



SUBSURFACE INVESTIGATION AND BRIDGE FOUNDATION DESIGN RECOMMENDATIONS

WBS Element No. 45360.1.36 Tip No. BD-5114AJ
Structure No. 870064 – Bridge on SR 1313 over North Fork Flat Creek
Transylvania County, North Carolina
F&R PROJECT NO. 63P-0310-8764

Prepared for:

Vaughn & Melton Consulting Engineers
1318-F Patton Avenue
Asheville, North Carolina 28806

September 8, 2014



FROEHLING & ROBERTSON, INC.

Engineering Stability Since 1881

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September 8, 2014

Mr. Hardy Willis, P.E.
Vaughn & Melton Consulting Engineers
1318-F Patton Avenue
Asheville, North Carolina 28806

Re: **Subsurface Investigation and Bridge Foundation Design Recommendations
Bridge Structure No. 870064 on SR 1313 over North Fork Flat Creek**
WBS Element No.: 45360.1.36
TIP No.: BD-5114AJ
County: Transylvania
F&R Project No.: 63P-0310-8764

Dear Mr. Willis,

Froehling & Robertson, Inc. (F&R) has completed the subsurface investigation and bridge foundation design recommendations for the new structure proposed on SR 1313 over North Fork Flat Creek. Our design is based on information provided to us by Vaughn & Melton. This work was performed in general accordance with F&R's Proposal No. 1363-164G, dated August 9, 2012. This report contains the foundation recommendations, Structure Subsurface Investigation Report, and supporting calculations.

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

Sincerely,

FROEHLING & ROBERTSON, INC.

D. Matthew Brewer, E.I.
Transportation Staff Professional



APPENDIX A

FOUNDATION RECOMMENDATIONS

FOUNDATION RECOMMENDATIONS

WBS # 45360.1.36 DESCRIPTION Structure No. 870064 on SR 1313 over
North Fork Flat Creek

T.I.P. NO. BD-5114AJ

COUNTY Transylvania

STATION 15+90.36 -L-



	INITIALS	DATE
DESIGN	DMB	Sep-14
CHECK	MJW	Sep-14
REVISED		

BENT	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
END BENT NO. 1	15+67.86	Spread Footing	8 TSF	BOF Elevation: 2,699.4 +/- ft. (Upstream Side) BOF Elevation: 2,703.3 +/- ft. (Downstream Side)
END BENT NO. 2	16+12.86	Spread Footing	8 TSF	BOF Elevation: 2,702.8 +/- ft. (Upstream Side) BOF Elevation: 2,699.8 +/- ft. (Downstream Side)

NOTES ON PLANS & COMMENTS

(See following page)

WBS # 45360.1.36

County Transylvania

FOUNDATION RECOMMENDATION NOTES ON PLANS

- 1) The spread footings are designed for a factored resistance of 8 TSF. Check field conditions for the required resistance of 18 TSF just before placing concrete.
- 2) Key spread footings at least 12" into rock with minimum thickness as shown on the plans.
- 3) The Scour Critical Elevation is the bottom of footing. Scour Critical Elevations are used to monitor possible scour problems during the life of the structure.

FOUNDATION RECOMMENDATION COMMENTS

- 1) Spread footings must be placed on non-scourable rock. If adequate material is not encountered at the plan bottom of footing excavation, excavate down and embed footing a minimum of 1-foot into non-scourable rock and backfill to the foundation bearing elevation with NCDOT Class A concrete or lower the foundation bearing elevation accordingly.
- 2) An irregular or sloping rock surface is generally not a problem if it can be sufficiently cleaned to obtain a good bond between the rock and concrete.



APPENDIX B

STRUCTURE SUBSURFACE INVESTIGATION

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

STRUCTURE
SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. 45360.1.36 F.A. PROJ. N/A
 COUNTY Transylvania
 PROJECT DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road)
over North Fork Flat Creek

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4	BORING LOCATION PLAN
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PERSONNEL

J. Fowler

J. Usery

M. Brewer, E.I.

INVESTIGATED BY F&R, Inc.

CHECKED BY M. Walko, P.E.

SUBMITTED BY F&R, Inc.

DATE September 2014

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) 707-6350. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE 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 (ON-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 THIS 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.

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N.C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - 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.

DRAWN BY: M. Brewer, E.I.

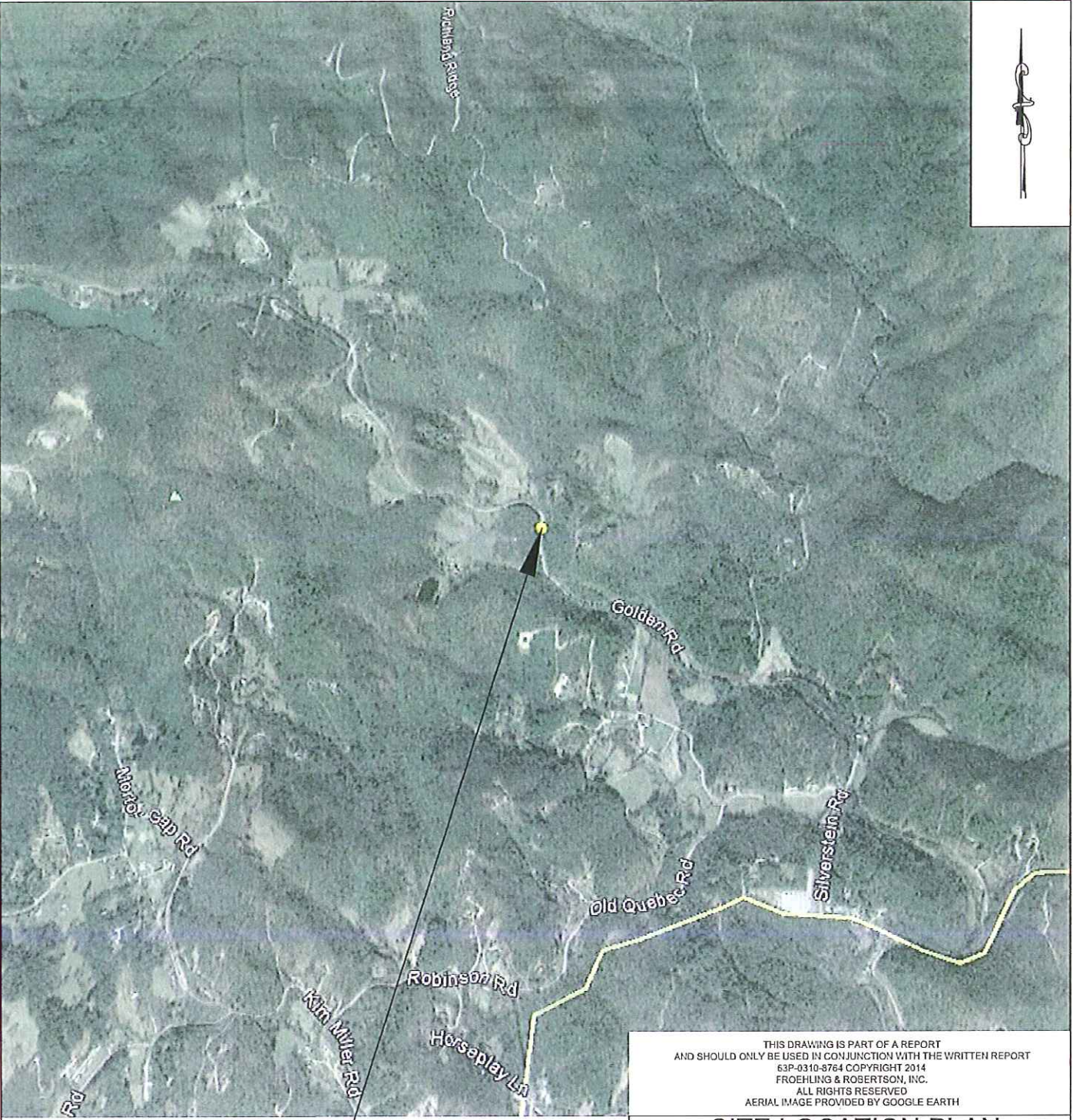


**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

SOIL DESCRIPTION												GRADATION																													
SOIL IS CONSIDERED TO BE THE 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 (ASTM T208, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE: <i>VERY STIFF, GRAY, SILTY CLAY, MOST WITH INTERBEDDED FINE SAND INTERMEDIATE PLASTIC, A-7-6</i>												WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED) GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.																													
THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS <u>ANGULAR</u> , <u>SUBANGULAR</u> , <u>SUBROUNDED</u> , OR <u>ROUNDED</u> .												ANGULARITY OF GRAINS																													
SOIL LEGEND AND AASHTO CLASSIFICATION												MINERALOGICAL COMPOSITION																													
GENERAL CLASS.						GRANULAR MATERIALS (≤ 35% PASSING #200)						SILT-CLAY MATERIALS (> 35% PASSING #200)						ORGANIC MATERIALS						MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.																	
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		COMPRESSIBILITY																	
SYMBOL		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		SLIGHTLY COMPRESSIBLE MODERATELY COMPRESSIBLE HIGHLY COMPRESSIBLE																	
% PASSING		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		10 30 50 75 100		LIQUID LIMIT LESS THAN 31 LIQUID LIMIT EQUAL TO 31-50 LIQUID LIMIT GREATER THAN 50																	
LIQUID LIMIT PLASTIC INDEX		6 4 3		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		10 8 7		PERCENTAGE OF MATERIAL ORGANIC MATERIAL GRANULAR SILT-CLAY OTHER MATERIAL 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																	
GROUP INDEX		0		0		0		0		0		0		0		0		0		0		0		GROUND WATER ▽ WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING ▽ 24 STATIC WATER LEVEL AFTER 24 HOURS ▽ PM PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA ○ SPRING OR SEEP																	
GENERAL RATING AS A SUBGRADE		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		EXCELLENT TO GOOD		PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30																	
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		TEST BORING W/ CORE		SPT N-VALUE		SPT REFUSAL		MONITORING WELL		PIEZOMETER INSTALLATION		SLOPE INDICATOR INSTALLATION		CONE PENETROMETER TEST		SOUNDING ROD			
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)		VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE		<4 4 TO 10 10 TO 30 30 TO 50 >50		N/A		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]					
GENERALLY SILT-CLAY MATERIAL (COHESIVE)		VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD		<2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 >30		<0.25 0.25 TO 0.50 0.5 TO 1.0 1 TO 2 2 TO 4 >4		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]					
TEXTURE OR GRAIN SIZE												ABBREVIATIONS																													
U.S. STD. SIEVE SIZE		4		10		40		60		200		270		AR - AUGER REFUSAL		FRAGS. - FRAGMENTS		w - MOISTURE CONTENT		V - VERY		WEA. - WEATHERED		γ - UNIT WEIGHT		γ _d - DRY UNIT WEIGHT		SAMPLE ABBREVIATIONS		S - BULK		SS - SPLIT SPOON		ST - SHELBY TUBE		RS - ROCK		RT - RECOMPACTED TRIAXIAL		CBR - CALIFORNIA BEARING RATIO	
OPENING (IN.)		4.76		2.00		0.42		0.25		0.075		0.053		BT - BORING TERMINATED		HI. - HIGHLY		MED. - MEDIUM		MICA. - MICACEOUS		MOD. - MODERATELY		NP - NON PLASTIC		ORG. - ORGANIC		PMT - PRESSUREMETER TEST		SAP. - SAPROLITIC		SOY. - SANDY		SL. - SILT, SILTY		SLI. - SLIGHTLY		FRAC. - FRACTURED, FRACTURES		TCR - TRICONE REFUSAL	
BOULDER (BLDR.)		COBBLE (COB.)		GRAVEL (GR.)		COARSE SAND (CSE. SD.)		FINE SAND (F. SD.)		SILT (SL.)		CLAY (CL.)		CL. - CLAY		CPT - CONE PENETRATION TEST		CSE. - COARSE		CT - CORING TERMINATED		DMT - DILATOMETER TEST		DPT - DYNAMIC PENETRATION TEST		e - VOID RATIO		EMBANK. - EMBANKMENT		F - FINE		FOSS. - FOSSILIFEROUS		FRAC. - FRACTURED, FRACTURES		TCR - TRICONE REFUSAL					
GRAIN SIZE		MM 305 IN. 12		75 3		2.0		0.25		0.05		0.005		CT - CORING TERMINATED		DMT - DILATOMETER TEST		DPT - DYNAMIC PENETRATION TEST		e - VOID RATIO		EMBANK. - EMBANKMENT		F - FINE		FOSS. - FOSSILIFEROUS		FRAC. - FRACTURED, FRACTURES		TCR - TRICONE REFUSAL		TCR - TRICONE REFUSAL		TCR - TRICONE REFUSAL							
SOIL MOISTURE - CORRELATION OF TERMS												EQUIPMENT USED ON SUBJECT PROJECT																													
SOIL MOISTURE SCALE (ATTERBERG LIMITS)		FIELD MOISTURE DESCRIPTION		GUIDE FOR FIELD MOISTURE DESCRIPTION		DRILL UNITS:		ADVANCING TOOLS:		HAMMER TYPE:		CORE SIZE:		HAND TOOLS:		DRILL UNITS:		ADVANCING TOOLS:		HAMMER TYPE:		CORE SIZE:		HAND TOOLS:																	
LL - LIQUID LIMIT		SATURATED - (SAT)		USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	
PL - PLASTIC LIMIT		WET - (W)		SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	
OM - OPTIMUM MOISTURE		MOIST - (M)		SOLID; AT OR NEAR OPTIMUM MOISTURE		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	
SL - SHRINKAGE LIMIT		DRY - (D)		REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	
PLASTICITY												MOBILE B-		CLAY BITS		AUTOMATIC		-B		POST HOLE DIGGER																					
NONPLASTIC		PLASTICITY INDEX (PI)		DRY STRENGTH		BK-51		6" CONTINUOUS FLIGHT AUGER		MANUAL		-N 02		HAND AUGER																											
LOW PLASTICITY		0-5		VERY LOW		DME-550X		8" HOLLOW AUGERS		SOUNDING ROD		-H		VANE SHEAR TEST																											
MED. PLASTICITY		6-15		SLIGHT		DME-75		HARD FACED FINGER BITS		[Symbol]		[Symbol]		[Symbol]																											
HIGH PLASTICITY		16-25		MEDIUM		PORTABLE HOIST		TUNG. CARBIDE INSERTS		[Symbol]		[Symbol]		[Symbol]																											
		26 OR MORE		HIGH		[Symbol]		CASING [Symbol] W/ ADVANCER		[Symbol]		[Symbol]		[Symbol]																											
COLOR												[Symbol]		TRICONE 2-15/16" STEEL TEETH		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	
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.												[Symbol]		TRICONE " " TUNG.-CARB.		[Symbol]		[Symbol]		[Symbol]		[Symbol]		[Symbol]																	

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

ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS 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, 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. FALLT - 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 (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.</p>	
<p>WEATHERED ROCK (WR)</p> 	<p>NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.</p>		
<p>CRYSTALLINE ROCK (CR)</p> 	<p>FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.</p>		
<p>NON-CRYSTALLINE ROCK (NCR)</p> 	<p>FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.</p>		
<p>COASTAL PLAIN SEDIMENTARY ROCK (CP)</p> 	<p>COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>		
WEATHERING			
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. <u>IF TESTED, WOULD YIELD SPT REFUSAL.</u>		
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. <u>IF TESTED, YIELDS SPT N VALUES > 100 BPF.</u>		
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <u>IF TESTED, YIELDS SPT N VALUES < 100 BPF.</u>		
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. COUGES 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 COUGED 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 COUGED 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	0.15 - 1.5 FEET
CLOSE	0.16 TO 1 FEET	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 THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.			
FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.		
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.		
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.		
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.		
		<p>BENCH MARK: Survey information provided by Vaughn & Melton, Inc. TBM BL-4: N - 531307.10, E - 838292.63 ELEVATION: 2706.61 FT.</p>	
		<p>NOTES:</p>	



SITE

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SITE LOCATION PLAN
Bridge No. 870064 on
SR 1313 (Golden Road) over
North Fork Flat River
Lake Toxaway, North Carolina

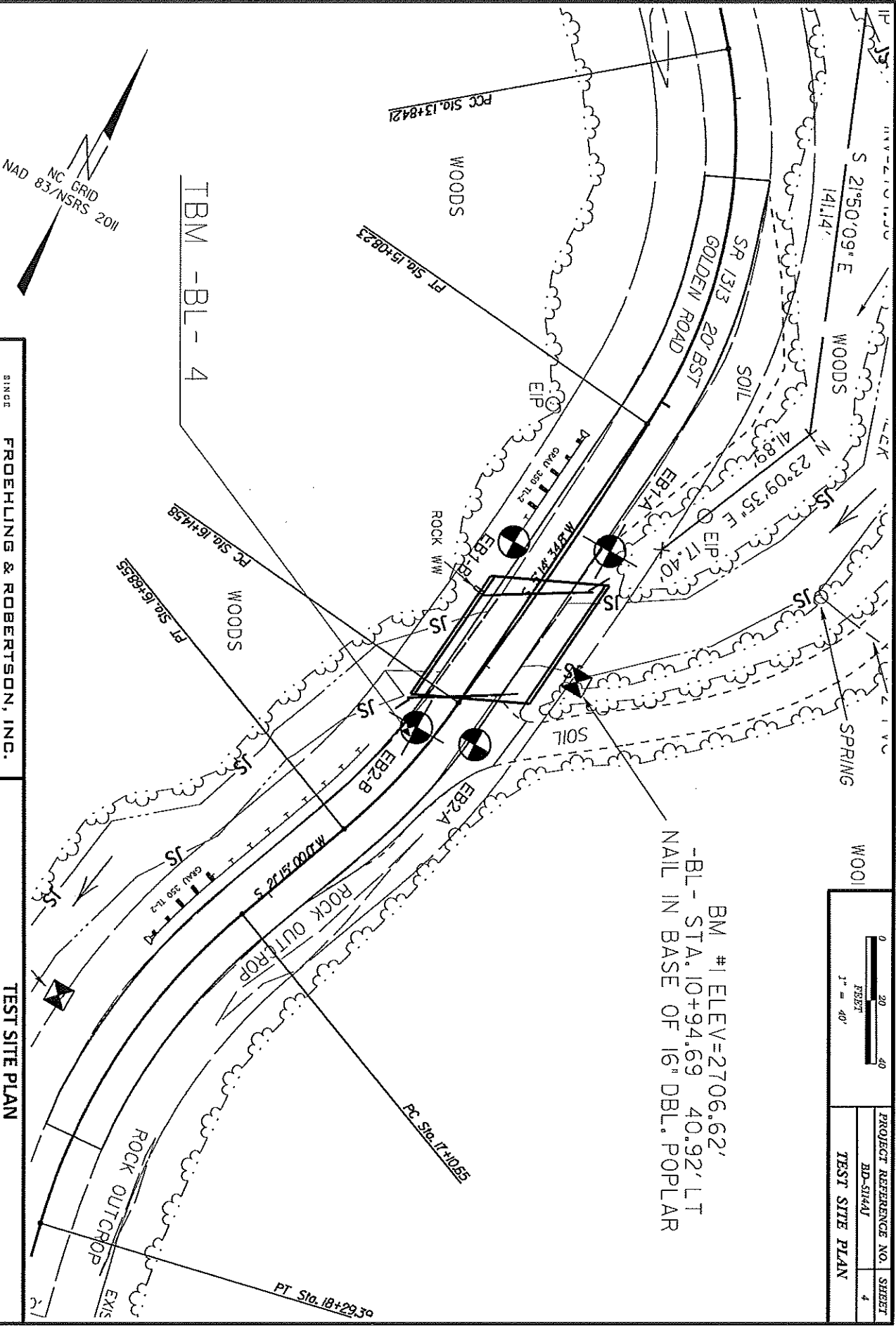
Scale: N.T.S.

CHK	DMB	CHK	MJW	REV
-----	-----	-----	-----	-----

Prepared For:
NCDOT TIP No.: BD-5114AJ



Froehling & Robertson, Inc.
2505 Hutchison-McDonald Road
Charlotte, North Carolina



		PROJECT REFERENCE NO.	BD-S144J	SHEET	4
		TEST SITE PLAN			

BM #1 ELEV=2706.62'
 -BL- STA. 10+94.69 40.92' LT
 NAIL IN BASE OF 16" DBL. POPLAR

FROEHLING & ROBERTSON, INC.
 Engineering Stability Since 1881



2505 Hurchison-Mcdonald Road
 Charlotte, North Carolina 28269
 T 704.596.2889 F 704.596.3741
 www.fandr.com

TEST SITE PLAN

WBS NO.: 45360.1.36	PROJECT ID: N/A	F&R PROJECT NO.: 63P-0310-8764
TIP NO.: BD-S144J	F.A. PROJECT NO.: N/A	COUNTY: Transylvania
PROJECT DESCRIPTION: Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek		
DRAWN BY: M. Brewer, E.I.	CHECKED BY: M. Walko, P.E.	
DATE: September 2014	SCALE: 1"=40'	



NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer										
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)									
BORING NO. EB1-A		STATION 15+48		OFFSET 13 ft LT		ALIGNMENT -L-	0 HR. 8.0									
COLLAR ELEV. 2,708.9 ft		TOTAL DEPTH 14.0 ft		NORTHING 531,382		EASTING 838,324	24 HR. FIAD									
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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)	DEPTH (ft)		
2710	2,708.9	0.0												2,708.9	0.0	GROUND SURFACE
			2	4	5								M	2,706.9	2.0	ROADWAY EMBANKMENT Gray-brown, silty fine SAND (A-2-4), with trace clay and gravel.
2705	2,705.4	3.5	1	1	2								W			ALLUVIAL Tan-brown, silty fine SAND (A-2-4), with trace gravel.
2700	2,700.4	8.5	60/0.1										▽	2,700.4	8.5	
	2,699.9	9.0	60/0.0													CRYSTALLINE ROCK White-gray, (TOXAWAY GNEISS).
2695														2,694.9	14.0	Boring Terminated at Elevation 2,694.9 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/5/14



NCDOT GEOTECHNICAL ENGINEERING UNIT

CORE BORING REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer					
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)				
BORING NO. EB1-A		STATION 15+48		OFFSET 13 ft LT		ALIGNMENT -L-	0 HR. 8.0				
COLLAR ELEV. 2,708.9 ft		TOTAL DEPTH 14.0 ft		NORTHING 531,382		EASTING 838,324	24 HR. FIAD				
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic					
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		TOTAL RUN 5.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RCD (ft) %	REC. (ft) %	RCD (ft) %			
2699.9										Begin Coring @ 9.0 ft	
	2,699.9	9.0	5.0	N=60/0.0 4:09/1.0 4:54/1.0 4:32/1.0 6:39/1.0 8:15/1.0	(4.8) 96%	(3.8) 76%	(4.8) 96%	(3.8) 76%	[Hatched Pattern]	2,699.9 Fresh, hard to very hard, gray-white, (TOXAWAY GNEISS), with very close, close and moderately close fracture spacing.	9.0
2695	2,694.9	14.0							[Hatched Pattern]	2,694.9 Boring Terminated at Elevation 2,694.9 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)	14.0

NCDOT CORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/6/14

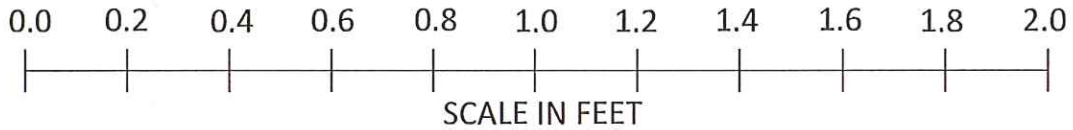


Bridge No. 870064 on SR 1313 (Golden Road) CORE PHOTOGRAPHS: EB1-A: Station 15+48, 13' LT

Begin Run 1
9.0 feet



End Run 1
14.0 feet





NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer										
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)									
BORING NO. EB1-B		STATION 15+63		OFFSET 14 ft RT		ALIGNMENT -L-	0 HR. Dry									
COLLAR ELEV. 2,707.8 ft		TOTAL DEPTH 4.0 ft		NORTHING 531,369		EASTING 838,296	24 HR. FIAD									
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100			ELEV. (ft)	DEPTH (ft)		
2710																
	2,707.8	0.0	2	1	2	3				2,707.8	0.0	GROUND SURFACE
2705	2,704.3	3.5												2,704.3	3.5	ROADWAY EMBANKMENT Red-brown, clayey fine SAND (A-2-6), with trace gravel.
	2,703.8	4.0	60/0.1											2,703.8	4.0	CRYSTALLINE ROCK Gray-white, (TOXAWAY GNEISS). Boring Terminated with Standard Penetration Test Refusal at Elevation 2,703.8 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)

NCDOT BORE SINGLE 63P-0310-8754-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/6/14



NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer											
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)										
BORING NO. EB2-A		STATION 16+22		OFFSET 12 ft LT		ALIGNMENT -L-	0 HR. Dry										
COLLAR ELEV. 2,706.8 ft		TOTAL DEPTH 3.0 ft		NORTHING 531,308		EASTING 838,316	24 HR. FIAD										
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMERTYPE Automatic											
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		SURFACE WATER DEPTH N/A											
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)		
2710																	
	2,706.8	0.0													2,706.8	GROUND SURFACE	0.0
2705			8	3	5	8							M			RESIDUAL	
	2,703.8	3.0													2,703.8	Tan-white-brown, silty fine to coarse SAND (A-2-4), with trace gravel-sized rock fragments.	3.0
			60/0.0							60/0.0						Boring Terminated with Standard Penetration Test Refusal at Elevation 2,703.8 ft ON CRYSTALLINE ROCK (TOXAWAY GNEISS)	

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/6/14



NCDOT GEOTECHNICAL ENGINEERING UNIT BORELOG REPORT

WBS 45360.1.36	TIP BD-5114AJ	COUNTY Transylvania	GEOLOGIST M. Brewer
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek			GROUND WTR (ft)
BORING NO. EB2-B	STATION 16+29	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 2,706.8 ft	TOTAL DEPTH 11.0 ft	NORTHING 531,303	EASTING 838,297
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014		DRILL METHOD H.S. Augers	HAMMERTYPE Automatic
DRILLER J. Fowler	START DATE 04/24/14	COMP. DATE 04/24/14	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)
2710														
	2,706.4	0.4												2,706.8 GROUND SURFACE 0.0
2705	2,704.8	2.0	12	8	5	.....	.....	.....	.....			M	Asphalt (3") and ABC Stone (2").	2.0
	2,703.3	3.5	2	3	4	.....	.....	.....	.....			M	ROADWAY EMBANKMENT Tan-brown, fine sandy, silty CLAY (A-6), with trace gravel.	
2700	2,700.8	6.0	60/0.0			.....	.....	.....	.....				RESIDUAL Tan-brown, silty fine SAND (A-2-4).	6.0
						.....	.....	.....	.....				CRYSTALLINE ROCK Gray-white, (TOXAWAY GNEISS).	
						.....	.....	.....	.....				Boring Terminated at Elevation 2,695.8 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)	11.0

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/5/14



NCDOT GEOTECHNICAL ENGINEERING UNIT

CORE BORING REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer					
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)				
BORING NO. EB2-B		STATION 16+29		OFFSET 6 ft RT		ALIGNMENT -L-					
COLLAR ELEV. 2,706.8 ft		TOTAL DEPTH 11.0 ft		NORTHING 531,303		EASTING 838,297					
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMERTYPE Automatic					
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		TOTAL RUN 5.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	ROD (%)	REC. (%)	ROD (%)			
2700.8											
2700	2,700.8	6.0	5.0	N-60/0.0 11:30/1.0 10:10/1.0 13:02/1.0 35:28/1.0 25:13/1.0	(4.5) 90%	(4.2) 84%	(4.5) 90%	(4.2) 84%	[Hatched Pattern]	2,700.8 Begin Coring @ 6.0 ft CRYSTALLINE ROCK Fresh, hard to very hard, gray-white, (TOXAWAY GNEISS), with very close, close and moderately close fracture spacing.	6.0
	2,695.8	11.0							[Hatched Pattern]	2,695.8 Boring Terminated at Elevation 2,695.8 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)	11.0

NCDOT CORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 05/14

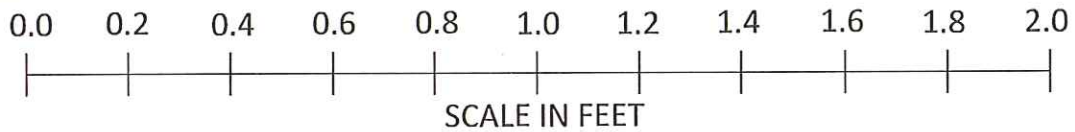


Bridge No. 870064 on SR 1313 (Golden Road) CORE PHOTOGRAPHS: EB2-B: Station 16+29, 6' RT

Begin Run 1
6.0 feet



End Run 1
11.0 feet





APPENDIX C
SUPPORTING CALCULATIONS



NCDOT GEOTECHNICAL ENGINEERING UNIT BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer											
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)										
BORING NO. EB1-A		STATION 15+48		OFFSET 13 ft LT		ALIGNMENT -L-	0 HR. 8.0										
COLLAR ELEV. 2,708.9 ft		TOTAL DEPTH 14.0 ft		NORTHING 531,382		EASTING 838,324	24 HR. FIAD										
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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)	DEPTH (ft)			
2710	2,708.9	0.0												2,708.9	0.0	GROUND SURFACE	
			2	4	5						M		2,706.9	2.0	ROADWAY EMBANKMENT Gray-brown, silty fine SAND (A-2-4), with trace clay and gravel.		
2705	2,705.4	3.5	1	1	2												W
2700	2,700.4	8.5	60/0.1											2,700.4	8.5	CRYSTALLINE ROCK White-gray, (TOXAWAY GNEISS).	
	2,699.9	9.0	60/0.0											2,694.9	14.0	Boring Terminated at Elevation 2,694.9 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)	
2695																	
<p>Top of Non-Scorable Rock at 2700.4'</p> <p>Set Bof at 2699.4' (1' into NSR)</p> <p>End Bent No. 1 Upstream Side</p>																	

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.CPJ NC_DOT.GDT 8/5/14



NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer									
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)								
BORING NO. EB1-B		STATION 15+63		OFFSET 14 ft RT		ALIGNMENT -L-	0 HR. Dry								
COLLAR ELEV. 2,707.8 ft		TOTAL DEPTH 4.0 ft		NORTHING 531,369		EASTING 838,296	24 HR. FIAD								
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMERTYPE Automatic									
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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					ELEV. (ft)
2710															
	2,707.8	0.0												2,707.8	0.0
			2	1	2										
2705	2,704.3	3.5												2,704.3	3.5
	2,703.8	4.0												2,703.8	4.0
			60/0.1												
			60/0.0												

Top of Non-Scorable
Rock at 2704.3'

Set BOF at 2703.3'
(1' into NSR)

END Bent No. 1
Downstream Side

GROUND SURFACE
ROADWAY EMBANKMENT
Red-brown, clayey fine SAND (A-2-6), with
trace gravel.

CRYSTALLINE ROCK
Gray-white, (TOXAWAY GNEISS).
Boring Terminated at Elevation 2,703.8 ft IN
CRYSTALLINE ROCK (TOXAWAY
GNEISS)

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/5/14



NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

WBS 45360.136		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer													
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)												
BORING NO. EB2-A		STATION 16+22		OFFSET 12 ft LT		ALIGNMENT -L-													
COLLAR ELEV. 2,706.8 ft		TOTAL DEPTH 3.0 ft		NORTHING 531,308		EASTING 838,316													
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73%02/22/2014				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic													
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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	ELEV. (ft)	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100									
2710																			
	2,706.8	0.0															2,706.8	GROUND SURFACE	0.0
2705			8	3	5														
	2,703.8	3.0															2,703.8	RESIDUAL Tan-white-brown, silty fine to coarse SAND (A-2-4), with trace gravel-sized rock fragments.	3.0
		60/0.0																	
<p style="text-align: center;">Top of Non Scorable Rock at 2703.8'</p> <p style="text-align: center;">SET Bof at 2702.8' (1' into NSR)</p> <p style="text-align: center;">End Bent No. 2 Upstream Side</p>																			
<p style="text-align: center;">Boring Terminated at Elevation 2,703.8 ft ON CRYSTALLINE ROCK (TOXAWAY GNEISS)</p>																			

NCDOT BORE SINGLE 63P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/5/14

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.36		TIP BD-5114AJ		COUNTY Transylvania		GEOLOGIST M. Brewer								
SITE DESCRIPTION Bridge No. 870064 on SR 1313 (Golden Road) over North Fork Flat Creek							GROUND WTR (ft)							
BORING NO. EB2-B		STATION 16+29		OFFSET 6 ft RT		ALIGNMENT -L-	0 HR. Dry							
COLLAR ELEV. 2,706.8 ft		TOTAL DEPTH 11.0 ft		NORTHING 531,303		EASTING 838,297	24 HR. FIAD							
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 73% 02/22/2014				DRILL METHOD H.S. Augers		HAMMERTYPE Automatic								
DRILLER J. Fowler		START DATE 04/24/14		COMP. DATE 04/24/14		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)
2710														
	2,706.4	0.4	12	8	5	13						M	2,706.8	GROUND SURFACE 0.0
2705	2,703.3	3.5	2	3	4							M	2,704.8	Asphalt (3") and ABC Stone (2") ROADWAY EMBANKMENT 2.0
	2,700.8	6.0	60/0.0										2,700.8	Tan-brown, fine sandy, silty CLAY (A-6), with trace gravel. RESIDUAL 6.0
2700													2,695.8	Tan-brown, silty fine SAND (A-2-4); CRYSTALLINE ROCK Gray-white, (TOXAWAY GNEISS). 11.0
<p>Top of Non Scourable Rock at 2700.8'</p> <p>Set BoF at 2699.8' (1' into NSR)</p> <p>End Bent No. 2 Downstream Side</p> <p>Boring Terminated at Elevation 2,695.8 ft IN CRYSTALLINE ROCK (TOXAWAY GNEISS)</p>														

NCDOT BORE SINGLE 53P-0310-8764-DIVISION 14 BRIDGE 870064.GPJ NC_DOT.GDT 8/5/14



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SHEET NO. 1 OF 2

JOB BRIDGE NO. 870064

DATE 8/6/14

COMPUTATIONS FOR END BENT 1

BY DMB CHKD MW

BEARING CAPACITY OF FOOTINGS ON NON-SCOURABLE ROCK	
ASSUMPTIONS: FOOTING DIMENSION: 4' x 37' FOR ABUTMENT FOOTINGS. FOR SIMPLICITY, SAY $N = 100$ BPF	
USE $\phi_b = 0.45$	
FOOTING $B = 4'$, $L = 37'$, $D_c = 10'$ BELOW EXISTING ROAD GRADE	
$\gamma = 120$ PCF = 0.120 KCF	
EQ 10.6.3.1-1 $q_u = \phi_b q_n$	
$q_n = C N_c + \gamma D_c N_q C_{wq} + 0.5 \gamma B N_{\gamma} C_{w\gamma}$	
$C = 0$ FOR SANDY SOILS	
$N_{cm} = N_c s_c i_c$	
$N_{qm} = N_q s_q i_q$	
$N_{\gamma m} = N_{\gamma} s_{\gamma} i_{\gamma}$	
TABLE 10.4.6.2.4-1 $N_{c0} = 50$, $\phi_c = 38-43^\circ$, USE $\phi = 42^\circ$	
TABLE 10.6.3.1.2a-1 $N_c = 93.7$, $N_q = 85.9$, $N_{\gamma} = 155.6$	
FOR WORST CASE, ASSUME WATER IS AT THE SURFACE	
TABLE 10.6.3.1.2a-2 $C_{wq} = 0.5$, $C_{w\gamma} = 0.5$	
PER TABLE 10.6.3.1.2a-3 $\phi_a > 0$	



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SHEET NO. 2 OF 2

JOB BRIDGE No. 870064

DATE 8/6/14

COMPUTATIONS FOR END BENT 1

BY DMD CHKD MW

$$S_c = 1 + \left(\frac{B}{L}\right) \left(\frac{N_q}{N_c}\right) = 1 + \left(\frac{4'}{37'}\right) \left(\frac{85.9}{93.7}\right) = 1.10$$

$$S_\gamma = 1 - 0.4 \left(\frac{B}{L}\right) = 1 - 0.4 \left(\frac{4'}{37'}\right) = 0.96$$

$$S_q = 1 + \left(\frac{B}{L} \tan \phi_p\right) = 1 + \left(\frac{4'}{37'}\right) \tan(43) = 1.10$$

TABLE 10.6.3.1.2c-4 $D_c/B = 10/4 = 2.5$, $d_q = 1.20$

HOWEVER, PER NOTE IN LRFD USE $d_q = 1.0$

ASSUME NO INCLINE LOADINGS AND FOOTING IS NOT ON A SLOPE
 $\alpha = 12 = 1.0$

$$N_{qm} = N_q S_q d_{q1} \alpha = (85.9)(1.10)(1.0)(1.0) = 94.5$$

$$N_{\gamma m} = N_\gamma S_\gamma i_\gamma \alpha = (155.6)(0.96)(1.0) = 149.4$$

$$q_N = \phi N_{qm} + 8 DF N_{qm} C_{wq} + 0.5 \gamma B N_{\gamma m} C_{w\gamma}$$

$$q_N = 0 + (0.120)(10')(94.5)(0.5) + (0.5)(0.12)(4)(149.4)(0.5)$$

$$q_N = 0 + 56.7 + 17.9 = 74.6 \text{ KSF} = 37.3 \text{ TSF}$$

$$q_R = \phi q_N = (0.45)(37.3 \text{ TSF}) = 16.8 \text{ TSF}$$

α SINCE $8 \text{ TSF} < 16.8 \text{ TSF}$, BEARING IS OK ✓

SETTLEMENT ANALYSIS OF SHALLOW FOUNDATIONS

Schmertmann Method

Date: August 6, 2014
 F&R Project No.: 63P-0310-8764
 Identification: Bridge 870064

	Input	Results
Units	E E or SI	
Shape	RE SQ, CI, CO, or RE	q = 16000 lb/ft ²
B =	4 ft	Δ = 0.38 in
L =	37 ft	2/3 Δ = 0.25 in
D =	10 ft	
P =	2146 k	
D _w =	10 ft	
γ =	120 lb/ft ³	
t =	1 yr	

Depth to Soil Layer		Es (lb/ft ²)	z _f (ft)	I _ε	strain (%)	Δ (in)
Top (ft)	Bottom (ft)					
0.0	10.0					
10.0	10.5	2718000	0.25	0.235	0.1108	0.0066
10.5	11.0	2718000	0.75	0.322	0.1517	0.0091
11.0	11.5	2718000	1.25	0.408	0.1926	0.0116
11.5	12.0	2718000	1.75	0.495	0.2335	0.0140
12.0	12.5	2718000	2.25	0.571	0.2693	0.0162
12.5	13.0	2718000	2.75	0.636	0.3001	0.0180
13.0	13.5	2718000	3.25	0.701	0.3309	0.0199
13.5	14.0	2718000	3.75	0.767	0.3617	0.0217
14.0	14.5	2718000	4.25	0.780	0.3680	0.0221
14.5	15.0	2718000	4.75	0.743	0.3505	0.0210
15.0	15.5	2718000	5.25	0.706	0.3329	0.0200
15.5	16.0	2718000	5.75	0.668	0.3154	0.0189
16.0	16.5	2718000	6.25	0.631	0.2978	0.0179
16.5	17.0	2718000	6.75	0.594	0.2803	0.0168
17.0	17.5	2718000	7.25	0.557	0.2627	0.0158
17.5	18.0	2718000	7.75	0.520	0.2452	0.0147
18.0	18.5	2718000	8.25	0.485	0.2290	0.0137
18.5	19.0	2718000	8.75	0.454	0.2142	0.0129
19.0	19.5	2718000	9.25	0.423	0.1995	0.0120
19.5	20.0	2718000	9.75	0.392	0.1847	0.0111
20.0	20.5	2718000	10.25	0.360	0.1699	0.0102
20.5	21.0	2718000	10.75	0.329	0.1551	0.0093
21.0	21.5	2718000	11.25	0.298	0.1404	0.0084
21.5	22.0	2718000	11.75	0.266	0.1256	0.0075
22.0	22.5	2718000	12.25	0.235	0.1108	0.0066
22.5	23.0	2718000	12.75	0.204	0.0960	0.0058
23.0	23.5	2718000	13.25	0.172	0.0813	0.0049
23.5	24.0	2718000	13.75	0.141	0.0665	0.0040
24.0	24.5	2718000	14.25	0.110	0.0517	0.0031

24.5	25.0	2718000	14.75	0.078	0.0369	0.0022
25.0	25.5	2718000	15.25	0.047	0.0222	0.0013
25.5	26.0	2718000	15.75	0.016	0.0074	0.0004
26.0	26.5	2718000	16.25	0.000	0.0000	0.0000
26.5	27.0	2718000	16.75	0.000	0.0000	0.0000
27.0	27.5	2718000	17.25	0.000	0.0000	0.0000
27.5	28.0	2718000	17.75	0.000	0.0000	0.0000
28.0	28.5	2718000	18.25	0.000	0.0000	0.0000
28.5	29.0	2718000	18.75	0.000	0.0000	0.0000
29.0	29.5	2718000	19.25	0.000	0.0000	0.0000
29.5	30.0	2718000	19.75	0.000	0.0000	0.0000
30.0	30.5	2718000	20.25	0.000	0.0000	0.0000
30.5	31.0	2718000	20.75	0.000	0.0000	0.0000
31.0	31.5	2718000	21.25	0.000	0.0000	0.0000
31.5	32.0	2718000	21.75	0.000	0.0000	0.0000
32.0	32.5	2718000	22.25	0.000	0.0000	0.0000
32.5	33.0	2718000	22.75	0.000	0.0000	0.0000
33.0	33.5	2718000	23.25	0.000	0.0000	0.0000
33.5	34.0	2718000	23.75	0.000	0.0000	0.0000
34.0	34.5	2718000	24.25	0.000	0.0000	0.0000
34.5	35.0	2718000	24.75	0.000	0.0000	0.0000
35.0	35.5	2718000	25.25	0.000	0.0000	0.0000
35.5	36.0	2718000	25.75	0.000	0.0000	0.0000
36.0	36.5	2718000	26.25	0.000	0.0000	0.0000
36.5	37.0	2718000	26.75	0.000	0.0000	0.0000
37.0	37.5	2718000	27.25	0.000	0.0000	0.0000
37.5	38.0	2718000	27.75	0.000	0.0000	0.0000
38.0	38.5	2718000	28.25	0.000	0.0000	0.0000
38.5	39.0	2718000	28.75	0.000	0.0000	0.0000
39.0	39.5	2718000	29.25	0.000	0.0000	0.0000
39.5	40.0	2718000	29.75	0.000	0.0000	0.0000
40.0	40.5	2718000	30.25	0.000	0.0000	0.0000
40.5	41.0	2718000	30.75	0.000	0.0000	0.0000
41.0	41.5	2718000	31.25	0.000	0.0000	0.0000
41.5	42.0	2718000	31.75	0.000	0.0000	0.0000
42.0	42.5	2718000	32.25	0.000	0.0000	0.0000
42.5	43.0	2718000	32.75	0.000	0.0000	0.0000
43.0	43.5	2718000	33.25	0.000	0.0000	0.0000
43.5	44.0	2718000	33.75	0.000	0.0000	0.0000
44.0	44.5	2718000	34.25	0.000	0.0000	0.0000
44.5	45.0	2718000	34.75	0.000	0.0000	0.0000
45.0	45.5	2718000	35.25	0.000	0.0000	0.0000
45.5	46.0	2718000	35.75	0.000	0.0000	0.0000
46.0	46.5	2718000	36.25	0.000	0.0000	0.0000
46.5	47.0	2718000	36.75	0.000	0.0000	0.0000
47.0	47.5	2718000	37.25	0.000	0.0000	0.0000
47.5	48.0	2718000	37.75	0.000	0.0000	0.0000
48.0	48.5	2718000	38.25	0.000	0.0000	0.0000
48.5	49.0	2718000	38.75	0.000	0.0000	0.0000
49.0	49.5	2718000	39.25	0.000	0.0000	0.0000
49.5	50.0	2718000	39.75	0.000	0.0000	0.0000
50.0	50.5	2718000	40.25	0.000	0.0000	0.0000
50.5	51.0	2718000	40.75	0.000	0.0000	0.0000

