STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	17BP.8.R.19	1B	14

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

STRUCTURE SUBSURFACE INVESTIGATION

PROJECT 17BP.8.R.19

COUNTY RANDOLPH

PROJECT DESCRIPTION REPLACE STRUCTURE NO. 750419 ON SR 2159 OVER PENWOOD BRANCH

SITE DESCRIPTION PROPOSED BRIDGE ON SR 2159 OVER PENWOOD BRANCH

TABLE OF CONTENTS

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	17BP.8.R.19	2A	14

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤35% PASSING #200)							SILT-CLAY MATERIALS (>35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2, A-3	A-4, A-5, A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6			
SYMBOL														
% PASSING # 10	50 MX											GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
# 40	30 MX	50 MX	51 MN											
# 200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN			
LIQUID LIMIT / PLASTIC INDEX	6 MX		N.P.	40 MX / 10 MX	41 MN / 10 MX	40 MX / 11 MN	41 MN / 11 MN	40 MX / 10 MX	41 MN / 10 MX	40 MX / 11 MN	41 MN / 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

P.I. OF A-7-5 ≤ L. - 30 : P.I. OF A-7-6 ≥ L. - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT2)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.5
	MEDIUM STIFF	4 TO 8	0.5 TO 1
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.0	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F. SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12"	3"				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, BLUE-GRAY) MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED- INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE
UNIFORM- INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED- INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE DESIGNATED BY THE TERMS; ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 30
MODERATELY COMPRESSIBLE	LIQUID LIMIT 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT-CLAY SOILS
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%
MODERATELY ORGANIC	5 - 10%	12 - 20%
HIGHLY ORGANIC	>10%	>20%

OTHER MATERIAL	
TRACE	1 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING.
- STATIC WATER LEVEL AFTER 24 HOURS.
- PW - PERCHED WATER, SATURATED ZONE OR WATER BEARING STRATA
- HC - HOLE CAVE
- SPRING OR SEEPAGE

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS
- INFERRED SOIL BOUNDARIES
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 - DIP/DIP DIRECTION OF ROCK STRUCTURES
- SOUNDING ROD
- SPT CPT DPT DMT VST PMT - TEST BORING
- AUGER BORING
- CORE BORING
- MW - MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- SPT N-VALUE

SAMPLE DESIGNATIONS

- S - BULK SAMPLE
- SS - SPLIT SPOON SAMPLE
- ST - SHELBY TUBE SAMPLE
- RS - ROCK SAMPLE
- RT - RECOMPACTED TRIAXIAL SAMPLE
- CBR - CBR SAMPLE

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F. - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED
FRAGS. - FRAGMENTS
MED. - MEDIUM
PMT - PRESSUREMETER TEST
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT
W - MOISTURE CONTENT
V. - VERY
VST - VANE SHEAR TEST

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- ☐ MOBILE B- ___
- ☐ DIEDRICH D-50
- ☐ CME-550x
- ☐ CME-750
- ☐ PORTABLE HOIST
- ☒ OTHER CME-55
- ☐ OTHER _____

ADVANCING TOOLS:
- ☐ 6" CONTINUOUS FLIGHT AUGER
- ☐ 8" HOLLOW AUGERS
- ☐ HARD FACED FINGER BITS
- ☐ TUNG.-CARBIDE INSERTS
- ☒ CASING ☐ W/ ADVANCER
- ☐ TRICONE _____" STEEL TEETH
- ☐ TRICONE _____" TUNG.-CARB.
- ☐ CORE BIT
- ☒ OTHER 3-1/4" H.S.A.
- ☐ OTHER _____

HAMMER TYPE:
- ☒ AUTOMATIC ☐ MANUAL

CORE SIZE:
- ☐ -B_____
- ☒ -N Q2
- ☐ -H_____

HAND TOOLS:
- ☐ POST HOLE DIGGER
- ☐ HAND AUGER
- ☐ SOUNDING ROD
- ☐ VANE SHEAR TEST
- ☐ OTHER _____

REVISED 10/08/2009

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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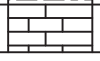
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL. 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 FOLOWS:

WEATHERED ROCK (WR)		NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.
CRYSTALLINE ROCK (CR)		FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)		FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)		COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V. SLI.)	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.
SLIGHT (SLI.)	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.
MODERATE (MOD.)	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.
MODERATELY SEVERE (MOD. SEV.)	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. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	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. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	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.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGISTS PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGISTS PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGISTS PICK.
SOFT	CAN BE GROVED 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.
VERY SOFT	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.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 – 4 FEET
THINLY BEDDED	0.16 – 1.5 FEET
VERY THINLY BEDDED	0.03 – 0.16 FEET
THICKLY LAMINATED	0.008 – 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) – SOILS WHICH 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, AS SHALE, SLATE, ETC.

ARTESIAN – GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IS IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) – SOILS WHICH 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 (F.P.) – 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 SOIL – SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (R.Q.D.) – 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 WHICH 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, WHICH 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 (N OR B.P.F.) 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 LESS THAN 0.1 FOOT PENETRATION WITH 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 (S.R.Q.D.) – 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.

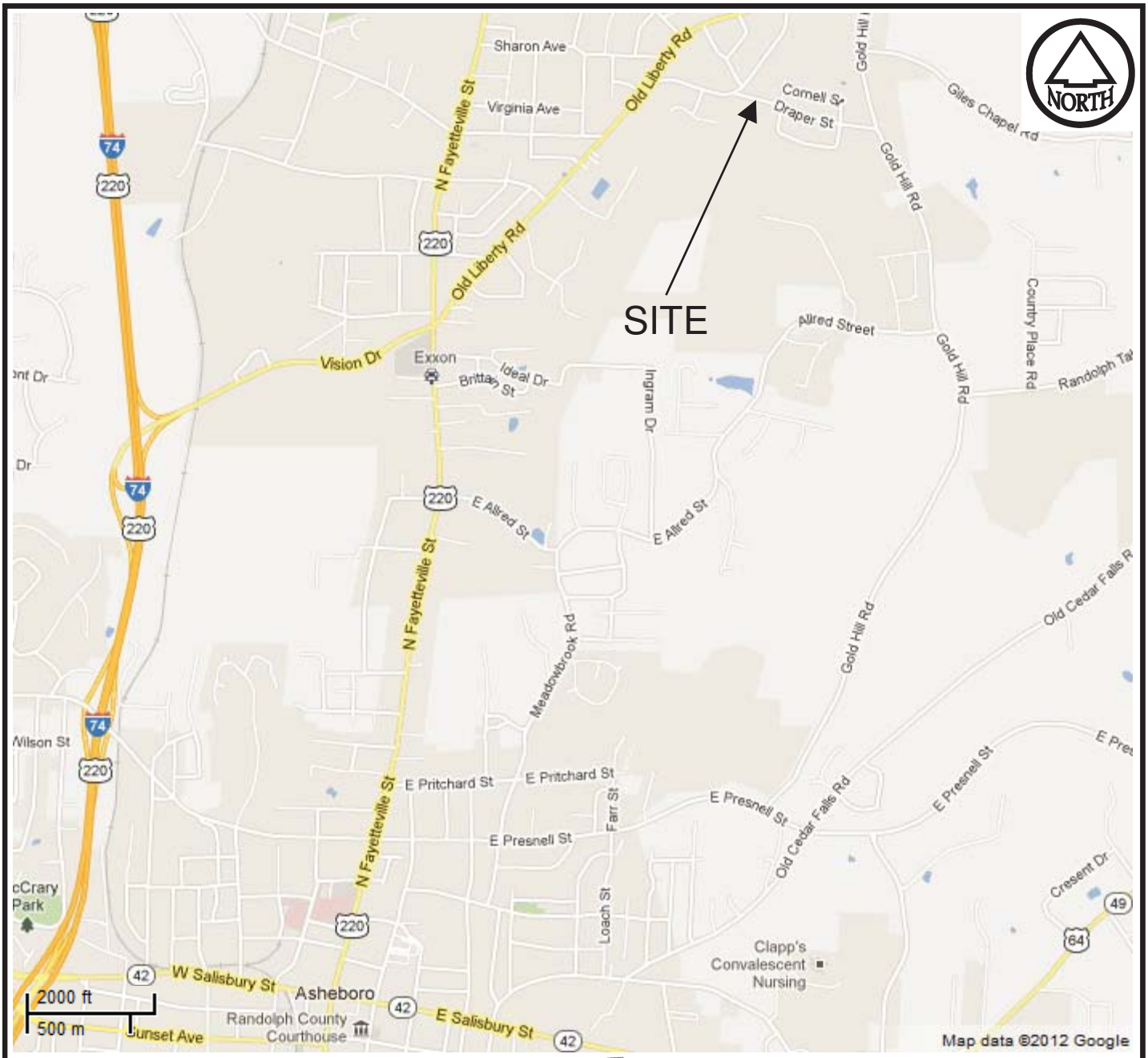
TOPSOIL (T.S.) – SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

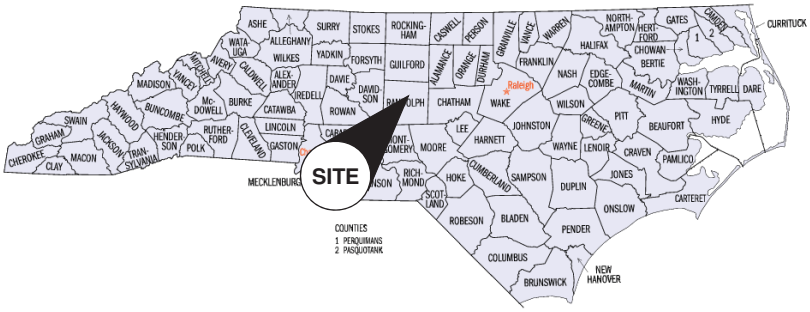
BENCH MARK: TOP NUT OF FIRE HYDRANT

ELEVATION: 652.42'

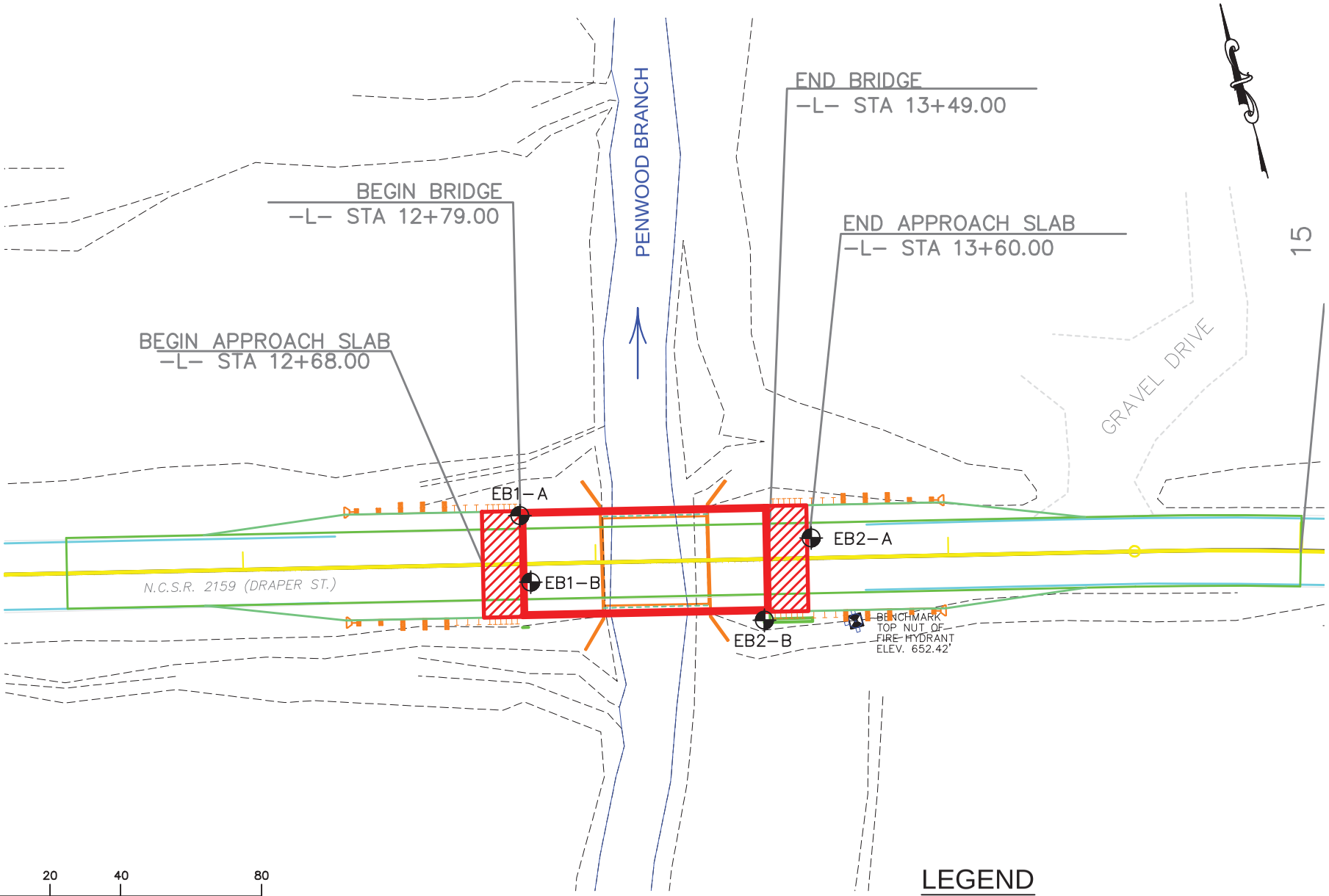
NOTES:

REVISED 10/08/2009





SCALE: AS SHOWN	S&ME ENGINEERING • TESTING ENVIRONMENTAL SERVICES	**SITE VICINITY MAP** **REPLACE STRUCTURE NO 750419** **ON SR 2159 OVER PENWOOD BRANCH** RANDOLPH COUNTY, NORTH CAROLINA	SHEET NO. 3
DRAWN BY: LAC			
CHECKED BY: SSL			
DATE: 9/19/2012		PROJECT NO.: 17BP.8.R.19	



SCALE: 1" = 40'	DATE: 9/19/2012	S&ME WWW.SMEINC.COM	**FIELD EXPLORATION PLAN**
PROJECT NO. 17BP.8.R.19	DRAWN BY: LAC		REPLACE STRUCTURE 750419 ON SR 2159 OVER PENWOOD BRANCH RANDOLPH COUNTY, NORTH CAROLINA
CHECKED BY: SSL		ENGINEERING LICENSE NO: F-0176	SHEET NO. 4

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 12+79	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 649.6 ft	**TOTAL DEPTH** 30.8 ft	**NORTHING** 727,692	**EASTING** 1,765,232	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA/NQ2 CORE	**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 07/31/12	**COMP. DATE** 07/31/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
650										649.6 GROUND SURFACE 0.0
	648.6	1.0	7	21	8	29		D		**ROADWAY EMBANKMENT** Red Brown Silty CLAY (A-7-5), Some Gravel
	646.1	3.5	4	3	3	6		D		
645										
	643.6	6.0	4	2	2	4		W		641.6 8.0
	641.1	8.5	WOH	WOH	3	3		W		**ALLUVIUM** Gray Sandy CLAY (A-6), Trace Gravel
640										637.6 12.0
	636.1	13.5	60/0.2			60/0.2		D		**WEATHERED ROCK** (Metamudstone)
635										
	631.1	18.5	60/0.1			60/0.1		D		
630										
	628.2	21.4	60/0.0			60/0.0				628.2 21.4 **NON-CRYSTALLINE ROCK** (Metamudstone)
625										
620										618.8 30.8
										Boring Terminated at Elevation 618.8 ft In Non-Crystalline Rock (Metamudstone)

1) 3 1/4" Hollow Stem Augers Advanced to 21.4 Feet
2) Standard Penetration Test Refusal at 21.4 Feet
3) NW Casing Advanced to 21.4 Feet
4) NQ2 Coring From 21.4 to 30.8 Feet
5) Water Used as Coring Fluid
6) Approximate Coring Fluid Density 62.4 pcf

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson	
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 12+79	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 649.6 ft	**TOTAL DEPTH** 30.8 ft	**NORTHING** 727,692	**EASTING** 1,765,232	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA/NQ2 CORE		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 07/31/12	**COMP. DATE** 07/31/12	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 9.4 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
628.2											Begin Coring @ 21.4 ft
	628.2	21.4	4.4	4:45/1.0 4:30/1.0 3:45/1.0 4:30/1.4	(2.7) 61%	(0.8) 18%		(5.4) 57%	(1.2) 13%		628.2 ELEV. (ft) **NON-CRYSTALLINE ROCK** 21.4 DEPTH (ft) Gray METAMUDSTONE, Very Fractured, Very Slightly to Slightly Weathered, Moderately Hard, Close to Very Close Fracture Spacing with 5 Joints at 60° and 1 Joint at 30°; All other Joints Indiscernible
625											
	623.8	25.8	5.0	4:45/1.0 4:30/1.0 3:30/1.0 2:15/1.0 2:30/1.0	(2.7) 54%	(0.4) 8%					
620											
	618.8	30.8									618.8 30.8 Boring Terminated at Elevation 618.8 ft In Non-Crystalline Rock (Metamudstone) 1) 3 1/4" Hollow Stem Augers Advanced to 21.4 Feet 2) Standard Penetration Test Refusal at 21.4 Feet 3) NW Casing Advanced to 21.4 Feet 4) NQ2 Coring From 21.4 to 30.8 Feet 5) Water Used as Coring Fluid 6) Approximate Coring Fluid Density 62.4 pcf

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson	
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 12+81	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 649.7 ft	**TOTAL DEPTH** 22.7 ft	**NORTHING** 727,673	**EASTING** 1,765,230	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 07/31/12	**COMP. DATE** 07/31/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
650										649.7 GROUND SURFACE	0.0
	648.7	1.0	5	5	4	9		M		**ROADWAY EMBANKMENT** Tan Brown Silty Clay (A-7-5), Trace Gravel	
	646.2	3.5	1	2	1	3		M			
645											
	643.7	6.0	3	2	2	4		M			
	641.2	8.5	WOH	2	1	3		W		641.7	8.0
640										**ALLUVIUM** Gray CLAY (A-7-6) 640.0	9.7
										ALLUVIUM Gray Clayey Fine to Coarse SAND (A-2-6), Trace Amounts of Gravel 637.7	12.0
	636.2	13.5	60/0.3			60/0.3		D		**WEATHERED ROCK** (Metamudstone)	
635											
	631.2	18.5	60/0.1			60/0.1		D			
630											
	627.1	22.6	60/0.1			60/0.1		D		627.0	22.7

Boring Terminated with Standard Penetration Test Refusal at Elevation 627.0 ft On Non-Crystalline Rock (Metamudstone)

1) 3 1/4" Hollow Stem Augers Advanced to 22.6 Feet
2) Standard Penetration Test Refusal at 22.7 Feet

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson	
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 13+61	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 650.4 ft	**TOTAL DEPTH** 21.0 ft	**NORTHING** 727,664	**EASTING** 1,765,310	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA/NQ2 CORE		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 07/31/12	**COMP. DATE** 07/31/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
655											
										650.4 GROUND SURFACE	0.0
650	649.4	1.0	3	2	1	3		M		**ROADWAY EMBANKMENT** Red Brown Silty CLAY (A-7-5)	
	646.9	3.5	6	5	15	20		M		647.4 **ROADWAY EMBANKMENT** Tan Brown Silty CLAY (A-7-5)	3.0
645	644.4	6.0	2	2	1	3		W		643.9 **ALLUVIUM** Brown Gray Silty CLAY (A-7-5)	6.5
	641.9	8.5	4	11	43	54		M		642.4 **RESIDUUM** Tan Gray Sandy SILT (A-4), Some Rock Fragments	8.0
640										639.9 **WEATHERED ROCK** (Metamudstone)	10.5
	637.6	12.8	60/0			60/0				637.6 **NON-CRYSTALLINE ROCK** (Metamudstone)	12.8
635											
										631.8 **NON-CRYSTALLINE ROCK** (Metamudstone)	18.6
630										629.4	21.0

Boring Terminated at Elevation 629.4 ft In Non-Crystalline Rock (Metamudstone)

1) 3 1/4" Hollow Stem Augers Advanced to 12.8 Feet
2) Standard Penetration Test Refusal at 12.8 Feet
3) NW Casing Advanced to 12.8 Feet
4) NQ2 Coring From 12.8 to 21.0 Feet
5) Water Used as Coring Fluid
6) Approximate Coring Fluid Density 62.4 pcf

NCDOT BORE SINGLE 419.GPJ NC_DOT.GDT 9/19/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson	
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 13+61	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 650.4 ft	**TOTAL DEPTH** 21.0 ft	**NORTHING** 727,664	**EASTING** 1,765,310	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA/NQ2 CORE	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 07/31/12	**COMP. DATE** 07/31/12	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 8.2 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
637.6											Begin Coring @ 12.8 ft
	637.6	12.8	3.2	9:00/1.0 8:00/1.0 7:00/1.2	(3.2) 100%	(1.5) 47%		(5.8) 100%	(1.5) 26%		**NON-CRYSTALLINE ROCK** Gray METAMUDSTONE, Slightly to Moderately Weathered, Hard to Moderately Hard, Close to Very Close Fracture Spacing with 6 Joints at 60° and 6 Joints at 30°: Other Joints Indiscernible
635	634.4	16.0	5.0	8:00/1.0 6:30/1.0 5:45/1.0	(5.0) 100%	(2.1) 42%					
				5:30/1.0 5:15/1.0				(2.4) 100%	(2.1) 88%		**NON-CRYSTALLINE ROCK** Gray METAMUDSTONE, Slightly to Very Slightly Weathered, Hard, Close Fracture Spacing with 1 Joint at 60°, 2 Joints at 30°, and 1 Vertical Joint
630	629.4	21.0									Boring Terminated at Elevation 629.4 ft In Non-Crystalline Rock (Metamudstone)

637.6 ELEV. (ft) — 12.8 DEPTH (ft)

631.8 ELEV. (ft) — 18.6 DEPTH (ft)

629.4 ELEV. (ft) — 21.0 DEPTH (ft)

1) 3 1/4" Hollow Stem Augers Advanced to 12.8 Feet
2) Standard Penetration Test Refusal at 12.8 Feet
3) NW Casing Advanced to 12.8 Feet
4) NQ2 Coring From 12.8 to 21.0 Feet
5) Water Used as Coring Fluid
6) Approximate Coring Fluid Density 62.4 pcf

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** 17BP.8.R.19	**COUNTY** Randolph	**GEOLOGIST** J. Williamson	
SITE DESCRIPTION Proposed Bridge on SR 2159 Over Penwood Branch				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 13+47	**OFFSET** 17 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 649.6 ft	**TOTAL DEPTH** 13.4 ft	**NORTHING** 727,645	**EASTING** 1,765,291	**24 HR.** Caved
DRILL RIG/HAMMER EFF./DATE CME-55 90% 8/17/2012		**DRILL METHOD** 3 1/4" HSA		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 07/30/12	**COMP. DATE** 07/30/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
650										649.6 GROUND SURFACE	0.0
	648.6	1.0	3	3	5	8		D		**ROADWAY EMBANKMENT** Red Brown Silty CLAY (A-7-5)	
	646.1	3.5	4	3	3	6		M		644.1	5.5
645										**ALLUVIUM** Gray Brown Sandy CLAY (A-6), Trace Roots and Rootlets	
	643.6	6.0	1	2	1	3		M			
	641.1	8.5	1	1	1						
640						2		W		637.1	12.5
	636.2	13.4	60/0			60/0				636.2 **WEATHERED ROCK** (Metamudstone)	13.4

Boring Terminated with Standard Penetration Test Refusal at Elevation 636.2 ft On Non-Crystalline Rock (Metamudstone)

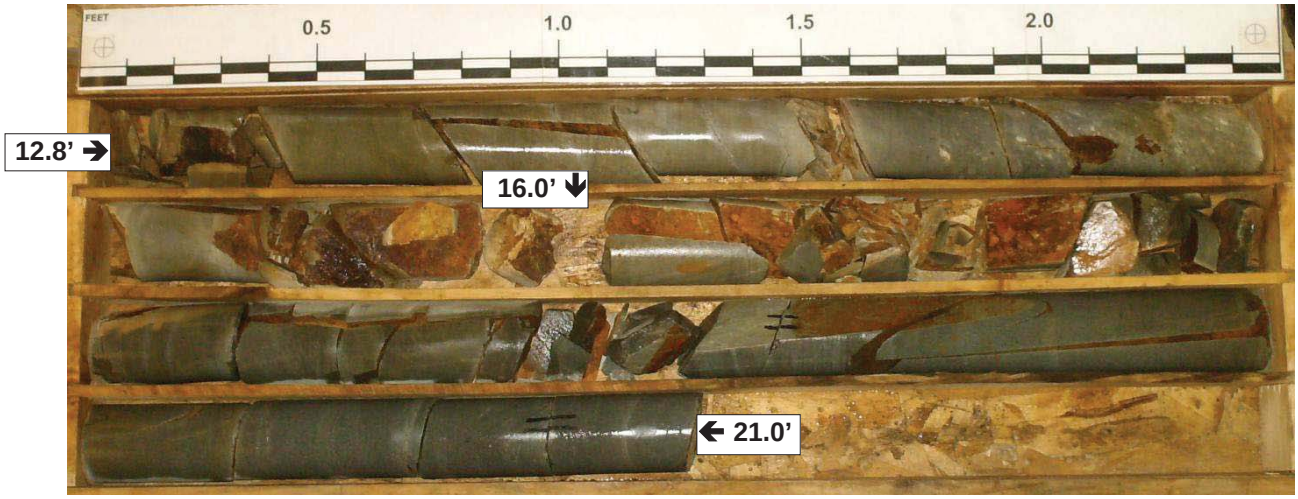
1) 3 1/4" Hollow Stem Augers Advanced to 13.4 Feet
2) Standard Penetration Test at 13.4 Feet

Project No: 1351-11-343G	*Project ID:* 17BP.8.R.19	*County:* Randolph	*Boring No.:* EB1-A
Site Description: Proposed Bridge on SR 2159 over Penwood Branch			*Driller*: C. Odom
Collar Elev.: 649.6	*Core Size:* NQ-2	*Equipment:* CME-55	*Geologist*: J. Williamson
Elev. at T.D.: 618.8	*Total Depth:* 30.8’	*Total Run:* 9.4’	*Date*: 07/31/2012

Box 1 of 1

Top of Box @ 21.4 feet; Bottom of Box @ 30.8 feet

Project No: 1351-11-343G	*Project ID:* 17BP.8.R.19	*County:* Randolph	*Boring No.:* EB2-A
Site Description: Proposed Bridge on SR 2159 over Penwood Branch			*Driller*: C. Odom
Collar Elev.: 650.4	*Core Size:* NQ-2	*Equipment:* CME-55	*Geologist*: J. Williamson
Elev. at T.D.: 629.4	*Total Depth:* 21.0'	*Total Run:* 8.2'	*Date*: 07/31/2012



Box 1 of 1

Top of Box @ 12.8 feet; Bottom of Box @ 21.0 feet

Photograph No. 1:
View looking east up-station from west approach

Photograph No. 2:
View looking west down-station from east approach

Photograph No. 3:
View looking south upstream from bridge deck

Photograph No. 4:
View looking north downstream from bridge deck

Photograph No. 5:
View looking west at left side of End Bent 1

Photograph No. 6:
View looking south at right side of End Bent 1

Photograph No. 7:
View looking east at left side of End Bent 2

Photograph No. 8:
View looking east at right side of End Bent 2