC) (3-ft)		2.0	SS-1	6	6	5		11	●		
	3.4												
		ALLUVIUM											
	4.0	Loose to Very Loose, Wet, Reddish Brown/Grayish Brown, Non-Plastic, Silty Fine to Medium SAND (SM/A-4(0)), Munsell=5YR 4/4 & 2.5Y 5/2		4.0	SS-2	4	5	3	4	8	●		
	6.0												
		@7-ft.: Micaceous											
	8.0	@SS-5: LL=NP, PL=NP, PI=NP, NMC=37.5%, %200=46.2		8.0	SS-3	2	2	1	2	3	●		
	13.5	@13.5-ft.: Dark Greenish Gray, Munsell=5GY 9/1		13.5	SS-4	1	1	1	2	2	●		
		@SS-6: NMC=26.3%, %200=18.2			SS-5				WOH/24"	0	●	○	▲
	18.5												
		@13.5-ft.: Dark Greenish Gray, Munsell=5GY 9/1											
	18.5	@SS-6: NMC=26.3%, %200=18.2		18.5	SS-6	3	4	5		9	●	▲	○
	23.5	Firm, Moist to Wet, Yellowish Brown, Non-Plastic, Fine to Medium, Fine to Medium Sandy SILT (ML/A-2-4), Munsell= 10YR 5/8		23.5	SS-7	1	2	5		7	●		▲
		@SS-7: %200=56.2											
	28.5	@23.5-ft.: Light Gray, with Trace of Gravel (Fragmented Rock), Munsell=10YR 7/1		28.5	SS-8	3	1	4		5	●		
	33.5	RESIDUUM		33.5	SS-9	5	4	6		10	●	▲	○
		Loose, Moist to Wet, Grayish Brown, Non-Plastic, Silty Fine to Medium SAND (SM), Micaceous, Munsell= 10YR 5/2											
		@SS-9: LL=NP, PL=NP, PI=NP, NMC=28.1%, %200=21.9											

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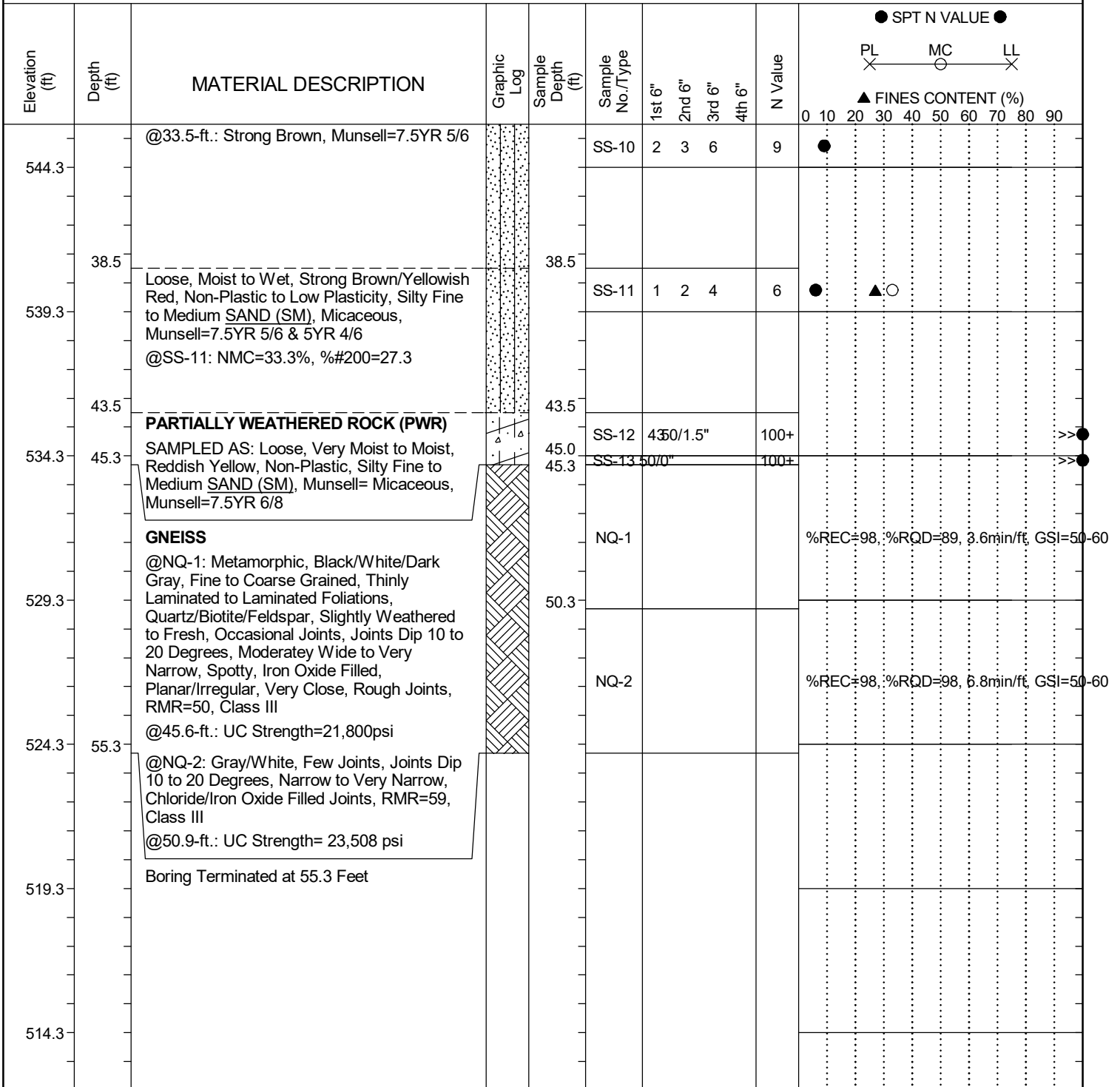
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SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD	
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P038300	County:	Laurens	Boring No.:	B-602
Site Description:	S-30-110 Replacement Bridge over North Lick Creek			Route:	S-30-110
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	579.3 ft	Latitude:	34.543236	Longitude:	-82.110841
Date Started:	6/4/2019				
Total Depth:	55.3 ft	Soil Depth:	45.3 ft	Core Depth:	10 ft
Date Completed:	6/4/2019				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 45B	Drill Method:	RW/RC
Hammer Type:	Automatic	Energy Ratio:	92%	Core Size:	NQ/8
Driller:	L. Guempel	Groundwater:	TOB	7 ft	24HR
					Backfilled



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	

S-30-110 Replacement Bridge over North Lick Creek

Geotechnical Base Line Report

















APPENDIX

SECTION 5 GENERALIZED SUBSURFACE PROFILE

KEY TO SYMBOLS

PROJECT NAME	Closed and Load-Restricted Bridge Package 2020-1 (S-30-110 Bridge Replacement over North Lick Creek)
PROJECT COUNTY	Laurens

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)



	ASPHALT
	GABC (Graded Aggregate Base Course)
	PWR: Partially Weathered Rock
	BEDROCK: Bedrock
	CH: USCS High Plasticity Clay
	CL: USCS Low Plasticity Clay
	CL-ML: USCS Low Plasticity Silty Clay
	MH: USCS Elastic Silt
	ML: USCS Silt
	SP: USCS Poorly Graded Sand
	SM: USCS Silty Sand
	SC: USCS Clayey Sand
	SP-SM: USCS Poorly Graded Sand w/ Silt
	SC-SM: USCS Silty, Clayey Sand
	SP-SC: USCS Poorly Graded Sand w/ Clay
	No Recovery

SOIL TEST ID'S

B-# SOIL TEST BORING

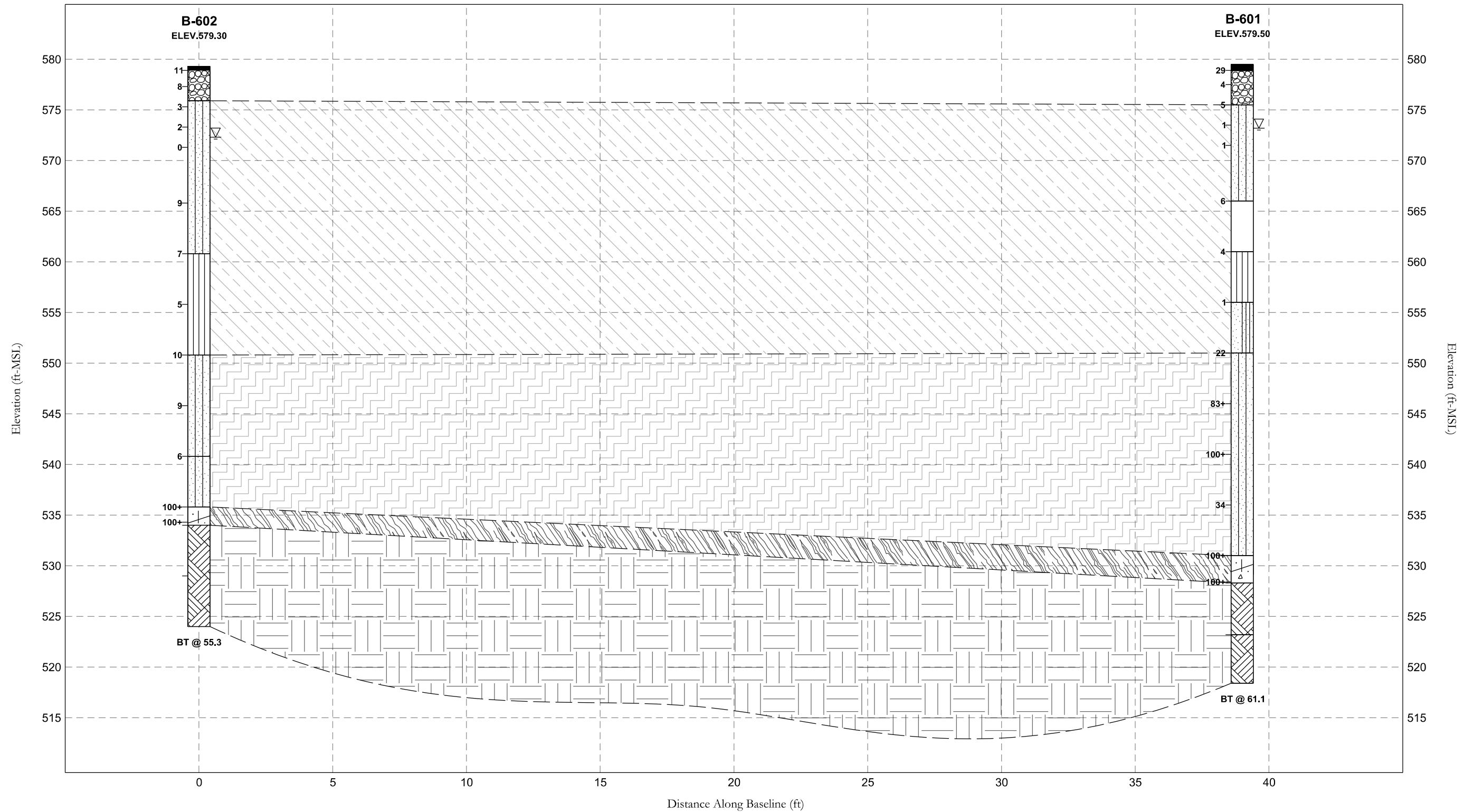
ABBREVIATIONS

- LL - LIQUID LIMIT (%)
- PL - PLASTIC LIMIT (%)
- PI - PLASTIC INDEX (%)
- NMC - MOISTURE CONTENT (%)
- NP - NON PLASTIC
- %#200 - PERCENT PASSING NO. 200 SIEVE

-  Water Level at Time Drilling, or as Shown
-  Water Level at End of Drilling, or as Shown

NOTES


- THE GENERALIZED SUBSURFACE PROFILES ARE PROVIDED ONLY FOR ILLUSTRATIVE PURPOSES. THE INTENT OF THESE DRAWINGS IS TO PROVIDE THE READER WITH VERY GENERAL INFORMATION ON SUBSURFACE CONDITIONS AT THE TIME OF THE INVESTIGATION. VARIATIONS IN THE INDICATED SUBSURFACE CONDITIONS WILL BECOME EVIDENT ONCE ADDITIONAL BORINGS ARE PERFORMED. THE INDICATED STRATIGRAPHY BETWEEN TESTING LOCATIONS WAS GENERATED USING STRAIGHT-LINE LINEAR INTERPOLATION, AND DOES NOT REPRESENT THE TRUE STRATIGRAPHY.



ALLUVIUM RESIDUUM PWR BEDROCK

The generalized subsurface profile is provided for illustrative purposes. The intent of this drawing is to provide the reader with very general information on soil stratigraphy at the bridge site. Variations in the indicated subsurface conditions will become evident once additional borings are performed.

4			
3			
2			
1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	JFH	DATE 8.27.19	GROUP - -
R/W		DATE	



**S-30-110 BRIDGE REPLACEMENT
OVER NORTH LICK CREEK**

GENERALIZED SUBSURFACE PROFILE

HRZ SCALE = NTS	
VRT SCALE = NTS	

S-30-110 Replacement Bridge over North Lick Creek

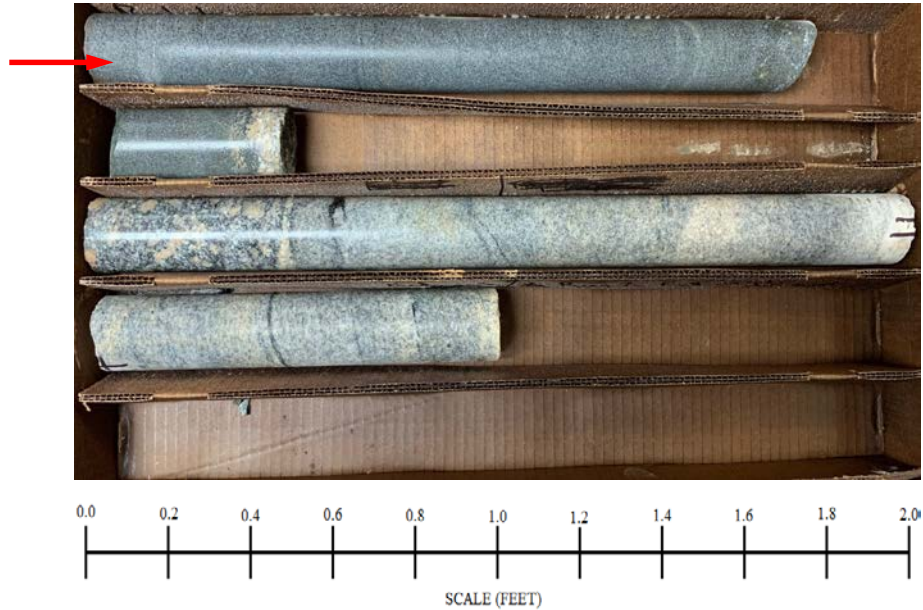
Geotechnical Base Line Report

APPENDIX

SECTION 6 ROCK CORE PHOTOS

S-30-110 RBO North Lick Creek
Boring B-601

Begin Run 1
51.2 feet



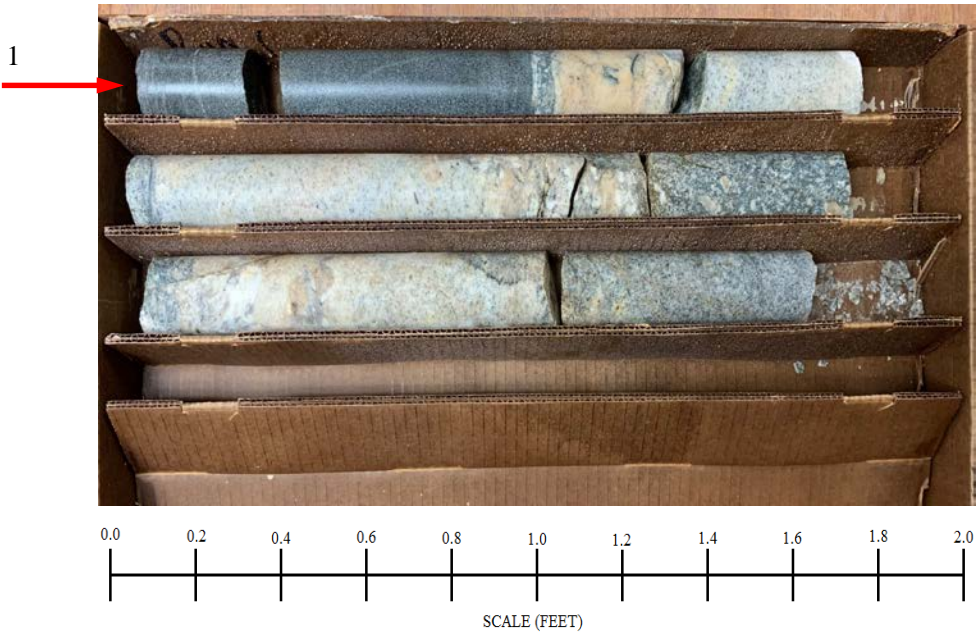
Begin Run 2
56.3 feet



S-30-110 RBO North Lick Creek
Boring B-602



Begin Run 1
45.3 Feet



Begin Run 2
50.3 feet



S-30-110 Replacement Bridge over North Lick Creek

Geotechnical Base Line Report

APPENDIX

SECTION 7 LABORATORY TEST RESULTS



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%-#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-601	10.0				4.76	85					
B-601	20.0	NP	NP	NP	4.76	64	ML	33.2			
B-601	25.0				4.76	6		29.8			
B-602	10.0	NP	NP	NP	4.76	46	SM	37.5			
B-602	15.0				4.76	18		26.3			
B-602	20.0				4.76	56					
B-602	30.0	NP	NP	NP	4.76	22	SM	28.1			
B-602	40.0				4.76	27		33.3			



Rock Coring Summary

Project ID: P038300

Project Name: S-30-110 RBO North Lick Creek

Project County: Laurens

Borehole	Core Run Number	Core Run Top Depth (ft)	REC (%)	RQD (%)	q _u (psi)	Poisson's Ratio	Elastic Modulus (ksi)	Unit Weight (pcf)	RMR
									GSI
B-601	NQ-1	51.2	100	100	31,199	0.33	6.60E+03	163	87
									50-60
	NQ-2	56.3	91	91	15,496	0.40	4.40E+03	164	87
									50-60
B-602	NQ-1	45.3	98	89	21,800	0.25	6.00E+03	173	50
									50-60
	NQ-2	50.3	98	98	23,508	0.35	5.10E+03	162	59
									50-60

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	S-30-110 Replacement Bridge over North Lick Creek	PROJECT NO.:	P038300
SAMPLE NUMBER:	19-1599	DATE SAMPLE RECEIVED:	6/18/2019
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	AMC	DATE OF TESTING:	8/9/2019
WEIGHED BY:	AMC	DATE OF WEIGHING:	8/10/2019

BORING NO.	B-601	B-601	B-601		
SAMPLE NO.	SS-3	SS-7	SS-8		
SAMPLE DEPTH	4-6'	18.5-20'	23.5-25'		
WATER CONTENT, W%	16.9	33.2	29.8		

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

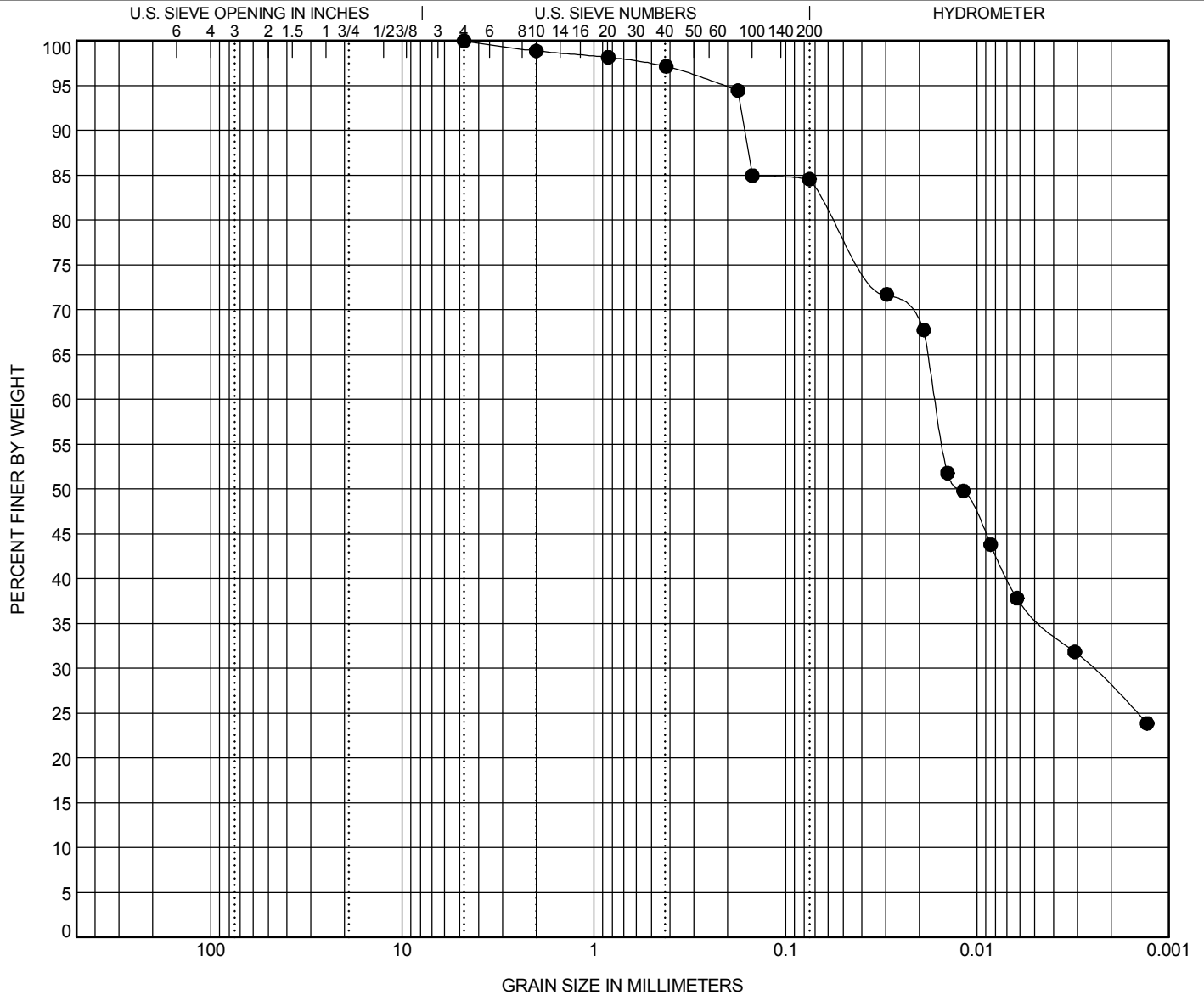


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



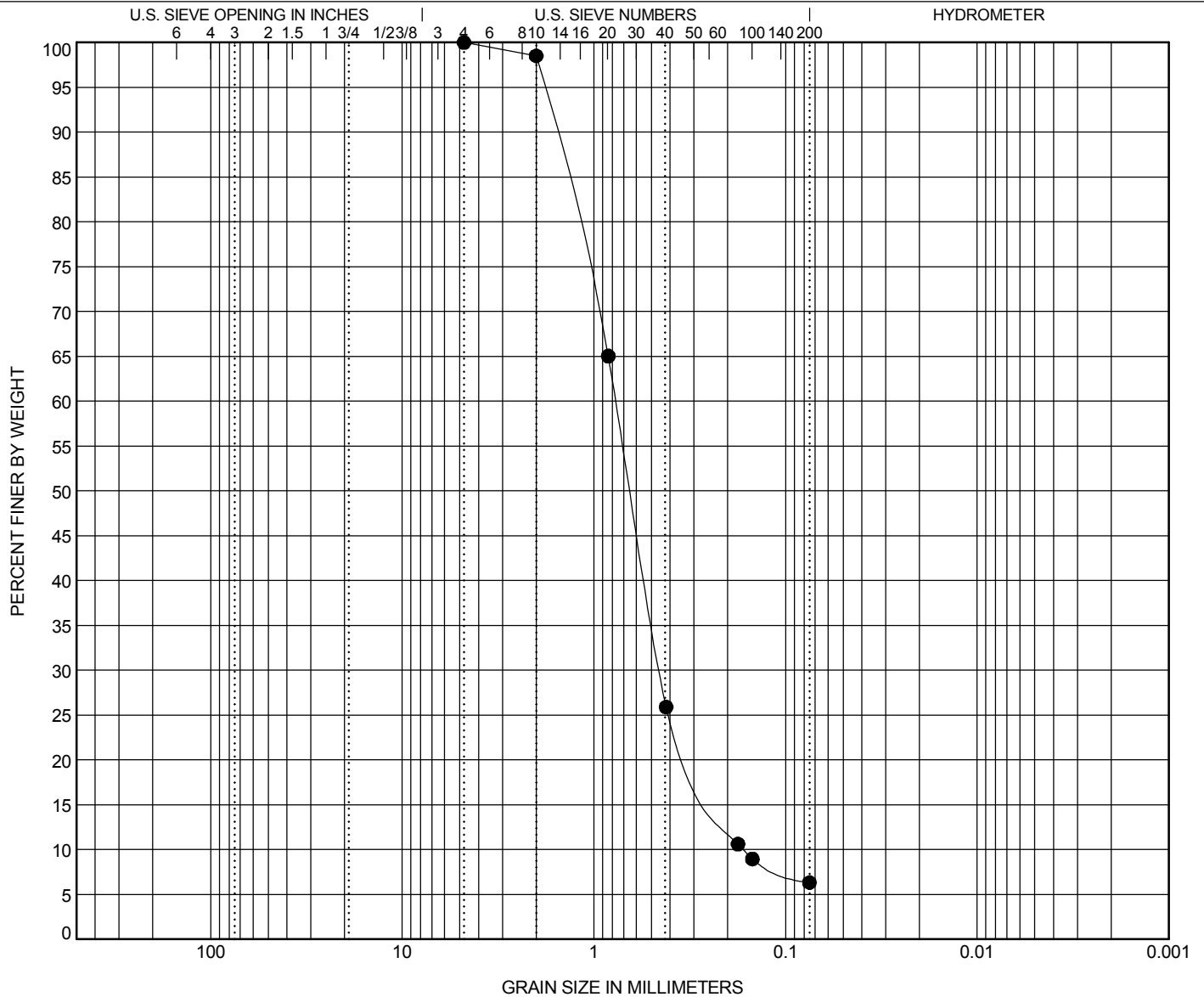


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

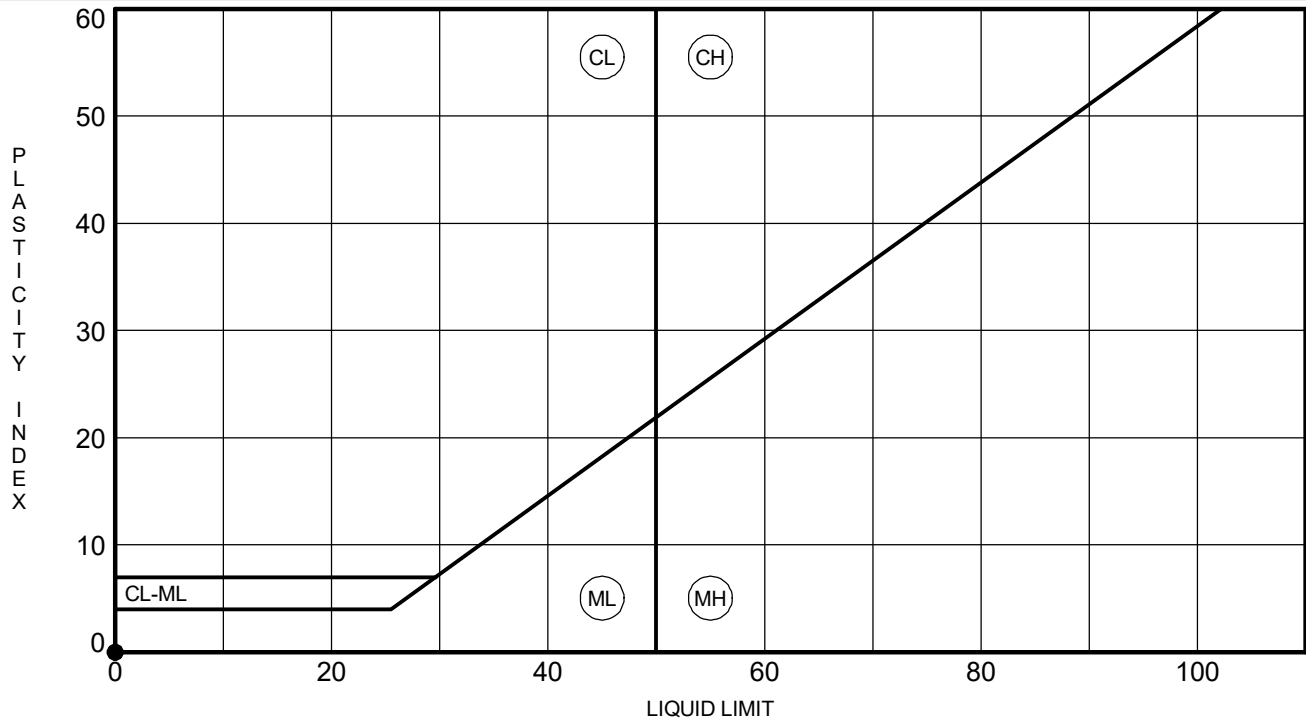
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-601	25.0	SAND (SP-SM) with Silt								1.60	4.63
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-601	25.0	4.76	1.826	0.644	0.166	0.0	93.7	6.3			

ATTERBERG LIMITS' RESULTS

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens

[illegible]

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression
ASTM D7012-14e1 (D) / D4543-08e1

Client F&ME Consultants
 Client Project G6100.050 - Load Restricted Bridge Projects
 Project Number 42140

Boring G6100.050.00004 - North Lick Creek
 Depth 54.2' - 54.5'
 Sample RC-601.1
 Lab ID number 42140013

Method of Calculating Young's Modulus from Axial Stress-Strain Curve

Average Modulus - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Description: Gray Granite
 As-Received Condition: Useable L/D > 2
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
2.87E-03	-6.77E-04	15607
1.69E-03	-2.91E-04	7848

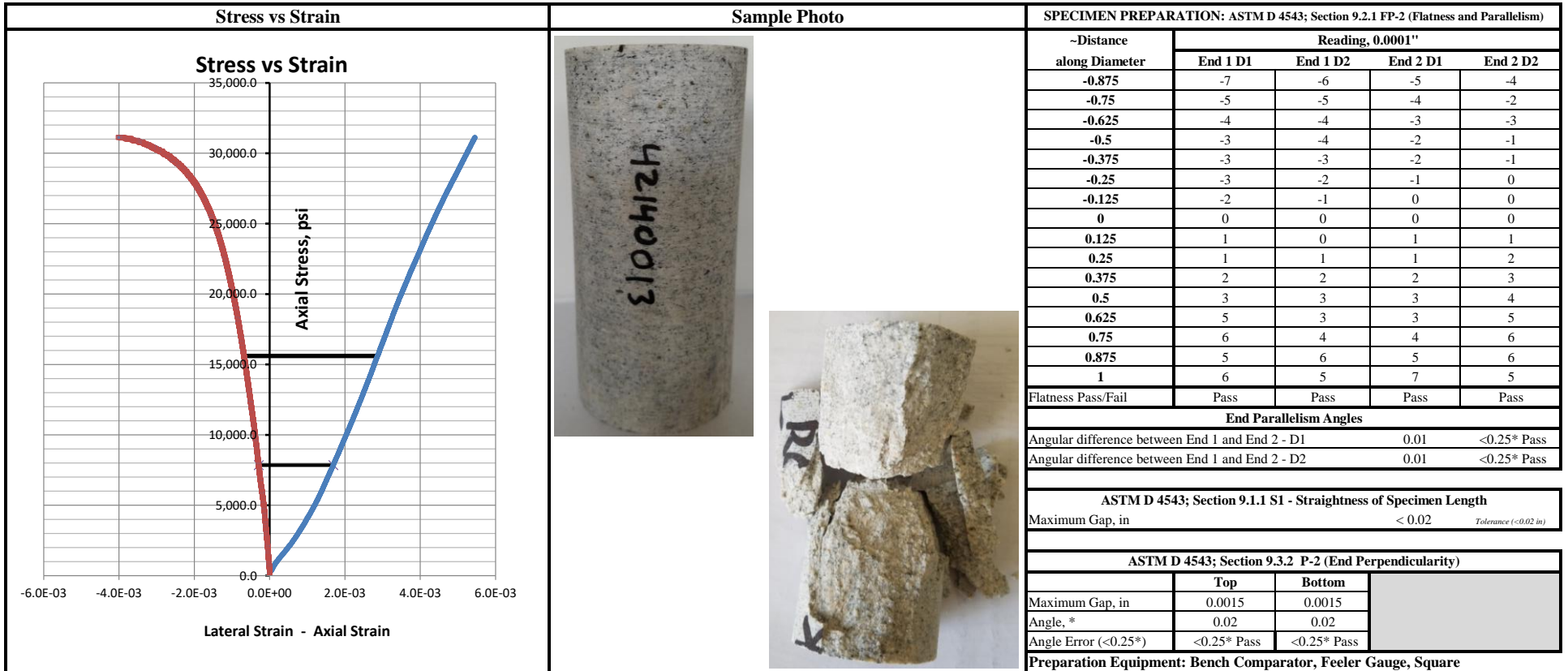
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.286
Mid Height Diameter #1, in	1.872
Mid Height Diameter #2, in	1.876
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.76
L/D Ratio (2.0-2.5)	2.29

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	504.59	
Sample Volume, cc	194	
Wet Density, pcf	163	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	86055
Unconfined Compressive Strength, psi	31,199
Youngs Modulus, E psi	6.6 E+06
Slope of Lateral Curve, psi	-20.1 E+06
Poisson's Ratio	0.33

Load Application in Relation to Lithology:

Unable to Determine



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression
ASTM D7012-14e1 (D) / D4543-08e1

Client F&ME Consultants
 Client Project G6100.050 - Load Restricted Bridge Projects
 Project Number 42140

Boring G6100.050.00004 - North Lick Creek
 Depth 57.6' - 57.9'
 Sample RC-601.2
 Lab ID number 42140014

Method of Calculating Young's Modulus from Axial Stress-Strain Curve

Average Modulus - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Description: Light Gray/White Granite
 As-Received Condition: Useable L/D > 2
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
2.26E-03	-5.33E-04	7794
1.39E-03	-1.82E-04	3953

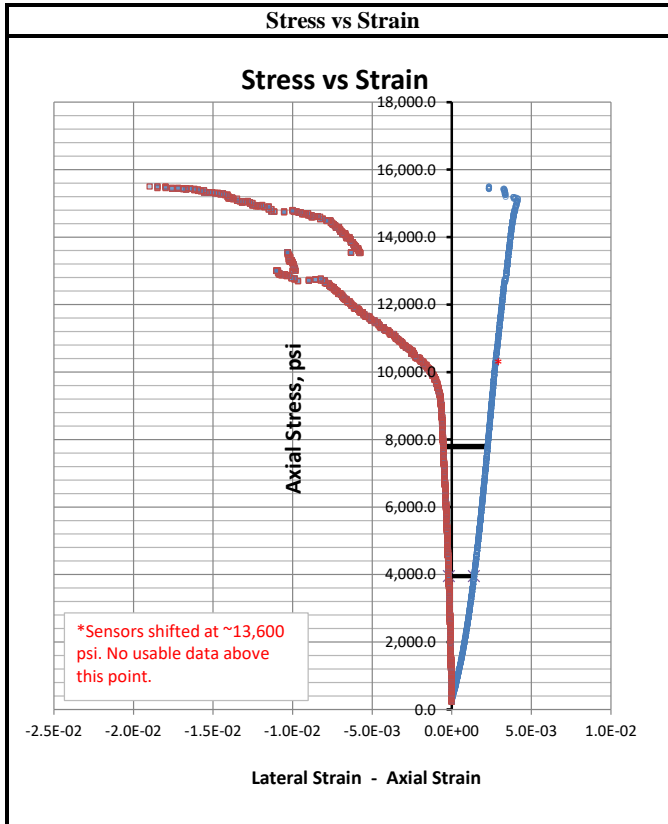
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.01
Mid Height Diameter #1, in	1.873
Mid Height Diameter #2, in	1.872
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.75
L/D Ratio (2.0-2.5)	2.14

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	474.18	
Sample Volume, cc	181	
Wet Density, pcf	164	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	42673
Unconfined Compressive Strength, psi	15,496
Youngs Modulus, E psi	4.4 E+06
Slope of Lateral Curve, psi	-11.0 E+06
Poisson's Ratio	0.40

Load Application in Relation to Lithology:

Perpendicular



SPECIMEN PREPARATION: ASTM D 4543; Section 9.2.1 FP-2 (Flatness and Parallelism)				
~Distance along Diameter	Reading, 0.0001"			
	End 1 D1	End 1 D2	End 2 D1	End 2 D2
-0.875	-8	-10	-5	-7
-0.75	-7	-9	-4	-8
-0.625	-6	-8	-3	-7
-0.5	-5	-6	-2	-4
-0.375	-4	-5	-2	-3
-0.25	-2	-4	-1	-2
-0.125	-1	-3	0	-1
0	0	0	0	0
0.125	1	-1	1	2
0.25	1	0	2	4
0.375	2	1	4	5
0.5	3	2	4	6
0.625	4	3	6	7
0.75	5	4	7	8
0.875	6	4	7	7
1	5	5	8	8
Flatness Pass/Fail	Pass	Pass	Pass	Pass
End Parallelism Angles				
Angular difference between End 1 and End 2 - D1			0.00	<0.25* Pass
Angular difference between End 1 and End 2 - D2			0.01	<0.25* Pass
ASTM D 4543; Section 9.1.1 S1 - Straightness of Specimen Length				
Maximum Gap, in			< 0.02	Tolerance (<0.02 in)
ASTM D 4543; Section 9.3.2 P-2 (End Perpendicularity)				
	Top	Bottom		
Maximum Gap, in	0.0015	0.0015		
Angle, *	0.02	0.02		
Angle Error (<0.25*)	<0.25* Pass	<0.25* Pass		
Preparation Equipment: Bench Comparator, Feeler Gauge, Square				

Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	<u>S-30-110 Replacement Bridge over North Lick Creek</u>	PROJECT NO.:	<u>P038300</u>
SAMPLE NUMBER:	<u>19-1601</u>	DATE SAMPLE RECEIVED:	<u>6/18/2019</u>
DESCRIPTION OF SOIL:	<u>VARIOUS</u>		
TESTED BY:	<u>AMC</u>	DATE OF TESTING:	<u>8/9/2019</u>
WEIGHED BY:	<u>AMC</u>	DATE OF WEIGHING:	<u>8/10/2019</u>

BORING NO.	B-602	B-602	B-602	B-602	
SAMPLE NO.	SS-5	SS-6	SS-9	SS-11	
SAMPLE DEPTH	8-10'	13.5-15'	28.5-30'	38.5-40'	
WATER CONTENT, W%	37.5	26.3	28.1	33.3	

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

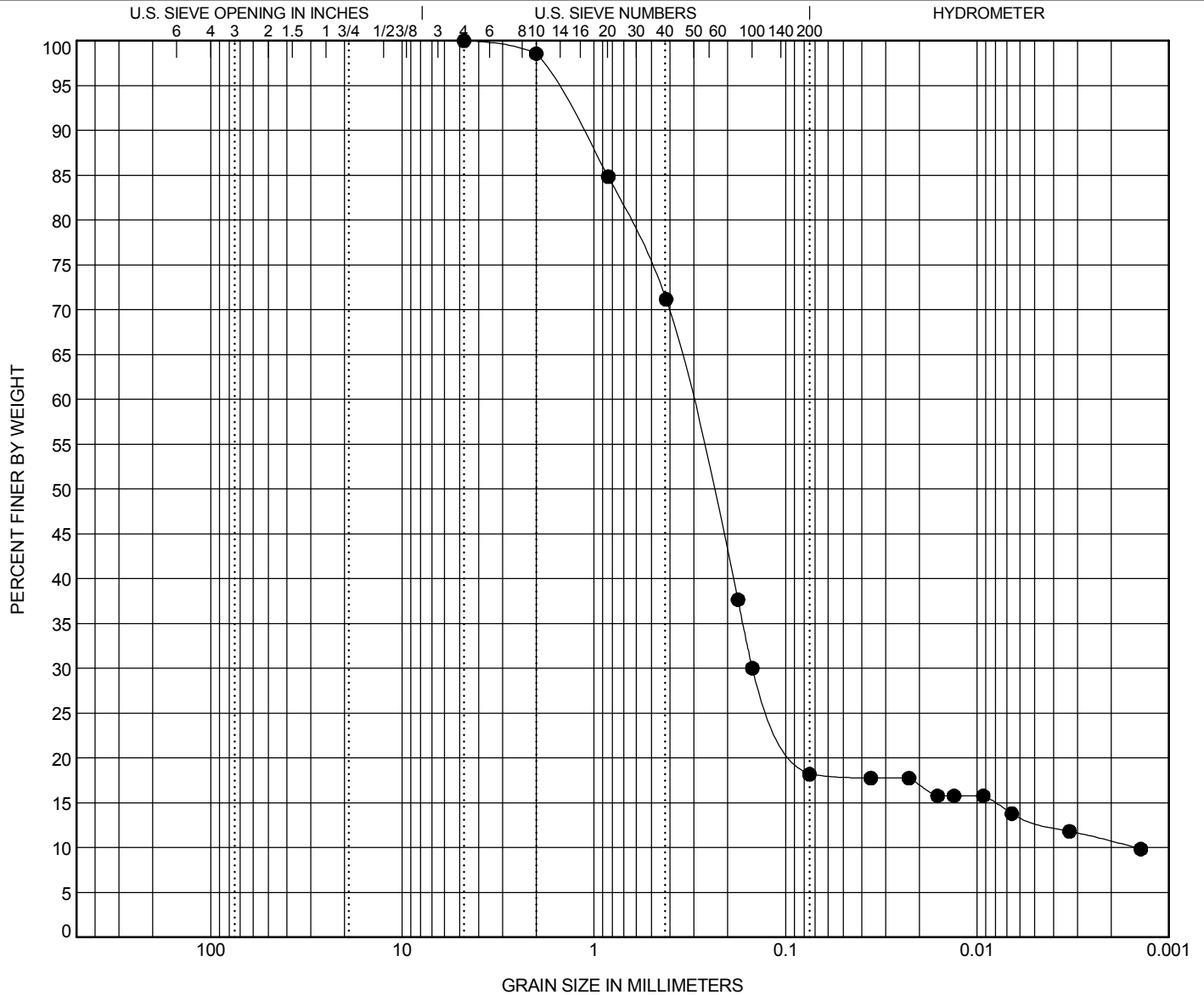


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



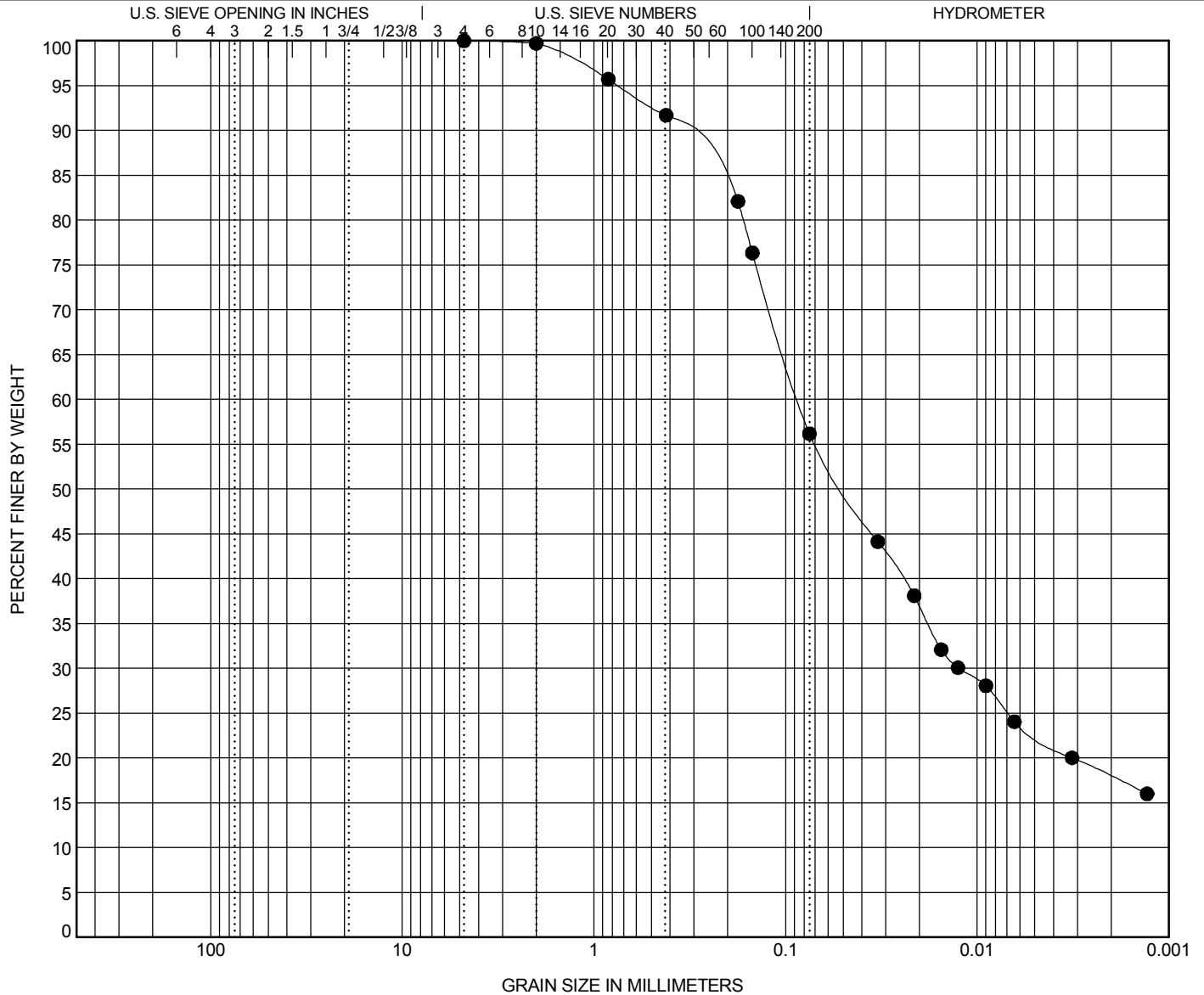


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-602	20.0	Sandy SILT (ML)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-602	20.0	4.76	0.743	0.049		0.0	43.8	33.6		22.6	

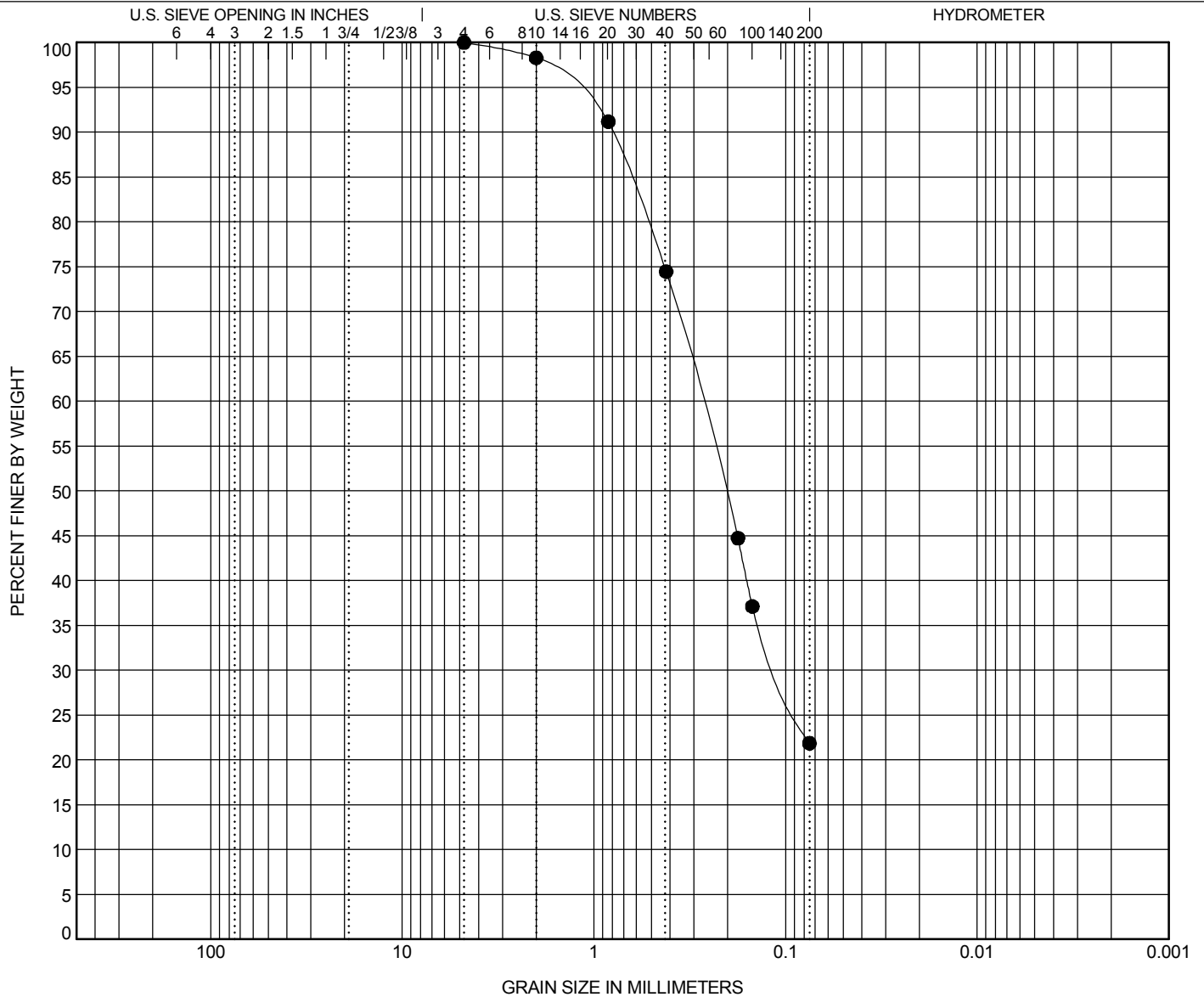


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-602	30.0	Silty SAND (SM/A-2-4)					NP	NP	NP		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-602	30.0	4.76	1.339	0.206		0.0	78.1	21.9			

GRAIN SIZE G6100.05.04 - RBO NORTH LICK CREEK.GPJ FME2017.GDT 9/10/19

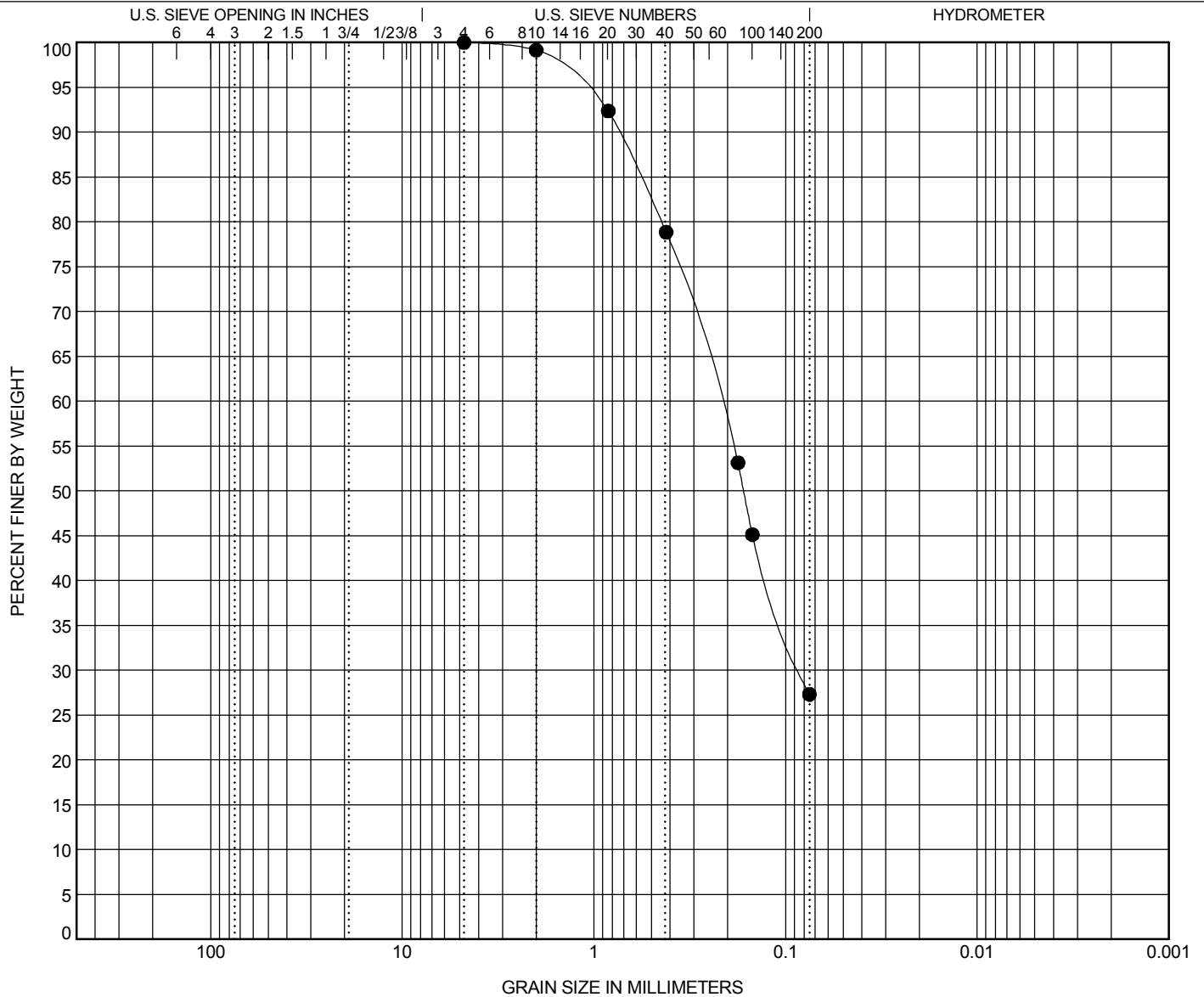


GRAIN SIZE DISTRIBUTION

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

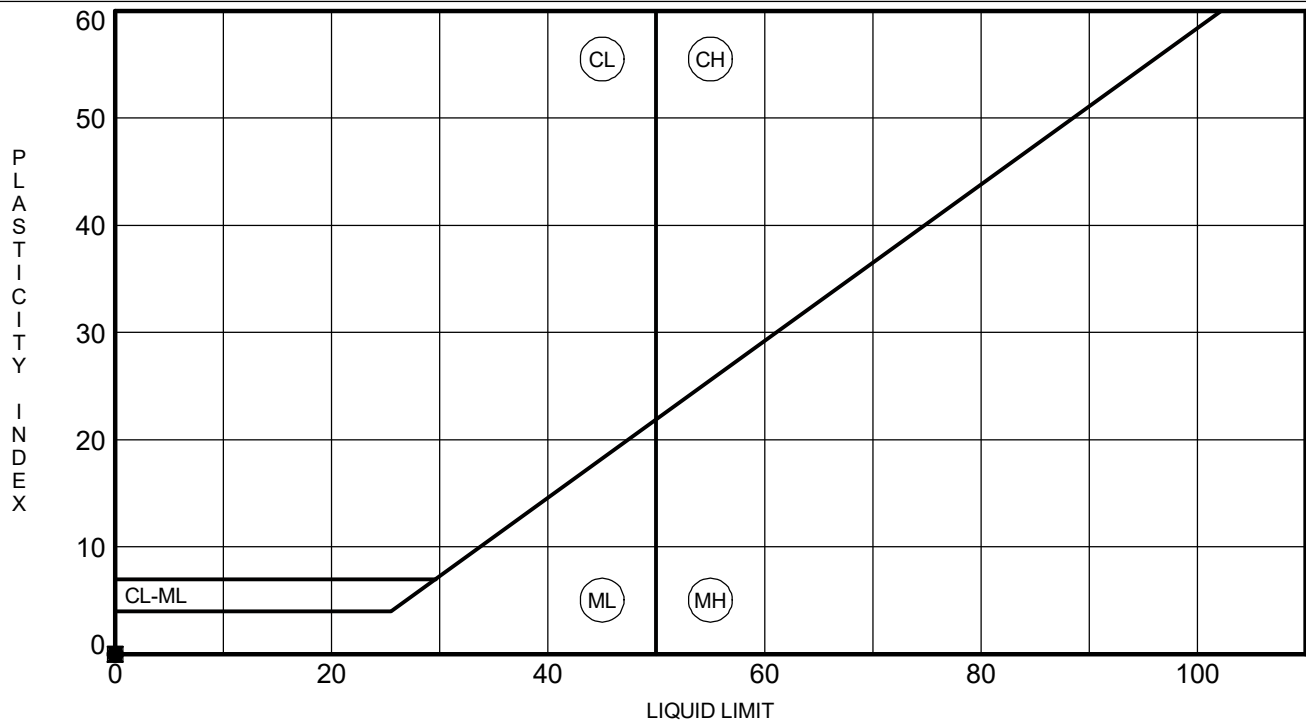
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-602	40.0	Silty SAND (SM)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-602	40.0	4.76	1.176	0.165		0.0	72.7	27.3			

ATTERBERG LIMITS' RESULTS

PROJECT ID P038300

PROJECT NAME S-30-110 Replacement Bridge over North Lick Creek

PROJECT COUNTY Laurens

[illegible]

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression
ASTM D7012-14e1 (D) / D4543-08e1

Client F&ME Consultants
 Client Project G6100.050 - Load Restricted Bridge Projects
 Project Number 42140

Boring G6100.050.00004 - North Lick Creek
 Depth 45.6' - 45.9
 Sample RC-602.3
 Lab ID number 42140015

Description: Gray Granite
 As-Received Condition: Useable L/D > 2
 Sample Preparation: Diamond saw blade cut, surface ground flat

Method of Calculating Young's Modulus from Axial Stress-Strain Curve

Average Modulus - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Axial Strain	Diametric Strain	Axial Stress psi
2.04E-03	-3.95E-04	10931
1.13E-03	-1.68E-04	5481

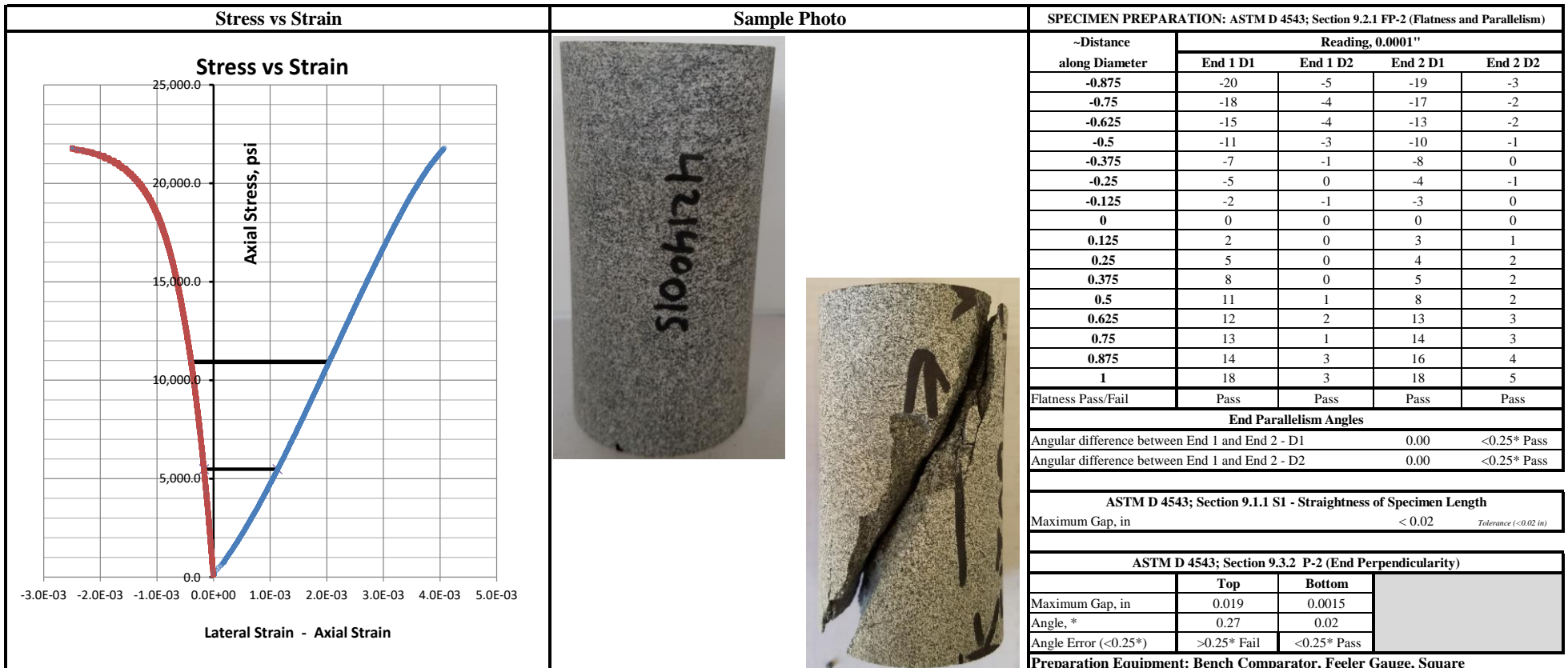
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.028
Mid Height Diameter #1, in	1.866
Mid Height Diameter #2, in	1.871
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.74
L/D Ratio (2.0-2.5)	2.16

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	503.03	
Sample Volume, cc	181	
Wet Density, pcf	173	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	59776
Unconfined Compressive Strength, psi	21,800
Youngs Modulus, E psi	6.0 E+06
Slope of Lateral Curve, psi	-24.1 E+06
Poisson's Ratio	0.25

Load Application in Relation to Lithology:

Unable to Determine



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested:

7/25/2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression
ASTM D7012-14e1 (D) / D4543-08e1

Client F&ME Consultants
 Client Project G6100.050 - Load Restricted Bridge Projects
 Project Number 42140

Boring G6100.050.00004 - North Lick Creek
 Depth 50.9' - 51.2'
 Sample RC-602.4
 Lab ID number 42140016

Method of Calculating Young's Modulus from Axial Stress-Strain Curve

Average Modulus - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Description: Light Gray Granite
 As-Received Condition: Useable L/D > 2
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
3.25E-03	-6.73E-04	11820
2.05E-03	-2.51E-04	5751

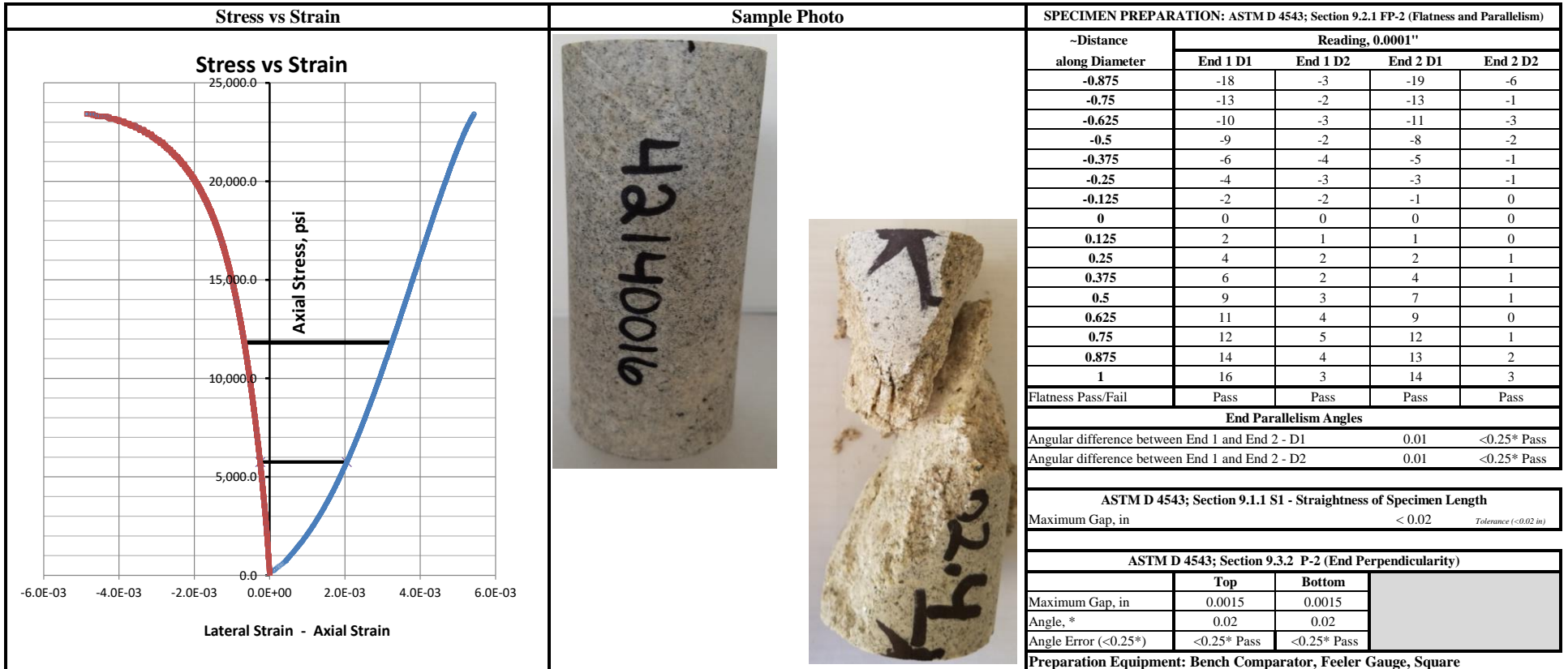
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.204
Mid Height Diameter #1, in	1.867
Mid Height Diameter #2, in	1.868
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.74
L/D Ratio (2.0-2.5)	2.25

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	491.35	
Sample Volume, cc	189	
Wet Density, pcf	162	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	64392
Unconfined Compressive Strength, psi	23,508
Youngs Modulus, E psi	5.1 E+06
Slope of Lateral Curve, psi	-14.4 E+06
Poisson's Ratio	0.35

Load Application in Relation to Lithology:

Unable to Determine



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019

Corrosivity Testing

Client F&ME Consultants
 Client Project G6100.050 Load Restricted Bridge Package 2020-1
 Project No. 42301

Lab Sample ID	Boring	Depth	Sample	Matrix	pH AASHTO T289			Chloride AASHTO T291 (Method B)			Sulfate AASHTO T290 (Method B)			Min. Soil Resistivity AASHTO T288		
					Result	Date Tested	Tested By	Result mg/kg (ppm)	Date Tested	Tested By	Result mg/kg (ppm)	Date Tested	Tested By	Result, Ohm-cm	Date Tested	Tested By
42301013	G6100.050.00001	B-901	0.0' - 10.0'	Soil	5.3	8/27/2019	AMP	75	8/29/2019	AMP	<30	8/28/2019	AMP	16,500	8/27/2019	AMP
42301014	G6100.050.00002	B-802	0.0' - 10.0'	Soil	5.4	8/27/2019	AMP	47	8/29/2019	AMP	<30	8/28/2019	AMP	9,850	8/27/2019	AMP
42301015	G6100.050.00003	B-1001	0.0' - 10.0'	Soil	5.7	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	16,500	8/27/2019	AMP
42301016	G6100.050.00004	B-602	0.0' - 10.0'	Soil	5.6	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	15,500	8/27/2019	AMP
42301017	G6100.050.00005	B-501	0.0' - 10.0'	Soil	6.0	8/27/2019	AMP	75	8/29/2019	AMP	<30	8/28/2019	AMP	4,900	8/27/2019	AMP
42301018	G6100.050.00006	B-701	0.0' - 10.0'	Soil	5.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	18,000	8/27/2019	AMP
42301019	G6100.050.00007	B-1202	0.0' - 10.0'	Soil	5.5	8/27/2019	AMP	38	8/29/2019	AMP	88	8/28/2019	AMP	1,700	8/27/2019	AMP
42301020	G6100.050.00008	B-1602	0.0' - 10.0'	Soil	6.1	8/27/2019	AMP	136	8/29/2019	AMP	<30	8/28/2019	AMP	3,500	8/27/2019	AMP
42301021	G6100.050.00009	B-402	0.0' - 10.0'	Soil	5.9	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	10,500	8/29/2019	AMP
42301022	G6100.050.00010	B-301	0.0' - 10.0'	Soil	7.5	8/27/2019	AMP	40	8/29/2019	AMP	28	8/28/2019	AMP	2,200	8/29/2019	AMP
42301023	G6100.050.00011	B-202	0.0' - 10.0'	Soil	5.9	8/27/2019	AMP	<10	8/29/2019	AMP	36	8/28/2019	AMP	7,200	8/29/2019	AMP
42301024	G6100.050.00012	B-101	0.0' - 10.0'	Soil	6.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	6,000	8/29/2019	AMP
42301025	G6100.050.00013	B-1302	0.0' - 10.0'	Soil	4.9	8/27/2019	AMP	40	8/29/2019	AMP	<30	8/28/2019	AMP	8,500	8/28/2019	AMP
42301026	G6100.050.000014	B-1402	0.0' - 10.0'	Soil	5.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	11,000	8/28/2019	AMP
42301027	G6100.050.00015	B-1501	0.0' - 10.0'	Soil	5.8	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	11,000	8/28/2019	AMP
42301028	G6100.050.00016	B-1102	0.0' - 10.0'	Soil	5.7	8/27/2019	AMP	78	8/29/2019	AMP	<30	8/28/2019	AMP	5,200	8/28/2019	AMP

Input Validation: AMP

Reviewed By: ALO