

PROJECT: 33654.1.1 ID: B-4317

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

STATE	STATE PROJECT REFERENCE NO.	SHEET No.	TOTAL SHEETS
N.C.	33654.1.1 (B-4317)	1	13

CONTENTS

SHEET	DESCRIPTION
1	TITLE SHEET
2	LEGEND
3	GEOTECHNICAL REPORT
4	SITE PLAN
5	CROSS SECTIONS
6	BORE LOG & CORE REPORTS
10	SCOUR REPORT
11	CORE PHOTOGRAPHS

STRUCTURE  
SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. 33654.1.1(B-4317) F.A. PROJ. BRZ-154(3)  
COUNTY WATAUGA  
PROJECT DESCRIPTION BRIDGE No. 16 ON SR-154I  
OVER MIDDLE FORK CREEK

SITE DESCRIPTION \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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PERSONNEL  
T B DANIEL

C J COFFEY

R D CHILDERS

INVESTIGATED BY C A DUNNAGAN

CHECKED BY W D FRYE, Jr

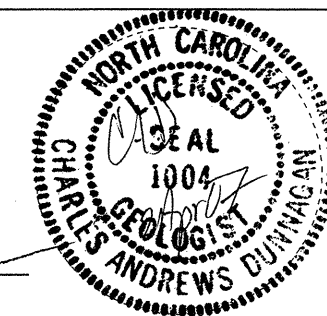
SUBMITTED BY W D FRYE, Jr

DATE APRIL 2007

DRAWN BY: C A DUNNAGAN

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS 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.



*C. A. Dunnagan*

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

**SUBSURFACE INVESTIGATION**

**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

SOIL DESCRIPTION		GRADATION		ROCK DESCRIPTION		TERMS AND DEFINITIONS			
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 STANDARD PENETRATION TEST (AASHTO T206, 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 LAYERS, HIGH 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.		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 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:		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. 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 (N 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 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.			
<b>SOIL LEGEND AND AASHTO CLASSIFICATION</b>		<b>MINERALOGICAL COMPOSITION</b>		<b>WEATHERING</b>					
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.		WEATHERED ROCK (WR) NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.					
GROUP CLASS. A-1, A-1-b, A-3, A-2, A-2-4, A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, A-1, A-2, A-3, A-6, A-7		<b>COMPRESSIBILITY</b>		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.					
SYMBOL		SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 31 MODERATELY COMPRESSIBLE LIQUID LIMIT EQUAL TO 31-50 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 50		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.					
% PASSING		<b>PERCENTAGE OF MATERIAL</b>		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.					
LIQUID LIMIT PLASTIC INDEX		ORGANIC MATERIAL GRANULAR SOILS SILT-CLAY SOILS OTHER MATERIAL							
GROUP INDEX		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC >10%							
USUAL TYPES OF MAJOR MATERIALS		<b>GROUND WATER</b>							
GEN. RATING AS A 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							
PI OF A-7-5 SUBGROUP IS <= LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30		<b>MISCELLANEOUS SYMBOLS</b>							
<b>CONSISTENCY OR DENSENESS</b>		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 SOUNDING ROD		SPT TEST BORING AUGER BORING CORE BORING MONITORING WELL PIEZOMETER INSTALLATION SLOPE INDICATOR INSTALLATION SPT N-VALUE SPT REFUSAL		SAMPLE DESIGNATIONS S - BULK SAMPLE SS - SPLIT SPOON SAMPLE ST - SHELBY TUBE SAMPLE RS - ROCK SAMPLE RT - RECOMPACTED TRIAXIAL SAMPLE CBR - CALIFORNIA BEARING RATIO SAMPLE			
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )		AR - AUGER REFUSAL BT - BORING TERMINATED CL - CLAY CPT - CONE PENETRATION TEST CSE - COARSE DMT - DILATOMETER TEST DPT - DYNAMIC PENETRATION TEST 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 SLL. - SLIGHTLY TCR - TRICONE REFUSAL		w - MOISTURE CONTENT v - VERY VST - VANE SHEAR TEST WEA. - WEATHERED WU - UNIT WEIGHT FIAD - FILLED IMMEDIATELY AFTER DRILLING WH - WEIGHT OF HAMMER			
TEXTURE OR GRAIN SIZE		<b>ABBREVIATIONS</b>		<b>ROCK HARDNESS</b>					
U.S. STD. SIEVE SIZE OPENING (MM)		DRILL UNITS: MOBILE B- BK-51 CME-45C CME-550 PORTABLE HOIST		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 FINGER NAIL.		ADVANCING TOOLS: CLAY BITS 6" CONTINUOUS FLIGHT AUGER 6" HOLLOW AUGERS HARD FACED FINGER BITS TUNG-CARBIDE INSERTS CASING w/ ADVANCER TRICONE STEEL TEETH TRICONE TUNG-CARB. CORE BIT		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 FINGER NAIL.	
SOIL MOISTURE - CORRELATION OF TERMS		<b>EQUIPMENT USED ON SUBJECT PROJECT</b>		<b>FRACTURE SPACING</b>		<b>BEDDING</b>			
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION		HAMMER TYPE: AUTOMATIC MANUAL CORE SIZE: B N XWL H HAND TOOLS: POST HOLE DIGGER HAND AUGER SOUNDING ROD VANE SHEAR TEST		TERM SPACING VERY WIDE MORE THAN 10 FEET WIDE 3 TO 10 FEET MODERATELY CLOSE 1 TO 3 FEET CLOSE 0.16 TO 1 FEET VERY CLOSE LESS THAN 0.16 FEET		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			
PLASTICITY				<b>INDURATION</b>					
NONPLASTIC LOW PLASTICITY MED. PLASTICITY HIGH PLASTICITY				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.					
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.									



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

April 2, 2007

STATE PROJECT: 33654.1.1 (B-4317)  
F. A. PROJECT: BRZ-1541(3)  
COUNTY: Watauga

DESCRIPTION: Bridge No. 16 on SR-1541 over Middle Fork Creek

SUBJECT: Geotechnical Report – Foundation Investigation

**Project Description**

The purpose of this investigation is to determine the subsurface conditions at the project site. The project site is located in south central Watauga County, between Boone and Blowing Rock. The proposed structure will be a single-span of 70 feet, with a skew of 88 degrees. The investigation was conducted using a CME-550 drill machine, with -NX- casing and advancer. Where applicable, Standard Penetration Tests were performed at intervals of 5.0 feet using an automatic drive hammer. Rock core was retrieved from three of the four borings using -NXWL- equipment. Soil samples were submitted for testing of quality.

**Physiography and Geology**

The bridge site is located in a small valley within the steeply rolling terrain near Boone. The geology of this area is controlled by the Grandfather Mountain Window.

The rock line across End Bent One climbs from left to right. In the boring for EB1-A, weathered rock was encountered at 23.2 feet (elevation 3253.0) and crystalline rock at 24.7 (elevation 3251.5). Overlaying these, in descending order are: silty sand roadway embankment, silty sand and gravel alluvium and sand silt saprolite. In the boring for End Bent Two crystalline rock was encountered at 3.3 feet (elevation 3274.0). Above this is silty sand (with boulder) roadway embankment.

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CENTURY CENTER COMPLEX  
BUILDING B  
1020 BIRCH RIDGE DRIVE  
RALEIGH NC 27610

3 / 13

The rock line across End Bent Two is comparatively flat. Weathered rock was encountered in both borings at 12.5 to 16.0 feet (elevation 3261.3), and crystalline rock at 13.8 to 17.0 feet (elevation 3260.0). Overlaying these are silty sand roadway embankment, and silty sand and gravel alluvium. A layer of sandy silt saprolite was present at EB2-B.

**Rock Properties**

The rocks underlying this project area are a greenish-gray chlorite schist. These are probably part of the unit labeled Zgms on the Geologic Map of North Carolina (1985). These rocks display a schistosity that ranges from flat (or planar) to highly folded. Shear zones are also present with slickensides. For the most part, these rocks are hard and fresh. An exception occurs in the rubble zone between 9.9 feet (elevation 3267.4) and 16.7 feet (elevation 3260.6) in EB1-B. The Recoveries for the three core borings ranged from 50 to 100 percent (86 percent average). The RQD's were from 20 to 100 percent (67 percent average).

**Groundwater**

Static groundwater levels were measured in three of the four borings. These elevations ranged from 3264.7 to 3267.1.

**Comments**

This subsurface investigation was based upon the Preliminary General Drawing dated December 2006 and the Bridge Survey and Hydraulic Design Report dated November 2006. If any significant changes are made in the design or location of the proposed structure, the subsurface information will have to be reviewed and modified as necessary.

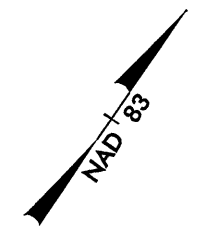
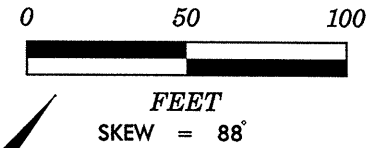
Respectfully Submitted,

Charles A. Dunnagan, LG  
Project Geological Engineer

8/17/99

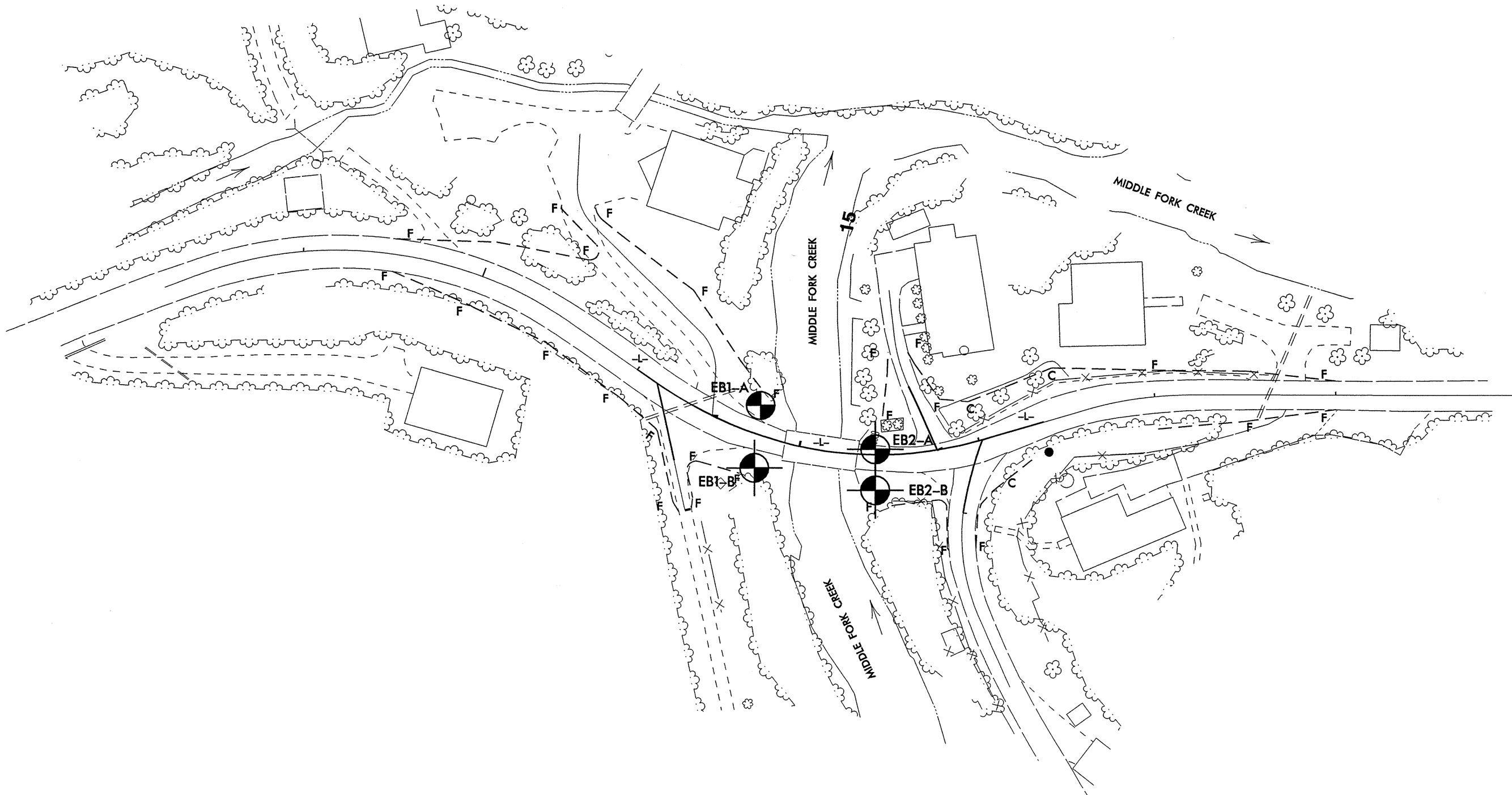
PROJECT REFERENCE NO. B-4317	SHEET NO. 4/15
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# BRIDGE NO.16 ON SR-1541 OVER MIDDLE FORK CREEK



REVISIONS

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14+00

15+00

16+00





**NCDOT GEOTECHNICAL ENGINEERING UNIT**  
**BORELOG REPORT**

SHEET

6/13

PROJECT NO. 33654.1.1		ID. B-4317		COUNTY Watauga		GEOLOGIST Daniel, T. B.									
SITE DESCRIPTION Bridge No. 16 on SR-1541 over Middle Fork Creek							GROUND WTR (ft)								
BORING NO. EB1-A		STATION 14+73		OFFSET 16 ft LT		ALIGNMENT -L-									
COLLAR ELEV. 3,276.2 ft		TOTAL DEPTH 24.7 ft		NORTHING 895,656		EASTING 1,216,917									
DRILL MACHINE CME-550		DRILL METHOD NW Casing w/ SPT				HAMMER TYPE Automatic									
START DATE 03/20/07		COMP. DATE 03/20/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 24.6 ft									
ELEV. (ft)	ELEV. 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						
3280														GROUND SURFACE	0.0
3275	3,273.0	3	2	1									W	ROADWAY EMBANKMENT Brown silty sand with gravel.	4.0
3270	3,268.0	0	0	0									W	ALLUVIAL Brown silty sand and gravel.	
3265	3,263.0	11	19	14									Sat.		
3260	3,258.0	8	6	5									SS-2	SAPROLITE Tan-gray sandy silt.	16.7
3255	3,253.0	25	75/1											WEATHERED ROCK Weathered rock of schist.	23.2
3250	3,251.5	60/02												CRYSTALLINE ROCK Schist	24.6
	24.7													Schist	24.7
														Boring Terminated with Standard Penetration Test Refusal at Elevation 3,251.5 ft in crystalline rock (schist)	

NCDOT BORE SINGLE GINT\_BORELOGS.GPJ NC\_DOT.GDT 04/02/07



PROJECT NO. 33654.1.1		ID. B-4317		COUNTY Watauga		GEOLOGIST Daniel, T. B.								
SITE DESCRIPTION Bridge No. 16 on SR-1541 over Middle Fork Creek							GROUND WTR (ft)							
BORING NO. EB1-B		STATION 14+79		OFFSET 18 ft RT		ALIGNMENT -L-								
COLLAR ELEV. 3,277.3 ft		TOTAL DEPTH 26.8 ft		NORTHING 895,625		EASTING 1,216,934								
DRILL MACHINE CME-550		DRILL METHOD NW Casing w/ Core			HAMMER TYPE Automatic									
START DATE 03/19/07		COMP. DATE 03/19/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 3.3 ft								
ELEV. (ft)	ELEV. DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT				SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
		0.5ft	0.5ft	0.5ft	0	25	50	75					100	
3280												3,277.3	GROUND SURFACE	0.0
3275												3,274.0	ROADWAY EMBANKMENT silty sand with boulder.	3.3
3270													CRYSTALLINE ROCK Schist	
3265														
3260														
3255														
3250												3,250.5	Boring Terminated with Standard Penetration Test Refusal at Elevation 3,250.5 ft in crystalline rock (schist)	26.8
3245														
3240														
3235														
3230														
3225														
3220														
3215														
3210														
3205														

**CORE BORING REPORT**

PROJECT: 33654.1.1 I. D. NO: B-4317 BORING NO: EB1-B GEOLOGIST: C A Dunnagan  
 DESCRIPTION: Bridge NO. 16 on SR-1541 over Middle Fork Creek  
 COUNTY: Watauga COLLAR ELEVATION: 3277.3 FT. TOTAL DEPTH: 26.8 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET %	RQD. FEET %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
3274.0	3.3			4.5	4.5		Gray-green chlorite schist. Hard, fresh. Planar to highly folded schistosity. Shear zones with slickensides.
			4.5	100	100		
3269.5	7.8						9.9
3269.5	7.8		5.0	2.5	1.4		
				50	28		Rubble zone with close to very close fracture spacing.
3264.5	12.8						
3264.5	12.8		5.0	2.8	1.0		16.7
				56	20		
3259.5	17.8						Gray-green chlorite schist. Hard, fresh. Planar to highly folded schistosity. Shear zones with slickensides.
3259.5	17.8		5.0	4.7	4.1		
				94	82		
3254.5	22.8						
3254.5	22.8		4.0	3.9	3.1		
				98	78		
3250.5	26.8						

CORING TERMINATED AT  
ELEVATION 3250.5 FT.

DRILLER: C J Coffey CORE SIZE: NXWL EQUIPMENT: CME-550

NCDOT BORE SINGLE GINT\_BORELOGS.GPJ NC\_DOT\_GDT 03/29/07

PROJECT NO. 33654.1.1		ID. B-4317		COUNTY Watauga		GEOLOGIST Daniel, T. B.									
SITE DESCRIPTION Bridge No. 16 on SR-1541 over Middle Fork Creek						GROUND WTR (ft)									
BORING NO. EB2-A		STATION 15+42		OFFSET 3 ft LT		ALIGNMENT -L-									
COLLAR ELEV. 3,276.9 ft		TOTAL DEPTH 27.4 ft		NORTHING 895,672		EASTING 1,216,983									
DRILL MACHINE CME-550		DRILL METHOD NW Casing w/ SPT Core				HAMMER TYPE Automatic									
START DATE 03/20/07		COMP. DATE 03/20/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 17.0 ft									
ELEV. (ft)	ELEV. DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	ELEV. (ft)	DEPTH (ft)	
		0.5ft	0.5ft	0.5ft	0	25	50	75	100						
3280													3,276.9	0.0	GROUND SURFACE
													3,272.9	4.0	ROADWAY EMBANKMENT Brown silty sand.
	3,272.8 4.1	1	1	1											ALLUVIAL Brown silty sand with gravel.
	3,267.8 9.1	2	5	5											ALLUVIAL Gray sand and gravel.
	3,262.8 14.1	9	9	12									3,261.0 3,259.9	15.9 17.0	WEATHERED ROCK Weathered rock of schist. CRYSTALLINE ROCK Schist.
													3,249.5	27.4	Boring Terminated with Standard Penetration Test Refusal at Elevation 3,249.5 ft in crystalline rock (schist)

SHEET 1 OE1

**CORE BORING REPORT**

DATE 28-Mar-07

PROJECT: 33654.1.1 I. D. NO: B-4317 BORING NO: EB2-A GEOLOGIST: C A Dunnagan

DESCRIPTION: Bridge No. 16 on SR-1541 over Middle Fork Creek

COUNTY: Watauga COLLAR ELEVATION: 3276.9 FT. TOTAL DEPTH: 27.4 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET %	RQD. FEET %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
3259.9	17.0		1.4	1.4	0.8		Green-gray chlorite schist with biotite. Very slightly weathered; moderately hard. Planar to highly folded schistosity. Shear zones with slickensides.
				100	57		
3258.5	18.4						
3258.5	18.4		5.0	4.1	2.1		
				82	42		
3253.5	23.4						
3253.5	23.4		4.0	3.9	3.9		
				98	98		
3249.5	27.4						

CORING TERMINATED AT ELEVATION 3249.5 FT.

DRILLER: C J Coffey CORE SIZE: NXWL EQUIPMENT: CME-550



PROJECT NO. 33654.1.1		ID. B-4317		COUNTY Watauga		GEOLOGIST Daniel, T. B.							
SITE DESCRIPTION Bridge No. 16 on SR-1541 over Middle Fork Creek							GROUND WTR (ft)						
BORING NO. EB2-B		STATION 15+43		OFFSET 20 ft RT		ALIGNMENT -L-							
COLLAR ELEV. 3,273.9 ft		TOTAL DEPTH 19.2 ft		NORTHING 895,653		EASTING 1,216,995							
DRILL MACHINE CME-550		DRILL METHOD NW Casing w/ SPT Core				HAMMER TYPE Automatic							
START DATE 03/20/07		COMP. DATE 03/20/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 13.8 ft							
ELEV. (ft)	ELEV. 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				
3275													3,273.9 GROUND SURFACE 0.0
													3,272.4 ROADWAY EMBANKMENT 1.5
	3,269.0	4	4	5									Brown silty sand.
	4.9												ALLUVIAL Gray sand and gravel.
3270													
	3,264.0	7	13	18									3,262.9 11.0
	9.9												3,261.5 12.4
3265													SAPROLITE Gray sandy silt.
													3,260.1 13.8
3260													WEATHERED ROCK Weathered rock of schist.
													CRYSTALLINE ROCK Schist.
3255													3,254.7 19.2
													Boring Terminated with Standard Penetration Test Refusal at Elevation 3,254.7 ft in crystalline rock (schist)

SHEET 1 OE1

DATE 28-Mar-07

**CORE BORING REPORT**

PROJECT: 33654.1.1 I. D. NO: B-4317 BORING NO: EB2-B GEOLOGIST: C A Dunnagan  
 DESCRIPTION: Bridge No. 16 on SR-1541 over Middle Fork Creek  
 COUNTY: Watauga COLLAR ELEVATION: 3273.9 FT. TOTAL DEPTH: 19.2 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET %	RQD. FEET %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
3260.1	13.8		5.4	5.2	5.2		Light green-gray chlorite schist with calcite. Hard, fresh.
3254.7	19.2			96	96		

CORING TERMINATED AT ELEVATION 3254.7 FT.

DRILLER: C J Coffey CORE SIZE: NXWL EQUIPMENT: CME-550

NCDOT BORE SINGLE GINT\_BORELOGS.GPJ NC\_DOT\_GDT 03/29/07



**FIELD  
 SCOUR REPORT**

WBS: 33654.1.1 TIP: B-4317 COUNTY: Watauga

DESCRIPTION(1): Bridge No.16 on SR-1541 over Middle Fork Creek

**EXISTING BRIDGE**

Information from: Field Inspection  Microfilm \_\_\_\_\_ (reel \_\_\_\_\_ pos: \_\_\_\_\_)  
 Other (explain) \_\_\_\_\_

Bridge No.: 16 Length: 40ft Total Bents: 2 Bents in Channel: 0 Bents in Floodplain: 2  
 Foundation Type: Footing

**EVIDENCE OF SCOUR(2)**

Abutments or End Bent Slopes: None noted.

Interior Bents: N/A

Channel Bed: None noted.

Channel Bank: Minor amount immediately upstream of EB1-B.

**EXISTING SCOUR PROTECTION**

Type(3): Concrete walls both end-bents. Boulder rip-rap either side at EB1. Concrete wingwalls EB2.

Extent(4): Rip-rap: 10ft to 15 ft either side of wall; wingwalls 10ft either side.

Effectiveness(5): Fair to good.

Obstructions(6): Concrete slabs (2ft X 3ft) in/on bank 5ft to 30ft upstream of EB1-B.

**INSTRUCTIONS**

- 1 Describe the specific site's location, including route number and body of water crossed.
- 2 Note scour evidence at existing end bents or abutments (e.g. undermining, sloughing, degradations).
- 3 Note existing scour protection (e.g. rip rap).
- 4 Describe extent of existing scour protection.
- 5 Describe whether or not the scour protection appears to be working.
- 6 Note obstructions such as dams, fallen trees, debris at bents, etc.
- 7 Describe the channel bed material based on observation and/or samples. Include any lab results with report.
- 8 Describe the channel bank material based on observation and/or samples. Include any lab results with report.
- 9 Describe the material covering the banks (e.g. grass, trees, rip rap, none).
- 10 Determine the approximate floodplain width from field observation or a topographic map.
- 11 Describe the material covering the floodplain (e.g. grass, trees, crops).
- 12 Use professional judgement to specify if the stream is degrading, aggrading, or static.
- 13 Describe potential and direction of the stream to migrate laterally during the bridge's life (approx. 100 years).
- 14 Give the design scour elevation (DSE) expected over the life of the bridge (approx. 100 years). This elevation can be given as a range across the site, or for each bent. Discuss the relationship between the Hydraulics Unit theoretical scour and the DSE. If the DSE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The DSE is based on the erodability of materials, giving consideration to the influence of joints, foliation, bedding characteristics, % core recovery, % RQD, differential weathering, shear strength, observations at existing structures, other tests deemed appropriate, and overall geologic conditions at the site.

**DESIGN INFORMATION**

Channel Bed Material(7): Sand, gravel and cobbles with boulders.

Channel Bank Material(8): Silty sand.

Channel Bank Cover(9): Grass with trees.

Floodplain Width(10): End Bent One: 0ft. EB2-A: 100ft, EB2-B: 20ft.

Floodplain Cover(11): Grass with trees.

Stream is(12): Aggrading \_\_\_\_\_ Degrading  Static \_\_\_\_\_

Channel Migration Tendency(13): Southwest.

Observations and Other Comments: Concrete wingwalls at End Bent One were removed and replaced with the aforementioned rip-rap.

**DESIGN SCOUR ELEVATIONS(14)**

Feet  Meters \_\_\_\_\_

**BENTS**

		EB2-A	EB2-B						
		3260.2	3260.1						

Comparison of DSE to Hydraulics Unit theoretical scour:  
 The GASE for End Bent Two is approximately 10.0ft above Hydraulics Unit.  
 Theoretical scour does not affect End Bent One, therefore no calculations were performed.

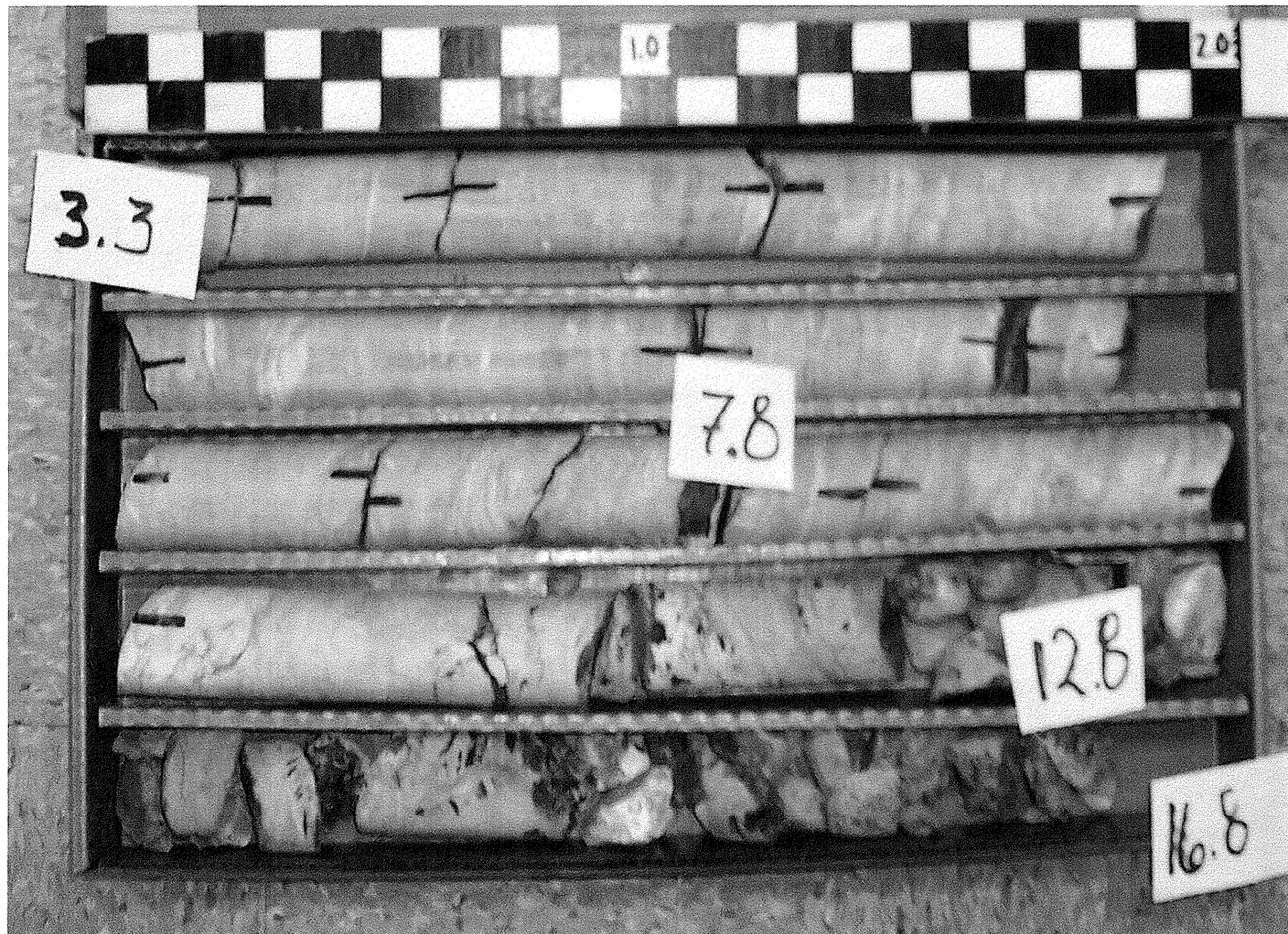
**SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL**

Bed or Bank							
Sample No.							
Retained #4							
Passed #10							
Passed #40							
Passed #200							
Coarse Sand							
Fine Sand							
Silt							
Clay							
LL							
PI							
AASHTO							
Station							
Offset							
Depth							

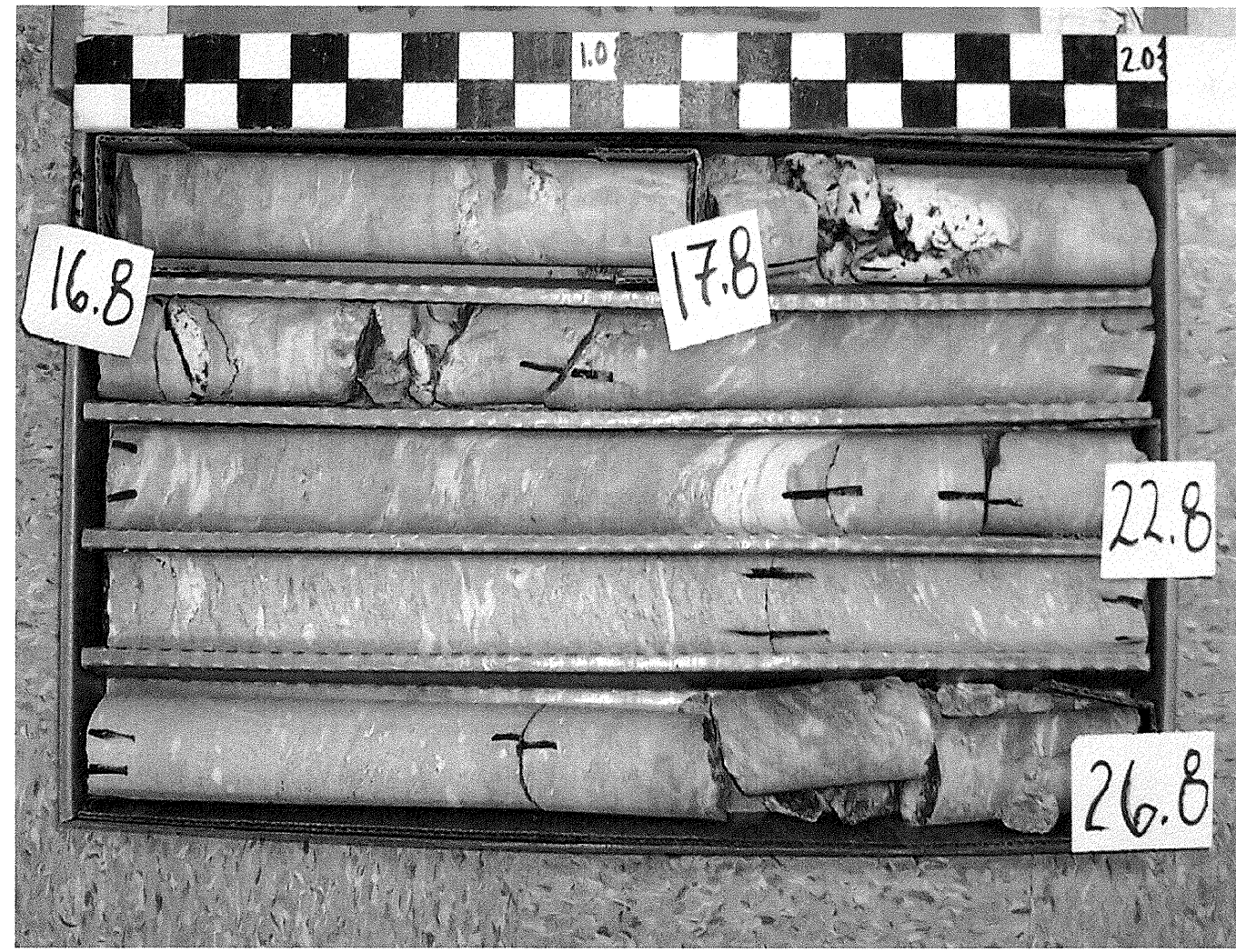
Template Revised 02/07/06

Reported by: *C. A. Dunnagan*  
 C. A. Dunnagan

Date: 3/26/2007



33654.1.1 B-4317  
 Bridge No. 16 on SR-1541 over  
 Middle Fork Creek.  
 EB1-B  
 Box 1 of 2



33654.1.1 B-4317  
 Bridge No. 16 on SR-1541 over  
 Middle Fork Creek.  
 EB1-B  
 Box 2 of 2



33645.1.1 B-4317  
Bridge No. 16 on SR-1541  
Over Middle Fork Creek.  
EB2-A  
Box 1 of 1



33654.1.1 B-4317  
Bridge No. 16 on SR-1541 over  
Middle Fork Creek.  
EB2-B  
Box 1 of 1