



**CAROLINAS
GEOTECHNICAL
GROUP**

Structure Foundation Recommendations

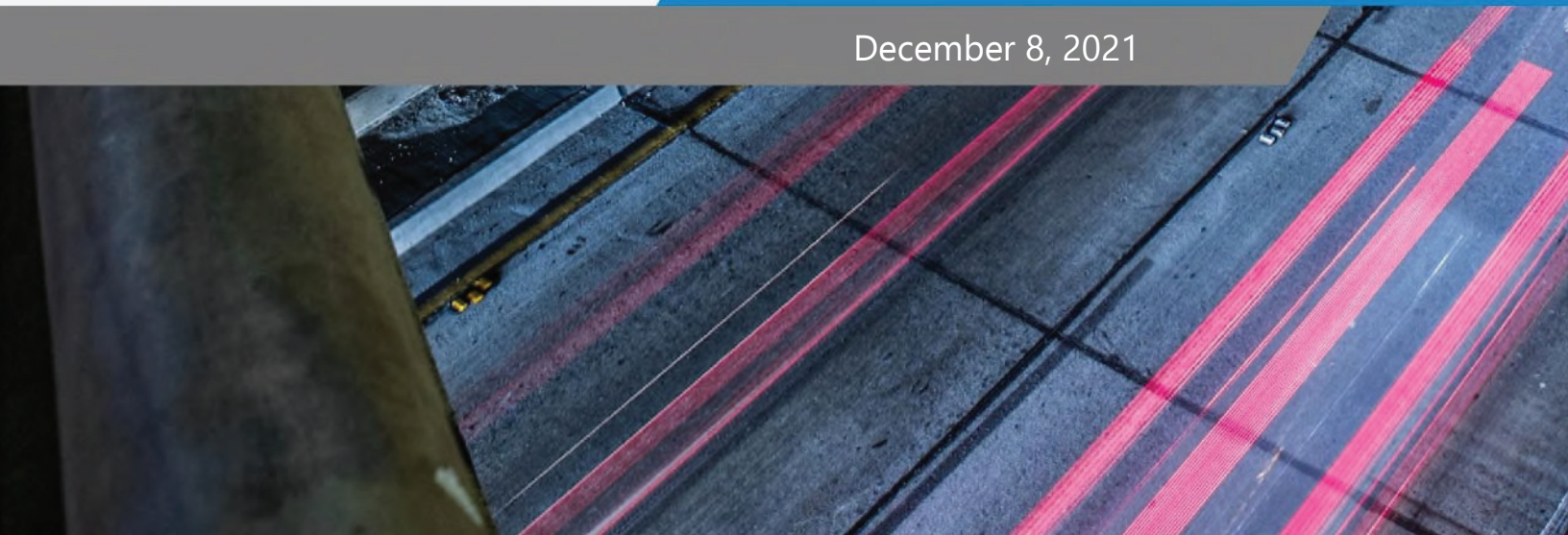
Prepared for:

TGS Engineers, Inc.

201 W. Marion Street, Suite 200

Shelby, North Carolina 28150

December 8, 2021





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www.carolinasgeotech.com

December 8, 2021

Mr. Jimmy L. Terry, P.E.
TGS Engineers, Inc.
201 W. Marion Street, Suite 200
Shelby, North Carolina 28150

CONTRACT I.D.: N/A
WBS ELEMENT: BP11.R002.1
T.I.P. NO.: SF-940087
I.D. NO.: SF-940087
COUNTY: Watauga
DESCRIPTION: Replace Bridge 087 on SR 1227 over North Fork Creek

SUBJECT: Structure Foundation Recommendations

Dear Mr. Terry,

Carolinas Geotechnical Group, PLLC (CG2) has completed the Structure Foundation Recommendations for the proposed replacement of the bridge on SR 1227 (North Fork Road) over North Fork Creek in Watauga County, North Carolina. This report contains the Foundation Recommendations Notes on Plans and Comments, NCDOT Bore Logs, and supporting calculations.

Details regarding the foundation recommendations for the Reinforced Concrete Box Culvert (2 @ 10 feet x 6 feet) at Station 15+32.00 -L- on SR 1227 (North Fork Road) are as follows:

FOUNDATION RECOMMENDATION NOTES ON PLANS:

1. EXCAVATE 12 INCHES BELOW THE BOTTOM OF THE CULVERT AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414 OF THE STANDARD SPECIFICATIONS. FOUNDATION CONDITIONING MATERIAL SHOULD CONSIST OF SELECT MATERIAL CLASS V OR VI FOR RCBC.
2. IF REQUIRED, UNDERCUT LOOSE SOILS THAT MAY BE ENCOUNTERED BENEATH THE BOTTOM OF THE FOUNDATION CONDITIONING MATERIAL. BACKFILL UNDERCUT AREAS WITH FOUNDATION CONDITIONING MATERIAL.

**N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENG. UNIT-WRO**

ACCEPTED

ACCEPTED AS NOTED

RETURNED FOR
CORRECTIONS

SEE LETTER

BY: Shane Clark, PE

DATE: January 25, 2022

Subsurface Inventory and Structure Foundation Recommendations
Replace Bridge 087 on SR 1227 (North Fork Road) over North Fork Creek
Watauga County, North Carolina

FOUNDATION RECOMMENDATION COMMENTS:

1. Culvert invert elevation at the centerline is 2,954.77 feet.
2. If rock is encountered at the invert elevation, excavate the rock materials within the neat lines of the barrel or footing to a depth of 1 foot below the invert elevation and backfill with foundation conditioning material.
3. We recommend a total of 110 cubic yards of weathered rock/crystalline rock excavation.
4. We recommend a quantity of 170 tons of foundation conditioning material (Class V or VI).
5. We anticipate the culvert settlement will be minimal. No camber is necessary.
6. Place Select Material Class V or VI when backfilling in water.

Please do not hesitate to contact us if you have any questions regarding this report or if you need additional services.

Sincerely,
Carolinas Geotechnical Group, PLLC

DocuSigned by:
Robert E Kral
8AD703B2A8484F4...
Robert E. Kral, P.E.
Senior Project Engineer

DocuSigned by:
D. Matthew Brewer
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D. Matthew Brewer, P.E.
Senior Project Engineer



ATTACHMENTS:

- Structure Subsurface Investigation (performed by CG2)
- Supporting Calculations

ATTACHMENTS

Structure Subsurface Investigation (performed by CG2)

REFERENCE: BP11.R002.1

PROJECT: SF-940087

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BP11.R002.1	1	8

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

STRUCTURE

SUBSURFACE INVESTIGATION

COUNTY WATAUGA

PROJECT DESCRIPTION REPLACE BRIDGE NO. 940087
ON SR 1227 (NORTH FORK ROAD) OVER NORTH
FORK CREEK

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND (SOIL & ROCK)
3	SITE PLAN
4-8	BORE LOGS

PERSONNEL
CG2 EXPLORATION

INVESTIGATED BY CG2, PLLC

DRAWN BY S. N. PATTERSON

CHECKED BY M. BREWER, P.E.

SUBMITTED BY CG2

DATE DECEMBER 2021

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.

Prepared in the Office of:



**CAROLINAS
GEOTECHNICAL
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CHARLOTTE, NC 28227
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DocuSigned by:
 12/8/2021

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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.									
SOIL LEGEND AND AASHTO CLASSIFICATION										ANGULARITY OF GRAINS									
GENERAL CLASS. GRANULAR MATERIALS (<= 35% PASSING #200) SILT-CLAY MATERIALS (> 35% PASSING #200) ORGANIC MATERIALS										THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.									
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										MINERALOGICAL COMPOSITION									
SYMBOL										MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.									
% PASSING #10 #40 #200										COMPRESSIBILITY									
MATERIAL PASSING #40 LL PI										SLIGHTLY COMPRESSIBLE LL < 31 MODERATELY COMPRESSIBLE LL = 31 - 50 HIGHLY COMPRESSIBLE LL > 50									
GROUP INDEX										PERCENTAGE OF MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										ORGANIC MATERIAL GRANULAR SOILS SILT - CLAY SOILS OTHER MATERIAL									
GEN. RATING AS SUBGRADE										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									
CONSISTENCY OR DENSENESS										GROUND WATER									
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT ²)										WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING STATIC WATER LEVEL AFTER 24 HOURS PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA SPRING OR SEEP									
TEXTURE OR GRAIN SIZE										MISCELLANEOUS SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM)										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT INFERRED SOIL BOUNDARY INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY									
BOULDER (BLDR.) COBBLE (COB.) GRAVEL (GR.) COARSE SAND (CSE. SD.) FINE SAND (F SD.) SILT (SL.) CLAY (CL.)										DIP & DIP DIRECTION OF ROCK STRUCTURES TEST BORING AUGER BORING CORE BORING MONITORING WELL PIEZOMETER INSTALLATION SLOPE INDICATOR INSTALLATION CONE PENETROMETER TEST SOUNDING ROD TEST BORING WITH CORE SPT N-VALUE									
SOIL MOISTURE - CORRELATION OF TERMS										RECOMMENDATION SYMBOLS									
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION										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									
PLASTICITY										ABBREVIATIONS									
NON PLASTIC SLIGHTLY PLASTIC MODERATELY PLASTIC HIGHLY PLASTIC										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, FRACTURES FRAGS. - FRAGMENTS HI. - HIGHLY MED. - MEDIUM MICA - MICACEOUS MOD. - MODERATELY NP - NON PLASTIC ORG. - ORGANIC PMT - PRESSUREMETER TEST SAP. - SAPROLITIC SD. - SAND, SANDY SL. - SILT, SILTY SLI. - SLIGHTLY TCR - TRICONE REFUSAL w - MOISTURE CONTENT V - VERY VST - VANE SHEAR TEST WEA. - WEATHERED ? - UNIT WEIGHT ? - DRY UNIT WEIGHT									
EQUIPMENT USED ON SUBJECT PROJECT										SAMPLE ABBREVIATIONS									
DRILL UNITS: CME-45C CME-55 CME-550 VANE SHEAR TEST PORTABLE HOIST MOBILE B-29										ADVANCING TOOLS: CLAY BITS 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									
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.										HAMMER TYPE: AUTOMATIC MANUAL CORE SIZE: B H N HAND TOOLS: POST HOLE DIGGER HAND AUGER SOUNDING ROD VANE SHEAR TEST									





**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 > 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 < 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

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FOOT
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 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 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 (ROD) - 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 (SROD) - 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.

BENCH MARK: N/A

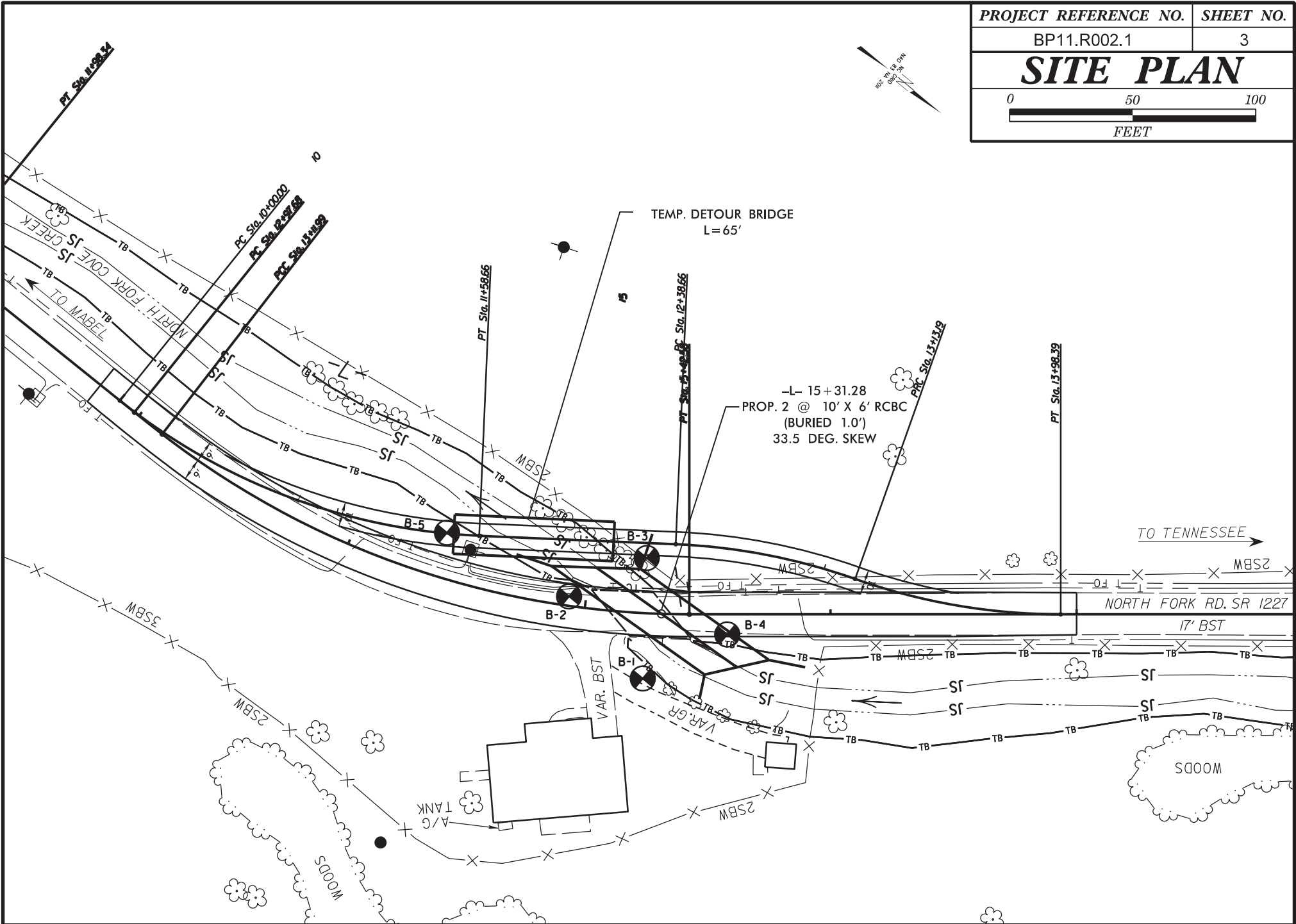
ELEVATION: FEET

NOTES:

FIAD = FILLED IMMEDIATELY AFTER DRILLING

ROADWAY DESIGN FILES PROVIDED BY TGS ENGINEERS 07/09/2021

PROJECT REFERENCE NO.	SHEET NO.
BP11.R002.1	3
SITE PLAN	
FEET	



GEOTECHNICAL BORING REPORT BORE LOG

WBS BP11.R002.1		TIP SF-940087		COUNTY WATAUGA		GEOLOGIST M. Brewer											
SITE DESCRIPTION Replace Bridge No. 940087 on SR 1227 (North Fork Road) over North Fork Creek							GROUND WTR (ft)										
BORING NO. B-1		STATION 15+25		OFFSET 27 ft RT		ALIGNMENT L	0 HR. 6.4										
COLLAR ELEV. 2,964.1 ft		TOTAL DEPTH 12.5 ft		NORTHING 946,701		EASTING 1,183,956	24 HR. FIAD										
DRILL RIG/HAMMER EFF./DATE CG29022 Mobile B-29 81% 03/12/2021				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER M. Brewer		START DATE 07/12/21		COMP. DATE 07/12/21		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)		
2965															2,964.1	GROUND SURFACE	0.0
	2,963.1	1.0	1	9	11								M		2,961.1	ALLUVIAL Very Stiff, Brown, Fine Sandy SILT (A-4), with little gravel and trace organics	3.0
2960	2,960.6	3.5	5	6	9								M		2,957.6	Medium Dense, Brown-Orange-Gray, Silty Fine to Coarse SAND (A-2-4), with trace gravel	6.5
	2,958.1	6.0	21	10	10								W		2,955.6	RESIDUAL Medium Dense, Brown, Silty Fine to Coarse Sand (A-2-4), with trace gravel-sized rock fragments	8.5
2955	2,955.6	8.5	25	75/0.3											2,951.7	WEATHERED ROCK Brown-Gray-Green, (Biotite GNEISS)	12.4
	2,953.1	11.0	100/0.2							100/0.2					2,951.6	CRYSTALLINE ROCK (Biotite GNEISS)	12.5
	2,951.7	12.4	60/0.1							60/0.1						Boring Terminated with Standard Penetration Test Refusal at Elevation 2,951.6 ft In Crystalline Rock (Biotite GNEISS)	
															<p style="text-align: center;"><u>Notes:</u></p> <p style="text-align: center;">Boulders and/or Hard Drilling encountered infrequently between the following depths: 4.0 - 9.0 ft</p>		

NCDOT BORE SINGLE WATAUGA 87 BORELOGS-WINDOWS-8ERUV72.GPJ NC_DOT.GDT 12/8/21

GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP11.R002.1		TIP SF-940087		COUNTY WATAUGA		GEOLOGIST M. Brewer								
SITE DESCRIPTION Replace Bridge No. 940087 on SR 1227 (North Fork Road) over North Fork Creek							GROUND WTR (ft)							
BORING NO. B-2		STATION 14+93		OFFSET 4 ft LT		ALIGNMENT L	0 HR. 6.5							
COLLAR ELEV. 2,962.7 ft		TOTAL DEPTH 11.0 ft		NORTHING 946,656		EASTING 1,183,950	24 HR. FIAD							
DRILL RIG/HAMMER EFF./DATE CG29022 Mobile B-29 81% 03/12/2021				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic								
DRILLER M. Brewer		START DATE 07/12/21		COMP. DATE 07/12/21		SURFACE WATER DEPTH N/A								
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)
2965														
	2,961.7	1.0	6	13	3									GROUND SURFACE 0.0
														Asphalt (0.7 ft) 0.7
2960	2,959.2	3.5	4	13	8									ROADWAY EMBANKMENT
	2,956.7	6.0	14	18	23									Very Stiff, Brown-Orange-Gray, Fine to Coarse Sandy SILT (A-4), with trace to little gravel and creosote odor
														ALLUVIAL
2955	2,954.2	8.5	61	31	33									Hard, Brown, Slightly Plastic, Fine Sandy SILT (A-4), with trace mica and trace to little gravel
	2,951.7	11.0	60/0.0											RESIDUAL
														Very Dense, Brown-Green-Orange, Fine Sandy SILT (A-4), with trace to little gravel-sized rock fragments
														Boring Terminated with Standard Penetration Test Refusal at Elevation 2,951.7 ft On Crystalline Rock (Biotite GNEISS)
														Notes:
														Boulders and/or Hard Drilling encountered infrequently between the following depths: 4.0 - 9.0 ft

NCDOT BORE SINGLE WATAUGA 87 BORELOGS-WINDOWS-8ERUV72.GPJ NC_DOT.GDT 12/8/21

GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP11.R002.1	TIP SF-940087	COUNTY WATAUGA	GEOLOGIST S. N. Patterson
SITE DESCRIPTION Replace Bridge No. 940087 on SR 1227 (North Fork Road) over North Fork Creek			GROUND WTR (ft)
BORING NO. B-3	STATION 15+24	OFFSET 22 ft LT	ALIGNMENT L
COLLAR ELEV. 2,961.4 ft	TOTAL DEPTH 23.6 ft	NORTHING 946,670	EASTING 1,183,918
DRILL RIG/HAMMER EFF./DATE CG29022 Mobile B-29 81% 03/12/2021		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER D. Demby	START DATE 12/02/21	COMP. DATE 12/02/21	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						
2965																
														2,961.4	GROUND SURFACE	0.0
2960	2,960.4	1.0	4	WOH	WOH								M	2,958.4	ALLUVIAL Very Soft, Brown, Fine Sandy SILT (A-4), with little gravel and trace organics	3.0
	2,957.9	3.5	6	6	9								M		Medium Dense to Very Dense, Tan-Brown, Silty Fine to Coarse SAND (A-2-4), with trace subangular to subrounded gravel	
2955	2,955.4	6.0	14	19	32								W			
	2,952.9	8.5	72	28/0.3										2,952.9	WEATHERED ROCK Brown-Gray-Green, (Biotite GNEISS)	8.5
2950																
	2,947.9	13.5														
2945																
	2,942.9	18.5														
2940																
	2,937.9	23.5												2,937.9	CRYSTALLINE ROCK (Biotite GNEISS)	23.5
														2,937.8	Boring Terminated with Standard Penetration Test Refusal at Elevation 2,937.8 ft In Crystalline Rock (Biotite GNEISS)	23.6

Notes:
Boulders and/or Hard Drilling encountered infrequently between the following depths:
4.0 - 8.0 ft

NCDOT BORE SINGLE WATAUGA 87 BORELOGS-WINDOWS-8ERUV72.GPJ NC_DOT.GDT 12/8/21

GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP11.R002.1			TIP SF-940087			COUNTY WATAUGA			GEOLOGIST S. N. Patterson											
SITE DESCRIPTION Replace Bridge No. 940087 on SR 1227 (North Fork Road) over North Fork Creek										GROUND WTR (ft)										
BORING NO. B-5			STATION 14+37			OFFSET 18 ft LT			ALIGNMENT L											
COLLAR ELEV. 2,959.2 ft			TOTAL DEPTH 13.5 ft			NORTHING 946,601			EASTING 1,183,962											
DRILL RIG/HAMMER EFF./DATE CG29022 Mobile B-29 81% 03/12/2021						DRILL METHOD H.S. Augers			HAMMER TYPE Automatic											
DRILLER D. Demby			START DATE 12/02/21			COMP. DATE 12/02/21			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	DEPTH (ft)					
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						ELEV. (ft)	DEPTH (ft)			
2960															2,959.2	0.0				
	2,958.2	1.0	60/0.0											2,953.7	5.5					
2955	2,955.7	3.5	10	13	8															
	2,953.2	6.0	12	21	30															
2950	2,950.7	8.5	60/0.1																	
	2,948.2														2,948.2	11.0				
	2,945.7	13.5	60/0.0												2,945.7	13.5				

GROUND SURFACE

ROADWAY EMBANKMENT
Very Stiff to Hard, Brown-Orange-Gray, Gravelly, Fine to Coarse Sandy SILT (A-4), with trace organics, boulders

ALLUVIAL
Hard, Brown, Slightly Plastic, Coarse to Fine Sandy SILT (A-4), with trace subangular to subrounded gravel, boulders

WEATHERED ROCK (BIOTITE GNEISS)

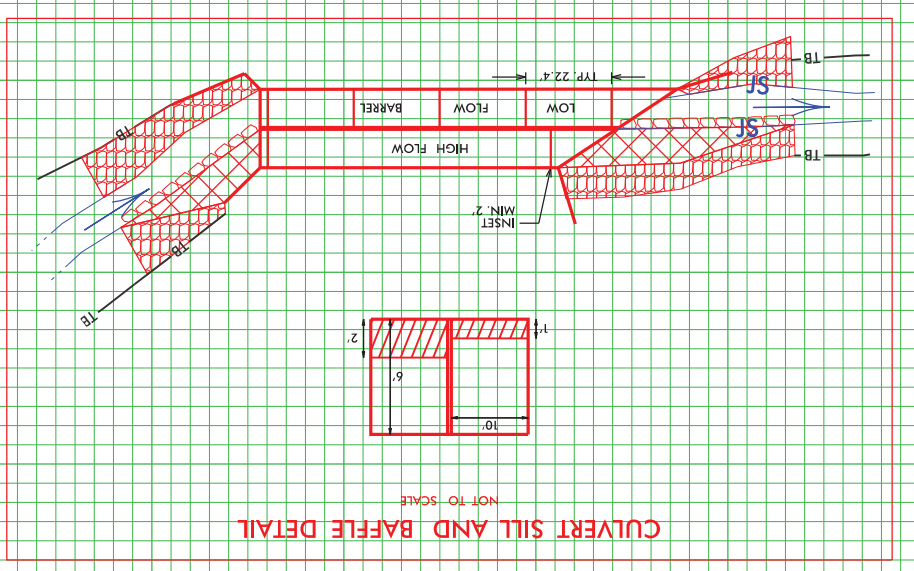
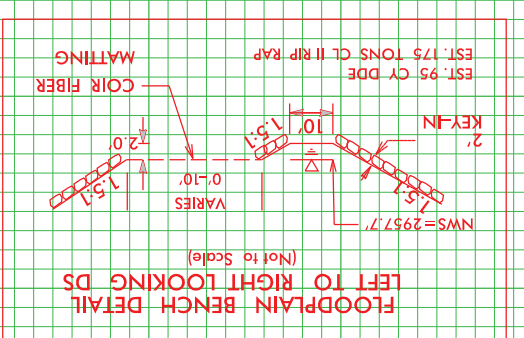
Boring Terminated with Standard Penetration Test Refusal at Elevation 2,945.7 ft On Crystalline Rock (Biotite GNEISS)

Notes:

Boulders and/or Hard Drilling encountered infrequently between the following depths:
1.0 - 4.0 ft, 8.5 - 10.0 ft

Supporting Calculations

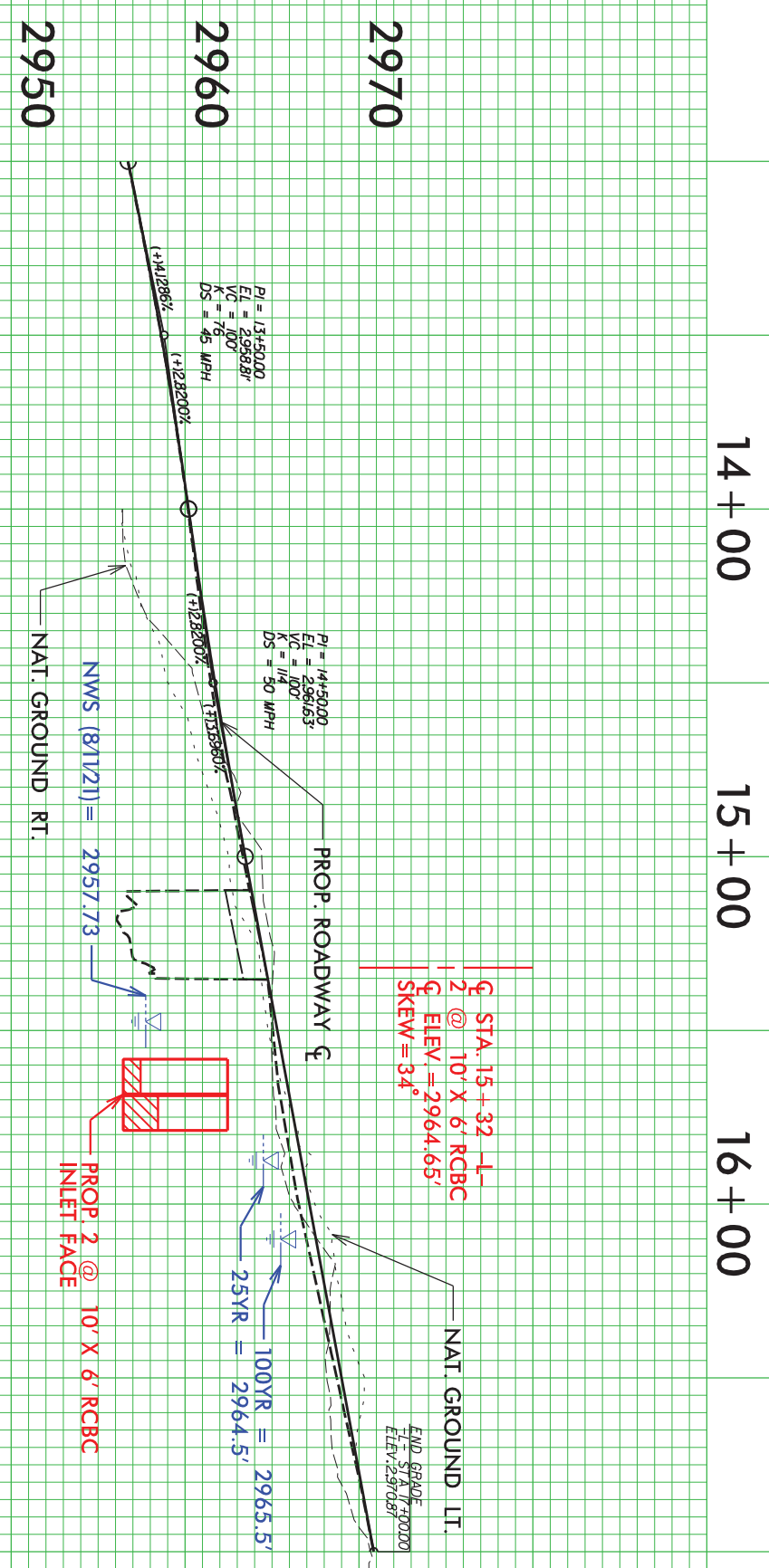
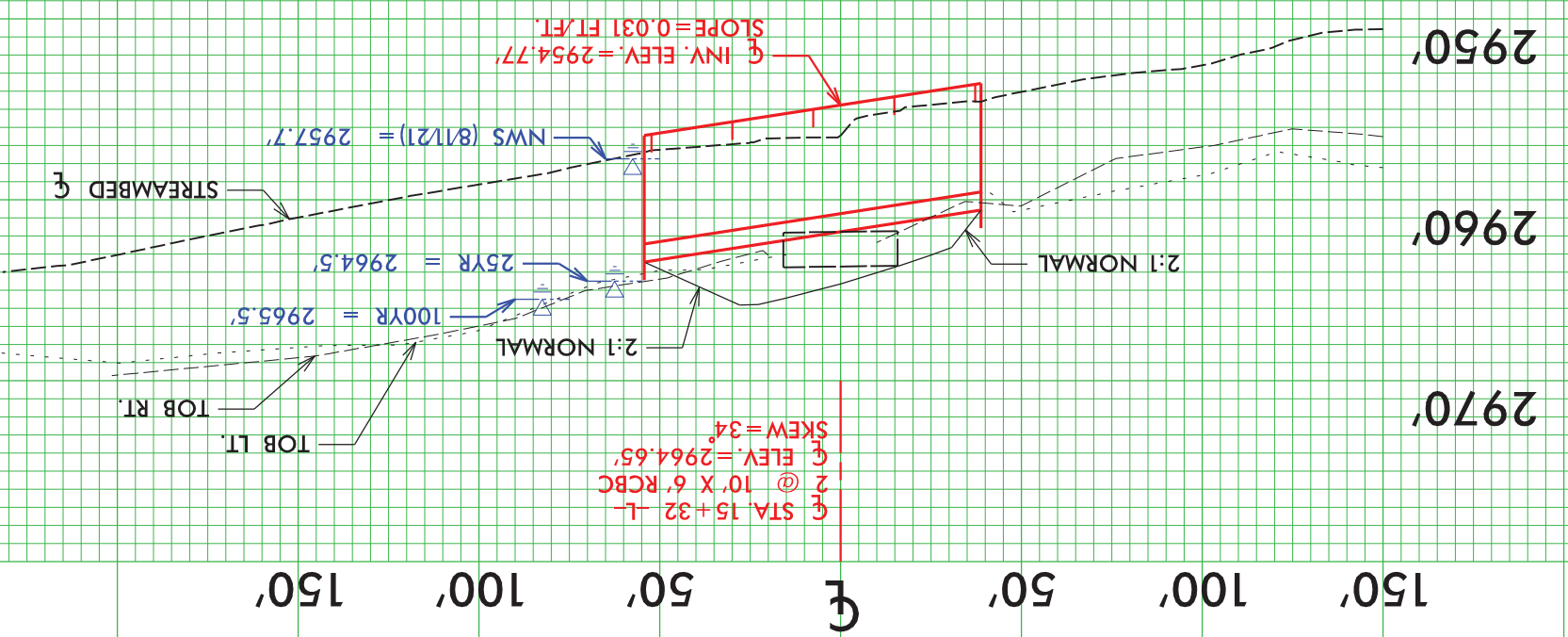
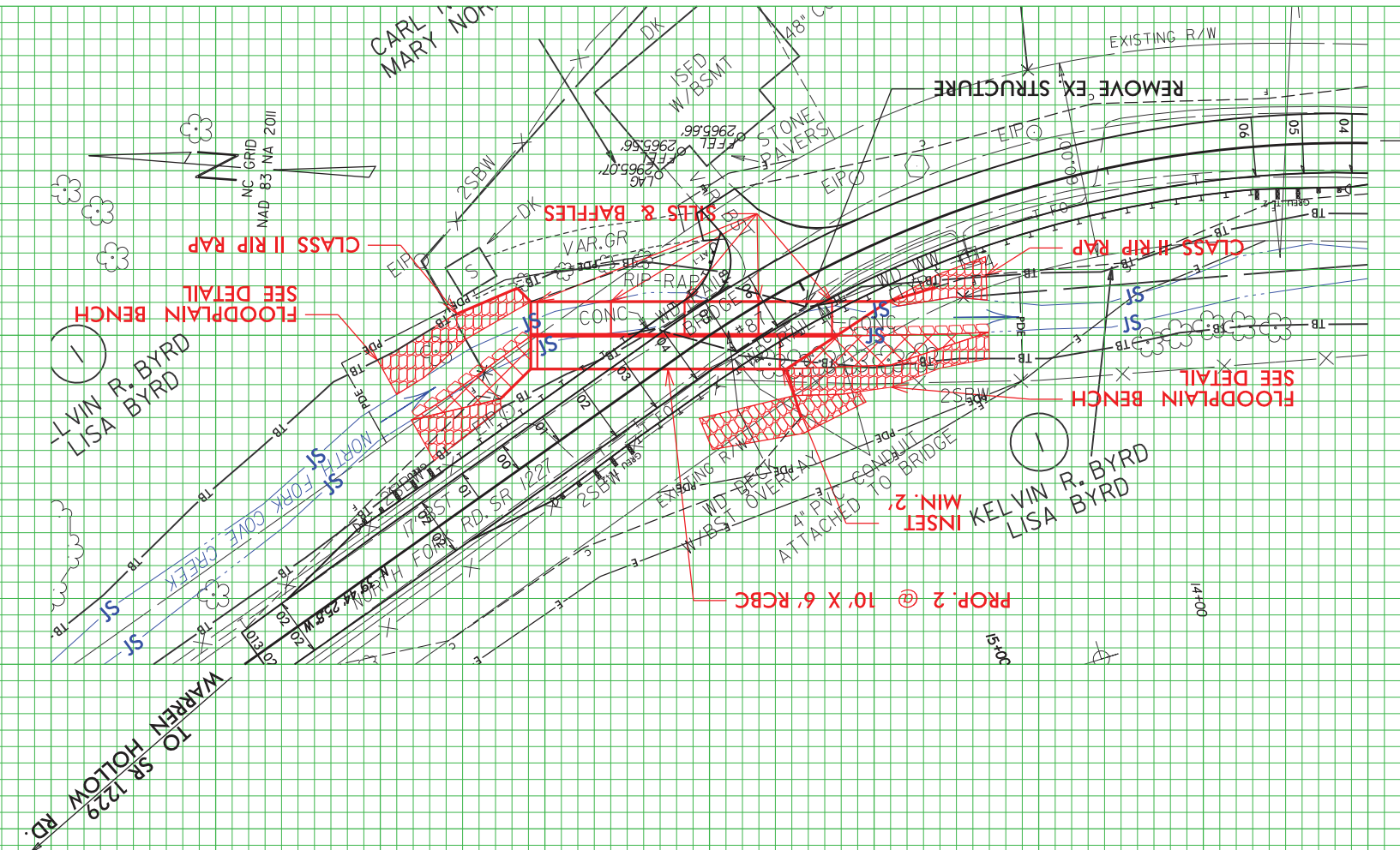
NOTES:
BACKFILL SILTS AND BAFFLES WITH NATIVE MATERIAL.
THAT IS EXCAVATED FROM THE STREAM AT THE PROJECT SITE DURING CONSTRUCTION. THE PROJECT SITE DURING CONSTRUCTION CLASS B RIP RAP MAY BE USED TO SUPPLEMENT THE NATIVE MATERIAL. NATIVE MATERIAL SHOULD BE PLACED ON TOP OF FILL VOIDS AND PROVIDE A FLAT SURFACE FOR ANIMAL PASSAGE. NATIVE MATERIAL AND RIP RAP IS SUBJECT TO APPROVAL BY THE ENGINEER AND MAYBE SUBJECT TO PERMIT CONDITIONS.
NO STRUCTURES ARE NEGATIVELY IMPACTED BY THIS PROJECT.



PERFORMANCE TABLE
NCDOT
FREQUENCY

PROPOSED	EXISTING	NATURAL
2963.7	2963.7	2963.7
2964.5	2964.5	2964.5
2966.5	2966.5	2966.5

39.5 FT FROM US FACE OF CULVERT
RS 527.1
50yr
100yr
500yr



ADDITIONAL INFORMATION AND COMPUTATIONS

DA = 2.6 SQ. MI.
REGION 2 = 100%
BLUE RIDGE
SIR 2009-5158
Q₁₀ = 288 (DA)^{0.736} = 583 → 580 CFS
Q₂₅ = 398 (DA)^{0.724} = 795 → 800 CFS
Q₅₀ = 479 (DA)^{0.718} = 950 → 950 CFS
Q₁₀₀ = 575 (DA)^{0.713} = 1140 → 1140 CFS
Q₅₀₀ = 794 (DA)^{0.704} = 1560 → 1560 CFS

MARY NORRIS AND CARL NORRIS ARE LOCAL RESIDENTS THAT HAVE LIVED IN THE HOUSE IMMEDIATELY UPSTREAM OF THE BRIDGE SINCE 1969. THEY HAVE NEVER SEEN THE ROAD OVERTOP AT THE STRUCTURE AND HAVE NEVER HAD WATER RUN THROUGH THEIR YARD FROM THE STREAM.

SITE DATA

Drainage Area 2.6 SQ. MI. Source STREAM STATS; USGS QUAD (SHERWOOD)
River Basin WATAUGA Character RURAL; MOUNTAINOUS
Stream Classification (Such as Trout, High Quality Water, etc.) C
Data on Existing Structure 1 @ 26' TIMBER DECK ON I-BEAMS; TIMBER END BENTS AND CAPS
Total Waterway Opening 81.8 s.f. Waterway Opening Below 100yr. WS EL. 81.8 s.f.
Debris Potential: Low Moderate High
Data on Structures Up and Down Stream US: 60" CMP UNDER SR 1227 DS: 2@7'X5' RCBC UNDER SR 1233
Gage Station No. NA Period of Records NA yrs.
Max. Discharge NA c.f.s Date NA Frequency NA

Historical Flood Information:
Date EST. 2015 Elev. NO OT Fr. Est. Freq. yr. Source MARY NORRIS - RESIDENT Period of Knowledge 52 yrs.
Date NEVER OT fr. Est. Freq. yr. Source CARL NORRIS - RESIDENT Period of Knowledge 52 yrs.
Allowable HW Elev. 2964.7 (EXISTING 25YR RS 527.1) ft. Normal Water Surface Elev. 2957.7 ft.
Manning's n : Left O.B. .07 Channel 0.045 Right O.B. 0.07 Obtained From INVESTIGATION FIELD
Flood Study /Status NO STUDY; PANEL 1984 EFF. DATE 12/3/2009 Floodway Established? NO
Flood Study 100 yr. Discharge NA c.f.s.; WS Elev.: Floodway NA ft. Without Floodway NA ft.

DESIGN DATA

Hydrological Method USGS SIR 2009-5158 RURAL REGRESSION
Hydraulic Design Method HEC-RAS 4.1.0 (SF-940087_NORTH FORK COVE CREEK_SR 1227.PRJ)
Design Tailwater : Q₁₀ 3.1 ft.; Q₂₅ 3.8 ft.; Q₅₀ ft.; Q₁₀₀ 4.9 ft.; Q₅₀₀ 5.8 ft.

Size & Type	Q (c.f.s.)	Inlet Control		Outlet Control					Remarks
		K _a	HW (ft.)	dc	dc+D/2	h _o	H	L ₅	
SEE HEC-RAS DATA									

Is a Floodway Revision Required? NO Total Proposed Waterway Opening 90 s.f.
Outlet Velocity (V₁₀) 10.8 f.p.s. Natural Channel Velocity (V₁₀) 9.5 f.p.s.
Required Outlet Protection CLASS II RIP RAP

INFORMATION TO BE SHOWN ON PLANS

Design: Discharge 800 c.f.s. Frequency 25 yr. Elev. 2964.5' ft.
Base Flood: Discharge 1140 c.f.s. Frequency 100 yr. Elev. 2965.5' ft.
Overtopping: Discharge 1140 c.f.s. Frequency 100 yr. Elev. 2964.4' ft.

*DUE TO THE SLOPE OF THE STREAM, THE OVERTOPPING ELEVATION IS LOWER THAN THE WS WHICH ARE REPORTED AT THE UPSTREAM TOE SECTION.

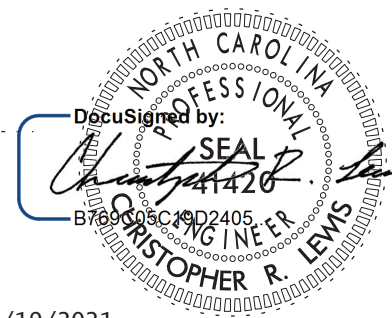
CULVERT SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

I.D. No. SF-940087 Project No. BP11.R002.1 Proj. Station 15+32 -L-
County WATAUGA Stream NORTH FORK COVE CREEK Stru. No. 0087
On Highway SR 1227 SR 1233 SR 1229
Between OLD US HWY 421 and WARREN HOLLOW RD.
Recommended Structure 2 @ 10' X 6' RCBC W/6" TOP BEVEL; BURIED 1' WITH SILLS AND BAFFLES
Recommended Width of Roadway 32' SHOULDER POINT TO SHOULDER POINT Skew 34°
Recommended Location is (Up, At, Down) Stream from Existing Crossing AT
Latitude 36.31977 Longitude -81.77015
Statewide Tier Regional Tier Sub-Regional Tier
Bench Mark is BM#1 RAILROAD SPIKE SET IN 30" OAK TREE; STA. 20+71.35 -L-
N 947143 E 1183620 Elev. 2987.29 ft. Datum: NAVD 88
Temporary Crossing ON-SITE DETOUR



Designed by: CHRISTOPHER R. LEWIS, PE
Assisted by: _____
Project Engineer: _____
Reviewed by: _____
Date: 10/19/2021



Stream NORTH FORK COVE CREEK ... Struct. Inv. No. 0087 I.D. No. SF-940087 Project No. BP11.R002.1 PDF File 940087_2021_SF-940087_NORTHFORKCOVECREEK_SR1227



JOB NAME BP11.R002.1 – Replace Bridge 087 on SR 1227
over North Fork Creek SF-940087

SUBJECT Recommendations Calculations

COMPUTED BY D. Matthew Brewer, P.E.

CHECKED BY Robert E. Kral, P.E.

PROVIDED INFORMATION

Station 15+32.00 -L-

Structure Type 2 @ 10 ft Span x 6 ft Rise RCBC

Invert Elevation @ CL of -L- 2,954.77 ft

Length 77 ft (LT), 94 ft (MID), 110 ft (RT),

Width 21 ft (width of culvert) + 4 ft (additional width per NCDOT FCM
for Box Culvert Memo dated 12/12/2011) = 25 ft

Slope 3.1%

ESTIMATED INFORMATION

Culvert Thickness Assumed 1 ft

Bottom of Culvert Elevation 2,953.5 ft - 1 ft Thick Culvert = 2,952.5 ft (Left)
2,954.8 ft - 1 ft Thick Culvert = 2,953.8 ft (Center)
2,956.3 ft - 1 ft Thick Culvert = 2,955.3 ft (Right)

Bottom of Excavation (1 ft of FCM) = 2,951.5 ft (Left)
= 2,952.8 ft (Center)
= 2,954.3 ft (Right)

Anticipate an irregular WR/CR surface.
WR/CR Excavation will be required.

Weathered Rock/Crystalline Rock Excavation Anticipated

Downstream, Down Station (B-2) – CR @ 2,951.7 ft Excavate 0.2 ft into CR
Upstream, Down Station (B-1) – WR @ 2,955.6 ft Excavate 1.3 ft into WR
Downstream, Up Station (B-3) – WR @ 2,952.9 ft Excavate 1.4 ft into WR
Upstream, Up Station (B-4) – WR @ 2,956.2 ft Excavate 1.9 ft into WR

ESTIMATED QUANTITIES

Estimated Weathered Rock Excavation Quantity

Average Depth from top of WR/CR to Bottom of Excavation: 1.2 ft

94 ft (avg. length) x 25 ft (width of culvert) x 1.2 ft = 2,820 ft³ / (27 ft³/yd³) = 104.4 yd³, **say 110 yd³**

Foundation Condition Material (Class V or VI) – Backfilling in Water, Assume up to 1 ft of FCM is placed.

Total Estimated Volume of FCM: 94.0 ft² (avg. length) * 25 ft (width of culvert) = 2,350 ft³ / (27 ft³/yd³) = 87.0 yd³, **say 90 yd³**

Total Weight of FCM: 87.0 yd³ * 1.904 tons/yd³ = 165.6 tons, **say 170 tons**



**CAROLINAS
GEOTECHNICAL
GROUP**

REFERENCE: SF-942307

PROJECT: 17BP.11.C.2

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-942307	1	12

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

**STRUCTURE
SUBSURFACE INVESTIGATION**

COUNTY WATAUGA
PROJECT DESCRIPTION REPLACE CULVERT NO. 2307 ON
ON SR 1233 (OLD US 421) OVER N.FORK COVE
CREEK

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND
3	BORING LOCATION PLAN
4-II	BORING LOGS, CORE LOGS AND CORE PHOTOGRAPHS

PERSONNEL
TRIGON
GOODNIGHT, D.J.

INVESTIGATED BY GOODNIGHT, D.J.
DRAWN BY HILL, M.J.
CHECKED BY HAMM, J.R.
SUBMITTED BY FALCON ENG.
DATE JANUARY 2017

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.

NORTH CAROLINA
PROFESSIONAL
SEAL
036283
M. S. HUNSBERGER
1/16/17

SIGNATURE _____ DATE _____

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)

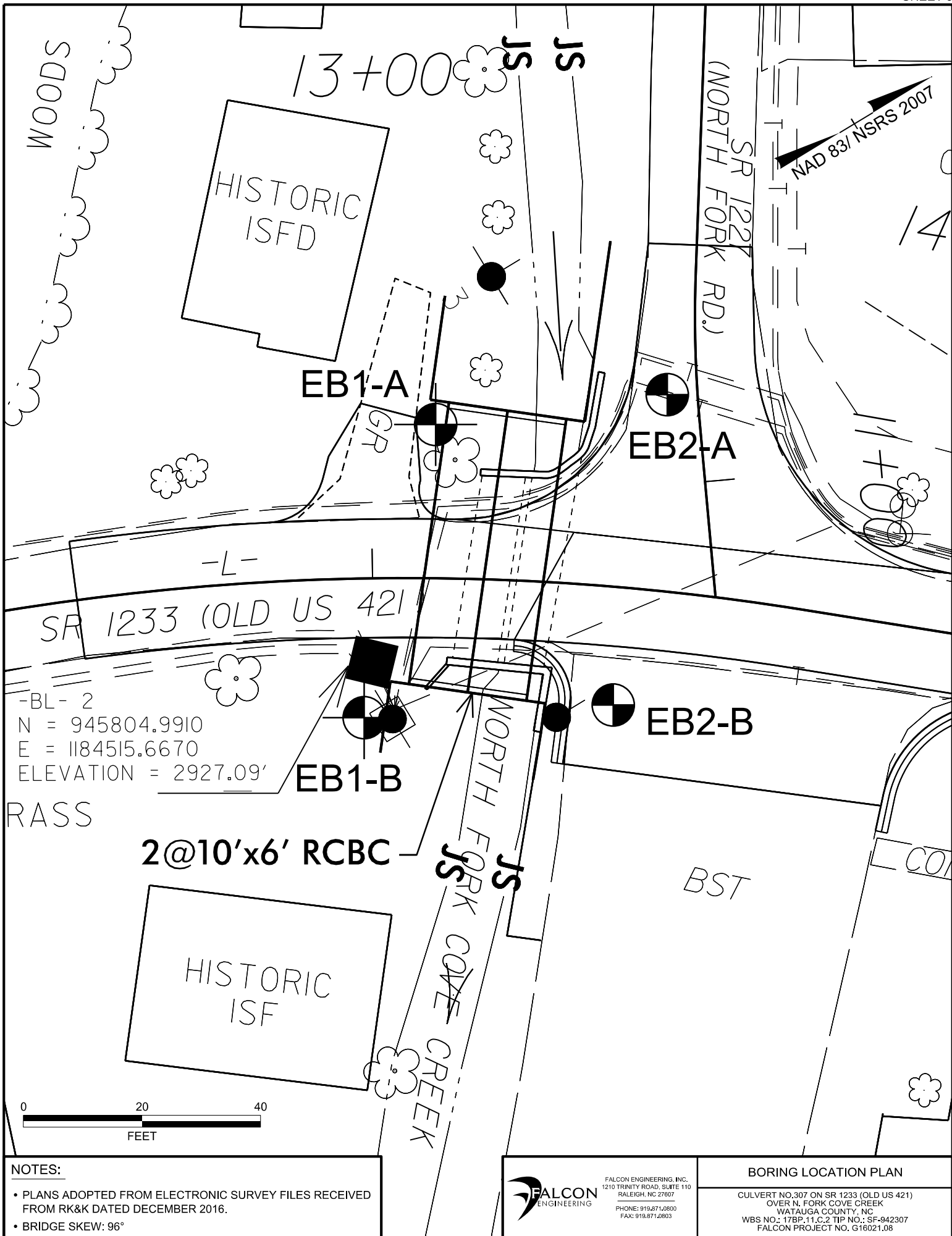
SOIL DESCRIPTION										GRADATION									
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL 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-A-2, 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, MODERATELY COMPRESSIBLE, HIGHLY COMPRESSIBLE									
MATERIAL PASSING #40 LL, PI										PERCENTAGE OF MATERIAL									
GROUP INDEX										ORGANIC MATERIAL, GRANULAR SOILS, SILT-CLAY SOILS, OTHER MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										GROUND WATER									
GEN. RATING AS SUBGRADE										WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING, STATIC WATER LEVEL AFTER 24 HOURS, 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 ²)										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION, SOIL SYMBOL, ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT, INFERRED SOIL BOUNDARY, INFERRED ROCK LINE, ALLUVIAL SOIL BOUNDARY, DIP & DIP DIRECTION OF ROCK STRUCTURES, TEST BORING, AUGER BORING, CORE BORING, MONITORING WELL, PIEZOMETER INSTALLATION, SLOPE INDICATOR INSTALLATION, CONE PENETROMETER TEST, SOUNDING ROD, TEST BORING WITH CORE, SPT N-VALUE									
TEXTURE OR GRAIN SIZE										RECOMMENDATION SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM), BOULDER (BLDR.), COBBLE (COB.), GRAVEL (GR.), COARSE SAND (CSE. SD.), FINE SAND (F SD.), SILT (SL.), CLAY (CL.)										UNDERCUT, UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE, UNCLASSIFIED EXCAVATION - ACCEPTABLE, UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK									
GRAIN SIZE										ABBREVIATIONS									
SOIL MOISTURE - CORRELATION OF TERMS										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, FRACTURES, FRAGS. - FRAGMENTS, HI. - HIGHLY, MED. - MEDIUM, MICA - MICACEOUS, MOD. - MODERATELY, NP - NON PLASTIC, ORG. - ORGANIC, PMT - PRESSUREMETER TEST, SAP. - SAPROLITIC, SD. - SAND, SANDY, SL. - SILT, SILTY, SLI. - SLIGHTLY, TCR - TRICONE REFUSAL, w - MOISTURE CONTENT, v - VERY, VST - VANE SHEAR TEST, WEA. - WEATHERED, ? - UNIT WEIGHT, ? - DRY UNIT WEIGHT, SAMPLE ABBREVIATIONS: S - BULK, SS - SPLIT SPOON, ST - SHELBY TUBE, RS - ROCK, RT - RECOMPACTED TRIAXIAL, CBR - CALIFORNIA BEARING RATIO									
PLASTICITY										EQUIPMENT USED ON SUBJECT PROJECT									
PLASTICITY INDEX (PI), DRY STRENGTH										DRILL UNITS: CME-45C, CME-55, CME-550, VANE SHEAR TEST, PORTABLE HOIST, ADVANCING TOOLS: CLAY BITS, 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, HAMMER TYPE: AUTOMATIC, MANUAL, CORE SIZE: B, H, N Q2, HAND TOOLS: POST HOLE DIGGER, HAND AUGER, SOUNDING ROD, VANE SHEAR TEST									
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
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT**

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>
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 > 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 < 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.
BENCH MARK: BL-2; 36" REBAR WITH ALUMINUM TRAVERSE CAP		
N: 945804.9910 E: 1184515.6670		
-L- 13+00, 14 FT RT		ELEVATION: 2927.09 FEET
NOTES:		
FIAD - FILLED IMMEDIATELY AFTER DRILLING		



-BL- 2
 N = 945804.9910
 E = 1184515.6670
 ELEVATION = 2927.09'

RASS

2@10'x6' RCBC

NOTES:

- PLANS ADOPTED FROM ELECTRONIC SURVEY FILES RECEIVED FROM RK&K DATED DECEMBER 2016.
- BRIDGE SKEW: 96°

FALCON ENGINEERING
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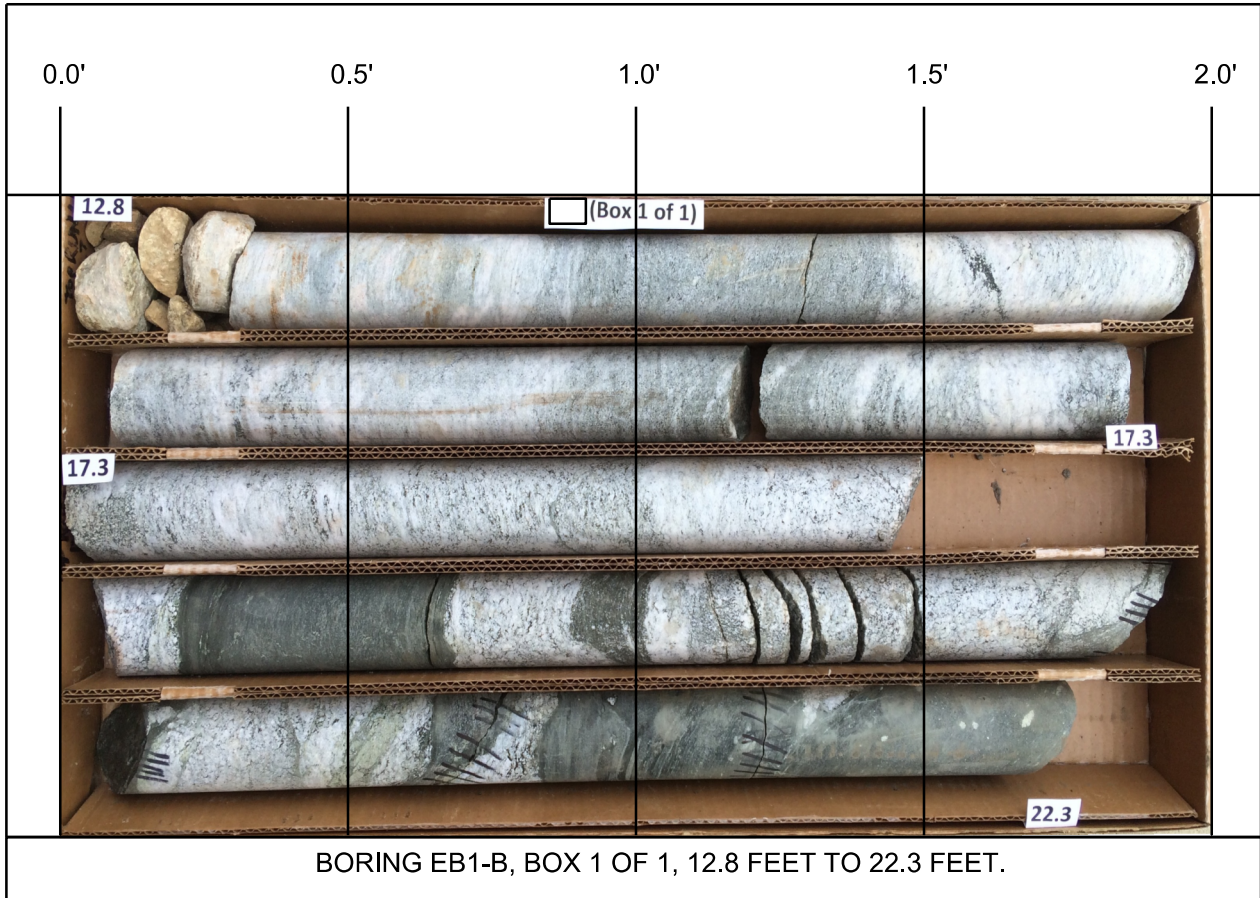
BORING LOCATION PLAN

CULVERT NO.307 ON SR 1233 (OLD US 421)
 OVER N. FORK COVE CREEK
 WATAUGA COUNTY, NC
 WBS NO.: 17BP.11.C.2 TIP NO.: SF-942307
 FALCON PROJECT NO. G16021.08

GEOTECHNICAL BORING REPORT CORE LOG

WBS 17BP.11.C.2			TIP SF-942307			COUNTY WATAUGA			GEOLOGIST Goodnight, D. J.		
SITE DESCRIPTION Culvert No. 942307 on SR 1233 (Old US 421) over N. Fork Cove Creek										GROUND WTR (ft)	
BORING NO. EB1-A			STATION 13+10			OFFSET 26 ft LT			ALIGNMENT -L-		0 HR. 2.5
COLLAR ELEV. 2,929.0 ft			TOTAL DEPTH 21.4 ft			NORTHING 945,835			EASTING 1,184,487		24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE TRI9435 CME-55 85% 02/22/2016						DRILL METHOD NW Casing W/SPT & Core			HAMMER TYPE Automatic		
DRILLER Contract Driller			START DATE 09/20/16			COMP. DATE 09/20/16			SURFACE WATER DEPTH N/A		
CORE SIZE NQ2			TOTAL RUN 10.7 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 (%)	REC. (%)	RQD (%)			
2918.3	2918.3	10.7	0.7	1:36/0.7	(0.7)	(0.7)				Begin Coring @ 10.7 ft	
	2917.6	11.4	5.0	3:13/1.0 2:56/1.0 3:14/1.0 3:32/1.0 2:21/1.0	100% (4.3)	100% (3.9)				2918.3 CRYSTALLINE ROCK VERY SLIGHT TO SLIGHT WEATHERING, MODERATELY HARD TO HARD, GRAY AND WHITE, BIOTITE GRANITIC GNEISS, WITH MODERATELY CLOSE TO WIDE FRACTURE SPACING (MORE SEVERELY WEATHERED AND HIGHLY FRACTURED ZONES WITH CORE LOSS AT 15.4'-16.1' AND 20.4'-20.9')	10.7
	2912.6	16.4	5.0	3:44/1.0 3:15/1.0 3:17/1.0 3:25/1.0 4:38/1.0	96% (4.8)	84% (4.2)					
	2907.6	21.4								2907.6 Boring Terminated at Elevation 2,907.6 ft in CR: BIOTITE GRANITIC GNEISS	21.4

NCDOT CORE SINGLE G16021.08 CULVERT 307.GPJ NC_DOT.GDT 1/6/17




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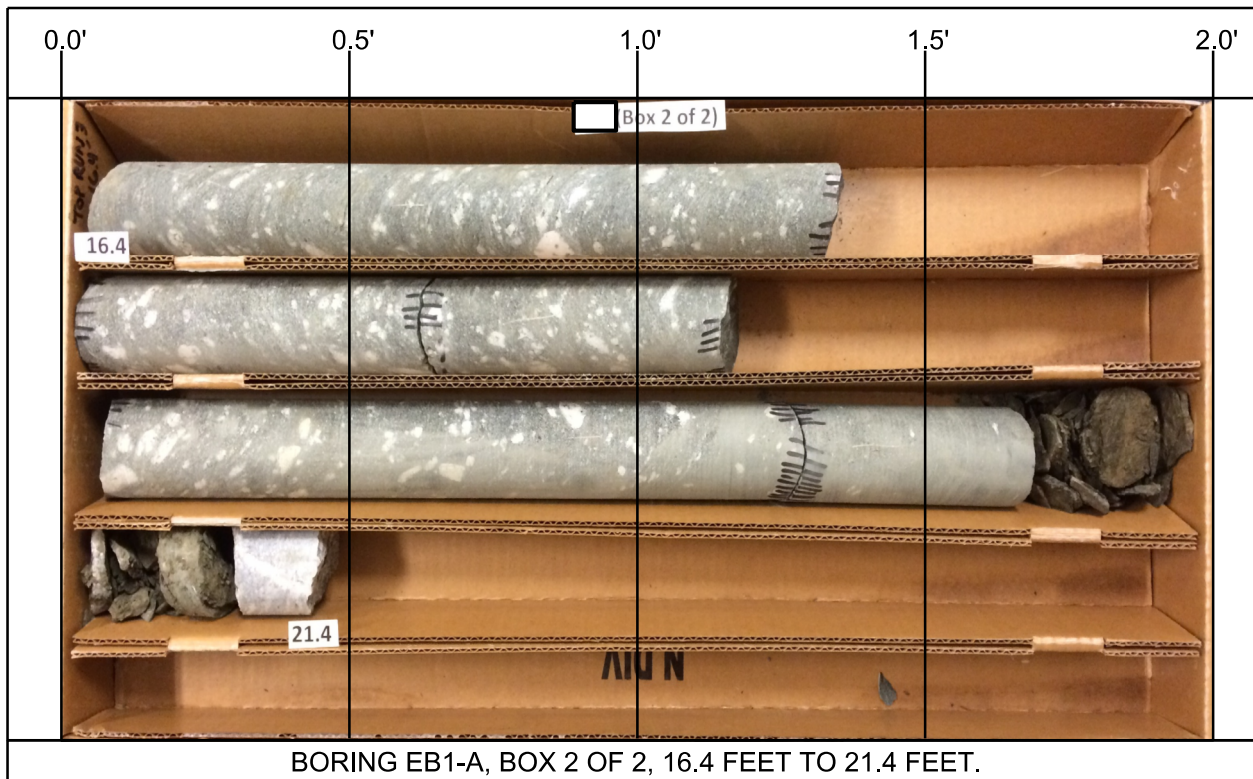
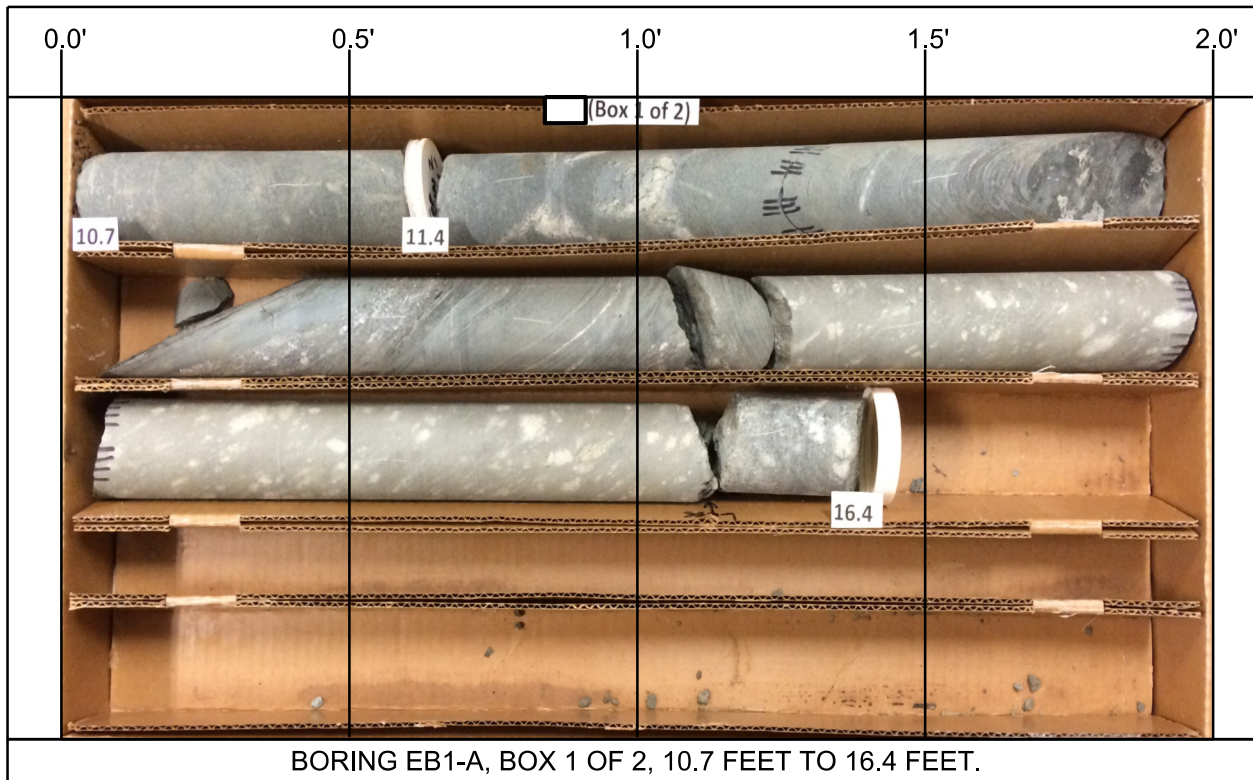
ROCK CORE PHOTOS

CULVERT NO.307 ON SR 1233 (OLD US 421)
OVER N. FORK COVE CREEK
WATAUGA COUNTY, NC
WBS NO.: 17BP.11.C.2 TIP NO.: SF-942307
FALCON PROJECT NO. G16021.08

GEOTECHNICAL BORING REPORT CORE LOG

WBS 17BP.11.C.2				TIP SF-942307		COUNTY WATAUGA			GEOLOGIST Goodnight, D. J.			
SITE DESCRIPTION Culvert No. 942307 on SR 1233 (Old US 421) over N. Fork Cove Creek										GROUND WTR (ft)		
BORING NO. EB1-B			STATION 12+98			OFFSET 23 ft RT			ALIGNMENT -L-		0 HR. 1.0	
COLLAR ELEV. 2,925.8 ft			TOTAL DEPTH 22.3 ft			NORTHING 945,799			EASTING 1,184,523		24 HR. 2.0	
DRILL RIG/HAMMER EFF./DATE TRI9435 CME-55 85% 02/22/2016						DRILL METHOD NW Casing W/SPT & Core			HAMMER TYPE Automatic			
DRILLER Contract Driller				START DATE 09/19/16			COMP. DATE 09/19/16			SURFACE WATER DEPTH N/A		
CORE SIZE NQ2				TOTAL RUN 9.5 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 (%)	REC. (ft)	RQD (%)				
2913												
2910	2,913.0	12.8	4.5	5:15/1.0 3:29/1.0 5:10/1.0 4:42/1.0 2:40/0.5	(3.8) 84%	(3.5) 78%				Begin Coring @ 12.8 ft CRYSTALLINE ROCK VERY SLIGHT WEATHERING TO FRESH, HARD, GRAY AND WHITE, BIOTITE GRANITIC GNEISS, WITH MODERATELY CLOSE TO CLOSE FRACTURE SPACING <i>(continued)</i>		
	2,908.5	17.3										
2905			5.0	5:22/1.0 3:20/1.0 3:28/1.0 3:05/1.0 3:01/1.0	(5.0) 100%	(4.8) 96%						
	2,903.5	22.3								2,903.5	22.3	
										Boring Terminated at Elevation 2,903.5 ft in CR: BIOTITE GRANITIC GNEISS		

NCDOT CORE SINGLE G16021.08 CULVERT 307.GPJ NC_DOT.GDT 1/6/17



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ROCK CORE PHOTOS

CULVERT NO.307 ON SR 1233 (OLD US 421)
OVER N. FORK COVE CREEK
WATAUGA COUNTY, NC
WBS NO.: 17BP.11.C.2 TIP NO.: SF-942307
FALCON PROJECT NO. G16021.08

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.11.C.2		TIP SF-942307		COUNTY WATAUGA		GEOLOGIST Goodnight, D. J.									
SITE DESCRIPTION Culvert No. 942307 on SR 1233 (Old US 421) over N. Fork Cove Creek							GROUND WTR (ft)								
BORING NO. EB2-A		STATION 13+47		OFFSET 33 ft LT		ALIGNMENT -L-									
COLLAR ELEV. 2,929.6 ft		TOTAL DEPTH 10.4 ft		NORTHING 945,871		EASTING 1,184,503									
DRILL RIG/HAMMER EFF./DATE TRI9435 CME-55 85% 02/22/2016				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic									
DRILLER Contract Driller		START DATE 09/20/16		COMP. DATE 09/20/16		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	L O G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2930															0.0
	2,928.6	1.0	15	56	44/0.2								M	0.2' Bitumenous Concrete 0.8' Gravel	1.0
2925	2,926.1	3.5	17	11	5								M	ROADWAY EMBANKMENT TAN, SILTY F. TO CSE. SAND (A-2-4) WITH SOME GRAVEL	5.5
	2,923.6	6.0	11	5	12								W	ALLUVIAL LIGHT GRAY, SLIGHTLY SILTY F. TO CSE. SAND (A-1-b) WITH SOME GRAVEL	9.0
2920	2,921.1	8.5	5	60	37								W	COBBLES AND GRAVEL WITH TAN SLIGHTLY SILTY CSE. TO F. SAND (A-1-b)	10.0
	2,919.2	10.4	60/0.0											WEATHERED ROCK TAN, BIOTITE GRANITIC GNEISS Boring Terminated with Standard Penetration Test Refusal at Elevation 2,919.2 ft on CR: BIOTITE GRANITIC GNEISS	10.4

NCDOT BORE SINGLE G16021.08 CULVERT 307.GPJ NC_DOT.GDT 1/6/17

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.11.C.2		TIP SF-942307		COUNTY WATAUGA		GEOLOGIST Goodnight, D. J.											
SITE DESCRIPTION Culvert No. 942307 on SR 1233 (Old US 421) over N. Fork Cove Creek							GROUND WTR (ft)										
BORING NO. EB2-B		STATION 13+42		OFFSET 20 ft RT		ALIGNMENT -L-											
COLLAR ELEV. 2,928.5 ft		TOTAL DEPTH 10.2 ft		NORTHING 945,836		EASTING 1,184,543											
DRILL RIG/HAMMER EFF./DATE TRI9435 CME-55 85% 02/22/2016				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER Contract Driller		START DATE 09/19/16		COMP. DATE 09/19/16		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)		
2930															2,928.5	0.2' BITUMENOUS CONCRETE	0.0
																ROADWAY EMBANKMENT	
	2,925.9	2.6													2,925.4	BOULDERS, COBBLES, AND GRAVEL	3.1
2925	2,924.0	4.5	15	3	3											BROWN, SILTY CSE. TO F. SAND (A-2-4) WITH SOME GRAVEL	
	2,922.5	6.0	6	3	5												
			3	7	10												
2920	2,920.0	8.5	6	11	89/0.4										2,920.5		8.0
	2,918.3	10.2	60/0.0												2,919.0	ALLUVIAL BROWN, SLIGHTLY SILTY F. TO CSE. SAND (A-1-b) WITH SOME COBBLES AND GRAVEL	9.5
															2,918.3	WEATHERED ROCK TAN AND WHITE, BIOTITE GRANITIC GNEISS	10.2
																Boring Terminated with Standard Penetration Test Refusal at Elevation 2,918.3 ft on CR: BIOTITE GRANITIC GNEISS	

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