STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4318	1	31
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
33655.1.1	BRZ-1598(1)	P.E.	
		CONST.	

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

STRUCTURE SUBSURFACE INVESTIGATION

STATE PROJECT 33655.1.1 I.D. NO. B-4318

F.A. PROJECT BRZ-1598(1)

COUNTY WATAUGA

PROJECT DESCRIPTION BRIDGE No. 321 OVER WATAUGA RIVER ON S. R. 1598 (GRANDFATHER RD.)

SITE DESCRIPTION

PROJECT: 33655.1.1 ID: B-4318

CONTENTS:

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS 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 UNIT @ (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA IS 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.

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For Letting

INVESTIGATED BY D.M. Gragg PERSONNEL D. Chittenden

CHECKED BY S.P. Washer R. Grady

SUBMITTED BY S.P. Washer D. Kofron

DATE 10-11-05

DRAWN BY: W. Shuecraft

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.

NORTH CAROLINA PROFESSIONAL SEAL 19378 ENGINEER SHAWN P. WASHER

SEAL

SIGNATURE

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
B-4318	33655.1.1	2	31

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

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

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

SOIL LEGEND AND AASHTO CLASSIFICATION

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

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

CONSISTENCY OR DENSENESS

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

TEXTURE OR GRAIN SIZE

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

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

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

SOIL MOISTURE - CORRELATION OF TERMS

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

PLASTICITY

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

COLOR

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

GRADATION

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

ANGULARITY OF GRAINS

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

MINERALOGICAL COMPOSITION

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

COMPRESSIBILITY

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

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT- CLAY SOILS	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

GROUND WATER

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

MISCELLANEOUS SYMBOLS

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

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

ABBREVIATIONS

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

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- ☐ MOBILE B-___
- ☐ BK-51
- ☒ CME-45
- ☐ CME-550
- ☐ PORTABLE HOIST
- ☐ OTHER _____
- ☐ OTHER _____

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
- ☐ OTHER _____

HAMMER TYPE:
- ☒ AUTOMATIC ☐ MANUAL

CORE SIZE:
- ☐ -B_____
- ☒ -N 02
- ☐ -H_____

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

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLOWS:

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

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V. SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCKS EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

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

FRACTURE SPACING

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

BEDDING

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

INDURATION

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

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

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS WHICH HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.

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

CALCAREOUS (CALC.) - SOILS WHICH CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (F.P.) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (R.Q.D.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL WHICH RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR B.P.F.) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS LESS THAN 0.1 FOOT PENETRATION WITH 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

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

BENCH MARK: BL-5 Nail set in pavement
-L- sta. 16+22.11 60.83' right.
ELEVATION: 3,527.67

NOTES:

SOIL SYMBOL → WEATHERED ROCK BOULDERS, COBBLES AND GRAVEL IN SOIL; CRYSTALLINE ROCK WITH SOIL; NON-CRYSTALLINE ROCK WITH SOIL } ALLUVIUM / COLLUVIUM BOULDERS

REVISED 09/15/00

Florence & Hutcheson, Inc. • Consulting Engineers

October 11, 2005

Mr. Don Moore
Consultant Coordinator
North Carolina Department of Transportation
Geotechnical Unit
P.O. Box 25201
Raleigh NC 27611

Re: Structure Foundation Investigation Report
Bridge No. 321 over the Watauga River on SR 1598 (Grandfather Road)
Watauga County, North Carolina
Project No. 33655.1.1
ID B-4318

Project Description:

The subsurface investigation for the referenced project has been completed and compiled into this geotechnical package. This report reflects comments as provided by your office. The purpose of this exploration was to investigate the subsurface conditions with drilling, sampling, laboratory testing and engineering analysis. Field and laboratory procedures were performed in accordance with applicable ASTM and AASHTO specifications and NCDOT methods for geotechnical engineering and design.

The project site is located on SR 1598 (Grandfather Road) approximately 10 miles southwest of Boone NC, near the Avery and Watauga County line. SR 1598 will be slightly re-aligned to accommodate a new three-span bridge over the Watauga River at this location. This new structure will have a width of 25', a length of 125' and a skew angle of 90° with -L-. Fill depths at the abutments range from 8 to 15 feet. Abutment slopes of 1.5H:1V shall be covered with Class II Rip-Rap erosion protection. Earthwork is not proposed at the interior bents.

The field investigation was conducted between August 25 and August 30. Eight test borings were advanced using a track-mounted CME 45C drill rig with NW casing. Upon termination of casing advancement, the underlying material was cored in each boring, utilizing Longyear NQ2 wireline coring equipment with diamond impregnated bits and water from the Watauga River. Borings were surveyed and staked by NCDOT personnel, with F&H surveyors providing additional field data.

The collected soil and rock samples were visually described in the field, visually grouped into strata units and then described on the field logs. Laboratory testing consisted of liquid limit, plastic limit, rock unconfined compression, sieve and hydrometer grain size analysis. A representative sample of the material from the channel bed and bank was also subjected to laboratory analysis. Rock core data including identified and described rock type, Core Recovery (REC) and Rock Quality Designation (RQD) were determined for each core run interval, as well as Strata Recovery and Strata Rock Quality Designation (SREC and SRQD) for each discrete rock unit. Rock core specimens were selected for laboratory testing of unconfined compressive strength.

P.O. Box 7267 • Paducah, Kentucky 42002-7267 • 2550 Irvin Cobb Drive • Paducah, Kentucky 42003 • (270) 444-9691 • fax (270) 443-3943

Geology:

The project site is located within the Grandfather Mountain window, a feature resulting from the erosion of overlying thrust sheets. Lithic units exposed are assigned to the Grandfather Mountain Formation. Typically materials are Late Proterozoic metasedimentary and metavolcanic sequences reported to be found only within the Grandfather Mountain window. The Grandfather Mountain window is surrounded by gneiss and granitic gneiss of the Tablerock and Blue Ridge thrust sheets.

Rock coring operations conducted at the bridge site intercepted alluvial, colluvial and residual origin materials. Alluvial materials consist of cobbles, gravel, sand and clay deposited in irregular thickness across the site. Boulders are noted within alluvium units and exposed at the surface but likely were deposited from up slope through gravity movement. Colluvium units consist of boulders and cobbles with finer gradation materials infilling between the boulders and cobbles. Residual units consist of mudstone and meta-siltstone underlying the colluvium materials. Advanced borings were terminated in mudstone or meta-siltstone at elevations ranging from 3493.4 feet to 3483.6 feet, although the inferred rock line is interpreted to range from 3504.0 feet to 3491.4 feet beneath the proposed structure. All intercepted units exhibit weathering characteristics ranging from fresh to complete.

The topography surrounding the site is dominated by Grandfather Mountain to the south. Topographic contours suggest the presence of a slide or gravity deposit underlying the site. River and creek channels are deeply incised and narrow. In-situ rock outcrops were not noted at the site as all surface materials are interpreted to be alluvium or colluvium.

Discussion of Subsurface Conditions:

Three predominant material types, based upon response to standard penetration testing, observation, review of rock core samples, and laboratory testing were identified within the borings: alluvium, colluvium and bedrock. The alluvial materials were composed of silts, gravels and silty gravels as well as a variety of cobbles. Standard penetration testing produced "N" values ranging from 40 to 100+ blows per foot throughout the proposed site. Samples of the colluvium material primarily consisted of boulders, cobbles, gravel, sand and clay infill, as well as intervals of competent rock (boulders) and weathered rock. Samples of recovered bedrock indicate a wide range of weathering characteristics from moderate to completely weathered. Rock unconfined compression testing on rock core specimens indicate strengths ranging from 617 psi to 2225 psi for mudstone/meta-siltstone and 13,923 psi for a meta-arkose boulder.

Rock recovered from coring operations consisted of meta-arkose, meta-sandstone and diabase in sizes ranging from boulders to clay and residual mudstone and meta-siltstone with intervals of complete weathering (soil). Fracture spacing, relevant only in the residual mudstone and meta-siltstone, ranges from close to very close. Iron oxide staining was noted in some of the alluvium and colluvium deposits and throughout the residual rock. Traces of pyrite were noted within the mudstone and meta-siltstone units.

Groundwater:

Immediately following drilling operations, groundwater measurements were recorded in each boring, with all readings indicating the absence of groundwater. Static groundwater levels (24 hour) were not permitted in borings along End Bent 1 and Bent 1 due to the presence of livestock, as these 4 borings were backfilled immediately upon completion. Static levels in borings B2-A, B2-B, EB2-A and EB2-B indicate groundwater ranging from Elevation 3510.1' to 3509.3'. This groundwater elevation is approximately equivalent to the Watauga River level.

Scour:

A field scour report was conducted on the existing Bridge No. 321 over the Watauga River on SR 1598 as part of this project. The scour investigation was performed during the field investigation and is included in this report.

Notes to Designer:

Documented potentially unstable materials (colluvium) and severely to completely weathered intervals were encountered in the rock core samples. The colluvium consisted of large boulders (12"+) to gravels (0.75") with a soil matrix in part.

Closure:

This geotechnical investigation is based upon the Preliminary General Drawing dated April 5, 2005. Changes to this design may require alteration and modification to the information discussed in this report. It should be noted that the presentations and discussions in this report are generalized interpretations of available information. Soil and rock descriptions and indicated boundaries are based on engineering interpretation of available subsurface information obtained at selected locations and may not necessarily reflect the actual variations in subsurface conditions between borings and samples.

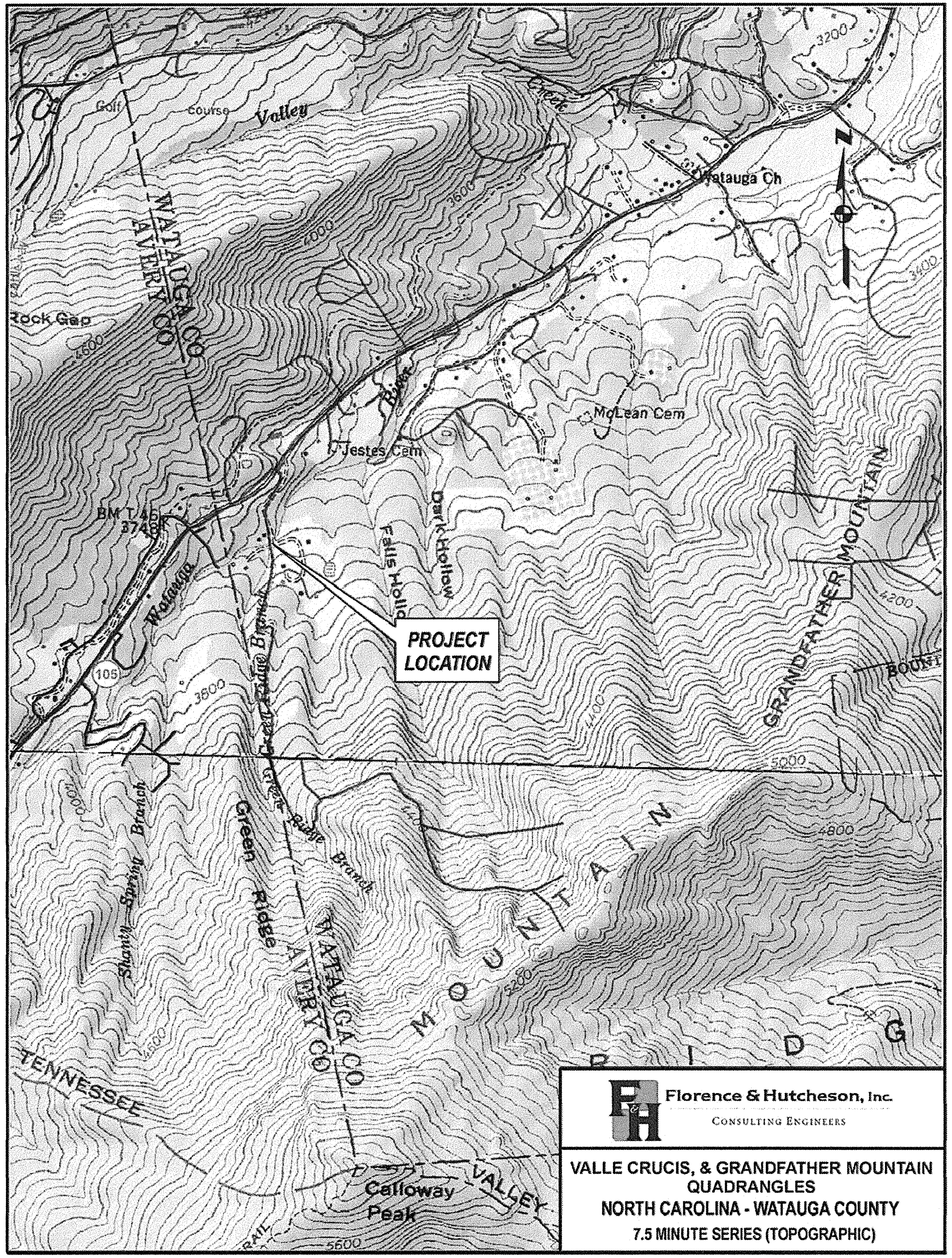
Thank you for the opportunity to provide geotechnical engineering services. Please contact our office if you have questions or comments.

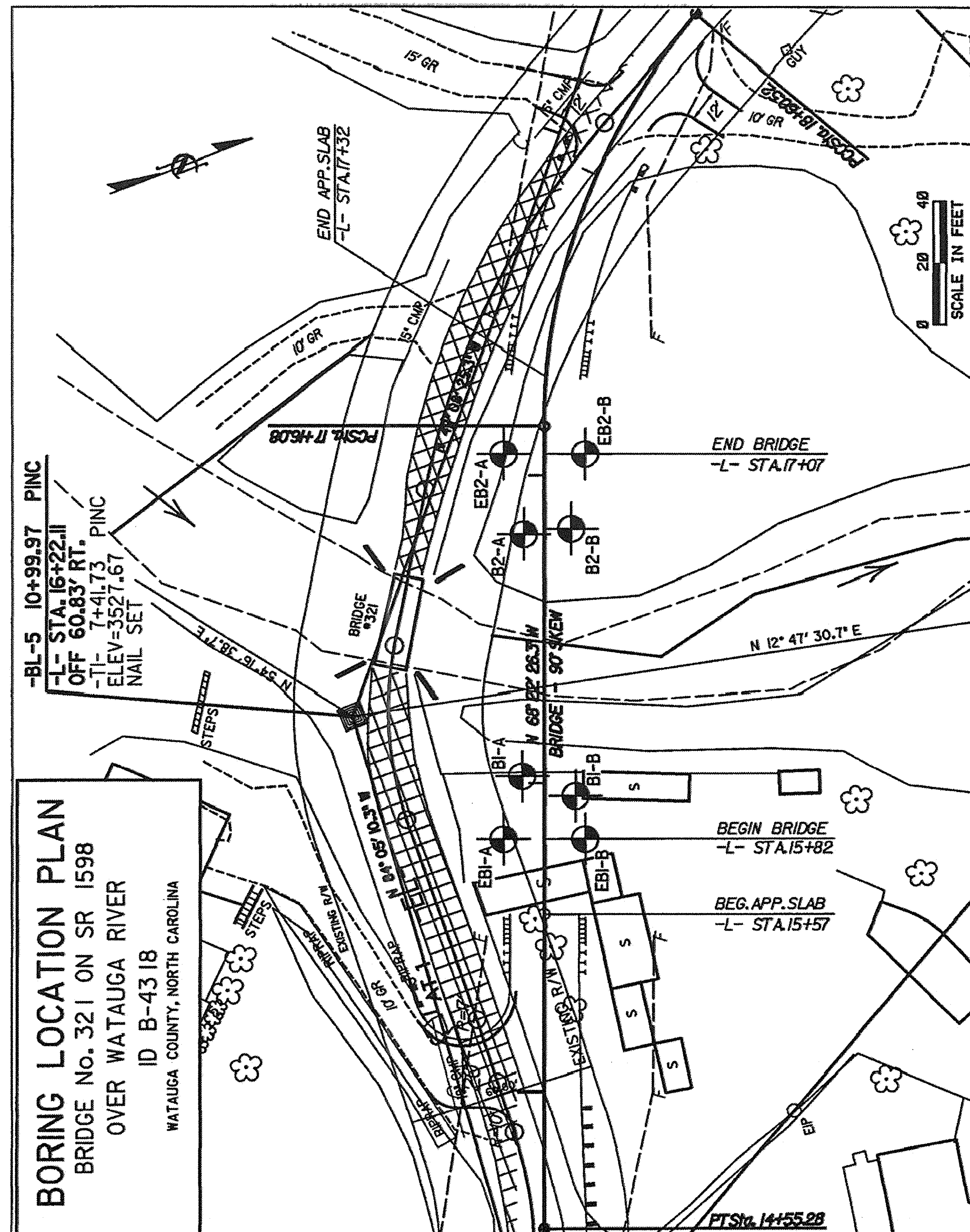
Respectfully,

FLORENCE & HUTCHESON, INC.

Shawn P. Washer, P.E.
Vice President

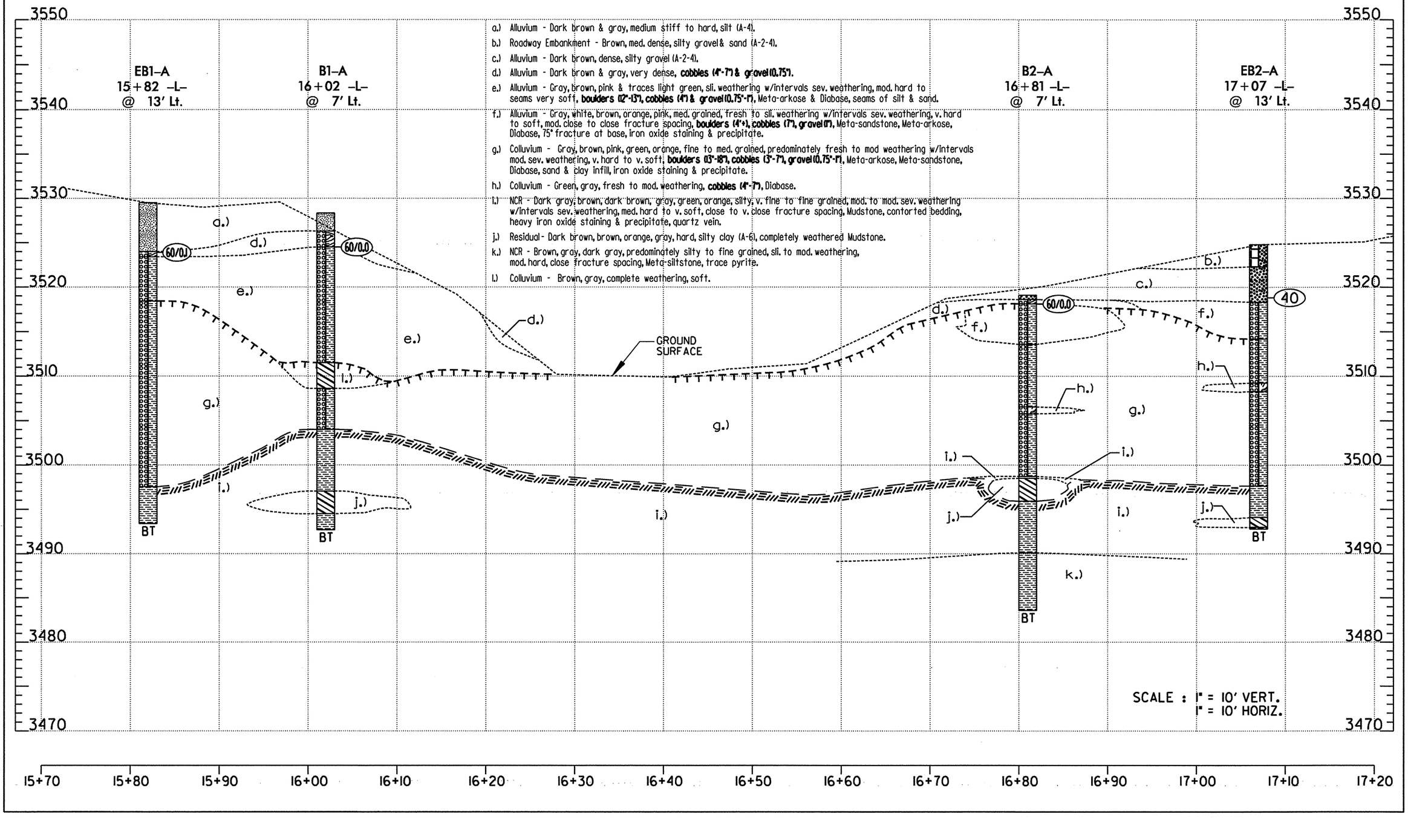
D. Michael Gragg, P.G.
Project Geologist


Golf Course
Valley
Creek
Watauga Ch
WATAUGA CO
AVERY CO
Rock Gap
McLean Cem
Jestes Cem
Dark Hollow
Falls Hollow
BM T 46
3748
Watauga
105
PROJECT LOCATION
GRANDFATHER MOUNTAIN
Green Ridge
Green Ridge Branch
Shanty Spring Branch
MOUNTAIN
TENNESSEE
VALLEY
Calloway Peak
Florence & Hutcheson, Inc.
CONSULTING ENGINEERS
VALLE CRUCIS, & GRANDFATHER MOUNTAIN QUADRANGLES
NORTH CAROLINA - WATAUGA COUNTY
7.5 MINUTE SERIES (TOPOGRAPHIC)


BORING LOCATION PLAN
BRIDGE No. 321 ON SR 1598
OVER WATAUGA RIVER
ID B-4318
WATAUGA COUNTY, NORTH CAROLINA
-BL-5 10+99.97 PINC
-L- STA. 16+22.11
OFF 60.83' RT.
-TI- 7+41.73 PINC
ELEV=3527.67
NAIL SET
END APP. SLAB
-L- STA.17+32
END BRIDGE
-L- STA.17+07
BEGIN BRIDGE
-L- STA.15+82
BEG. APP. SLAB
-L- STA.15+57
PCSta. 17+16.08
PCSta. 18+80.52
PTSta. 14+55.28
EB2-A
EB2-B
B2-A
B2-B
EB1-A
EB1-B
B1-A
B1-B
BRIDGE #321
BRIDGE - 90° SKEW
N 68° 22' 26.5" W
N 84° 05' 10.3" W
N 12° 47' 30.7" E
N 54° 16' 38.7" E
15' GR
10' GR
12' GR
15' CMP
STEPS
EXISTING R/W
RIP RAP
GUY
EIP
SCALE IN FEET
0 20 40

ID
B-4318

GENERALIZED SUBSURFACE PROFILE 13' Lt. of –L–



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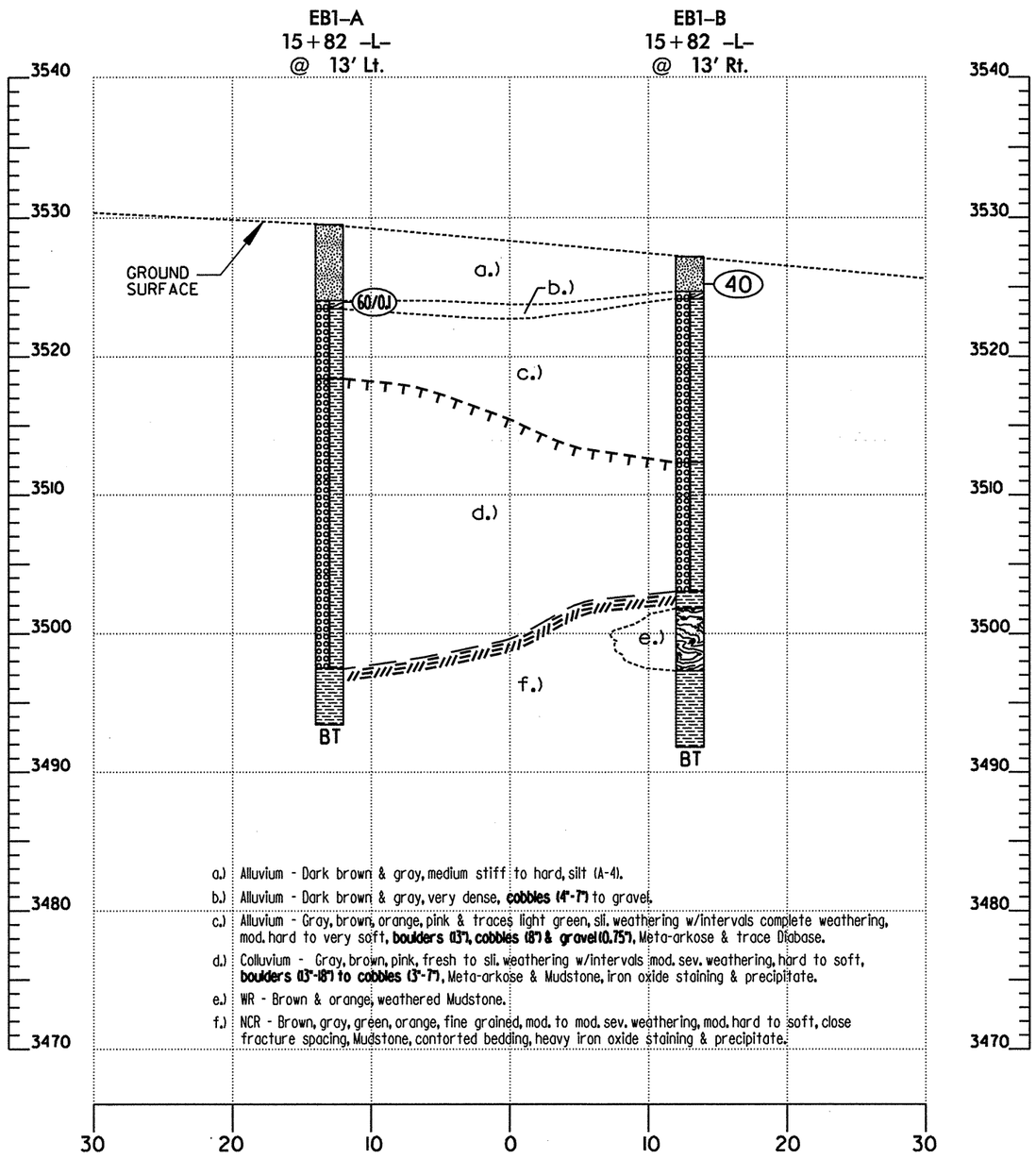
B-4318



a.) Alluvium - Dark brown & gray, medium stiff to hard, silt (A-4).

b.) Alluvium - Dark brown & gray, very dense, **cobbles (4"-7")** to gravel.

c.) Alluvium - Gray, brown, orange, pink & traces light green, sli. weathering w/intervals complete weathering, mod. hard to very soft, **boulders (3"), cobbles (8") & gravel (0.75")**, Meta-arkose & trace Diabase.

d.) Colluvium - Gray, brown, pink, fresh to sli. weathering w/intervals mod. sev. weathering, hard to soft, **boulders (13"-18") to cobbles (3"-7")**, Meta-arkose & Mudstone, iron oxide staining & precipitate.

e.) WR - Brown & orange, weathered Mudstone.

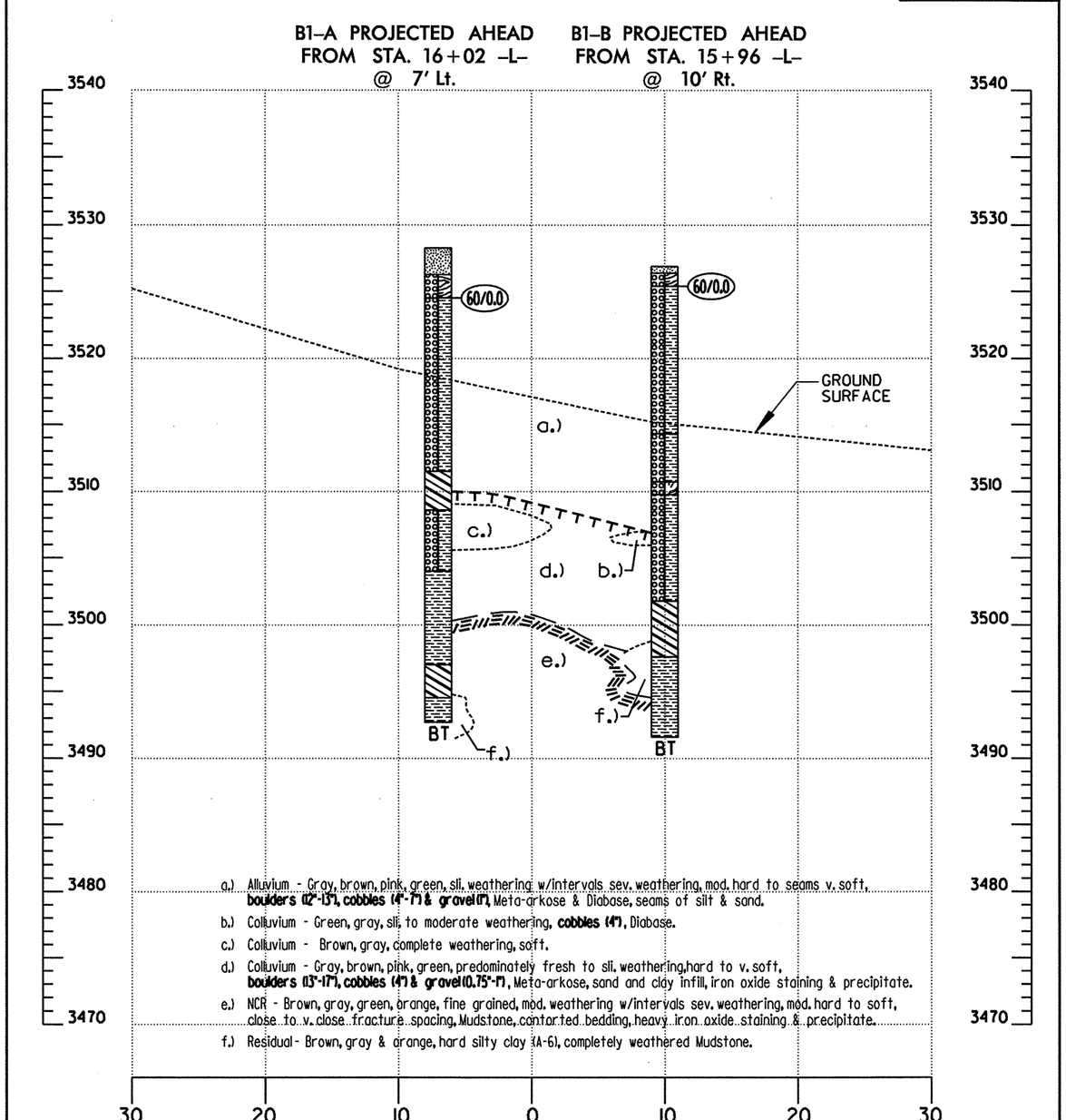
f.) NCR - Brown, gray, green, orange, fine grained, mod. to mod. sev. weathering, mod. hard to soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining & precipitate.

CROSS SECTION @ END BENT 1

0 10 20 — VERTICAL SCALE IN FEET

0 10 20 — HORIZONTAL SCALE IN FEET

ID
B-4318



a.) Alluvium - Gray, brown, pink, green, sli. weathering w/intervals sev. weathering, mod. hard to seams v. soft, **boulders (12"-13"), cobbles (4"-7") & gravel (1")**, Meta-arkose & Diabase, seams of silt & sand.

b.) Colluvium - Green, gray, sli. to moderate weathering, **cobbles (4")**, Diabase.

c.) Colluvium - Brown, gray, complete weathering, soft.

d.) Colluvium - Gray, brown, pink, green, predominately fresh to sli. weathering, hard to v. soft, **boulders (13"-17"), cobbles (4") & gravel (0.75"-1")**, Meta-arkose, sand and clay infill, iron oxide staining & precipitate.

e.) NCR - Brown, gray, green, orange, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to soft, close to v. close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining & precipitate.

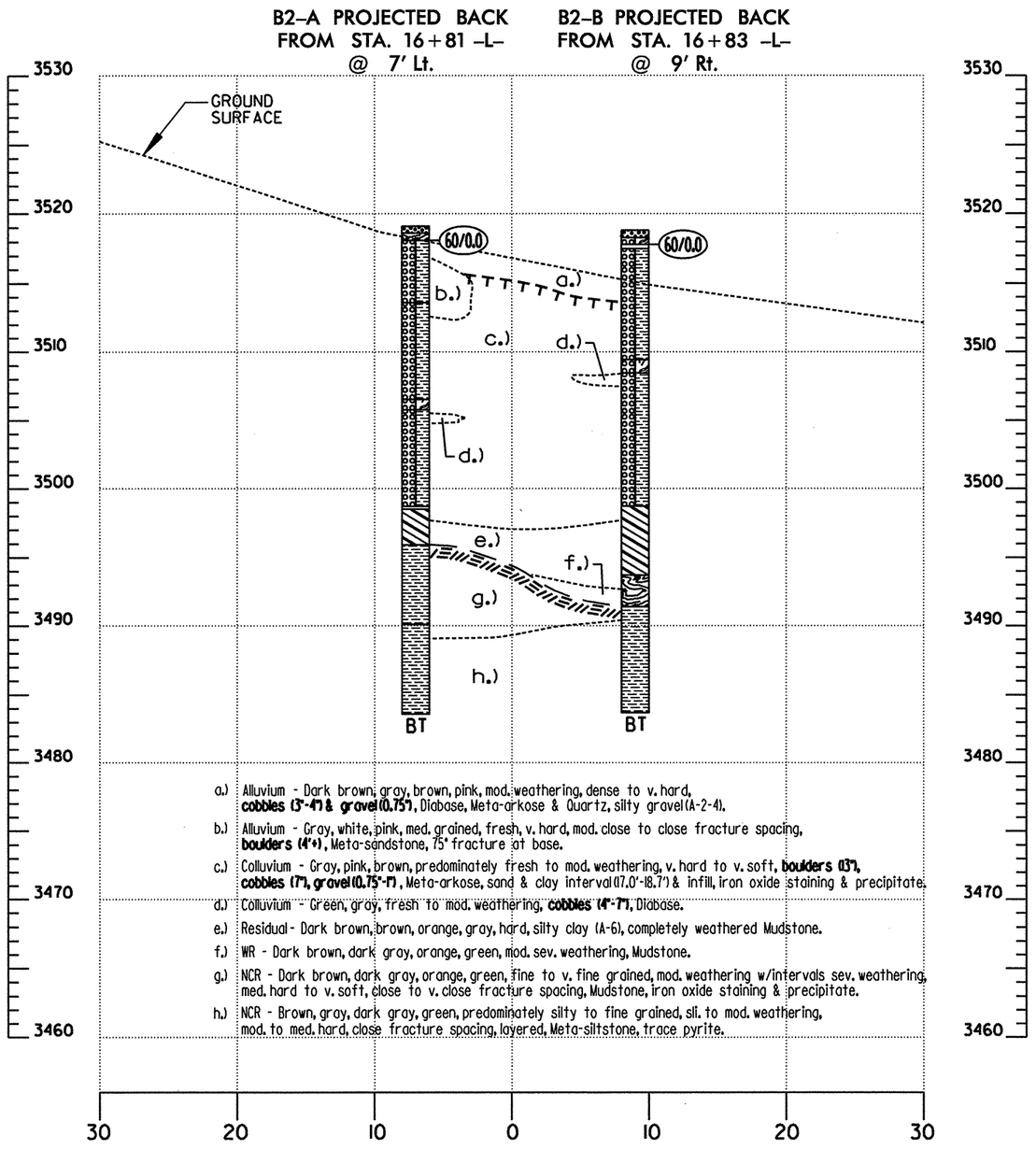
f.) Residual - Brown, gray & orange, hard silty clay (A-6), completely weathered Mudstone.

CROSS SECTION @ BENT 1

0 10 20 — VERTICAL SCALE IN FEET

0 10 20 — HORIZONTAL SCALE IN FEET

ID
B-4318



a.) Alluvium - Dark brown, gray, brown, pink, mod. weathering, dense to v. hard, **cobbles (3"-4") & gravel (0.75")**, Diabase, Meta-arkose & Quartz, silty gravel (A-2-4).

b.) Alluvium - Gray, white, pink, med. grained, fresh, v. hard, mod. close to close fracture spacing, **boulders (4'+)**, Meta-sandstone, 75° fracture at base.

c.) Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to v. soft, **boulders (3')**, **cobbles (7"), gravel (0.75'-1')**, Meta-arkose, sand & clay interval (17.0'-18.7') & infill, iron oxide staining & precipitate.

d.) Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4"-7")**, Diabase.

e.) Residual - Dark brown, brown, orange, gray, hard, silty clay (A-6), completely weathered Mudstone.

f.) WR - Dark brown, dark gray, orange, green, mod. sev. weathering, Mudstone.

g.) NCR - Dark brown, dark gray, orange, green, fine to v. fine grained, mod. weathering w/intervals sev. weathering, med. hard to v. soft, close to v. close fracture spacing, Mudstone, iron oxide staining & precipitate.

h.) NCR - Brown, gray, dark gray, green, predominately silty to fine grained, sli. to mod. weathering, mod. to med. hard, close fracture spacing, layered, Meta-siltstone, trace pyrite.

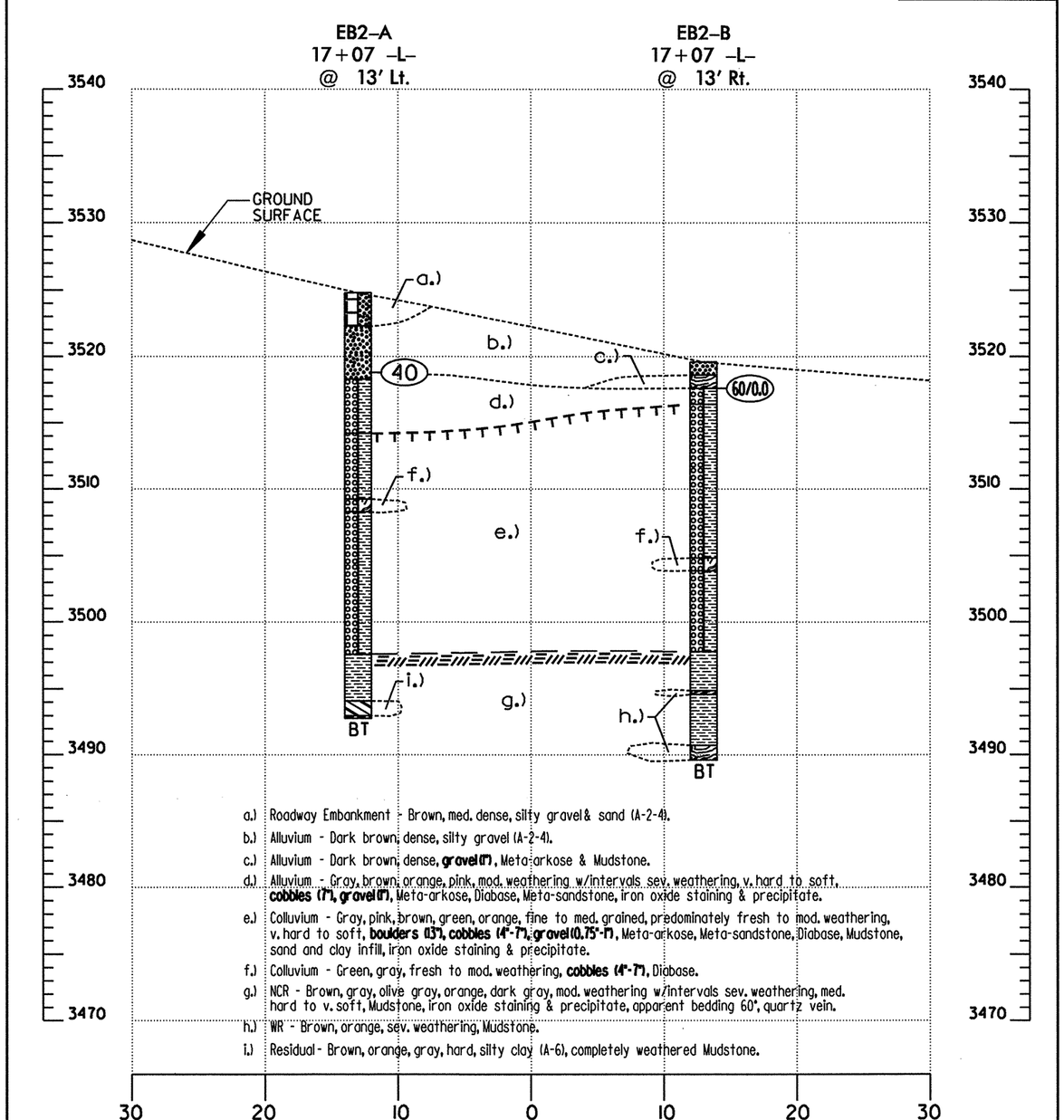
30 20 10 0 10 20 30

CROSS SECTION @ BENT 2

0 10 20 0 10 20

VERTICAL SCALE IN FEET HORIZONTAL SCALE IN FEET

ID
B-4318



a.) Roadway Embankment - Brown, med. dense, silty gravel & sand (A-2-4).

b.) Alluvium - Dark brown, dense, silty gravel (A-2-4).

c.) Alluvium - Dark brown, dense, **gravel (1")**, Meta-arkose & Mudstone.

d.) Alluvium - Gray, brown, orange, pink, mod. weathering w/intervals sev. weathering, v. hard to soft, **cobbles (1"), gravel (1")**, Meta-arkose, Diabase, Meta-sandstone, iron oxide staining & precipitate.

e.) Colluvium - Gray, pink, brown, green, orange, fine to med. grained, predominately fresh to mod. weathering, v. hard to soft, **boulders (3'), cobbles (4"-7"), gravel (0.75'-1')**, Meta-arkose, Meta-sandstone, Diabase, Mudstone, sand and clay infill, iron oxide staining & precipitate.

f.) Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4"-7")**, Diabase.

g.) NCR - Brown, gray, olive gray, orange, dark gray, mod. weathering w/intervals sev. weathering, med. hard to v. soft, Mudstone, iron oxide staining & precipitate, apparent bedding 60°, quartz vein.

h.) WR - Brown, orange, sev. weathering, Mudstone.

i.) Residual - Brown, orange, gray, hard, silty clay (A-6), completely weathered Mudstone.

30 20 10 0 10 20 30

CROSS SECTION @ END BENT 2

0 10 20 0 10 20

VERTICAL SCALE IN FEET HORIZONTAL SCALE IN FEET

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. EB1-A	**BORING LOCATION** 15+82	**OFFSET** 13ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,529.5 ft	**NORTHING** 878,950	**EASTING** 1,168,804		**24 HR.** N/A
TOTAL DEPTH 36.1 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic
DATE STARTED 8/27/05	**COMPLETED** 8/27/05	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,529.5					Topsoil				3,529.5 — 0.00
									Alluvium - Dark brown & gray, medium stiff, silt (A-4).
3,524.5	5.0								3,524.0 — 5.5
		4	60/0.1		60/0.1	SS-5	M		3,523.4 — 6.1 Alluvium - Dark brown & gray, very dense, **cobbles (7")** to gravel. Begin coring at elev. 3,523.4.
									3,518.4 — 11.1 Alluvium - Gray, brown, pink & traces light green, sli. weathering, mod. hard, **boulders (13") to gravel (0.75")**, Meta-arkose & trace Diabase.
									Colluvium - Gray, brown, pink, sli. weathering w/intervals mod. sev. weathering, hard, **boulders (18") to cobbles (3")**, Meta-arkose & Mudstone, iron oxide staining and precipitate.
						RS-4			3,497.5 — 32.0 NCR - Brown, gray, green, orange, fine grained, mod. sev. weathering, soft, close fracture, Mudstone, contorted bedding, heavy iron oxide.
									3,493.4 — 36.1 Boring Terminated at Elevation 3,493.4 ft in Mudstone

NCDOT BORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

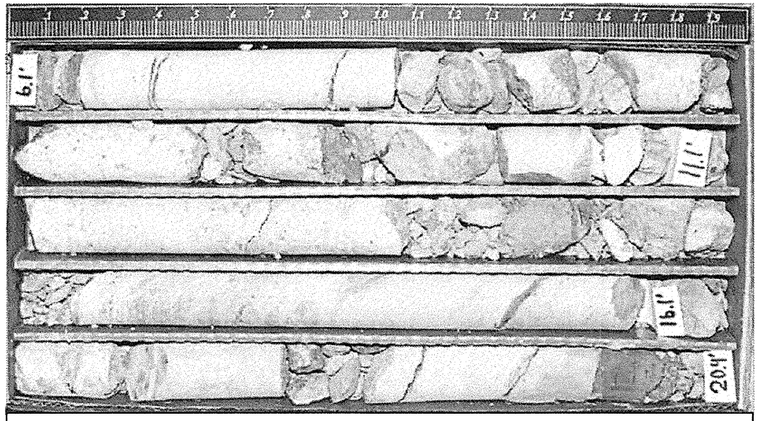
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

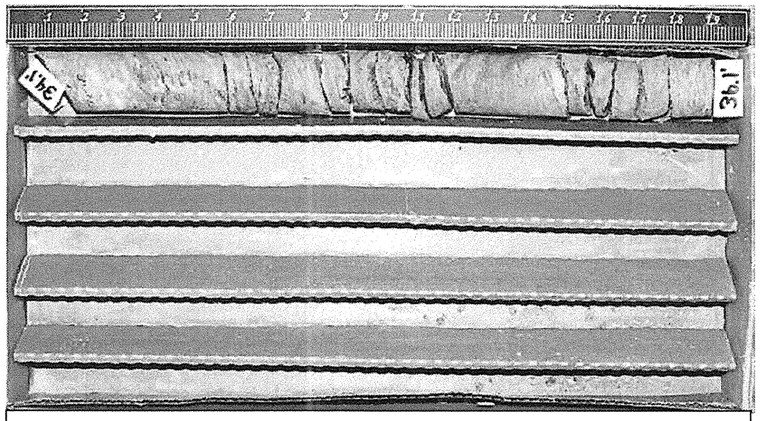
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. EB1-A	**BORING LOCATION** 15+82	**OFFSET** 13ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,529.5 ft	**NORTHING** 878,950	**EASTING** 1,168,804		**24 HR.** N/A
TOTAL DEPTH 36.1 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic
DATE STARTED 8/27/05	**COMPLETED** 8/27/05	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 30.0 ft	**DRILLER** B. Grady	

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 6.1 ft
3,523.4	6.1	5.0	2:34	(2.7) 54%		Run-1	(2.7) 54%			3,523.4 — 6.1 Alluvium - Gray, brown, pink & traces light green, sli. weathering, mod. hard, **boulders (13") to gravel (0.75")**, Meta-arkose & trace Diabase.
			2:38							
			2:29							
			3:06							
3,518.4	11.1		2:29							3,518.4 — 11.1
		5.0	2:32	(3.8) 75%		Run-2	(12.5) 60%			Colluvium - Gray, brown, pink, sli. weathering w/intervals mod. sev. weathering, hard, **boulders (18") to cobbles (3")**, Meta-arkose & Mudstone, iron oxide staining and precipitate.
			2:38							
			2:52							
3,513.4	16.1		2:03							
			3:02							
		5.0	3:05	(2.6) 52%		Run-3				
			2:38							
			2:22							
3,508.4	21.1		2:06							
		5.0	2:44	(3.5) 70%		Run-4				
			2:37							
			2:32							
3,503.4	26.1		2:44							
			1:27							
		5.0	2:17	(2.3) 46%		Run-5				
			2:44							
			1:39							
			1:27							
3,498.4	31.1		2:40							
		5.0	3:06	(4.4) 88%	(0.9) 18%	Run-6 *RS-4*	(4.1) 100%	(0.9) 22%		3,497.5 — 32.0 NCR - Brown, gray, green, orange, fine grained, mod. sev. weathering, soft, close fracture, Mudstone, contorted bedding, heavy iron oxide.
			2:31							
			2:26							
3,493.4	36.1		2:23							3,493.4 — 36.1 Boring Terminated at Elevation 3,493.4 ft in Mudstone
			2:31							
			2:49							

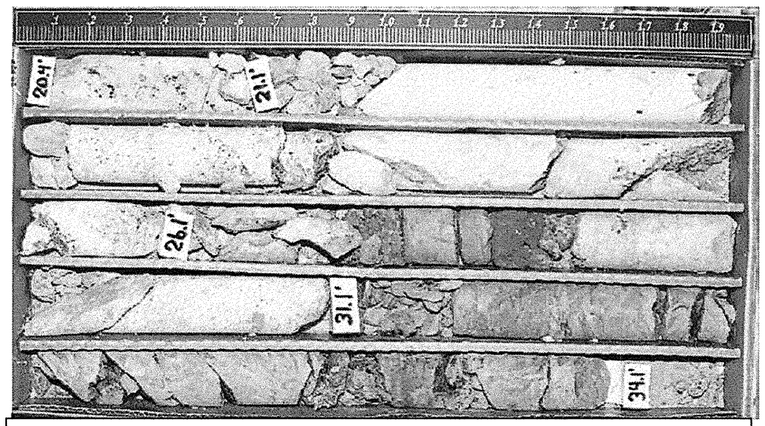
NCDOT CORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring EB1-A – Station 15+82 @ 13' Left - Box 1 of 3



Boring EB1-A – Station 15+82 @ 13' Left - Box 3 of 3



Boring EB1-A – Station 15+82 @ 13' Left - Box 2 of 3

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. EB1-B	**BORING LOCATION** 15+82	**OFFSET** 13ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,527.0 ft	**NORTHING** 878,974	**EASTING** 1,168,814		**24 HR.** N/A
TOTAL DEPTH 35.4 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/28/05	**COMPLETED** 8/29/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,527.0					Topsoil				3,527.0 — 0.0
3,526.0	1.0								Alluvium - Dark brown & gray, hard, silt (A-4).
		10	20	20	●40	SS-7	M		3,524.5 — 2.5
									3,524.0 — 3.0 Alluvium - Dark brown & gray, very dense, **cobbles (4")** to gravel. Begin coring at elev. 3,524.0. Alluvium - Gray, brown, orange, pink, sli. weathering w/intervals complete weathering, hard to v. soft, **cobbles (8")**, Meta-arkose & trace Diabase.
									3,512.1 — 14.9 Colluvium - gray, brown, pink, fresh to sli. weathering w/intervals mod. sev. weathering, hard to soft, **boulders (13") to cobbles (7")**, Meta-arkose, iron oxide staining and precipitate.
									3,502.8 — 24.2
									3,501.6 — 25.4 NCR - Brown, gray, green, orange, fine grained, mod. weathering, mod. hard to soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
									3,497.1 — 29.9 WR - Brown & orange, weathered Mudstone.
									NCR - Brown, gray, green, orange, fine grained, mod. weathering, mod. hard to soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
									3,491.6 — 35.4 Boring Terminated at Elevation 3,491.6 ft in Mudstone

NCDOT BORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

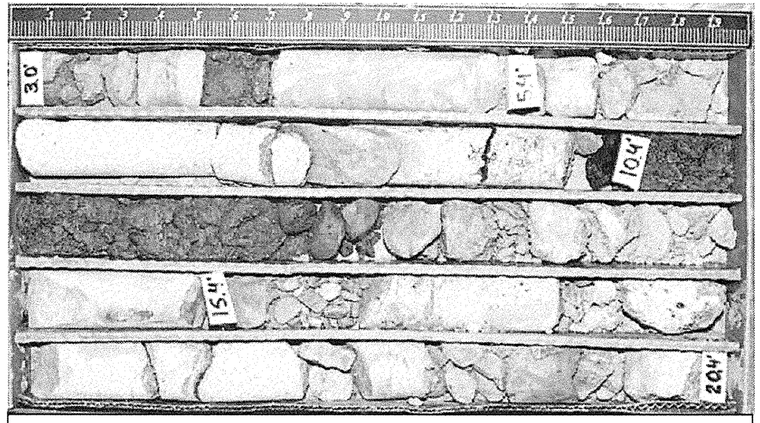
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

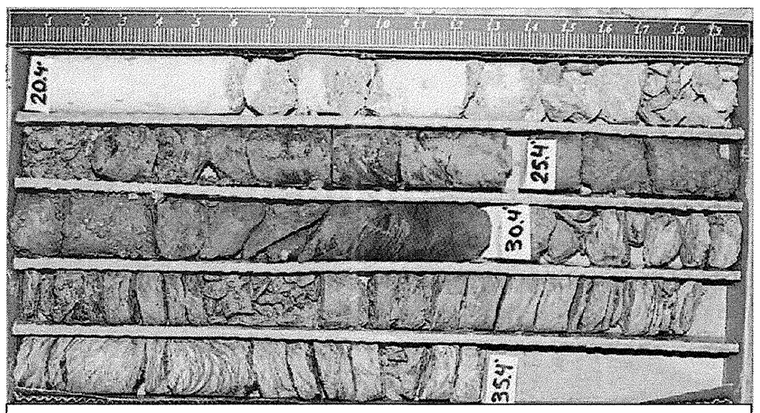
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg	
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)				**GROUND WATER (ft)**
BORING NO. EB1-B	**BORING LOCATION** 15+82	**OFFSET** 13ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,527.0 ft	**NORTHING** 878,974	**EASTING** 1,168,814		**24 HR.** N/A
TOTAL DEPTH 35.4 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/28/05	**COMPLETED** 8/29/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 32.4 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 3.0 ft
3,524.0	3.0	2.4	2:16	(1.3)		Run-1	(5.5)			3,524.0 Alluvium - Gray, brown, orange, pink, sli. weathering w/intervals complete weathering, hard to v. soft, **cobbles (8")**, Meta-arkose & trace Diabase. — 3.0
3,521.6	5.4		1:46	54%			46%			
		5.0	1:01/0.4	(1.9)		Run-2				
			2:10	38%						
3,516.6	10.4		1:58							
		5.0	2:15	(2.7)		Run-3				
			2:22	54%						
3,511.6	15.4		2:44							3,512.1 — 14.9
		5.0	2:04	(3.2)		Run-4	(5.4)			Colluvium - gray, brown, pink, fresh to sli. weathering w/intervals mod. sev. weathering, hard to soft, **boulders (13") to cobbles (7")**, Meta-arkose, iron oxide staining and precipitate.
			1:46	64%			58%			
			2:39							
3,506.6	20.4		2:22							
		5.0	2:26	(3.1)	(0.6)	Run-5				
			2:28	62%	11%					
			2:38							
			2:44							
3,501.6	25.4		2:28							3,502.8 — 24.2
		5.0	1:53	(1.9)	(0.4)	Run-6	(1.2)	(0.4)		3,501.6 NCR - Brown, gray, green, orange, fine grained, mod. weathering, mod. hard to soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate. — 25.4
			2:38	37%	8%		100%	33%		
			2:41				(1.6)	(0.0)		WR - Brown & orange, weathered Mudstone.
			2:45				36%	0%		3,497.1 — 29.9
3,496.6	30.4		2:25							NCR - Brown, gray, green, orange, fine grained, mod. weathering, mod. hard to soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
		5.0	2:13	(3.8)	(0.0)	Run-7	(4.1)	(0.0)		
			1:44	75%	0%		75%	0%		
			1:59							
			2:19							
			2:25							
			2:40							
			2:28							
3,491.6	35.4		2:22							3,491.6 — 35.4 Boring Terminated at Elevation 3,491.6 ft in Mudstone
			2:13							
			2:58							
			2:50							

NCDOT CORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring EB1-B – Station 15+82 @ 13' Right - Box 1 of 2



Boring EB1-B – Station 15+82 @ 13' Right - Box 2 of 2

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B1-A	**BORING LOCATION** 16+02	**OFFSET** 7ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,528.3 ft	**NORTHING** 878,963	**EASTING** 1,168,787		**24 HR.** N/A
TOTAL DEPTH 35.6 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/28/05	**COMPLETED** 8/28/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,528.3					Topsoil				3,528.3 0.0
									Alluvium - Dark brown & gray, hard, silt (A-4). 3,526.3 2.0
3,524.5	3.8	60/0.0			60/0.0				Alluvium - Dark brown & gray, very dense, gravel (0.75"). Begin coring at elev. 3,524.5. 3,524.5 3.8
									Alluvium - Gray, brown, pink, green, sli. weathering w/intervals sev. weathering, mod. hard to seams v. soft, **boulders (12"), cobbles (4") & gravel (1")**, Meta-arkose & Diabase, seams of silt & sand.
									3,511.5 16.8
									Colluvium - Brown & gray, complete weathering, soft. 3,508.6 19.7
									Colluvium - Gray, pink, brown, green, predominately fresh to sli. weathering, hard to v. soft, **boulders (13") to gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining, precipitate. 3,504.0 24.3
									NCR - Gray, brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate. 3,497.0 31.3
									Residual - Brown & orange, hard, silty clay (A-6), complete weathering of Mudstone. 3,494.5 33.8
									NCR - Gray, brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate. 3,492.7 35.6
									Boring Terminated at Elevation 3,492.7 ft in Mudstone

NCDOT BORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

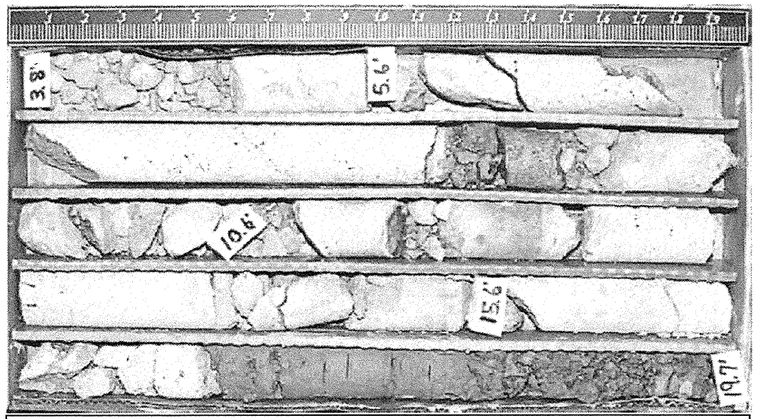
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

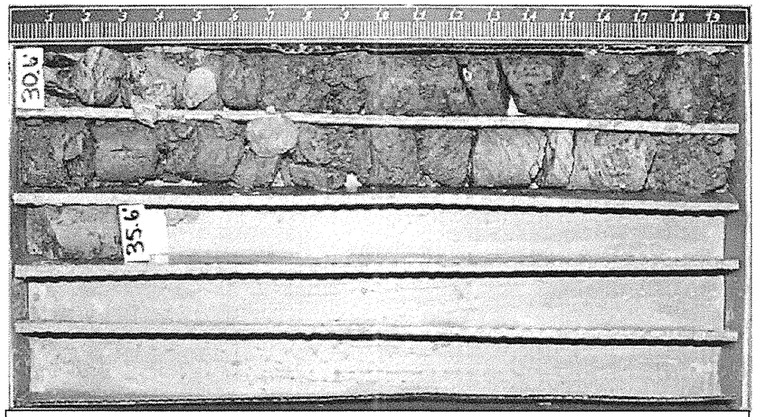
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B1-A	**BORING LOCATION** 16+02	**OFFSET** 7ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,528.3 ft	**NORTHING** 878,963	**EASTING** 1,168,787		**24 HR.** N/A
TOTAL DEPTH 35.6 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/28/05	**COMPLETED** 8/28/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 31.8 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 3.8 ft
3,524.5	3.8	1.8	2:31	(0.8)		Run-1	(8.8)			3,524.5 Alluvium - Gray, brown, pink, green, sli. weathering w/intervals sev. weathering, mod. hard to seams v. soft, **boulders (12"), cobbles (4") & gravel (1")**, Meta-arkose & Diabase, seams of silt & sand. 3.8
3,522.7	5.6		*N=60/0.0*	44%			68%			
		5.0	1:55/0.8	(3.1)		Run-2				
			2:23	62%						
			2:39							
3,517.7	10.6		2:49							
		5.0	2:34	(2.4)		Run-3				
			2:50	48%						
			2:20							
			2:42							
3,512.7	15.6		2:25							
		5.0	2:47	(3.2)		Run-4				3,511.5 16.8
			2:20	64%			(1.4)			Colluvium - Brown & gray, complete weathering, soft.
			2:29				48%			3,508.6 19.7
			1:39							
3,507.7	20.6		1:56							
		5.0	2:13	(3.4)	(0.5)	Run-5	(2.8)			Colluvium - Gray, pink, brown, green, predominately fresh to sli. weathering, hard to v. soft, **boulders (13") to gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining, precipitate.
			2:28	68%	10%		61%			3,504.0 24.3
			2:17							
			2:19							
3,502.7	25.6		2:22				(7.0)	(0.0)		NCR - Gray, brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
		5.0	2:28	(4.9)	(0.0)	Run-6	100%	0%		
			3:05	97%	0%					
			3:04							
			2:47							
3,497.7	30.6		2:47							3,497.0 31.3
		5.0	2:33	(4.1)	(0.0)	Run-7	(1.5)	(0.0)		Residual - Brown & orange, hard, silty clay (A-6), complete weathering of Mudstone.
			2:26	82%	0%		60%	0%		3,494.5 33.8
			2:01				(1.8)	(0.0)		
3,492.7	35.6		1:38				100%	0%		3,492.7 NCR - Gray, brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate. 35.6
			1:26							Boring Terminated at Elevation 3,492.7 ft in Mudstone
			2:13							
			2:20							

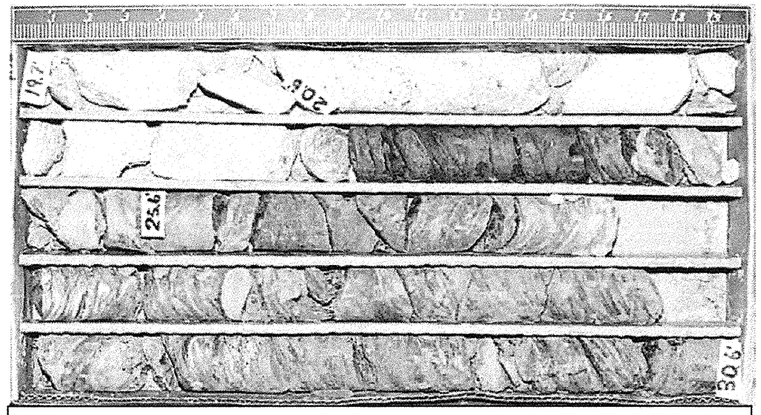
NCDOT CORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring B1-A – Station 16+02 @ 7' Left - Box 1 of 3



Boring B1-A – Station 16+02 @ 7' Left - Box 3 of 3



Boring B1-A – Station 16+02 @ 7' Left - Box 2 of 3

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B1-B	**BORING LOCATION** 15+96	**OFFSET** 10ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,526.9 ft	**NORTHING** 878,977	**EASTING** 1,168,799		**24 HR.** N/A
TOTAL DEPTH 35.3 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/29/05	**COMPLETED** 8/29/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,526.9					Topsoil				3,526.9 — 0.00
3,526.4									Alluvium - Dark brown & gray, hard, silt (A-4). — 0.5
3,525.4	1.5	60/0.0			60/0.0				Alluvium - Dark brown & gray, very dense, **gravel (0.75")**. Begin coring at elev. 3,525.4. — 1.5
									Alluvium - Gray, brown, pink, green, sli. weathering w/intervals sev. weathering, mod. hard to seams v. soft, **boulders (13"), cobbles (7") & gravel (1")**, Meta-arkose & Diabase, seams of silt & sand.
3,514.3									12.6
									Colluvium - Gray, brown, pink, predominately fresh to sli. weathering, hard to v. soft, **boulders (13"), cobbles (4") & gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
3,510.7									16.2
3,509.8									Colluvium - Green, gray, sli. to mod. weathering, **cobbles (4")**, Diabase. — 17.1
									Colluvium - Gray, brown, pink, predominately fresh to sli. weathering, hard to v. soft, **boulders (17") to gravel (1")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
3,501.8									25.1
									Residual - Brown, gray, hard, silty clay (A-6), complete weathering of Mudstone.
3,497.6									29.3
						RS-5			NCR - Brown, gray, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close to v. close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
3,491.6									35.3
									Boring Terminated at Elevation 3,491.6 ft in Mudstone

NCDOT BORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

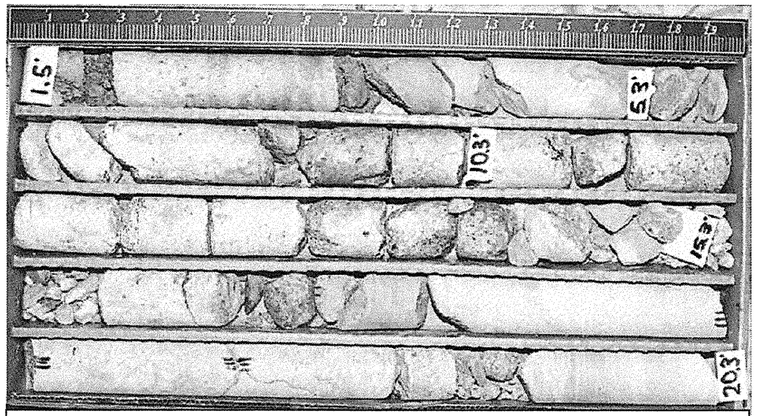
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

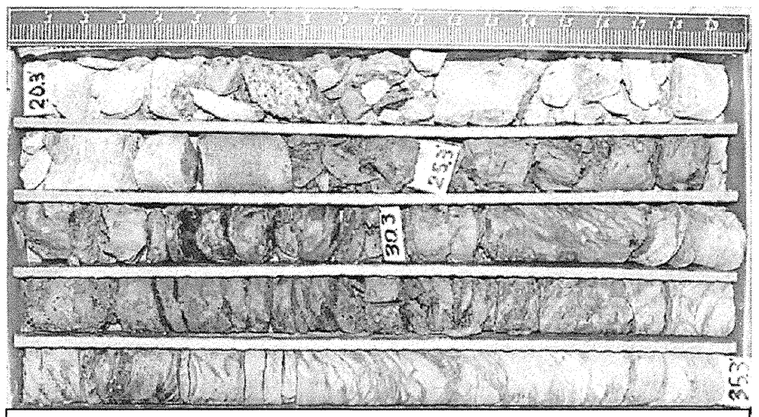
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B1-B	**BORING LOCATION** 15+96	**OFFSET** 10ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,526.9 ft	**NORTHING** 878,977	**EASTING** 1,168,799		**24 HR.** N/A
TOTAL DEPTH 35.3 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/29/05	**COMPLETED** 8/29/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 33.8 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 1.5 ft
3,525.4	1.5	3.8	2:46	(1.6) 42%		Run-1	(5.3) 48%			3,525.4 Alluvium - Gray, brown, pink, green, sli. weathering w/intervals sev. weathering, mod. hard to seams v. soft, **boulders (13"), cobbles (7") & gravel (1")**, Meta-arkose & Diabase, seams of silt & sand. — 1.5
			N=60/0.0							
3,521.6	5.3		2:20							
		5.0	2:10							
			2:02/0.8	(1.4) 28%		Run-2				
			2:26							
3,516.6	10.3		2:37							
		5.0	2:20							
			2:40	(2.5) 50%		Run-3				
			2:19				(1.1) 31%			
			2:22							
3,511.6	15.3		2:25							
		5.0	2:43							3,514.3 — 12.6
			2:19	(3.9) 77%		Run-4				Colluvium - Gray, brown, pink, predominately fresh to sli. weathering, hard to v. soft, **boulders (13"), cobbles (4") & gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
			2:09				(0.5) 56%			3,510.7 — 16.2
			2:27				(5.3) 66%			3,509.8 Colluvium - Green, gray, sli. to mod. weathering, **cobbles (4")**, Diabase. — 17.1
3,506.6	20.3		2:36							Colluvium - Gray, brown, pink, predominately fresh to sli. weathering, hard to v. soft, **boulders (17") to gravel (1")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
		5.0	2:10							
			2:22	(3.0) 60%		Run-5				
			2:25							
			1:53							
3,501.6	25.3		2:20							3,501.8 — 25.1
		5.0	3:04	(1.8) 36%	(0.0) 0%	Run-6	(1.1) 26%	(0.0) 0%		Residual - Brown, gray, hard, silty clay (A-6), complete weathering of Mudstone.
			2:59							3,497.6 — 29.3
			2:25							NCR - Brown, gray, orange, green, fine grained, mod. weathering w/intervals sev. weathering, mod. hard to v. soft, close to v. close fracture spacing, Mudstone, contorted bedding, heavy iron oxide staining and precipitate.
3,496.6	30.3		1:58				(5.7) 95%	(1.2) 20%		
			1:44							
		5.0	1:39	(4.8) 96%	(1.2) 23%	Run-7 *RS-5*				
			2:04							
			2:44							
3,491.6	35.3		2:40							3,491.6 — 35.3
			2:44							Boring Terminated at Elevation 3,491.6 ft in Mudstone
			1:59							
			2:21							
			2:46							

NCDOT CORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring B1-B – Station 15+96 @ 10' Right - Box 1 of 2



Boring B1-B – Station 15+96 @ 10' Right - Box 2 of 2

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B2-A	**BORING LOCATION** 16+81	**OFFSET** 7ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,519.1 ft	**NORTHING** 878,993	**EASTING** 1,168,714		**24 HR.** 9.0'
TOTAL DEPTH 35.5 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/27/05	**COMPLETED** 8/27/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,519.1					Topsoil w/Colluvial Boulders				3,519.1 0.00
3,518.1	1.0	60/0.0			60/0.0				3,518.6 Alluvium - Dark brown, silty gravel (A-2-4). 0.5 3,518.1 Alluvium - Dark brown, very dense, **gravel (0.75")**. Begin coring at elev. 3,518.1. 1.0
									Alluvium - Gray, white, pink, medium grained, fresh, v. hard, mod. close to close fracture spacing, **boulders (4'+)**, Meta-sandstone, 75° fracture at base.
3,513.6	5.5								5.5
									Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to v. soft, **boulders (13"), gravel (1")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
3,508.6	10.5								3,506.5 12.6
									3,505.8 Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4")**, Diabase. 13.3
									Colluvium - gray, pink, brown, predominately fresh to mod. weathering, v. hard to v. soft, **boulders (13"), gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
3,503.6	15.5								3,498.7 20.4
									3,498.5 NCR - Dark gray, dark brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, med. hard to v. soft, close to v. close fracture spacing, Mudstone, iron oxide staining and precipitate. 20.6
									3,495.9 Residual - Dark brown, hard, silty clay (A-6), complete weathering Mudstone. 23.2
3,498.6	20.5								3,490.1 NCR - Dark gray, dark brown, orange, green, v. fine grained, mod. weathering w/intervals sev. weathering, medium hard to v. soft, close to v. close fracture spacing, Mudstone, iron oxide staining and precipitate. 29.0
3,493.6	25.5								
						RS-1			
3,488.6	30.5								
									3,483.6 NCR - Brown, gray, dark gray, predominately silty to fine grained, sli. to mod. weathering, mod. hard, close fracture spacing, Meta-siltstone, trace pyrite. 35.5
3,483.6	35.5								Boring Terminated at Elevation 3,483.6 ft in Meta-siltstone

NCDOT BORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

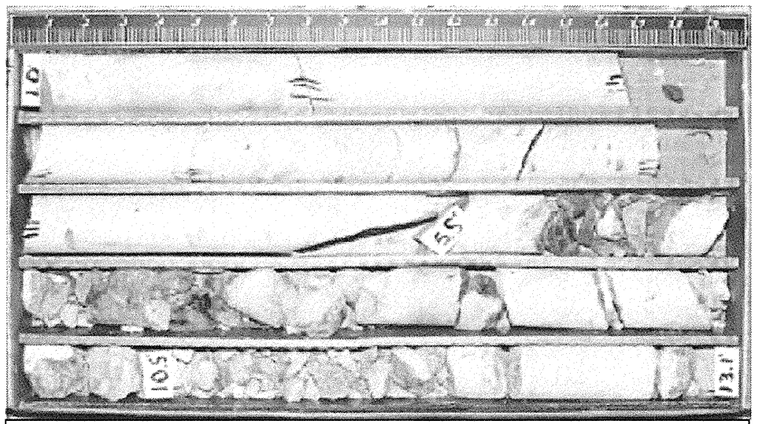
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

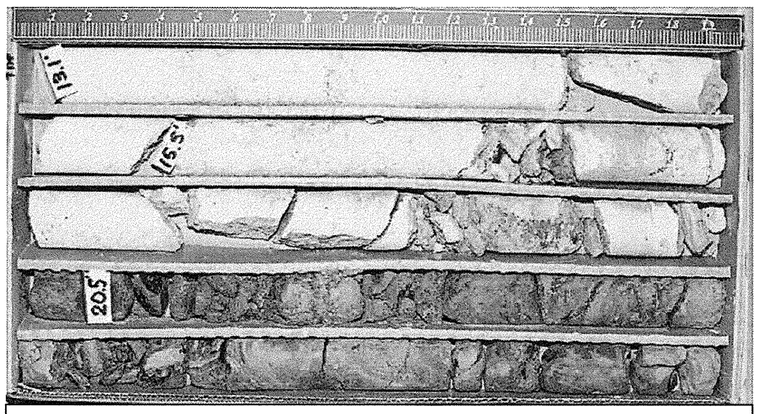
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B2-A	**BORING LOCATION** 16+81	**OFFSET** 7ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,519.1 ft	**NORTHING** 878,993	**EASTING** 1,168,714		**24 HR.** 9.0'
TOTAL DEPTH 35.5 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/27/05	**COMPLETED** 8/27/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 34.5 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 1.0 ft
3,518.1	1.0	4.5	3:06	(4.5)		Run-1	(4.5)			3,518.1 Alluvium - Gray, white, pink, medium grained, fresh, v. hard, mod. close to close fracture spacing, **boulders (4'+)**, Meta-sandstone, 75° fracture at base. 1.0
			N=60/0.0	99%			99%			
			3:05							
3,513.6	5.5		3:03							3,513.6 5.5
		5.0	2:51	(2.9)		Run-2	(3.7)			Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to v. soft, **boulders (13"), gravel (1")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
			1:24/0.5	58%			52%			
			2:28							
3,508.6	10.5		2:40							
		5.0	2:28	(3.7)		Run-3				3,506.5 12.6
			2:31	73%						3,505.8 Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4")**, Diabase. 13.3
			2:49				(0.3)			Colluvium - gray, pink, brown, predominately fresh to mod. weathering, v. hard to v. soft, **boulders (13"), gravel (0.75")**, Meta-arkose, sand and clay infill, iron oxide staining and precipitate.
			2:06				43%			
3,503.6	15.5		2:14				(6.0)			
		5.0	2:33	(3.5)		Run-4	85%			
			2:53	70%						
			3:01							
			2:55							
3,498.6	20.5		2:27							3,498.7 20.4
		5.0	2:22	(4.7)	(0.3)	Run-5	(0.2)	(0.0)		3,498.5 NCR - Dark gray, dark brown, orange, green, fine grained, mod. weathering w/intervals sev. weathering, med. hard to v. soft, close to v. close fracture spacing, Mudstone, iron oxide staining and precipitate. 20.6
			2:13	93%	7%		100%	0%		
			1:52				(1.9)	(0.0)		3,495.9 Residual - Dark brown, hard, silty clay (A-6), complete weathering Mudstone. 23.2
			1:25				73%	0%		
3,493.6	25.5		1:23							
		5.0	1:51	(2.6)	(0.9)	Run-6	(3.4)	(0.4)		NCR - Dark gray, dark brown, orange, green, v. fine grained, mod. weathering w/intervals sev. weathering, medium hard to v. soft, close to v. close fracture spacing, Mudstone, iron oxide staining and precipitate.
			2:25	51%	17%		59%	7%		
			2:22							3,490.1 29.0
			2:26			RS-1	(6.5)	(1.3)		NCR - Brown, gray, dark gray, predominately silty to fine grained, sli. to mod. weathering, mod. hard, close fracture spacing, Meta-siltstone, trace pyrite.
3,488.6	30.5		2:37				100%	19%		
		5.0	2:44	(5.0)	(0.4)	Run-7				
			2:45	100%	8%					
			2:28							
3,483.6	35.5		1:44							3,483.6 35.5
			3:02							Boring Terminated at Elevation 3,483.6 ft in Meta-siltstone
			2:20							
			2:28							
			2:14							

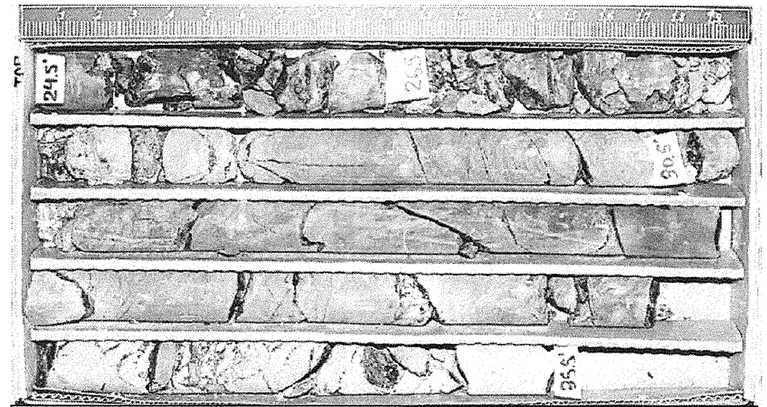
NCDOT CORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring B2-A – Station 16+81 @ 7' Left - Box 1 of 3



Boring B2-A – Station 16+81 @ 7' Left - Box 2 of 3



Boring B2-A – Station 16+81 @ 7' Left - Box 3 of 3

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B2-B	**BORING LOCATION** 16+83	**OFFSET** 9ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,518.8 ft	**NORTHING** 879,007	**EASTING** 1,168,718		**24 HR.** 10.0'
TOTAL DEPTH 35.1 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/26/05	**COMPLETED** 8/26/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,518.8									Topsoil w/Colluvial Boulders
3,517.8	1.0	60/0.0			60/0.0	RS-3			3,518.8 — 0.0 3,518.3 — Alluvium - Dark brown, dense, silty gravel (A-2-4). — 0.5 3,517.8 — 1.0 3,517.5 — Alluvium - Dark brown, very dense, **cobbles (4")**, Diabase. Begin coring at elev. 3,517.8. — 1.3 Alluvium - gray, brown, pink, mod. weathering, v. hard, **cobbles (3") to gravel (0.75")**, Meta-arkose & Quartz. 3,509.4 — Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to soft, **boulders (13"), cobbles (7") & gravel (1")**, Meta-arkose, iron oxide staining and precipitate. — 9.4 3,508.5 — Colluvium - Green, gray, fresh to mod. weathering, **cobbles (7")**, Diabase. — 10.3 Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to soft, **boulders (13") & cobbles (7")**, Meta-arkose, sand and clay interval (17.0'-18.7') and infill, iron oxide staining and precipitate. 3,498.7 — 20.1 Residual - Brown, orange, gray, hard, silty clay (A-6), complete weathering of Mudstone.
						RS-2			3,493.7 — 25.1 3,491.4 — WR - Dark brown, dark gray, orange, green, mod. sev. weathering, Mudstone. — 27.4 NCR - Brown, gray, green, predominately silty to v. fine grained, mod. weathering, mod. to med. hard, close fracture spacing, layered, Meta-siltstone. 3,483.7 — 35.1 Boring Terminated at Elevation 3,483.7 ft in Meta-siltstone

NCDOT BORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

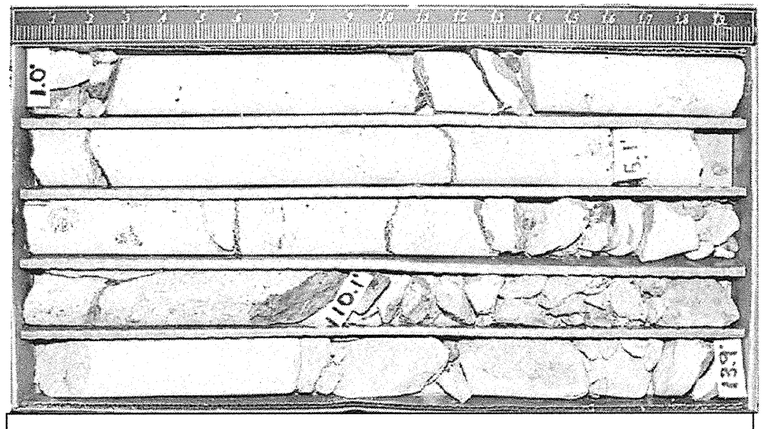
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

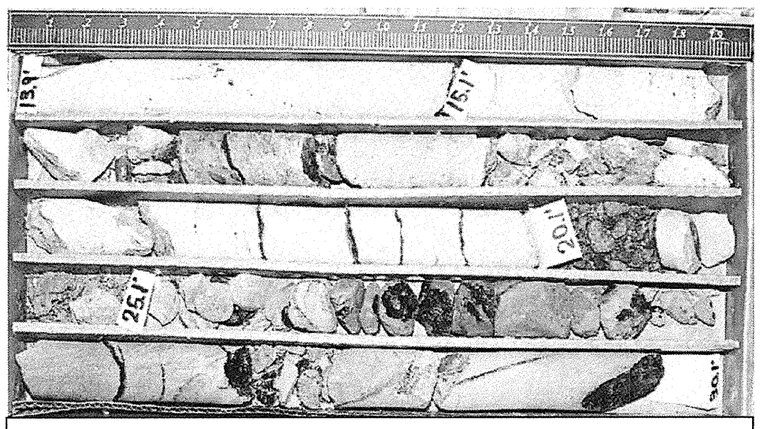
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. B2-B	**BORING LOCATION** 16+83	**OFFSET** 9ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,518.8 ft	**NORTHING** 879,007	**EASTING** 1,168,718		**24 HR.** 10.0'
TOTAL DEPTH 35.1 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/26/05	**COMPLETED** 8/26/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 34.1 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 1.0 ft
3,517.8	1.0	4.1	3:13	(3.5)		Run-1	(0.3)			3,517.8 — Aluvium - gray, brown, pink, mod. weathering, v. hard, **cobbles (3") to gravel (0.75")**, Meta-arkose & Quartz. — 1.0
			N=60/0.0	86%			100%			3,517.5 — 1.3
3,513.7	5.1		2:58				(5.7)			Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to soft, **boulders (13"), cobbles (7") & gravel (1")**, Meta-arkose, iron oxide staining and precipitate.
		5.0	1:49 2:13	(3.9)		Run-2	70%			
			0:19/0.1	78%		*RS-3*				
3,508.7	10.1		2:31 2:40				(0.8)			3,509.4 — 9.4 3,508.5 — Colluvium - Green, gray, fresh to mod. weathering, **cobbles (7")**, Diabase. — 10.3
		5.0	2:44	(4.1)		Run-3	89%	(5.4)		Colluvium - Gray, pink, brown, predominately fresh to mod. weathering, v. hard to soft, **boulders (13") & cobbles (7")**, Meta-arkose, sand and clay interval (17.0'-18.7') and infill, iron oxide staining and precipitate.
			1:59 3:00	81%			(8.6)	55%		
3,503.7	15.1		2:57 2:44				88%			
		5.0	2:22	(4.0)		Run-4				
			2:14 2:28	79%						
3,498.7	20.1		2:28							3,498.7 — 20.1
		5.0	2:22 1:43	(0.8)	(0.0)	Run-5	(0.6)	(0.0)		Residual - Brown, orange, gray, hard, silty clay (A-6), complete weathering of Mudstone.
			1:50	15%	0%		12%	0%		
3,493.7	25.1		2:01 2:05							3,493.7 — 25.1
		5.0	1:59 1:52	(3.0)	(0.4)	Run-6	(0.5)	(0.0)		3,491.4 — WR - Dark brown, dark gray, orange, green, mod. sev. weathering, Mudstone. — 27.4
			2:09	60%	7%		22%	0%		
			2:25				(7.6)	(1.1)		NCR - Brown, gray, green, predominately silty to v. fine grained, mod. weathering, mod. to med. hard, close fracture spacing, layered, Meta-siltstone.
3,488.7	30.1		2:10				98%	14%		
		5.0	2:21 2:44	(4.9)	(0.8)	Run-7				
			2:55	97%	15%	*RS-2*				
3,483.7	35.1		2:33 2:25							3,483.7 — 35.1 Boring Terminated at Elevation 3,483.7 ft in Meta-siltstone
			2:31							
			2:14							
			2:43							
			2:51							

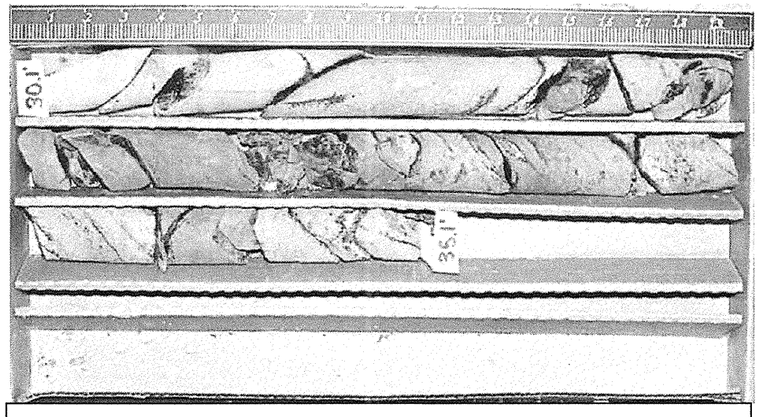
NCDOT CORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring B2-B – Station 16+83 @ 9' Right - Box 1 of 3



Boring B2-B – Station 16+83 @ 9' Right - Box 2 of 3



Boring B2-B – Station 16+83 @ 9' Right - Box 3 of 3

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg	
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)				**GROUND WATER (ft)**
BORING NO. EB2-A	**BORING LOCATION** 17+07	**OFFSET** 13ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,524.3 ft	**NORTHING** 878,996	**EASTING** 1,168,688		**24 HR.** 15.0'
TOTAL DEPTH 32.0 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/25/05	**COMPLETED** 8/25/05	**SURFACE WATER DEPTH** N/A		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
3,524.3					Colluvial Boulders				3,524.3 0.0
									Roadway Embankment - Brown, medium dense, silty gravel & sand (A-2-4). 3,521.8 2.5
3,519.3	5.0								Alluvium - Dark brown, dense, silty gravel (A-2-4). Begin coring at elev. 3,517.8.
		5	24	16	49	SS-1	M		3,517.8 6.5
									Alluvium - Gray, brown, orange, pink, sli. weathering w/intervals sev. weathering, v. hard to soft, **cobbles (7"), gravel (1")**, Meta-arkose & Diabase, iron oxide staining and precipitate. 3,513.7 10.6
									Colluvium - Gray, pink, brown, green, orange, fine to medium grained, predominately fresh to mod. weathering, v. hard to soft, **boulders (13"), cobbles (7")**, Meta-arkose, Meta-sandstone, Diabase, sand and clay infill, iron oxide staining and precipitate. 3,508.7 15.6
									3,507.8 16.5
									Colluvium - Green, gray, fresh to mod. weathering, **cobbles (7")**, Diabase.
									Colluvium - Gray, pink, brown, green, orange, predominately fresh to mod. weathering, v. hard to soft, **cobbles (7") to gravel (1")**, Meta-arkose, Meta-sandstone, Diabase, sand and clay infill, iron oxide staining and precipitate. 3,497.1 27.2
									NCR - Brown, gray, orange, mod. weathering w/intervals sev. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate, apparent bedding 60°, quartz vein. 3,493.6 30.7
									3,492.5 31.8
									3,492.3 32.0
									Residual - Brown, orange, gray, hard, silty clay (A-6), complete weathering of Mudstone.
									NCR - Brown, gray, orange, silty, mod. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate, apparent bedding 60°, quartz vein.
									Boring Terminated at Elevation 3,492.3 ft in Mudstone

NCDOT BORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

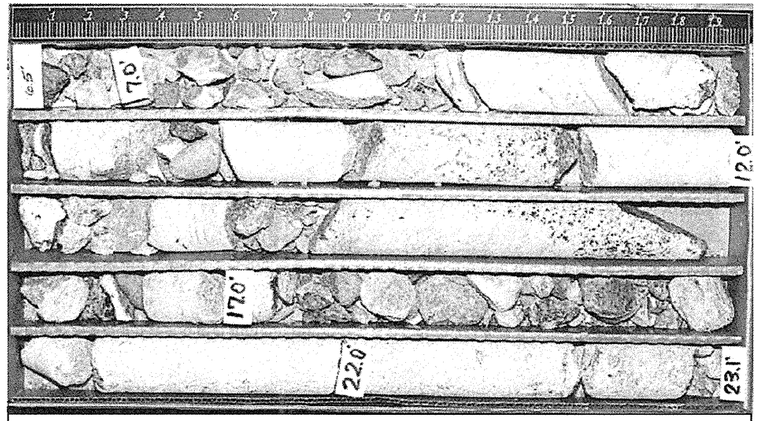
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

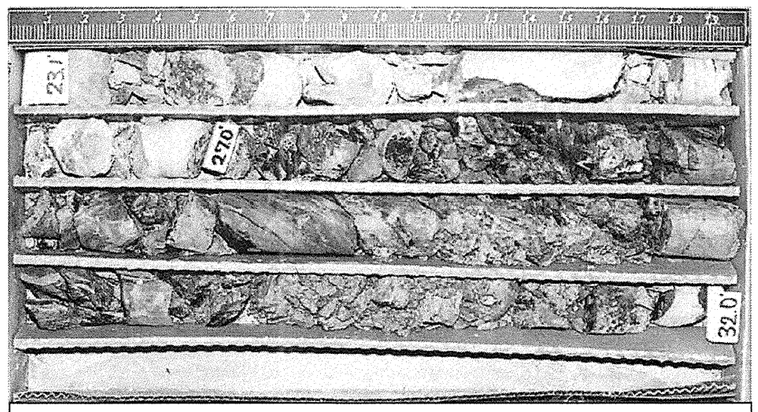
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg	
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)				**GROUND WATER (ft)**
BORING NO. EB2-A	**BORING LOCATION** 17+07	**OFFSET** 13ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,524.3 ft	**NORTHING** 878,996	**EASTING** 1,168,688		**24 HR.** 15.0'
TOTAL DEPTH 32.0 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic	
DATE STARTED 8/25/05	**COMPLETED** 8/25/05	**SURFACE WATER DEPTH** N/A		
CORE SIZE NQ2	**TOTAL RUN** 25.5 ft	**DRILLER** B. Grady		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN ROD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA ROD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 6.5 ft
3,517.8	6.5	0.5	1:13/0.5	(0.2)		Run-1	(2.3)			3,517.8 Alluvium - Gray, brown, orange, pink, sli. weathering w/intervals sev. weathering, v. hard to soft, **cobbles (7"), gravel (1")**, Meta-arkose & Diabase, iron oxide staining and precipitate. 6.5
3,517.3	7.0	5.0	2:16	40%		Run-2	57%			3,513.7 10.6
			2:58	(3.5)						Colluvium - Gray, pink, brown, green, orange, fine to medium grained, predominately fresh to mod. weathering, v. hard to soft, **boulders (13"), cobbles (7")**, Meta-arkose, Meta-sandstone, Diabase, sand and clay infill, iron oxide staining and precipitate. 3,508.7 15.6
3,512.3	12.0		2:04	71%			(2.5)			
		5.0	1:58				50%			
			2:19	(1.2)		Run-3				
			2:28	24%						
			2:20							
			3:07							
3,507.3	17.0		2:59				(0.3)			3,507.8 Colluvium - Green, gray, fresh to mod. weathering, **cobbles (7")**, Diabase. 16.5
		5.0	2:20	(2.2)		Run-4	33%			Colluvium - Gray, pink, brown, green, orange, predominately fresh to mod. weathering, v. hard to soft, **cobbles (7") to gravel (1")**, Meta-arkose, Meta-sandstone, Diabase, sand and clay infill, iron oxide staining and precipitate.
			2:26	43%			(5.6)			
			2:32				52%			
			2:40							
3,502.3	22.0		2:43							
		5.0	2:28	(3.4)		Run-5				
			2:08	68%						
			2:22							
			2:43							
3,497.3	27.0		2:34							3,497.1 27.2
		5.0	2:38	(5.0)	(0.0)	Run-6	(3.5)	(0.0)		NCR - Brown, gray, orange, mod. weathering w/intervals sev. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate, apparent bedding 60°, quartz vein.
			2:31	100%	0%		100%	0%		3,493.6 30.7
			2:28							
3,492.3	32.0		2:44				(1.1)	(0.0)		3,492.5 Residual - Brown, orange, gray, hard, silty clay (A-6), complete weathering of Mudstone. 31.8
			2:04				100%	0%		3,492.3 32.0
			1:58				(0.2)	(0.0)		NCR - Brown, gray, orange, silty, mod. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate, apparent bedding 60°, quartz vein.
							100%	0%		Boring Terminated at Elevation 3,492.3 ft in Mudstone

NCDOT CORE - F&H WATAUGA.GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring EB2-A – Station 17+07 @ 13' Left - Box 1 of 2



Boring EB2-A – Station 17+07 @ 13' Left - Box 2 of 2

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. EB2-B	**BORING LOCATION** 17+07	**OFFSET** 13ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,519.4 ft	**NORTHING** 879,020	**EASTING** 1,168,697		**24 HR.** 10.0'
TOTAL DEPTH 30.0 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic
DATE STARTED 8/26/05	**COMPLETED** 8/26/05	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	
3,519.4					Topsoil w/Colluvial Boulders				3,519.4	0.00
3,518.4									Alluvium - Dark brown, dense, silty gravel (A-2-4).	1.0
3,517.4	2.0								3,517.4	2.0
		60/0.0			60/0.0				3,516.2 Alluvium - Dark brown, dense, **gravel (1")**, Meta-arkose & Mudstone. Begin coring at elev. 3,517.4.	3.2
									Alluvium - Gray, brown, orange, pink, mod. weathering w/intervals sev. weathering, v. hard, **cobbles (7")**, **gravel (1")**, Meta-arkose, Meta-sandstone, Diabase.	
									Colluvium - Gray, pink, brown, orange, predominately fresh to mod. weathering, v. hard to soft, **boulders (13")**, **cobbles (7")**, **gravel (0.75")**, Meta-arkose,	
									3,504.6 Meta-sandstone, Mudstone, sand and clay	14.8
									3,503.7 infill, iron oxide staining and precipitate.	15.7
									Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4")**, Diabase.	
									Colluvium - Gray, pink, brown, orange, predominately fresh to mod. weathering, v. hard to soft, **boulders (13")**, **cobbles (4")**,	
									3,497.6 Meta-arkose, Meta-sandstone, Mudstone, sand and clay infill, iron oxide staining and precipitate.	21.8
									3,494.7	24.7
									3,494.4 NCR - Brown, gray, orange, olive gray, dark gray, mod. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate.	25.0
									3,490.5 WR - Brown, orange, sev. weathered Mudstone.	28.9
									3,489.4	30.0
									NCR - Brown, gray, orange, olive gray, dark gray, silty, mod. weathering, med. hard to v. soft, Mudstone, iron oxide staining and precipitate.	
									WR - Brown, orange, sev. weathering, Mudstone.	
									Boring Terminated at Elevation 3,489.4 ft in Mudstone	

NCDOT BORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS

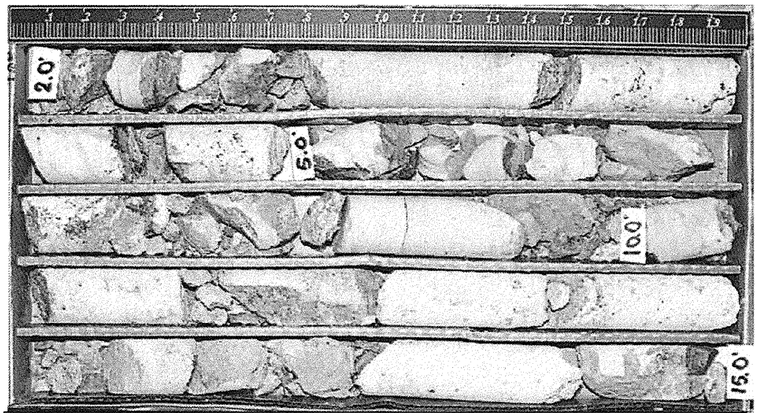
N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 1 OF 1

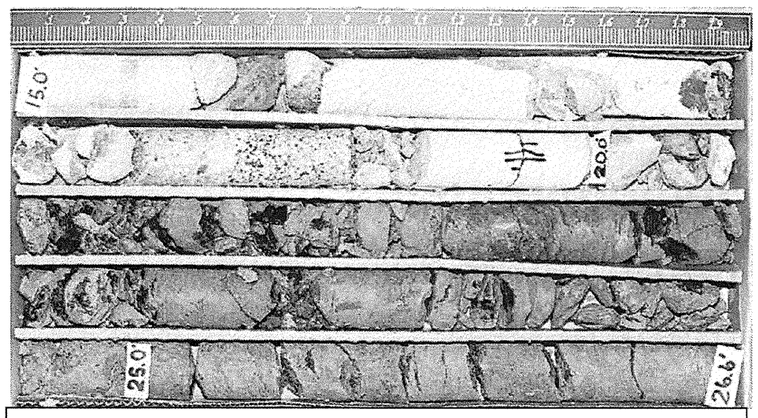
PROJECT NO. 33655.1.1	**ID.** B-4318	**COUNTY** Watauga	**GEOLOGIST** Gragg
SITE DESCRIPTION Bridge No. 321 over Watauga River on S.R. 1598 (Grandfather Rd.)			**GROUND WATER (ft)**
BORING NO. EB2-B	**BORING LOCATION** 17+07	**OFFSET** 13ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,519.4 ft	**NORTHING** 879,020	**EASTING** 1,168,697		**24 HR.** 10.0'
TOTAL DEPTH 30.0 ft	**DRILL MACHINE** CME-45C	**DRILL METHOD** NW Case/SPT/Core	**HAMMER TYPE** Automatic
DATE STARTED 8/26/05	**COMPLETED** 8/26/05	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 28.0 ft	**DRILLER** B. Grady	

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS	
										Begin Coring @ 2.0 ft	
3,517.4	2.0	3.0	3:07	(2.7)		Run-1	(0.7)			3,517.4 Alluvium - Gray, brown, orange, pink, mod. weathering w/intervals sev.	2.0
			N=60/0.0	88%			58%			3,516.2 weathering, v. hard, **cobbles (7")**, **gravel (1")**, Meta-arkose,	3.2
3,514.4	5.0		2:55				(8.9)			Meta-sandstone, Diabase.	
		5.0	2:26	(2.8)		Run-2	77%			Colluvium - Gray, pink, brown, orange, predominately fresh to mod.	
			2:26	56%						weathering, v. hard to soft, **boulders (13")**, **cobbles (7")**, **gravel (0.75")**,	
			2:38							Meta-arkose, Meta-sandstone, Mudstone, sand and clay infill, iron oxide	
3,509.4	10.0		2:20							staining and precipitate.	
		5.0	2:16	(4.0)		Run-3					
			2:10	79%							
			2:17								
3,504.4	15.0		2:20								
		5.0	2:19								
			2:22	(3.5)		Run-4	(0.5)			3,504.6	14.8
			2:45	69%			56%			3,503.7 Colluvium - Green, gray, fresh to mod. weathering, **cobbles (4")**, Diabase.	15.7
			3:03				(4.1)			Colluvium - Gray, pink, brown, orange, predominately fresh to mod.	
			3:01				67%			weathering, v. hard to soft, **boulders (13")**, **cobbles (4")**, Meta-arkose,	
3,499.4	20.0		2:51							Meta-sandstone, Mudstone, sand and clay infill, iron oxide staining and	
		5.0	2:38	(4.5)	(0.0)	Run-5				precipitate.	
			2:31	90%	0%					3,497.6	21.8
			2:08				(2.8)	(0.4)		NCR - Brown, gray, orange, olive gray, dark gray, mod. weathering, med.	
			2:14				97%	12%		hard to v. soft, Mudstone, iron oxide staining and precipitate.	
3,494.4	25.0		2:10							3,494.7	24.7
		5.0	2:22	(4.9)	(0.4)	Run-6	(0.3)	(0.0)		3,494.4 WR - Brown, orange, sev. weathered Mudstone.	25.0
			2:25	98%	7%		100%	0%		NCR - Brown, gray, orange, olive gray, dark gray, silty, mod. weathering,	
			2:26				(3.9)	(0.0)		med. hard to v. soft, Mudstone, iron oxide staining and precipitate.	
			2:11				100%	0%		3,490.5	28.9
3,489.4	30.0		1:50				(1.1)	(0.0)		3,489.4 WR - Brown, orange, sev. weathering, Mudstone.	30.0
			2:13				100%	0%		Boring Terminated at Elevation 3,489.4 ft in Mudstone	
			1:55								

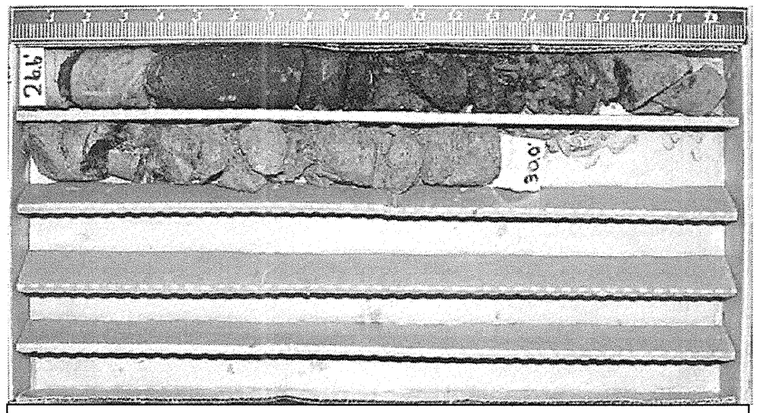
NCDOT CORE - F&H WATAUGA GINT LOGS.GPJ NC_DOT.GDT 10/12/05



Boring EB2-B – Station 17+07 @ 13' Right - Box 1 of 3



Boring EB2-B – Station 17+07 @ 13' Right - Box 2 of 3



Boring EB2-B – Station 17+07 @ 13' Right - Box 3 of 3

STATE PROJECT NO.: 33655.1.1
TIP NO.: B-4318
COUNTY: Watauga
PROJECT DESC.: Bridge No. 321 over Watauga River on SR 1598 (Grandfather Road)

SUMMARY OF SOIL CLASSIFICATIONS AND GRADATIONS

Boring No.	Sample No.	Depth Interval (ft.)	AASHTO Class.	N	Soil No.	Percent Passing No.10	Percent Passing No.40	Percent Passing No.200	Percent Retained No. 60	SOIL MORTAR				LL	PI	PL	Percent Moisture
										Coarse Sand	Fine Sand	Silt	Clay				
EB1-A	SS-5	5.0'-5.6'	A-4 (0)	100+	1	91	62	44	44	38	17	33	12	31	NP	NP	N/A
EB1-B	SS-7	1.0'-2.5'	A-4 (0)	40	2	82	56	36	51	40	20	27	13	38	2	36	N/A
EB2-A	SS-1	5.0'-6.5'	A-2-4 (0)	40	3	50	26	14	79	59	18	18	5	25	NP	NP	N/A
Bank	S-1	0.0'-2.0'	A-2-4 (0)	N/A	4	53	28	12	80	61	20	16	3	28	NP	NP	N/A
Bed	S-2	0.0'-2.0'	A-1-a (0)	N/A	5	23	10	6	92	66	13	19	2	25	NP	NP	N/A

STATE PROJECT NO.: 33655.1.1
TIP NO.: B-4318
COUNTY: Watauga
PROJECT DESC.: Bridge No. 321 over Watauga River on SR 1598 (Grandfather Road)

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

Sample No.	Boring No.	Depth Interval (ft)	Rock Type	Run RQD (%)	Height (inches)	Diameter (inches)	Unit Weight (PCF)	Unconfined Compressive Strength (PSI)	Young's Modulus	Splitting Tensile Strength	Remarks
RS-1	B2-A	29.4'-29.9'	Meta-Siltstone	17	3.96	1.97	149.1	1159	N/A	N/A	
RS-2	B2-B	30.8'-31.4'	Meta-Siltstone	15	3.92	1.96	145.1	942	N/A	N/A	
RS-3	B2-B	5.3'-5.8'	Meta-Arkose	N/A	3.99	1.98	160.3	13923	N/A	N/A	
RS-4	EB1-A	31.5'-32.0'	Mudstone	18	3.52	1.97	159.1	2225	N/A	N/A	
RS-5	B1-B	30.5'-30.9'	Mudstone	23	3.58	1.97	155.9	617	N/A	N/A	

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT

FIELD SCOUR REPORT

WBS: 33655.1.1 TIP: B-4318 COUNTY: Watuaga

DESCRIPTION(1): Bridge No. 321 over Watauga River on SR 1598 (Grandfather Road)

EXISTING BRIDGE

Information from: Field Inspection X Microfilm ____ (reel ____ pos: ____)
Other (explain) ____

Bridge No.: 321 Length: 29.5' Total Bents: 2 Bents in Channel: 0 Bents in Floodplain: 2
Foundation Type: Timber Abutments on Concrete Footings

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: Some from stream on footings, some abutment damage from boulders on the southeast abutment, undermining on northwest abutment.

Interior Bents: None

Channel Bed: None

Channel Bank: None

EXISTING SCOUR PROTECTION

Type(3): None

Extent(4): None

Effectiveness(5): None

Obstructions(6): Fallen Trees and Boulders at both Abutments

DESIGN INFORMATION

Channel Bed Material(7): Sample results attached, material also includes Alluvium: boulders (13"+) to gravel (0.75"), Meta-arkose and trace Diabase.

Channel Bank Material(8): Sample results attached, material also includes Alluvium: Boulders (13"+) to gravel (0.75"), Meta-arkose and trace Diabase.

Channel Bank Cover(9): Mostly grass and small brush with boulders

Floodplain Width(10): 200'

Floodplain Cover(11): Grass, brush, trees and boulders

Stream is(12): Aggrading X Degrading ____ Static ____

Channel Migration Tendency(13): North to Northeast

Observations and Other Comments: ____

Reported by: Shawn P. Washer **Date:** 9/15/2005
Shawn P. Washer, P.E.

GEOTECHNICALLY ADJUSTED SCOUR ELEVATIONS(14) Feet x Meters ____

Comparison of GASE to Hydraulics Unit theoretical scour:
We agree with the scour computations presented in the Bridge Survey and Hydraulic Design Report for B-4318, dated 3/4/05.

GASE determined by: Bradley D. Whitley **Date:** 10-14-05

SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAl

Bed or Bank	Bed	Bank					
Sample No.	S-2	S-1					
Retained #4	61	35					
Passed #10	23	53					
Passed #40	10	28					
Passed #200	6	12					
Coarse Sand	92	80					
Fine Sand	3	11					
Silt	4	7					
Clay	1	2					
LL	25	28					
PI	NP	NP					
AASHTO	A-1-a (0)	A-2-4 (0)					
Station	16+38	16+60					
Offset	CL	CL					
Depth	0.0'-2.0'	0.0'-2.0'					

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 geotechnically adjusted scour elevation (GASE) 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 theoritical scour and the GASE. If the GASE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The GASE 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.

PROJECT #: 33655.1.1/B-4318

COUNTY: Watauga

DESCRIPTION: Bridge No. 321 over Watauga River on SR 1598 (Grandfather Road)

	CHANNEL BED MATERIAL			CHANNEL BANK MATERIAL		
SAMPLE #	S-2			S-1		
RETAINED #4	61			35		
PASSING #10	23			53		
PASSING #40	10			28		
PASSING # 200	6			12		
COARSE SAND	92			80		
FINE SAND	3			11		
SILT	4			7		
CLAY	1			2		
LL	25			28		
PL	NP			NP		
AASHTO CLASSIFICATION	A-1-a (0)			A-2-4 (0)		
STATION	16+38			16+60		
OFFSET	CL			CL		
DEPTH	0.0'-2.0'			0.0'-2.0'		

Florence & Hutcheson, Inc.

CONSULTING ENGINEERS

SOIL CLASSIFICATION

Project Name	: Bridge No. 321 over Watauga River on S.R. 1598		
Project No.	: 05001	Sample No.	: S - 1
Project County	: Watauga	Sample Loc.	: Bank
Project State	: North Carolina	Sample Depth	: 0.0' to 2.0'
Laboratory No.	: 05001 - 04	Date Tested	: 09-08-05
Submitted By	: Florence & Hutcheson, Inc.	Date Reported	: 09-13-05
Soil Type	: Brown & Gray Silty Gravel		

				% Passing
4	in.	100	mm	
3 1/2	in.	90	mm	
3	in.	75	mm	
2 1/2	in.	63	mm	
2	in.	50	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	100.0
1 1/4	in.	31.5	mm	
1	in.	25	mm	92.0
3/4	in.	19	mm	85.4
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	74.1
No.4		4.75	mm	64.6
No.6		3.35	mm	
No.8		2.36	mm	
No.10		2	mm	52.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	27.6
No.50		0.3	mm	
No.60		0.25	mm	20.4
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	11.9
No.270		0.053	mm	9.8
Hyd. Rd.	# 1	0.0090	mm	4.0
Hyd. Rd.	# 2	0.0064	mm	3.2
Hyd. Rd.	# 3	0.0046	mm	1.8
Hyd. Rd.	# 4	0.0035	mm	1.3
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D50 = 1.7120mm

Califomia Bearing Ratio	: NA
Maximum Dry Density	: NA
Optimum Moisture	: NA

Natural Moisture (%)	: NA
Liquid Limit	: 28
Plastic Limit	: NP
Plasticity Index	: NP
Liquidity Index	: NA
Activity	: NA
Specific Gravity	: 2.704
AASHTO Classification	: A-2-4 (0)
ASTM Classification	: SW-SM

AASHTO Composition of Total Sample

Gravel (3in. + No.10)	: 47.5
Coarse Sand (-No.10 + No.40)	: 24.9
Fine Sand (-No.40 + No.200)	: 15.7
Silt (-No.200 + 0.002mm)	: 10.8
Clay (-0.002mm + 0.001mm)	: 0.2
Colliods (-0.001mm)	: 0.8

ASTM Composition of Total Sample

Coarse Gravel (3in. + 3/4in.)	: 14.6
Fine Gravel (-3/4in. + No.4)	: 20.8
Coarse Sand (-No.4 + No.10)	: 12.1
Medium Sand (-No.10 + No.40)	: 24.9
Fine Sand (-No.40 + No.200)	: 15.7
Silt (-No.200 + 0.005mm)	: 9.7
Clay (-0.005mm + 0.001mm)	: 1.3
Colliods (-0.001mm)	: 0.8

N. C. Composition of Total Sample

Coarse Gravel (3in. + No.10)	: 47.5
Coarse Sand (-No.10 + No.60)	: 32.1
Fine Sand (-No.60 + No.270)	: 10.6
Silt (-No.270 + 0.005mm)	: 7.6
Clay (-0.005mm)	: 2.2

Approved By : SPW

Soil No. 4

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mail@flohut.com

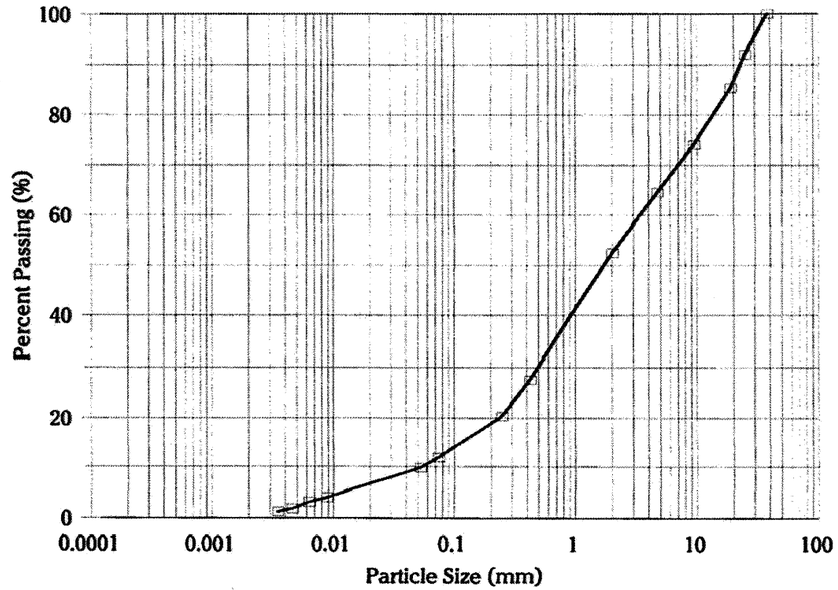
Florence & Hutcheson, Inc.

CONSULTING ENGINEERS

SOIL CLASSIFICATION

Project Name	: Bridge No. 321 over Watauga River on S.R. 1598		
Project No.	: 05001	Sample No.	: S - 1
Project County	: Watauga	Sample Loc.	: Bank
Project State	: North Carolina	Sample Depth	: 0.0' to 2.0'
Laboratory No.	: 05001 - 04	Date Tested	: 09-08-05
Submitted By	: Florence & Hutcheson Inc.	Date Reported	: 09-13-05
Soil Type	: Brown & Gray Silty Gravel		

Grain Size Distribution



Minus 2.00mm Fraction
Soil Mortar = 100% (as per NCDOT)

Coarse Sand Retained #60	Fine Sand Retained #270	Silt 0.05 to 0.005mm	Clay <0.005mm
61.1	20.1	15.6	3.2

Approved By : SPW

Soil No. 4

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Florence & Hutcheson, Inc.

CONSULTING ENGINEERS

SOIL CLASSIFICATION

Project Name	: Bridge No. 321 over Watauga River on S.R. 1598		
Project No.	: 05001	Sample No.	: S - 2
Project County	: Watauga	Sample Loc.	: Channel Bed
Project State	: North Carolina	Sample Depth	: 0.0' to 2.0'
Laboratory No.	: 05001 - 04	Date Tested	: 09-08-05
Submitted By	: Florence & Hutcheson, Inc.	Date Reported	: 09-13-05
Soil Type	: Brown & Gray Gravel		

				% Passing
4	in.	100	mm	
3 1/2	in.	90	mm	
3	in.	75	mm	
2 1/2	in.	63	mm	100.0
2	in.	50	mm	97.7
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	95.1
1 1/4	in.	31.5	mm	
1	in.	25	mm	86.2
3/4	in.	19	mm	79.7
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	57.8
No.4		4.75	mm	39.5
No.6		3.35	mm	
No.8		2.36	mm	
No.10		2	mm	23.2

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	9.5
No.50		0.3	mm	
No.60		0.25	mm	7.9
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	5.5
No.270		0.053	mm	4.9
Hyd. Rd.	# 1	0.0087	mm	1.7
Hyd. Rd.	# 2	0.0062	mm	1.2
Hyd. Rd.	# 3	0.0045	mm	0.9
Hyd. Rd.	# 4	0.0034	mm	0.7
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D50 = 7.0699mm

California Bearing Ratio	: NA	Natural Moisture (%)	: NA
Maximum Dry Density	: NA	Liquid Limit	: 25
Optimum Moisture	: NA	Plastic Limit	: NP
		Plasticity Index	: NP
		Liquidity Index	: NA
		Activity	: NA
		Specific Gravity	: 2.803
		AASHTO Classification	: A-1-a (0)
		ASTM Classification	: GW-GM

AASHTO Composition of Total Sample

Gravel (3in. + No.10)	: 76.8
Coarse Sand (-No.10 + No.40)	: 13.7
Fine Sand (-No.40 + No.200)	: 4.0
Silt (-No.200 + 0.002mm)	: 4.9
Clay (-0.002mm + 0.001mm)	: 0.1
Colliods (-0.001mm)	: 0.4

ASTM Composition of Total Sample

Coarse Gravel (3in. + 3/4in.)	: 20.3
Fine Gravel (-3/4in. + No.4)	: 40.2
Coarse Sand (-No.4 + No.10)	: 16.3
Medium Sand (-No.10 + No.40)	: 13.7
Fine Sand (-No.40 + No.200)	: 4.0
Silt (-No.200 + 0.005mm)	: 4.5
Clay (-0.005mm + 0.001mm)	: 0.6
Colliods (-0.001mm)	: 0.4

N. C. Composition of Total Sample

Coarse Gravel (3in. + No.10)	: 76.8
Coarse Sand (-No.10 + No.60)	: 15.3
Fine Sand (-No.60 + No.270)	: 3.0
Silt (-No.270 + 0.005mm)	: 3.9
Clay (-0.005mm)	: 1.0

Approved By : SPW

Soil No. 5

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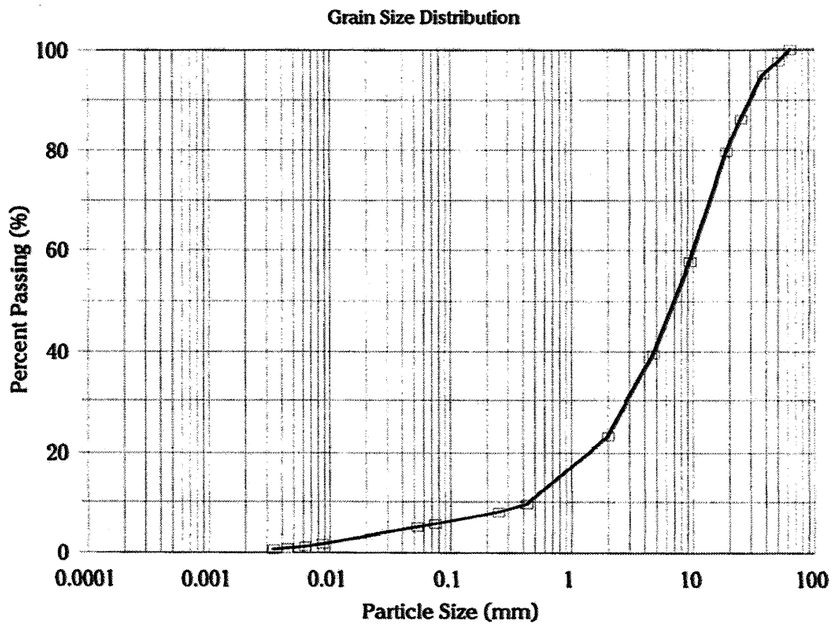
Florence & Hutcheson, Inc.

CONSULTING ENGINEERS

SOIL CLASSIFICATION

Project Name	: Bridge No. 321 over Watauga River on S.R. 1598		
Project No.	: 05001	Sample No.	: S - 2
Project County	: Watauga	Sample Loc.	: Channel Bed
Project State	: North Carolina	Sample Depth	: 0.0' to 2.0'
Laboratory No.	: 05001 - 04	Date Tested	: 09-08-05
Submitted By	: Florence & Hutcheson Inc.	Date Reported	: 09-13-05
Soil Type	: Brown & Gray Gravel		



Minus 2.00mm Fraction
Soil Mortar = 100% (as per NCDOT)

Coarse Sand Retained #60	Fine Sand Retained #270	Silt 0.05 to 0.005mm	Clay <0.005mm
66.0	13.1	19.1	1.8

Approved By : SPW

Soil No. 5

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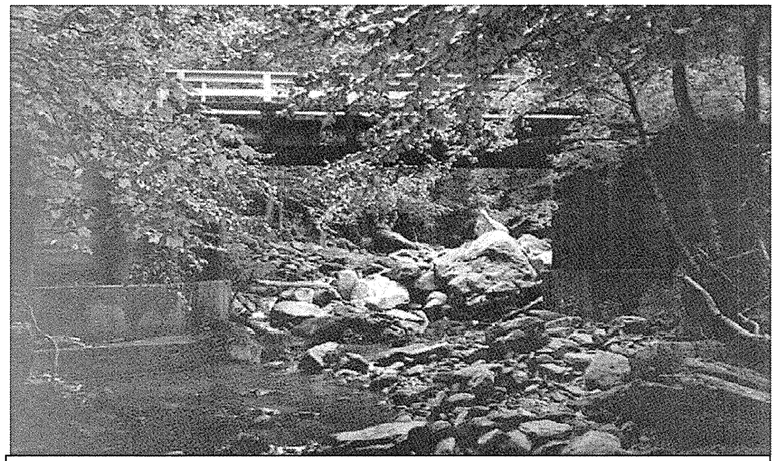
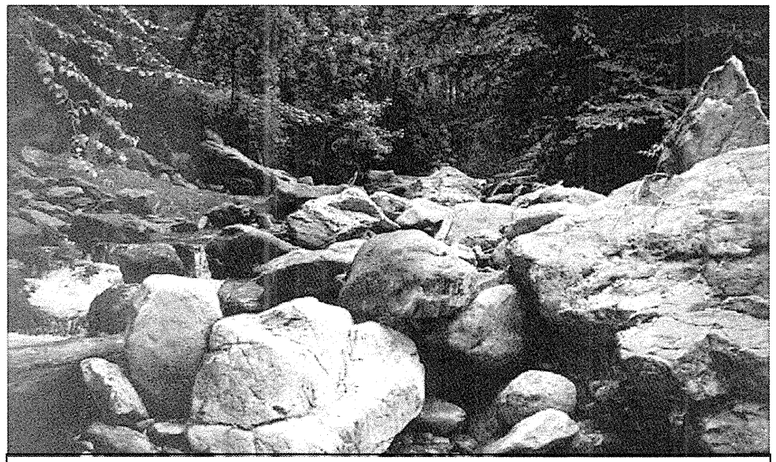
PHOTOGRAPHIC RECORD

Replacement of Bridge No. 321 on SR 1598 over Watauga River

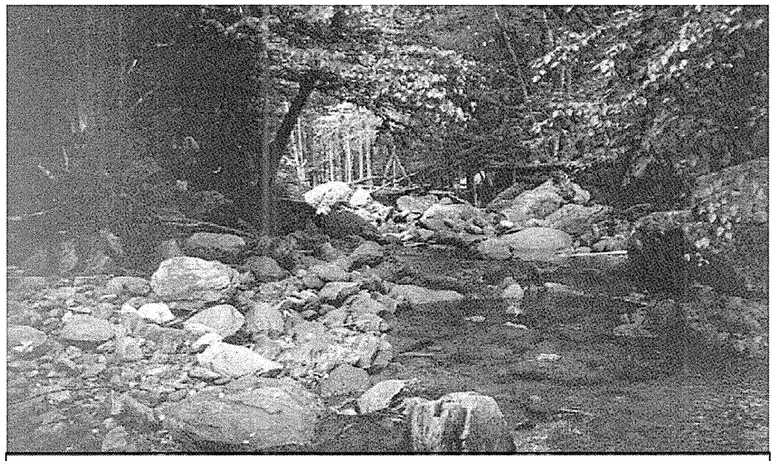
Photograph No. 1:
This photograph was taken standing on the south end of the existing bridge looking north.



Photograph No. 2:
This photograph was taken from the center of the new bridge location looking south at old bridge.



Photograph No. 3:
This photograph was taken underneath the center of the old bridge looking south upstream.



Photograph No. 4:
This photograph was taken underneath the center of the old bridge looking north downstream.