

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	17BP.8.R.123	1	14

REFERENCE: 17BP.8.R.123

**STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT**

**STRUCTURE
SUBSURFACE INVESTIGATION**

COUNTY RICHMOND
 PROJECT DESCRIPTION REPLACE BRIDGE NO. 760064
ON -L- (SR 1424/SANDHILL GAME MANAGEMENT
RD) OVER ROCKY FORK CREEK
 SITE DESCRIPTION _____

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND (SOIL & ROCK)
2B, 2C	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4-5	PROFILES
6-7	CROSS SECTIONS
8-II	BORE LOGS & CORE LOGS
12-13	CORE PHOTOGRAPHS
14	SITE PHOTOGRAPHS

PERSONNEL

<u>J. WILLIAMSON</u>
<u>T. WILLIAMS</u>
<u>N. BRADLEY</u>
<u>C. CHANDLER</u>
<u>R. KRAL</u>

INVESTIGATED BY S&ME, INC.
 DRAWN BY N. BRADLEY
 CHECKED BY K. HILL
 SUBMITTED BY J. WILLIAMSON
 DATE JANUARY 2018



9751 SOUTHERN PINE BLVD
 CHARLOTTE, NC 28273
 (704) 523-4726

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

- NOTES:
- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
 - BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PROJECT: N/A



DocuSigned by:
Joseph Williamson 1/4/2018
 87C18468607084C6 SIGNATURE DATE

**DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED**

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT**

SUBSURFACE INVESTIGATION





SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 1 OF 2)

SOIL DESCRIPTION										GRADATION																																																
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6										WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.																																																
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<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">PLASTICITY INDEX (PI)</th> <th style="width: 50%;">DRY STRENGTH</th> </tr> <tr> <td>NON PLASTIC</td> <td>VERY LOW</td> </tr> <tr> <td>SLIGHTLY PLASTIC</td> <td>SLIGHT</td> </tr> <tr> <td>MODERATELY PLASTIC</td> <td>MEDIUM</td> </tr> <tr> <td>HIGHLY PLASTIC</td> <td>HIGH</td> </tr> </table>										PLASTICITY INDEX (PI)	DRY STRENGTH	NON PLASTIC	VERY LOW	SLIGHTLY PLASTIC	SLIGHT	MODERATELY PLASTIC	MEDIUM	HIGHLY PLASTIC	HIGH																																							
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MODERATELY PLASTIC	MEDIUM																																																									
HIGHLY PLASTIC	HIGH																																																									
COLOR																																																										
DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.																																																										

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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SUBSURFACE INVESTIGATION

**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS
(PAGE 2 OF 2)**

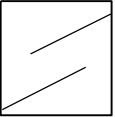
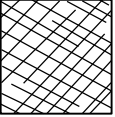


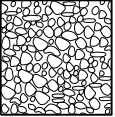

ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>		<p>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC. ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS. SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS IN OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE. TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>	
<p>WEATHERED ROCK (WR)</p>		<p>NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.</p>	
<p>CRYSTALLINE ROCK (CR)</p>		<p>FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.</p>	
<p>NON-CRYSTALLINE ROCK (NCR)</p>		<p>FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.</p>	
<p>COASTAL PLAIN SEDIMENTARY ROCK (CP)</p>		<p>COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>	
WEATHERING			
<p>FRESH</p>	<p>ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.</p>		
<p>VERY SLIGHT (V SL.)</p>	<p>ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.</p>		
<p>SLIGHT (SL.)</p>	<p>ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.</p>		
<p>MODERATE (MOD.)</p>	<p>SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.</p>		
<p>MODERATELY SEVERE (MOD. SEV.)</p>	<p>ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i></p>		
<p>SEVERE (SEV.)</p>	<p>ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF</i></p>		
<p>VERY SEVERE (V SEV.)</p>	<p>ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF</i></p>		
<p>COMPLETE</p>	<p>ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.</p>		
ROCK HARDNESS			
<p>VERY HARD</p>	<p>CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.</p>		
<p>HARD</p>	<p>CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.</p>		
<p>MODERATELY HARD</p>	<p>CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.</p>		
<p>MEDIUM HARD</p>	<p>CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.</p>		
<p>SOFT</p>	<p>CAN BE GROOVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.</p>		
<p>VERY SOFT</p>	<p>CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.</p>		
FRACTURE SPACING		BEDDING	
<p>TERM</p>	<p>SPACING</p>	<p>TERM</p>	<p>THICKNESS</p>
<p>VERY WIDE</p>	<p>MORE THAN 10 FEET</p>	<p>VERY THICKLY BEDDED</p>	<p>4 FEET</p>
<p>WIDE</p>	<p>3 TO 10 FEET</p>	<p>THICKLY BEDDED</p>	<p>1.5 - 4 FEET</p>
<p>MODERATELY CLOSE</p>	<p>1 TO 3 FEET</p>	<p>THINLY BEDDED</p>	<p>0.16 - 1.5 FEET</p>
<p>CLOSE</p>	<p>0.16 TO 1 FOOT</p>	<p>VERY THINLY BEDDED</p>	<p>0.03 - 0.16 FEET</p>
<p>VERY CLOSE</p>	<p>LESS THAN 0.16 FEET</p>	<p>THICKLY LAMINATED</p>	<p>0.008 - 0.03 FEET</p>
		<p>THINLY LAMINATED</p>	<p>< 0.008 FEET</p>
INDURATION			
<p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p>			
<p>FRIABLE</p>	<p>RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p>		
<p>MODERATELY INDURATED</p>	<p>GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p>		
<p>INDURATED</p>	<p>GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p>		
<p>EXTREMELY INDURATED</p>	<p>SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>		
<p>BENCH MARK: BM#1 STA. 17+82 -L-, 67' LT N 464499, E 1788169</p>		<p>ELEVATION: 258.16 FEET</p>	
<p>NOTES: FIAD: FILLED IMMEDIATELY AFTER DRILLING</p>			
<p>DATE: 8-15-14</p>			

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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SUBSURFACE INVESTIGATION

**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)**

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

<p>GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)</p> <p>From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.</p> <p>STRUCTURE</p>	<p>SURFACE CONDITIONS</p> <p>VERY GOOD Very rough, fresh unweathered surfaces</p> <p>GOOD Rough, slightly weathered, iron stained surfaces</p> <p>FAIR Smooth, moderately weathered and altered surfaces</p> <p>POOR Slackensided, highly weathered surfaces with compact coatings or fillings or angular fragments</p> <p>VERY POOR Slackensided, highly weathered surfaces with soft clay coatings or fillings</p>	<p align="center">DECREASING SURFACE QUALITY →</p>			
<p>INTERLOCKING OF ROCK PIECES</p> <p>↓</p>	<p align="center">DECREASING SURFACE QUALITY →</p>				
 <p>INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p>	90	80	70	N/A	N/A
 <p>BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p>	80	70	60	50	40
 <p>VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p>	70	60	50	40	30
 <p>BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p>	60	50	40	30	20
 <p>DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p>	50	40	30	20	10
 <p>LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>	N/A	N/A	10	10	10

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**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)**

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

SURFACE CONDITIONS OF DISCONTINUITIES
(Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces

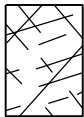
GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

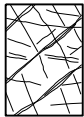
POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments

VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

COMPOSITION AND STRUCTURE



A. Thick bedded, very blocky sandstone. The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.



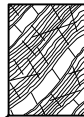
B. Sandstone with thin inter-layers of siltstone



C. Sandstone and siltstone in similar amounts



D. Siltstone or silty shale with sandstone layers



E. Weak siltstone or clayey shale with sandstone layers

C, D, E, and G - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H**.



F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure

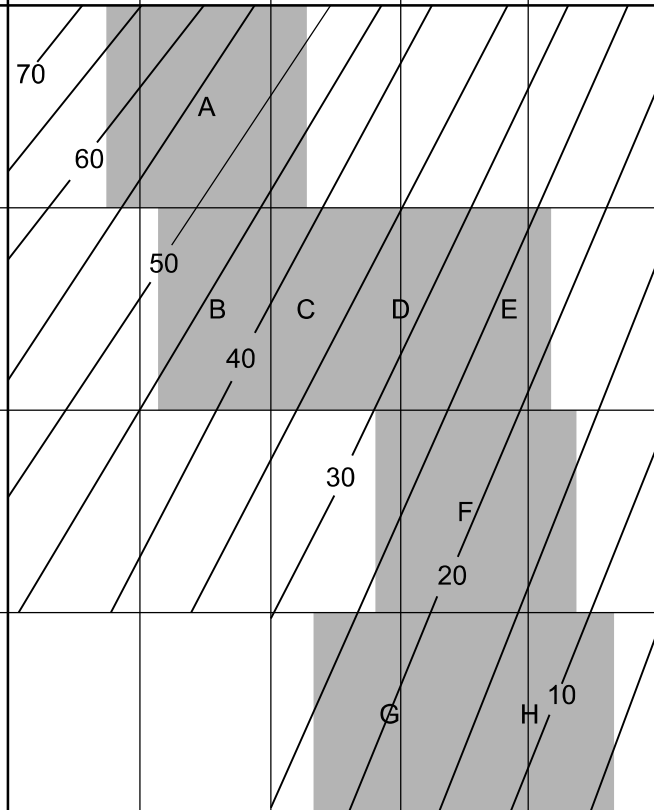


G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers



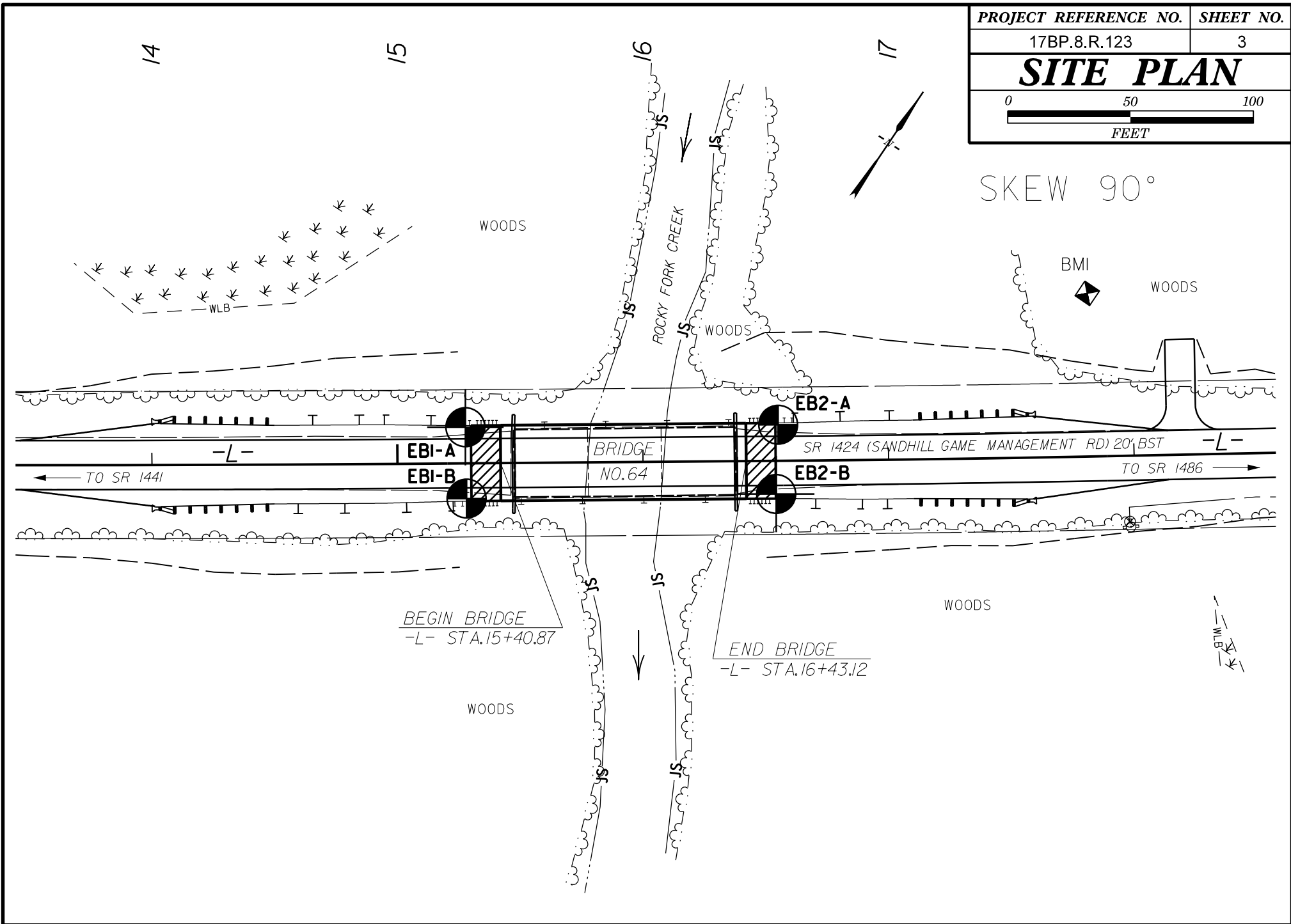
H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

➔ Means deformation after tectonic disturbance



PROJECT REFERENCE NO.	SHEET NO.
17BP.8.R.123	3
SITE PLAN	
0 50 100 FEET	

SKREW 90°



BEGIN BRIDGE
-L- STA.15+40.87

END BRIDGE
-L- STA.16+43.12

WOODS

WOODS

WOODS

WOODS

BRIDGE
NO. 64

SR 1424 (SANDHILL GAME MANAGEMENT RD) 20' BST

TO SR 1441

TO SR 1486

14

15

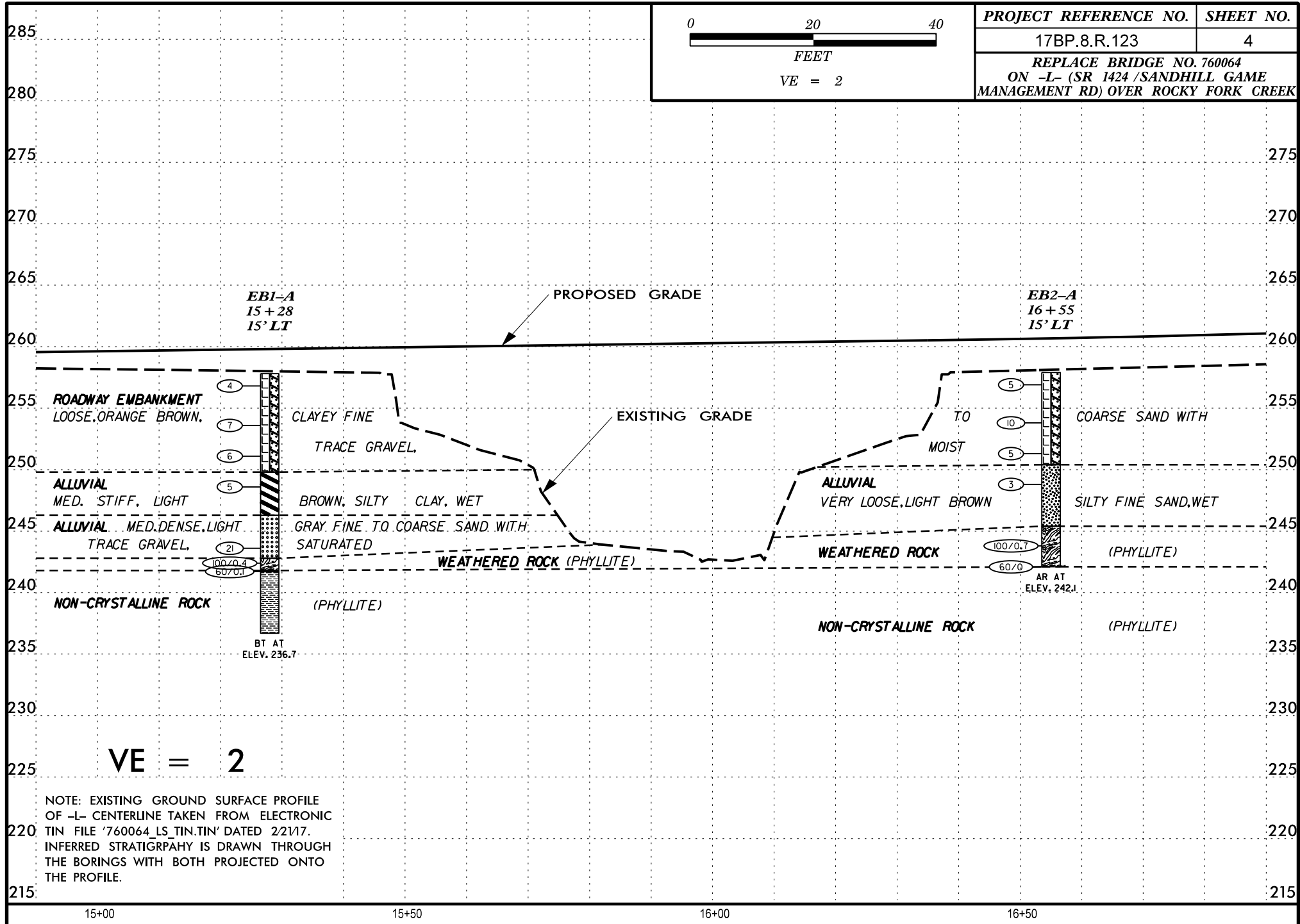
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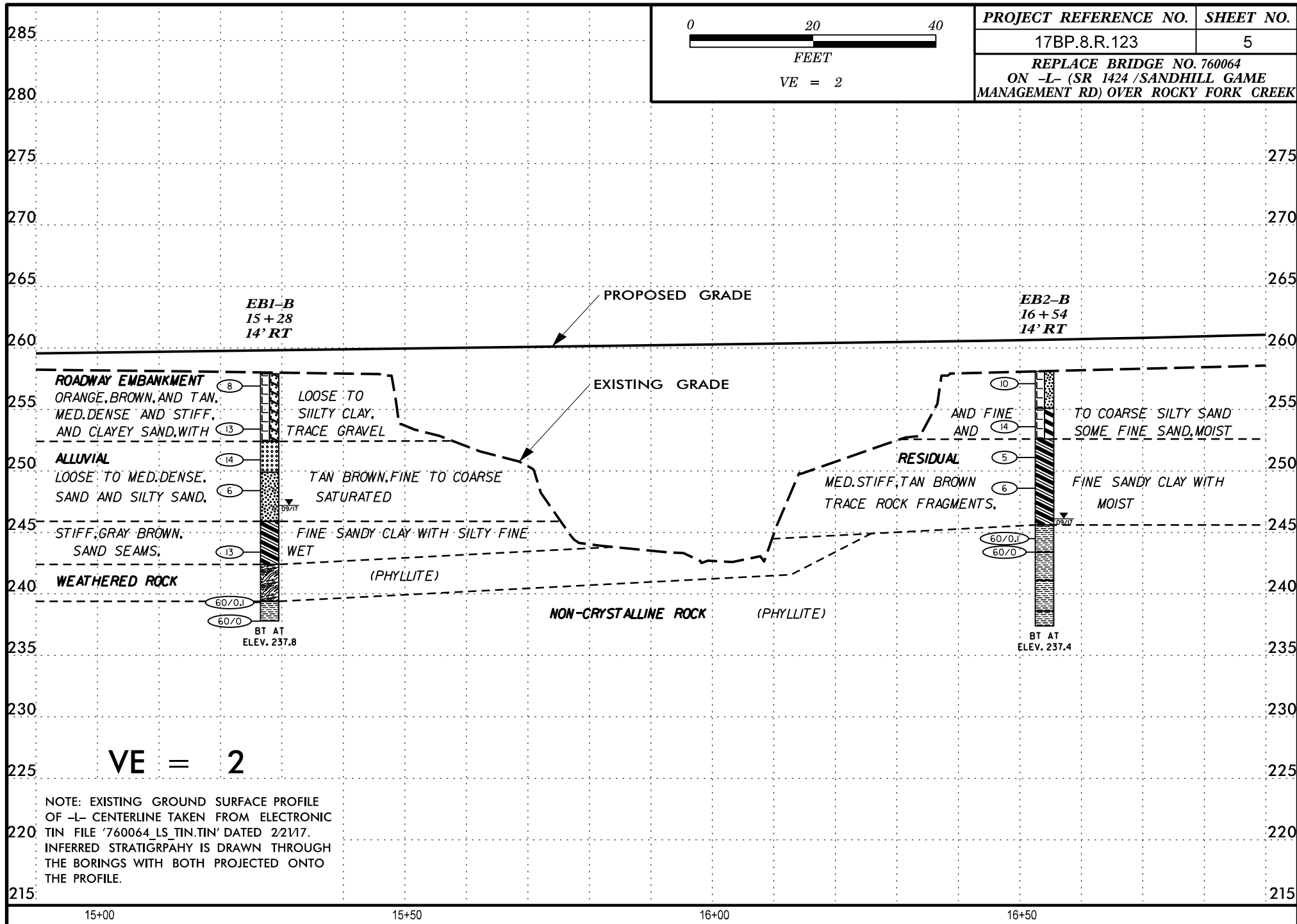
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BMI

WLB

WLB

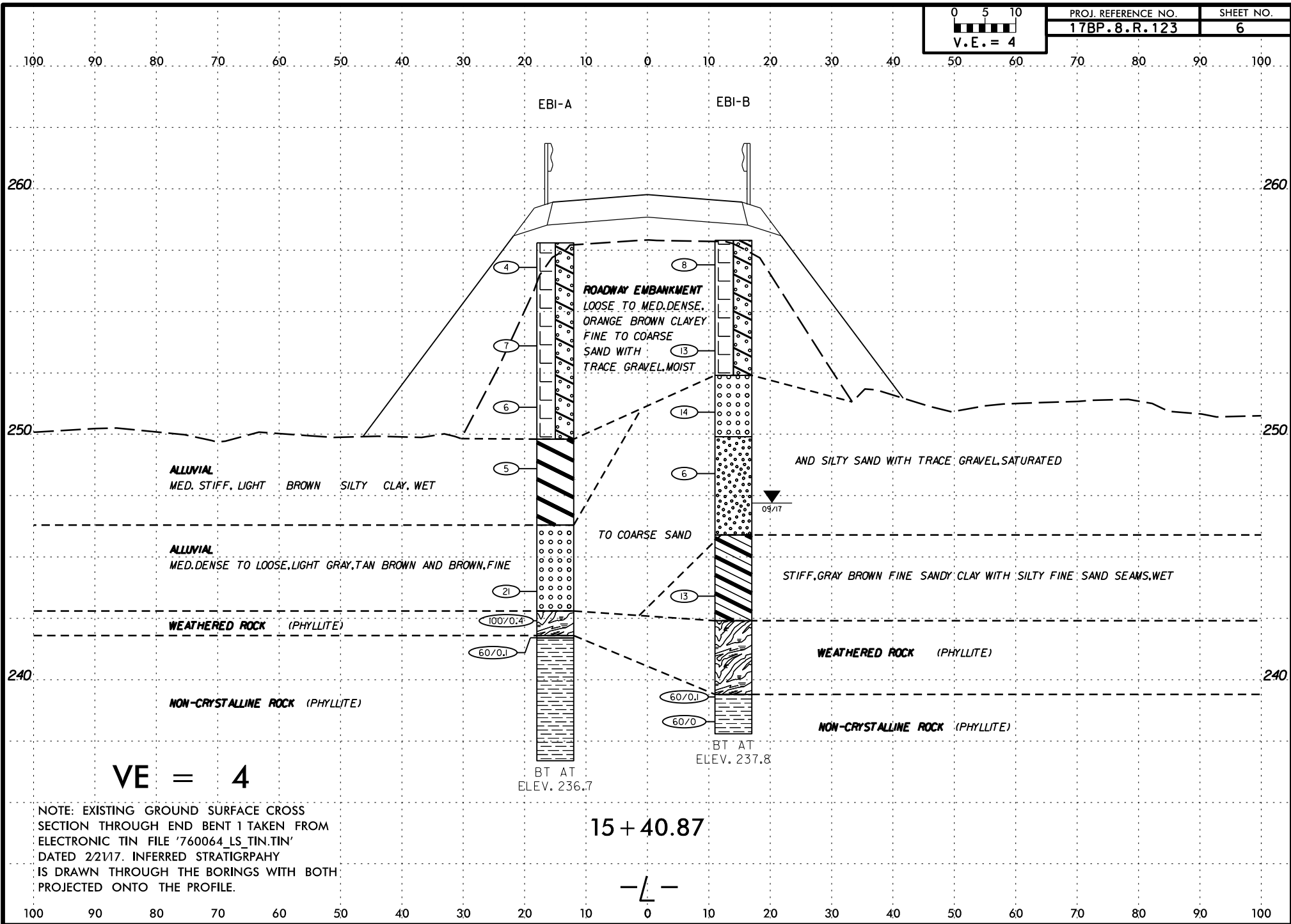




VE = 2

NOTE: EXISTING GROUND SURFACE PROFILE OF -L- CENTERLINE TAKEN FROM ELECTRONIC TIN FILE '760064_LS_TIN.TIN' DATED 2/21/17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

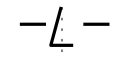
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	17BP.8.R.123	6



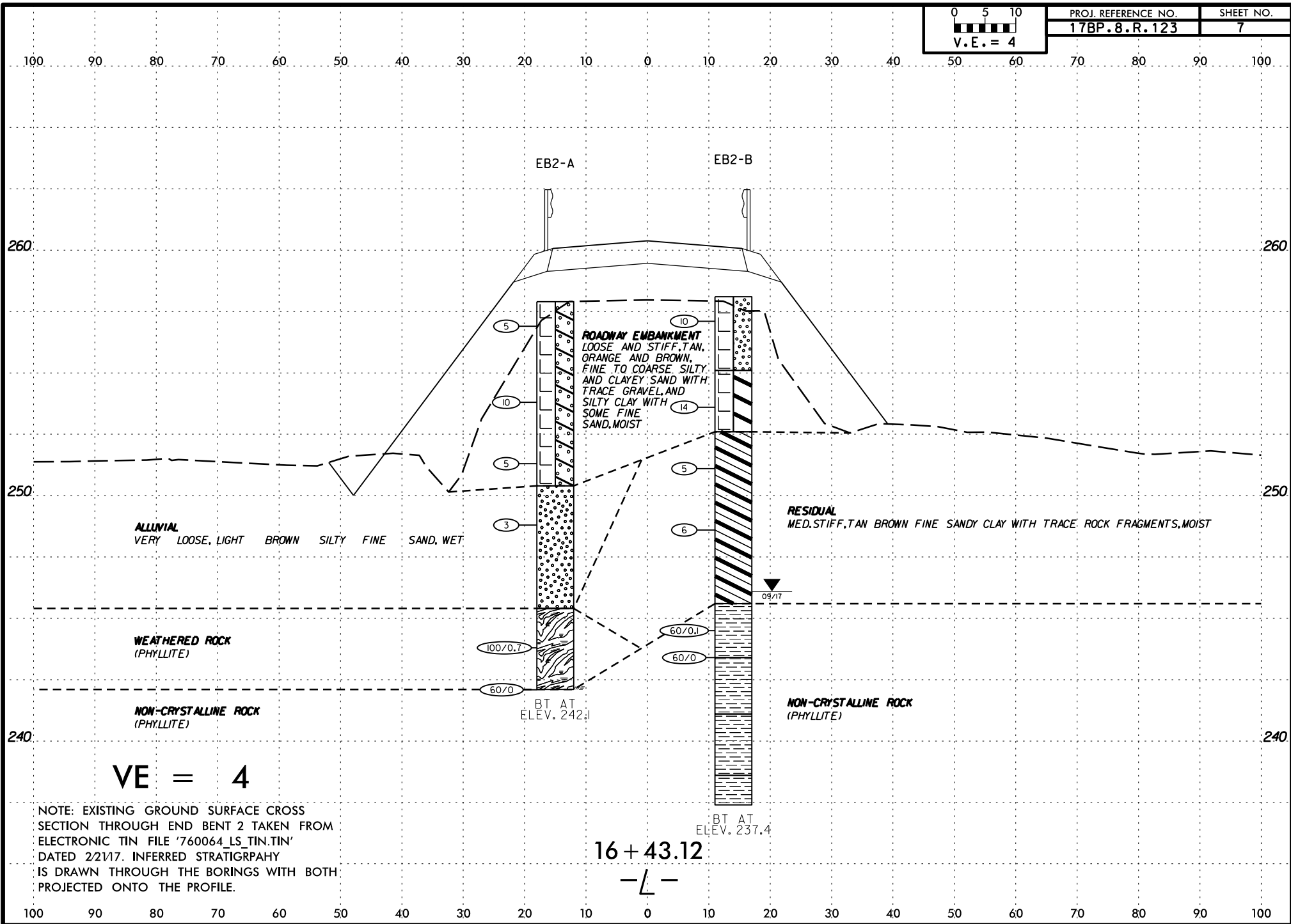
VE = 4

NOTE: EXISTING GROUND SURFACE CROSS SECTION THROUGH END BENT 1 TAKEN FROM ELECTRONIC TIN FILE '760064_LS_TIN.TIN' DATED 2/21/17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

15 + 40.87



	PROJ. REFERENCE NO.	SHEET NO.
	17BP.8.R.123	7



NOTE: EXISTING GROUND SURFACE CROSS SECTION THROUGH END BENT 2 TAKEN FROM ELECTRONIC TIN FILE '760064_LS.TIN.TIN' DATED 2/21/17. INFERRED STRATIGRAHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

GEOTECHNICAL BORING REPORT CORE LOG

WBS 17BP.8.R.123				TIP N/A		COUNTY RICHMOND				GEOLOGIST J. Williamson			
SITE DESCRIPTION Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek										GROUND WTR (ft)			
BORING NO. EB1-A				STATION 15+28		OFFSET 15 ft LT				ALIGNMENT -L-			
COLLAR ELEV. 257.8 ft				TOTAL DEPTH 21.1 ft		NORTHING 464,313				EASTING 1,787,990			
DRILL RIG/HAMMER EFF./DATE SME275 DIETRICH D-50 87% 10/21/2017						DRILL METHOD Mud Rotary				HAMMER TYPE Automatic			
DRILLER T. Williams				START DATE 09/08/17		COMP. DATE 09/08/17				SURFACE WATER DEPTH N/A			
CORE SIZE NQ2				TOTAL RUN 5.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS			
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %		ELEV. (ft)	DEPTH (ft)		
241.7	241.7	16.1	5.0	1:15	(4.8)	(1.2)	(4.8)	(1.2)		241.7	16.1		
240				1:30						Brownish Gray PHYLLITE, Slightly to Moderately Weathered, Moderately Hard to Hard, Close Fracture Spacing, with 16 Joints at 45°			
				1:00						GSI = 60-65			
				2:00									
				1:45									
	236.7	21.1								236.7	21.1		
											Boring Terminated at Elevation 236.7 ft In Non-Crystalline Rock		

NCDOT CORE SINGLE RICHMOND NO. 64.GPJ NC_DOT.GDT 12/15/17

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.123		TIP N/A		COUNTY RICHMOND		GEOLOGIST J. Williamson											
SITE DESCRIPTION Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek							GROUND WTR (ft)										
BORING NO. EB1-B		STATION 15+28		OFFSET 14 ft RT		ALIGNMENT -L-	0 HR. N/A										
COLLAR ELEV. 257.9 ft		TOTAL DEPTH 20.1 ft		NORTHING 464,289		EASTING 1,788,006	24 HR. 10.7										
DRILL RIG/HAMMER EFF./DATE SME275 DIEDRICH D-50 87% 10/21/2017				DRILL METHOD Mud Rotary		HAMMER TYPE Automatic											
DRILLER T. Williams		START DATE 09/07/17		COMP. DATE 09/07/17		SURFACE WATER DEPTH N/A											
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)		
260																	
	257.9	0.0													257.9	0.0	GROUND SURFACE
			4	4	4												ROADWAY EMBANKMENT Orange Brown Clayey Fine to Coarse SAND with Trace Gravel (A-2-6)
255																	
	254.4	3.5	15	9	4												
	251.9	6.0	3	6	8										252.4	5.5	ALLUVIAL Tan Brown Fine to Coarse SAND (A-3)
250																	
	249.4	8.5	3	3	3										249.9	8.0	Brown Silty Fine SAND (A-2-4)
245																	
	244.4	13.5	3	4	9										245.9	12.0	Gray Brown Fine Sandy CLAY with Silty Fine Sand Seams (A-6)
240																	
	239.4	18.5													242.4	15.5	WEATHERED ROCK (Phyllite)
	237.8	20.1													239.4	18.5	NON-CRYSTALLINE ROCK (Phyllite)
															237.8	20.1	Boring Terminated at Elevation 237.8 ft In Non-Crystalline Rock

NCDOT BORE SINGLE RICHMOND NO. 64.GPJ NC_DOT.GDT 12/20/17

GEOTECHNICAL BORING REPORT BORE LOG

WBS 17BP.8.R.123		TIP N/A		COUNTY RICHMOND		GEOLOGIST J. Williamson	
SITE DESCRIPTION Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek							GROUND WTR (ft)
BORING NO. EB2-A		STATION 16+55		OFFSET 15 ft LT		ALIGNMENT -L-	0 HR. Dry
COLLAR ELEV. 257.9 ft		TOTAL DEPTH 15.8 ft		NORTHING 464,385		EASTING 1,788,095	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE SME275 DIEDRICH D-50 87% 10/21/2017				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic	
DRILLER T. Williams		START DATE 09/08/17		COMP. DATE 09/08/17		SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)	
260																
	257.9	0.0													257.9	0.0
			2	3	2	5						M			GROUND SURFACE	
															ROADWAY EMBANKMENT Brown Clayey Fine to Coarse SAND with Trace Gravel (A-2-6)	
255	254.8	3.1	5	5	5	10						M				
	252.3	5.6	8	3	2	5						M				
250	249.8	8.1	3	1	2							W			250.4	7.5
															ALLUVIAL Light Brown Silty Fine SAND (A-2-4)	
245	244.8	13.1	48	52	0.2										245.4	12.5
															WEATHERED ROCK (Phyllite)	
	242.1	15.8				100				0.7					242.1	15.8
			60	0											Boring Terminated by Auger Refusal at Elevation 242.1 ft On Non-Crystalline Rock	

NCDOT BORE SINGLE RICHMOND NO. 64.GPJ NC_DOT.GDT 12/20/17

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.123		TIP N/A		COUNTY RICHMOND		GEOLOGIST J. Williamson										
SITE DESCRIPTION Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek							GROUND WTR (ft)									
BORING NO. EB2-B		STATION 16+54		OFFSET 14 ft RT		ALIGNMENT -L-	0 HR. N/A									
COLLAR ELEV. 258.1 ft		TOTAL DEPTH 20.7 ft		NORTHING 464,361		EASTING 1,788,110	24 HR. 12.0									
DRILL RIG/HAMMER EFF./DATE SME275 DIEDRICH D-50 87% 10/21/2017				DRILL METHOD Mud Rotary		HAMMER TYPE Automatic										
DRILLER T. Williams		START DATE 09/07/17		COMP. DATE 09/07/17		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)	
260																
	258.1	0.0	4	3	7									258.1	0.0	GROUND SURFACE
																ROADWAY EMBANKMENT
																Tan Orange Silty Fine SAND (A-2-4)
255	254.6	3.5	8	8	6									255.1	3.0	Tan Brown Silty CLAY with Some Fine Sand (A-7-5)
	252.1	6.0	3	3	2									252.6	5.5	RESIDUAL
																Tan Brown Fine Sandy CLAY with Trace Rock Fragments (A-6)
250	249.6	8.5	3	3	3											
245	244.6	13.5												245.6	12.5	NON-CRYSTALLINE ROCK (Phyllite)
	243.4	14.7												243.4	14.7	NON-CRYSTALLINE ROCK (Phyllite)
														241.1	17.0	(Phyllite)
240																
														238.6	19.5	(Phyllite)
														237.4	20.7	(Phyllite)
																Boring Terminated at Elevation 237.4 ft In Non-Crystalline Rock

NCDOT BORE SINGLE RICHMOND NO. 64.GPJ NC_DOT.GDT 12/20/17

GEOTECHNICAL BORING REPORT CORE LOG

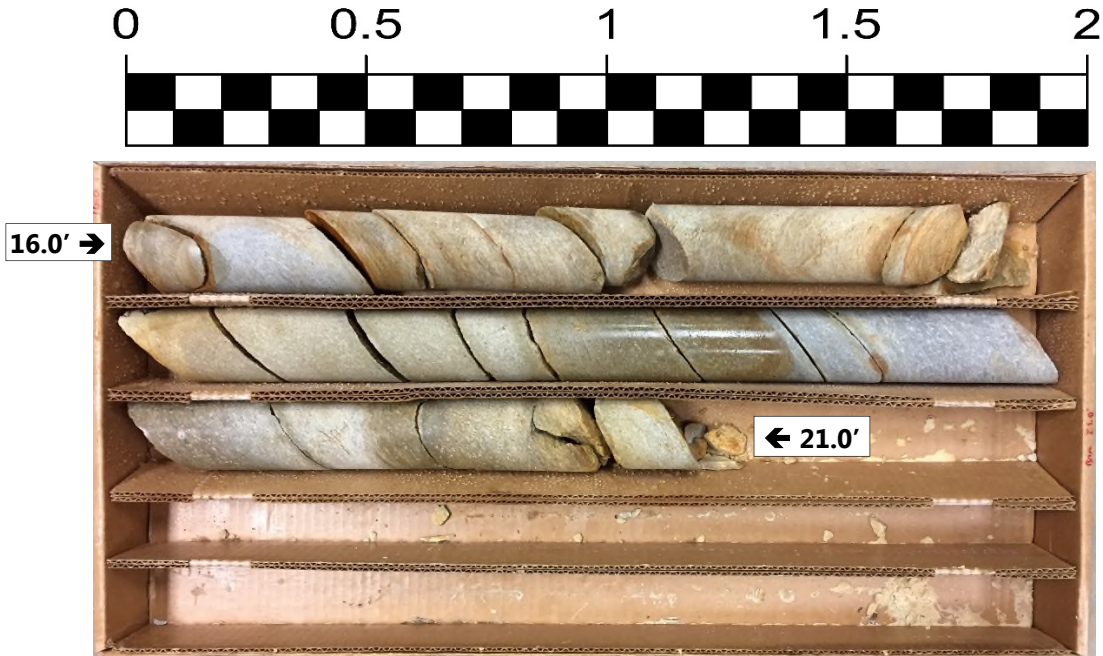
WBS 17BP.8.R.123				TIP N/A		COUNTY RICHMOND				GEOLOGIST J. Williamson									
SITE DESCRIPTION Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek										GROUND WTR (ft)									
BORING NO. EB2-B				STATION 16+54				OFFSET 14 ft RT				ALIGNMENT -L-							
COLLAR ELEV. 258.1 ft				TOTAL DEPTH 20.7 ft				NORTHING 464,361				EASTING 1,788,110							
DRILL RIG/HAMMER EFF./DATE SME275 DIEDRICH D-50 87% 10/21/2017						DRILL METHOD Mud Rotary						HAMMER TYPE Automatic							
DRILLER T. Williams				START DATE 09/07/17				COMP. DATE 09/07/17				SURFACE WATER DEPTH N/A							
CORE SIZE NQ2				TOTAL RUN 6.0 ft															
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS									
					REC. (ft) %	RQD (ft) %	SAMP. NO.	REC. (ft) %						RQD (ft) %	ELEV. (ft)	DEPTH (ft)			
243.4										Begin Coring @ 14.7 ft									
	243.4	14.7	1.3	2:00/1.3	(1.3)	(1.0)		(2.2)	(2.0)		243.4	14.7	NON-CRYSTALLINE ROCK						
	242.1	16.0			100%	77%		96%	87%		243.4		Light Gray PHYLLITE, Fresh to Slightly Weathered, Very Hard, Moderately Close to Close Fracture Spacing, with 1 Joint at 45°						
			4.7	2:30	(4.4)	(1.8)					241.1	17.0	GSI = 80-85						
				1:45	94%	38%		(2.3)	(0.4)				Dark Gray PHYLLITE, Moderately Weathered, Moderately Hard to Soft, Close to Very Close Fracture Spacing, with 5 Joints at 45°, 1 at 20°, and 1 at 60°						
240				1:45				92%	16%		238.6	19.5	GSI = 50-55						
				1:45								Light Gray PHYLLITE, Slightly Weathered, Very Hard to Hard, Close Fracture Spacing, with 1 Joint at 60°							
	237.4	20.7		2:15/0.7				(1.2)	(0.4)	237.4	20.7	GSI = 60-65							
								100%	33%	Boring Terminated at Elevation 237.4 ft In Non-Crystalline Rock									

NCDOT CORE SINGLE RICHMOND NO. 64.GPJ NC_DOT.GDT 12/15/17

CORE PHOTO REPORT

WBS: 17BP.8.R.123	TIP: N/A	COUNTY: Richmond	Boring No.: EB1-A
Site Description: Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek			Geologist: J. Williamson
Collar Elevation: 257.8 ft	Core Size: NQ2	Equipment: Diedrich D-50	Driller: T. Williams
Elevation at T.D.: 252.8 ft	Total Depth: 21.0 ft	Total Run: 5.0 ft	Date: 09/08/17

FEET



Box 1 of 1: Top of Box @ 16.0 Feet; Bottom of Box @ 21.0 Feet

CORE PHOTO REPORT

WBS: 17BP.8.R.123	TIP: N/A	COUNTY: Richmond	Boring No.: EB2-B
Site Description: Replace Bridge No. 760064 on SR 1424 over Rocky Fork Creek			Geologist: J. Williamson
Collar Elevation: 258.1 ft	Core Size: NQ2	Equipment: Diedrich D-50	Driller: T. Williams
Elevation at T.D.: 252.1 ft	Total Depth: 20.7 ft	Total Run: 6.0 ft	Date: 09/07/17

FEET



Box 1 of 1: Top of Box @ 14.7 Feet; Bottom of Box @ 20.7 Feet

PHOTOGRAPHIC RECORD
Bridge No. 760064 Over Rocky Fork Creek



Photograph No. 1:
View of -L- and Rocky Fork Creek looking west.



Photograph No. 2:
View of -L- and Rocky Fork Creek looking northeast.