

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BP10.R040.1	1	14

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

**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

COUNTY UNION

SITE DESCRIPTION BRIDGE NO. 93 ON SR 1937 (OLD  
PAGELAND-MARSHVILLE RD.) OVER HANEY  
BRANCH

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<u>SHEET NO.</u>	<u>DESCRIPTION</u>
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2B, 2C	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
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6-13	BORELOGS, CORELOGS, AND ROCK CORE PHOTOS
14	SITE PHOTOS

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DATE SEPTEMBER 2022

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Prepared in the Office of:



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D. Matthew Brewer 09/15/2022

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SIGNATURE

DATE

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**REFERENCE: BP10.R040.1**

**PROJECT: SF-890093**

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.									
SOIL LEGEND AND AASHTO CLASSIFICATION										ANGULARITY OF GRAINS									
GENERAL CLASS. GRANULAR MATERIALS (<= 35% PASSING #200) SILT-CLAY MATERIALS (> 35% PASSING #200) ORGANIC MATERIALS										MINERALOGICAL COMPOSITION									
GROUP CLASS. A-1, A-3, A-2, A-4, A-5, A-6, A-7, A-1-A2, A-3, A-4, A-5, A-6, A-7										MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.									
SYMBOL										COMPRESSIBILITY									
% PASSING #10, #40, #200										SLIGHTLY COMPRESSIBLE LL < 31 MODERATELY COMPRESSIBLE LL = 31 - 50 HIGHLY COMPRESSIBLE LL > 50									
MATERIAL PASSING #40 LL, PI										PERCENTAGE OF MATERIAL									
GROUP INDEX										ORGANIC MATERIAL GRANULAR SOILS SILT - CLAY SOILS OTHER MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										TRACE OF ORGANIC MATTER 2 - 3% 3 - 5% TRACE 1 - 10% LITTLE ORGANIC MATTER 3 - 5% 5 - 12% LITTLE 10 - 20% MODERATELY ORGANIC 5 - 10% 12 - 20% SOME 20 - 35% HIGHLY ORGANIC > 10% > 20% HIGHLY 35% AND ABOVE									
GEN. RATING AS SUBGRADE										GROUND WATER									
EXCELLENT TO GOOD FAIR TO POOR FAIR TO POOR POOR UNSUITABLE										▽ WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING ▽ STATIC WATER LEVEL AFTER 24 HOURS ▽PW PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA ○ SPRING OR SEEP									
CONSISTENCY OR DENSENESS										MISCELLANEOUS SYMBOLS									
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION 25/025 DIP & DIP DIRECTION OF ROCK STRUCTURES SOIL SYMBOL SPT DMT VST PMT TEST BORING ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT AUGER BORING CONE PENETROMETER TEST INFERRED SOIL BOUNDARY CORE BORING SOUNDING ROD INFERRED ROCK LINE MONITORING WELL TEST BORING WITH CORE ALLUVIAL SOIL BOUNDARY PIEZOMETER INSTALLATION SPT N-VALUE									
TEXTURE OR GRAIN SIZE										RECOMMENDATION SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM) 4 10 40 60 200 270 4.76 2.00 0.42 0.25 0.075 0.053										UNDERCUT UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL SHALLOW UNDERCUT UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK									
GRAIN SIZE MM 305 75 2.0 0.25 0.05 0.005 IN. 12 3										ABBREVIATIONS									
SOIL MOISTURE - CORRELATION OF TERMS										AR - AUGER REFUSAL MED. - MEDIUM VST - VANE SHEAR TEST BT - BORING TERMINATED MICA - MICACEOUS WEA. - WEATHERED CL. - CLAY MOD. - MODERATELY ? - UNIT WEIGHT CPT - CONE PENETRATION TEST NP - NON PLASTIC 7/2 - DRY UNIT WEIGHT CSE. - COARSE ORG. - ORGANIC DMT - DILATOMETER TEST PMT - PRESSUREMETER TEST SAMPLE ABBREVIATIONS DPT - DYNAMIC PENETRATION TEST SAP. - SAPROLITIC S - BULK e - VOID RATIO SD. - SAND, SANDY SD. - SAND, SANDY SS - SAND, SANDY F - FINE SL. - SILT, SILTY SL. - SILT, SILTY ST - SHELBY TUBE FOSS. - FOSSILIFEROUS SLLI. - SLIGHTLY SLLI. - SLIGHTLY RS - ROCK FRAC. - FRACTURED, FRACTURES TCR - TRICONE REFUSAL RT - RECOMPACTED TRIAXIAL FRAGS. - FRAGMENTS w - MOISTURE CONTENT CBR - CALIFORNIA BEARING RATIO HI. - HIGHLY v - VERY									
PLASTICITY										EQUIPMENT USED ON SUBJECT PROJECT									
PLASTICITY INDEX (PI) DRY STRENGTH										DRILL UNITS: ADVANCING TOOLS: HAMMER TYPE:									
NON PLASTIC 0-5 VERY LOW SLIGHTLY PLASTIC 6-15 SLIGHT MODERATELY PLASTIC 16-25 MEDIUM HIGHLY PLASTIC 26 OR MORE HIGH										<input type="checkbox"/> CME-45C <input type="checkbox"/> CLAY BITS <input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL <input type="checkbox"/> CME-55 <input type="checkbox"/> 6' CONTINUOUS FLIGHT AUGER <input type="checkbox"/> CME-550X <input checked="" type="checkbox"/> 8" HOLLOW AUGERS <input type="checkbox"/> VANE SHEAR TEST <input type="checkbox"/> HARD FACED FINGER BITS <input type="checkbox"/> PORTABLE HOIST <input type="checkbox"/> TUNG-CARBIDE INSERTS <input type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER <input type="checkbox"/> TRICONE _____ * STEEL TEETH <input type="checkbox"/> TRICONE _____ * TUNG-CARB. <input checked="" type="checkbox"/> DIEDRICH D-50 <input checked="" type="checkbox"/> CORE BIT <input type="checkbox"/>									
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.										CORE SIZE: <input type="checkbox"/> -B _____ <input type="checkbox"/> -H _____ <input checked="" type="checkbox"/> -N Q _____ HAND TOOLS: <input type="checkbox"/> POST HOLE DIGGER <input type="checkbox"/> HAND AUGER <input type="checkbox"/> SOUNDING ROD <input type="checkbox"/> VANE SHEAR TEST <input type="checkbox"/>									





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

# SUBSURFACE INVESTIGATION

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

### ROCK DESCRIPTION

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:

WEATHERED ROCK (WR)		NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
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 YIELD 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 SL.)	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 (SL.)	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. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i>
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. <i>IF TESTED, WOULD YIELD SPT N VALUES &gt; 100 BPF</i>
VERY SEVERE (V SEV.)	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 &lt; 100 BPF</i>
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 GEOLOGIST'S 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 GEOLOGIST'S 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 PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	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.
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

### BEDDING

TERM	SPACING	TERM	THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET
		THINLY LAMINATED	< 0.008 FEET

### INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF 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

<b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.	<b>AQUIFER</b> - A WATER BEARING FORMATION OR STRATA.
<b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.	<b>ARGILLACEOUS</b> - 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.
<b>ARTESIAN</b> - 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.	<b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.
<b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.	<b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.
<b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.	<b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.
<b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.	<b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.
<b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.	<b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.
<b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.	<b>FORMATION (FM.)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.
<b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.	<b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.
<b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.	<b>MOTTLED (MOT.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.
<b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.	<b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.
<b>ROCK QUALITY DESIGNATION (ROD)</b> - 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.	<b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.
<b>SILL</b> - 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.	<b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.
<b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - 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.	<b>STRATA CORE RECOVERY (SREC.)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.
<b>STRATA ROCK QUALITY DESIGNATION (SROD)</b> - 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.	<b>TOPSOIL (TS.)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: BM2: N = 437,261.9970 E = 1,585,273.8410

SET R/R SPIKE IN 48" RED OAK

ELEVATION: 487.70 FEET

### NOTES:

ROADWAY PLANS PROVIDED BY NCDOT ON 8/14/2022

FIAD = FILLED IMMEDIATELY AFTER DRILLING



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

**SUBSURFACE INVESTIGATION**

**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

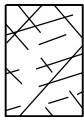
GOOD - Rough, slightly weathered surfaces

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.



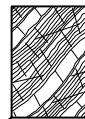
**B. Sandstone with thin inter-layers of siltstone**



**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**

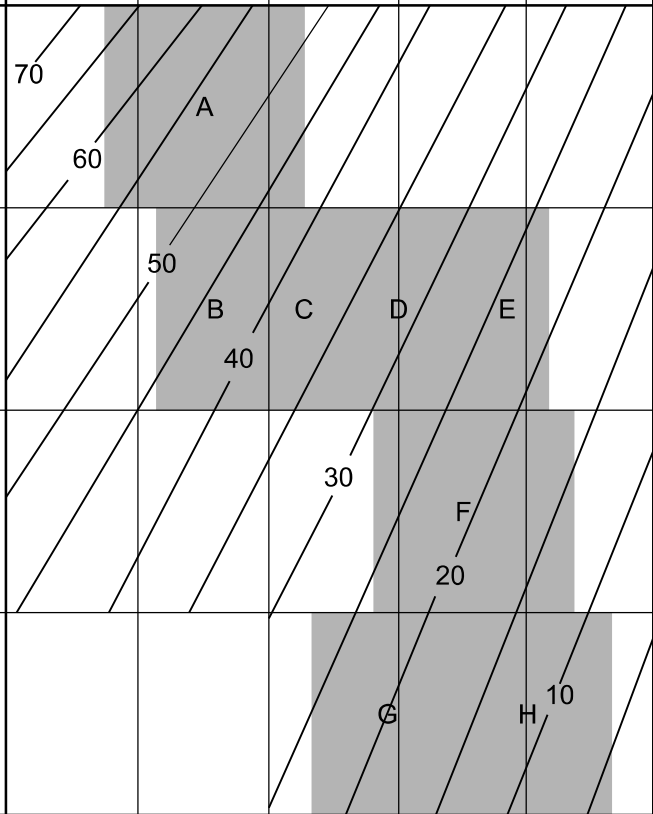


**G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers**

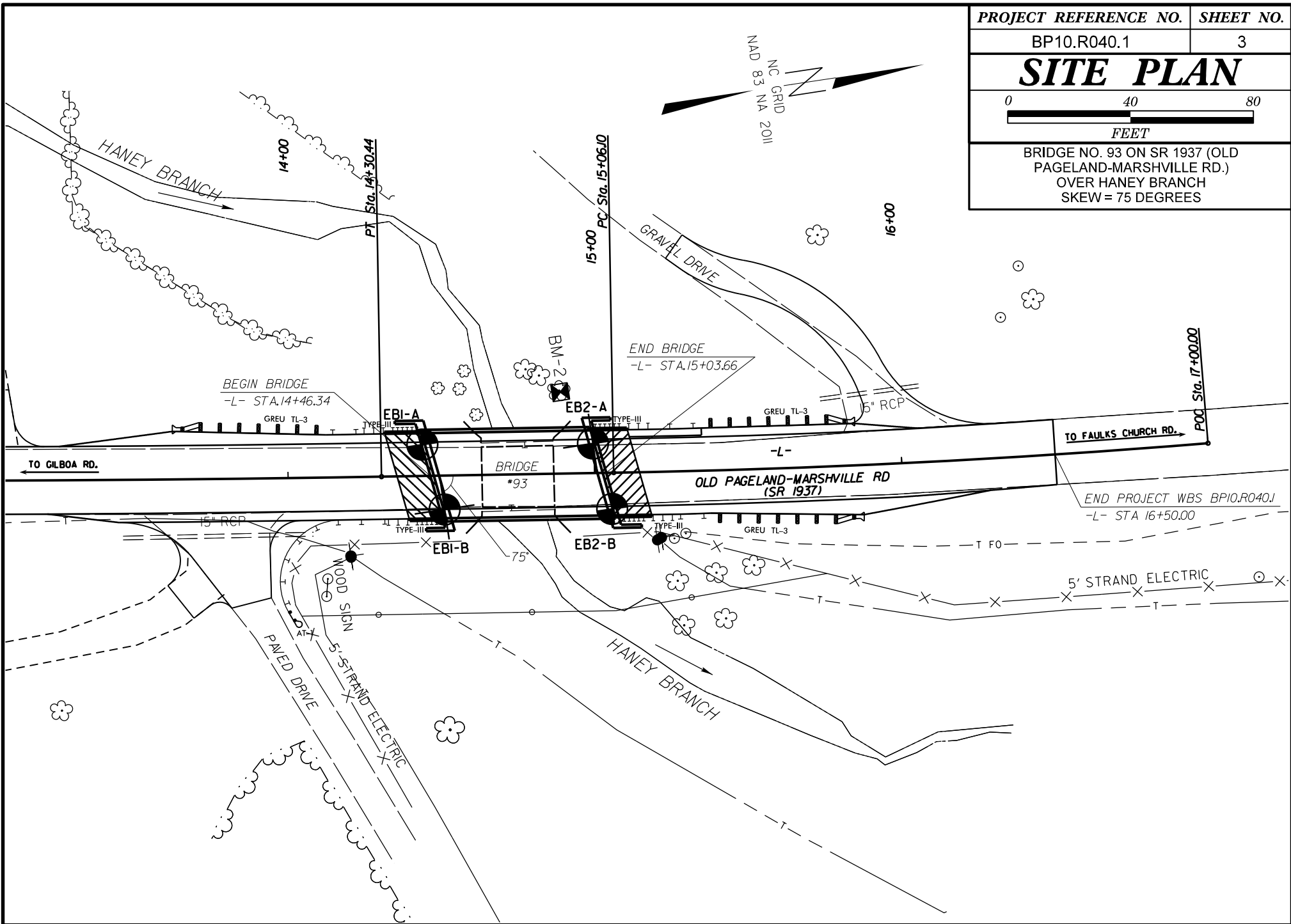


**H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.**

➔ Means deformation after tectonic disturbance



<b>PROJECT REFERENCE NO.</b>	<b>SHEET NO.</b>
BP10.R040.1	3
<b>SITE PLAN</b>	
 <b>FEET</b>	
BRIDGE NO. 93 ON SR 1937 (OLD PAGELAND-MARSHVILLE RD.) OVER HANEY BRANCH SKEW = 75 DEGREES	

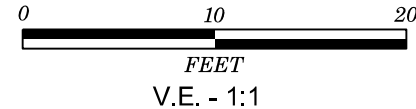


45 40 35 30

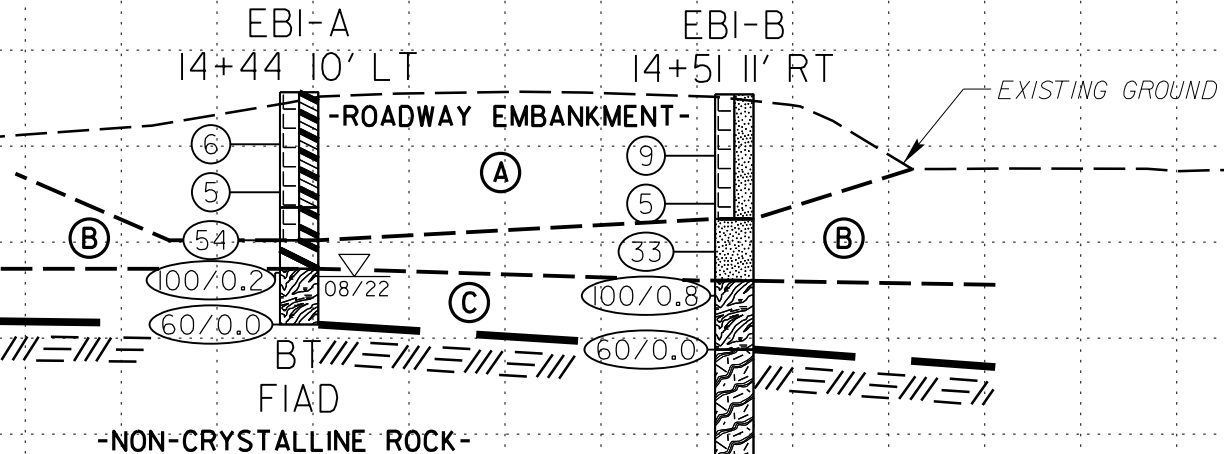
Prepared in the Office of:



CAROLINAS  
GEOTECHNICAL  
GROUP



PROJECT REFERENCE NO.	SHEET NO.
BP10.R040.1	4
BRIDGE NO. 93 ON SR 1937 (OLD PAGELAND -MARSHVILLE RD.) OVER HANEY BRANCH SKEW = 75 DEGREES	



VERY SLIGHTLY WEATHERED TO FRESH, MODERATELY HARD TO HARD, BLUE-GRAY, (META-ARGILLITE), WITH VERY CLOSE TO CLOSE FRACTURE SPACING, THICKLY LAMINATED TO THINLY BEDDED, AND MODERATELY INDURATED

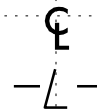
REC=91%  
RQD=24%  
GSI=25-30

(A) -ROADWAY EMBANKMENT- MEDIUM STIFF TO STIFF, MOIST, ORANGE-BROWN-TAN, FINE TO COARSE SANDY SILT (A-4), SILTY, FINE TO COARSE SANDY CLAY (A-6), AND FINE TO COARSE SANDY, SILTY CLAY (A-7), WITH TRACE GRAVEL

(B) -RESIDUAL- HARD, MOIST TO WET, BLACK-BROWN-GRAY, FINE TO COARSE SANDY SILT (A-4) AND SILTY CLAY (A-7), WITH TRACE GRAVEL-SIZED ROCK FRAGMENTS

(C) -WEATHERED ROCK- (META-ARGILLITE)

14 + 46.34

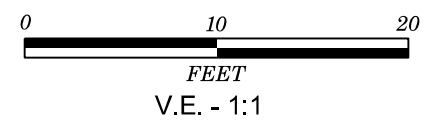


-L- EXISTING GROUND LINE ALONG END BENT 1 SKEW TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY NCDOT ON 8/14/2022. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

45 40 35 30

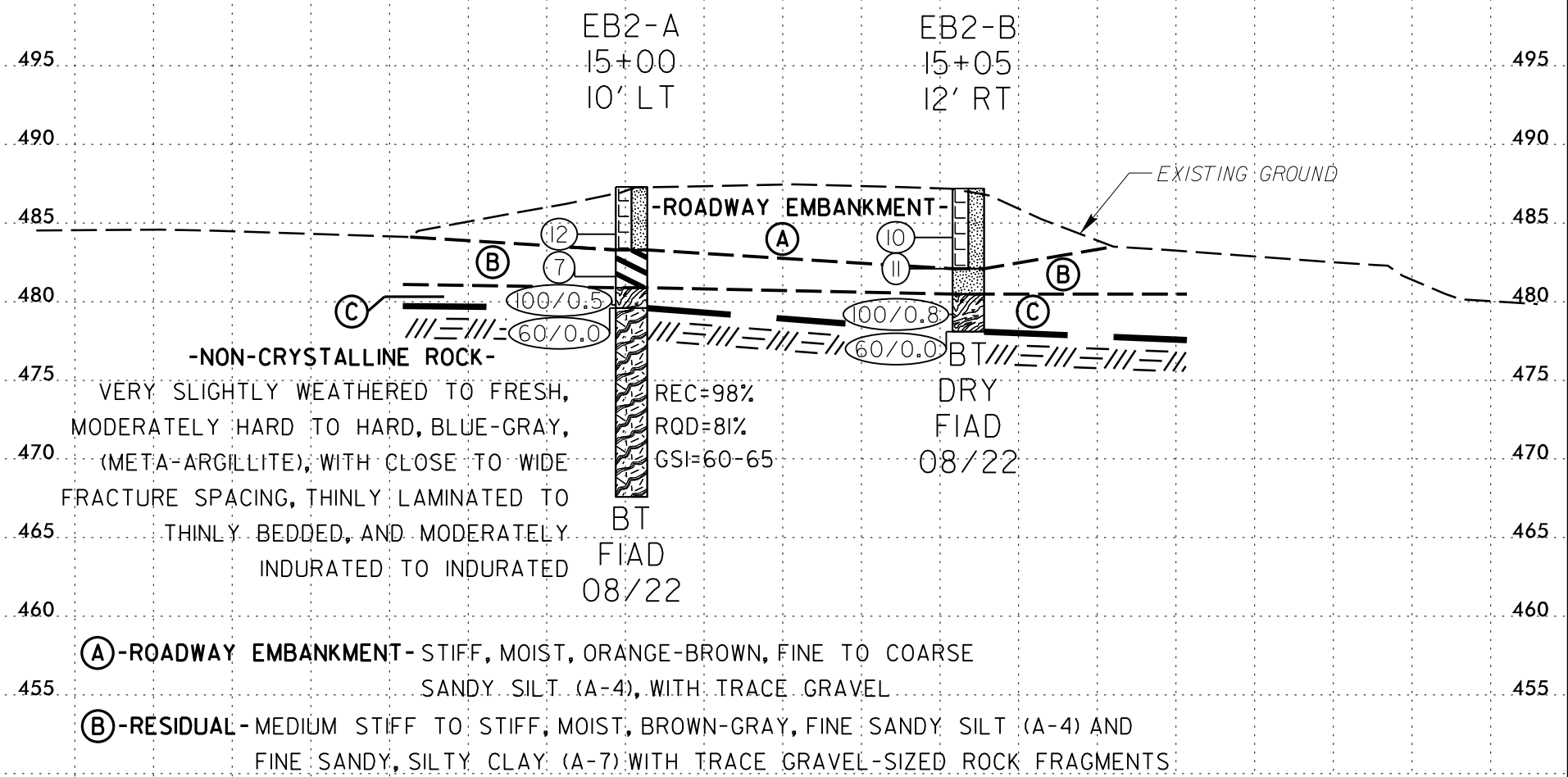
25 20 15 10 5 0 5 10 15 20 25 30 35 40 45

45 40 35 30

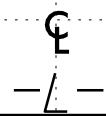


<b>PROJECT REFERENCE NO.</b>	<b>SHEET NO.</b>
BP10.R040.1	5
BRIDGE NO. 93 ON SR 1937 (OLD PAGELAND - MARSHVILLE RD.) OVER HANEY BRANCH SKEW = 75 DEGREES	

25 20 15 10 5 0 5 10 15 20 25 30 35 40 45



15 + 03.66



-L- EXISTING GROUND LINE ALONG END BENT 2 SKEW TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY NCDOT ON 8/14/2022. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45



# GEOTECHNICAL BORING REPORT

## BORE LOG

WBS BP10.R040.1	TIP SF-890093	COUNTY UNION	GEOLOGIST S. N. Patterson
SITE DESCRIPTION Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch			GROUND WTR (ft)
BORING NO. EB1-A	STATION 14+44	OFFSET 10 ft LT	ALIGNMENT -L-
COLLAR ELEV. 487.5 ft	TOTAL DEPTH 12.1 ft	NORTHING 437,215	EASTING 1,585,284
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D50 87% 05/10/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Odom	START DATE 08/25/22	COMP. DATE 08/25/22	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
490																
														487.5	GROUND SURFACE	0.0
	485.8	1.7	3	4	2										<b>ROADWAY EMBANKMENT</b>	
485	483.3	4.2	2	2	3										Medium Stiff, Orange-Brown, Silty, Fine to Coarse Sandy CLAY (A-6), with trace gravel	
	480.8	6.7	2	4	50										Medium Stiff, Orange-Tan-Brown, Fine to Coarse Sandy, Silty CLAY (A-7), with trace gravel	6.0
480	478.3	9.2	100/0.2													7.7
	475.4	12.1	60/0.0												Hard, Brown-Gray, Silty CLAY (A-7), with trace gravel-sized rock fragments	9.2
															<b>RESIDUAL WEATHERED ROCK</b>	
															Brown-Gray, (Meta-Argillite)	12.1
															Boring Terminated with Standard Penetration Test Refusal at Elevation 475.4 ft On Non-Crystalline Rock (Meta-Argillite)	
															Notes: Hard drilling encountered from approximately 7.7 to 12.1 feet	

NCDOT BORE SINGLE UNION 93.GPJ NC\_DOT.GDT 9/14/22

# GEOTECHNICAL BORING REPORT


## BORE LOG

<b>WBS</b> BP10.R040.1			<b>TIP</b> SF-890093			<b>COUNTY</b> UNION			<b>GEOLOGIST</b> S. N. Patterson							
<b>SITE DESCRIPTION</b> Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch									<b>GROUND WTR (ft)</b>							
<b>BORING NO.</b> EB1-B			<b>STATION</b> 14+51			<b>OFFSET</b> 11 ft RT			<b>ALIGNMENT</b> -L-							
<b>COLLAR ELEV.</b> 487.4 ft			<b>TOTAL DEPTH</b> 29.7 ft			<b>NORTHING</b> 437,219			<b>EASTING</b> 1,585,306							
<b>DRILL RIG/HAMMER EFF./DATE</b> CG20446 Diedrich D50 87% 05/10/2022						<b>DRILL METHOD</b> SPT Core Boring			<b>HAMMER TYPE</b> Automatic							
<b>DRILLER</b> C. Odom			<b>START DATE</b> 08/25/22			<b>COMP. DATE</b> 08/25/22			<b>SURFACE WATER DEPTH</b> N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
490																
485	485.2	2.2	10	5	4									487.4	GROUND SURFACE	0.0
	482.7	4.7	1	1	4										<b>ROADWAY EMBANKMENT</b> Medium Stiff to Stiff, Orange-Brown, Fine to Coarse Sandy SILT (A-4), with trace gravel	
480	480.2	7.2	15	18	15									480.9	<b>RESIDUAL</b>	6.5
	477.7	9.7	32	68/0.3										477.7	Hard, Brown-Black-Gray, Fine to Coarse Sandy SILT (A-4), with trace gravel-sized rock fragments	9.7
475	474.1	13.3												474.1	<b>WEATHERED ROCK</b> Brown-Gray, (Meta-Argillite)	13.3
			60/0.0												<b>NON-CRYSTALLINE ROCK</b> Blue-Gray, (Meta-Argillite)	
470																
465																
460																
														457.7	Boring Terminated at Elevation 457.7 ft In Non-Crystalline Rock (Meta-Argillite)	29.7

NCDOT BORE SINGLE UNION 93.GPJ NC\_DOT.GDT 9/14/22

# GEOTECHNICAL BORING REPORT

## CORE LOG

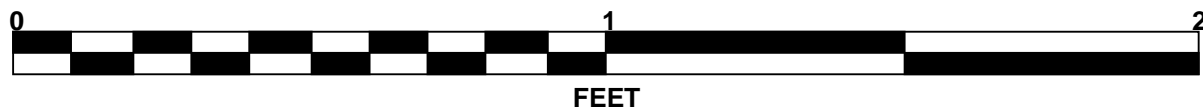
WBS BP10.R040.1			TIP SF-890093			COUNTY UNION			GEOLOGIST S. N. Patterson			
SITE DESCRIPTION Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch										GROUND WTR (ft)		
BORING NO. EB1-B			STATION 14+51			OFFSET 11 ft RT			ALIGNMENT -L-			
COLLAR ELEV. 487.4 ft			TOTAL DEPTH 29.7 ft			NORTHING 437,219			EASTING 1,585,306			
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D50 87% 05/10/2022						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic			
DRILLER C. Odom			START DATE 08/25/22			COMP. DATE 08/25/22			SURFACE WATER DEPTH N/A			
CORE SIZE NQ			TOTAL RUN 16.4 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		L O G	DESCRIPTION AND REMARKS	
					REC. (ft) %	RQD (ft) %		REC. (ft) %	RQD (ft) %			
474.05											Begin Coring @ 13.3 ft	
	474.1 472.7	13.3 14.7	1.4 5.0	N=60/0.0 4:11/1.0 0:55/0.4	(0.5) 36%	(0.0) 0%		(15.0) 91%	(3.9) 24%		474.1	
				5:46/1.0 4:37/1.0 2:50/1.0 2:54/1.0 2:56/1.0	(5.0) 100%	(2.2) 44%					13.3	
	467.7	19.7										GSI: 25-30
			5.0	3:24/1.0 3:52/1.0 5:25/1.0 3:04/1.0 3:26/1.0	(4.8) 96%	(0.6) 12%						
	462.7	24.7										
			5.0	4:28/1.0 4:34/1.0 4:43/1.0 3:18/1.0 2:24/1.0	(4.7) 94%	(1.1) 22%						
	457.7	29.7								457.7	29.7	
Boring Terminated at Elevation 457.7 ft In Non-Crystalline Rock (Meta-Argillite)												

NCDOT CORE SINGLE UNION 93.GPJ NC\_DOT.GDT 9/14/22



**Bridge No. 93 on SR 1937 over Haney Branch  
Union County, NC  
Rock Core Photographs  
Boring: EB1-B**

13.3 to 29.7 Feet



# GEOTECHNICAL BORING REPORT


## BORE LOG

<b>WBS</b> BP10.R040.1			<b>TIP</b> SF-890093			<b>COUNTY</b> UNION			<b>GEOLOGIST</b> S. N. Patterson							
<b>SITE DESCRIPTION</b> Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch									<b>GROUND WTR (ft)</b>							
<b>BORING NO.</b> EB2-A			<b>STATION</b> 15+00			<b>OFFSET</b> 10 ft LT			<b>ALIGNMENT</b> -L-							
<b>COLLAR ELEV.</b> 487.3 ft			<b>TOTAL DEPTH</b> 19.7 ft			<b>NORTHING</b> 437,270			<b>EASTING</b> 1,585,292							
<b>DRILL RIG/HAMMER EFF./DATE</b> CG20446 Diedrich D50 87% 05/10/2022						<b>DRILL METHOD</b> SPT Core Boring			<b>HAMMER TYPE</b> Automatic							
<b>DRILLER</b> C. Odom			<b>START DATE</b> 08/25/22			<b>COMP. DATE</b> 08/25/22			<b>SURFACE WATER DEPTH</b> N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
490																
485	485.3	2.0	11	7	5									487.3	GROUND SURFACE	0.0
	482.6	4.7	2	3	4									483.3	<b>ROADWAY EMBANKMENT</b> Stiff, Orange-Brown, Fine to Coarse Sandy SILT (A-4), with trace gravel	4.0
480	480.3	7.0												480.9	<b>RESIDUAL</b> Medium Stiff, Brown, Fine Sandy, Silty CLAY (A-7)	6.4
	479.6	7.7	100/0.5							100/0.5				479.6	<b>WEATHERED ROCK</b> Brown-Gray, (Meta-Argillite)	7.7
			60/0.0							60/0.0					<b>NON-CRYSTALLINE ROCK</b> Blue-Gray, (Meta-Argillite)	
475																
470																
														467.6	Boring Terminated at Elevation 467.6 ft In Non-Crystalline Rock (Meta-Argillite)	19.7
<p><b>Notes:</b></p> <p>Hard drilling encountered from approximately 6.4 to 7.7 feet</p>																

NCDOT BORE SINGLE UNION 93.GPJ NC\_DOT.GDT 9/14/22

# GEOTECHNICAL BORING REPORT

## CORE LOG

WBS BP10.R040.1				TIP SF-890093		COUNTY UNION			GEOLOGIST S. N. Patterson		
SITE DESCRIPTION Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch										GROUND WTR (ft)	
BORING NO. EB2-A				STATION 15+00		OFFSET 10 ft LT		ALIGNMENT -L-			0 HR. N/A
COLLAR ELEV. 487.3 ft				TOTAL DEPTH 19.7 ft		NORTHING 437,270		EASTING 1,585,292			24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D50 87% 05/10/2022						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic		
DRILLER C. Odom				START DATE 08/25/22		COMP. DATE 08/25/22		SURFACE WATER DEPTH N/A			
CORE SIZE NQ				TOTAL RUN 12.0 ft							
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %			
479.57											
	479.6	7.7	2.0	N=60/0.0	(1.8)	(1.8)	(11.8)	(9.7)		<p style="text-align: center;">Begin Coring @ 7.7 ft</p> <p style="text-align: center;"><b>NON-CRYSTALLINE ROCK</b></p> <p style="text-align: center;">Very Slightly Weathered to Fresh, Moderately Hard to Hard, Blue-Gray, (Meta-Argillite), with Close to Wide Fracture Spacing, Thinly Laminated to Thinly Bedded, and Moderately Indurated to Indurated</p> <p style="text-align: center;">GSI: 60-65</p>	479.6
	477.6	9.7	5.0	6:27/1.0 6:02/1.0	90%	90%	98%	81%			7.7
475				4:47/1.0 3:12/1.0 3:10/1.0 4:02/1.0	(5.0)	(4.7)					
	472.6	14.7	5.0	3:48/1.0	100%	94%					
470				3:01/1.0 2:38/1.0 2:27/1.0 2:33/1.0 2:50/1.0	(5.0)	(3.2)					
	467.6	19.7								467.6	
<p>Boring Terminated at Elevation 467.6 ft In Non-Crystalline Rock (Meta-Argillite)</p> <p>Notes:</p> <p style="text-align: center;">Hard drilling encountered from approximately 6.4 to 7.7 feet</p>											





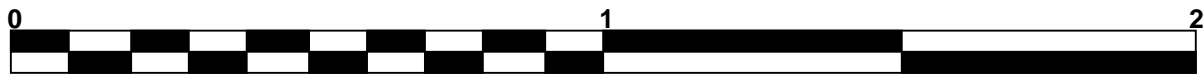
CAROLINAS  
GEOTECHNICAL  
GROUP

**Bridge No. 93 on SR 1937 over Haney Branch  
Union County, NC**

**Rock Core Photographs**

**Boring: EB2-A**

**7.7 to 19.7 Feet**



FEET

# GEOTECHNICAL BORING REPORT

## BORE LOG

<b>WBS</b> BP10.R040.1			<b>TIP</b> SF-890093			<b>COUNTY</b> UNION			<b>GEOLOGIST</b> S. N. Patterson							
<b>SITE DESCRIPTION</b> Bridge No. 93 on SR 1937 (Old Pageland-Marshville Rd) over Haney Branch									<b>GROUND WTR (ft)</b>							
<b>BORING NO.</b> EB2-B			<b>STATION</b> 15+05			<b>OFFSET</b> 12 ft RT			<b>ALIGNMENT</b> -L-							
<b>COLLAR ELEV.</b> 487.2 ft			<b>TOTAL DEPTH</b> 9.1 ft			<b>NORTHING</b> 437,273			<b>EASTING</b> 1,585,314							
<b>DRILL RIG/HAMMER EFF./DATE</b> CG20446 Diedrich D50 87% 05/10/2022						<b>DRILL METHOD</b> H.S. Augers			<b>HAMMER TYPE</b> Automatic							
<b>DRILLER</b> C. Odom			<b>START DATE</b> 08/25/22			<b>COMP. DATE</b> 08/25/22			<b>SURFACE WATER DEPTH</b> N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
490																
														487.2	GROUND SURFACE	0.0
485	485.1	2.1	9	6	4	•	•	•	•						<b>ROADWAY EMBANKMENT</b> Stiff, Orange-Brown, Fine to Coarse Sandy SILT (A-4), with trace gravel	
	483.1	4.1	3	4	7	•	•	•	•					482.1		5.1
480	480.0	7.2	61	39/0.3		•	•	•	•					480.5	<b>RESIDUAL</b> Stiff, Gray, Fine Sandy SILT (A-4), with trace gravel-sized rock fragments	6.7
	478.1	9.1	60/0.0			•	•	•	•	100/0.8				478.1	<b>WEATHERED ROCK</b> Gray, (Meta-Argillite) Boring Terminated with Standard Penetration Test Refusal at Elevation 478.1 ft On Non-Crystalline Rock (Meta-Argillite)	9.1
										60/0.0						

Notes:

Hard drilling encountered from approximately 6.7 to 9.1 feet





Photo #1: Bridge 093 End Bent 1 looking north(upstation) towards End Bent 2



Photo #1: Bridge 093 End Bent 2 looking south (downstation) towards End Bent 1