STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	33544.1.1 (B-4197)	1	13

STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION
33544.1.1		P.E.
		CONST.

ID: B-4197

CONTRACT:

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

STRUCTURE SUBSURFACE INVESTIGATION

STATE PROJECT 33544.1.1 I.D. NO. B-4197

F.A. PROJECT BRZ-1552(9)

COUNTY McDOWELL

PROJECT DESCRIPTION BRIDGE NO. 73 ON SR-1552 OVER DALES CREEK

SITE DESCRIPTION

CONTENTS:

CAUTION NOTICE

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INVESTIGATED BY C A DUNNAGAN PERSONNEL M M HAGAR

CHECKED BY W D FRYE, Jr G K ROSE

SUBMITTED BY W D FRYE, Jr L E LANKFORD

DATE JANUARY 2006

DRAWN BY: C A DUNNAGAN

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NORTH CAROLINA LICENSED GEOLOGIST CHARLES A. DUNNAGAN

C A Dunnagan

PROJECT REFERENCE NO.	SHEET NO.
33544.1.1 (B-4197)	2/13

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING 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 THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

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-7-5, A-7-6)	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							
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		NP	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

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	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	2.00	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, YELLOW-BROWN, 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 IS 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 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 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 SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SOUNDING ROD
- SPT CPT CPT SPT — 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
RM - RESILIENT MODULUS SAMPLE
RS - ROCK SAMPLE
RT - RECOMPACTED TRIAXIAL SAMPLE
CBR - CALIFORNIA BEARING RATIO 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, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B-___
- [ ] BK-51
- [ ] CME-45C
- [X] CME-550
- [ ] PORTABLE HOIST
- [ ] OTHER _____
- [ ] OTHER _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [ ] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [X] CASING [X] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [ ] CORE BIT
- [ ] OTHER _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B-_____
- [X] -N- XWL
- [ ] -H-_____

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

ROCK DESCRIPTION

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

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD 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 ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *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 GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S 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 THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: BM #2 - NAIL IN BASE OF 12" POPLAR, -BL- STA. 17+22, 50' RT
ELEVATION: 1242.23 FT.

NOTES:

REVISED 03/07/05

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

January 9, 2006

STATE PROJECT: 33544.1.1 (B-4197)
COUNTY: McDowell

DESCRIPTION: Bridge No. 73 on SR-1552 over Dales Creek

SUBJECT: Geotechnical Report – Foundation Investigation

Introduction

This project is located in northeastern McDowell County, on the north shore of Lake James. Proposed is the replacement of the existing 3-span structure with a single span bridge. The span length is 95.0 feet with a skew of 60 degrees. The foundation investigation was conducted using a CME-550 drill machine. Borings were advanced using -N- casing and advancer. Standard Penetration Tests were performed at intervals of 5.0 feet. Rock core was retrieved using -NXWL- equipment. Due to the close proximity of horses, and their owner's inability to keep them fenced in, bore holes were filled immediately after drilling. Static groundwater elevations are almost certainly near the creek surface elevations.

Foundation Materials

End Bent One

The existing roadway embankment consists of 2.0 to 4.0 feet of silty sand and gravel. The alluvium under the embankment at EB1-A is 11.0 feet of medium to very dense gravel, cobbles and boulders. At EB1-B, it is 4.0 feet of very soft sandy silt with a basal gravel layer.

At both locations, the alluvium rests directly upon rock. At EB1-A, coring was begun at 15.5 feet (elevation 1222.8) and terminated at 24.7 feet (elevation 1213.6). The Recoveries were 90 and 100 percent. The RQD's were 90 and 88 percent.

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
1589 MAIL SERVICE CENTER
RALEIGH NC 27699-1589

TELEPHONE: 919-250-4088
FAX: 919-250-4237

WEBSITE: WWW.DOH.DOT.STATE.NC.US

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

End Bent Two

The embankment at EB2-A consists of sandy silt with gravel and cobbles. At EB2-B, it is a red silty clay with occasional gravel. No alluvium was encountered in the boring for EB2-A. At EB2-B, the alluvium consists of 2.0 feet of very stiff sandy silt underlain by 5.0 feet of very dense gravel, cobbles and boulders.

Coring was begun in EB2-A at 5.0 feet (elevation 1231.8) and terminated at 14.0 feet (elevation 1222.8). The Recoveries were 95 and 100 percent; the RQD's were also 95 and 100 percent. For EB2-B, coring was begun at 15.5 feet (elevation 1221.7) and terminated at 24.6 feet (elevation 1212.6). Both the Recoveries and RQD's were 95 and 100 percent.

Comments

In some cases, the rock line as noted on the borelogs and cross-sections, is higher than the coring elevation. This is due to the penetration of the casing advancer into the rock.

If piles are to be used on this project, pile-tip protection should be used. This is recommended because of the abundant cobbles and boulders.

Respectfully Submitted,

C. A. Dunnagan

Charles A. Dunnagan, L.G.
Project Engineering Geologist

PROJECT REFERENCE NO.	SHEET
33544.1.1 (B-4197)	

SITE PLAN

0 50 100
FEET

BEGIN -DETOUR
PT -L- Sta. 21+76.81

18" RCP

DALES CREEK

WOODS

-N-

-DET-

-L-

EB1-A

ROCK OUTCROP

EB2-A

EB1-B

EB2-B

WOODS

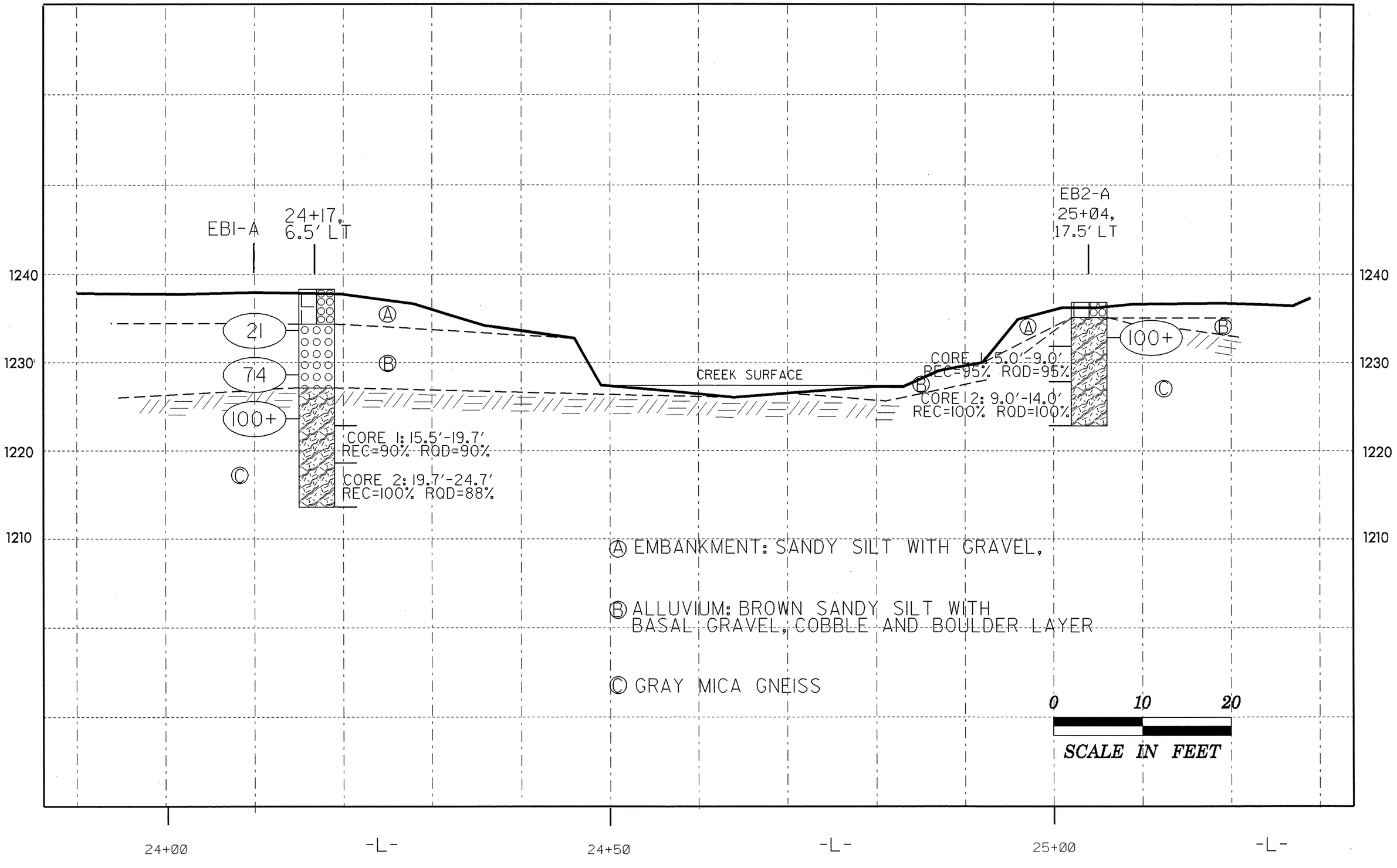
WOODS

BM-2 ELEV. = 1242.23
-BL- STA. 17+22 50' RT
NAIL IN BASE OF 12"
POPLAR

25

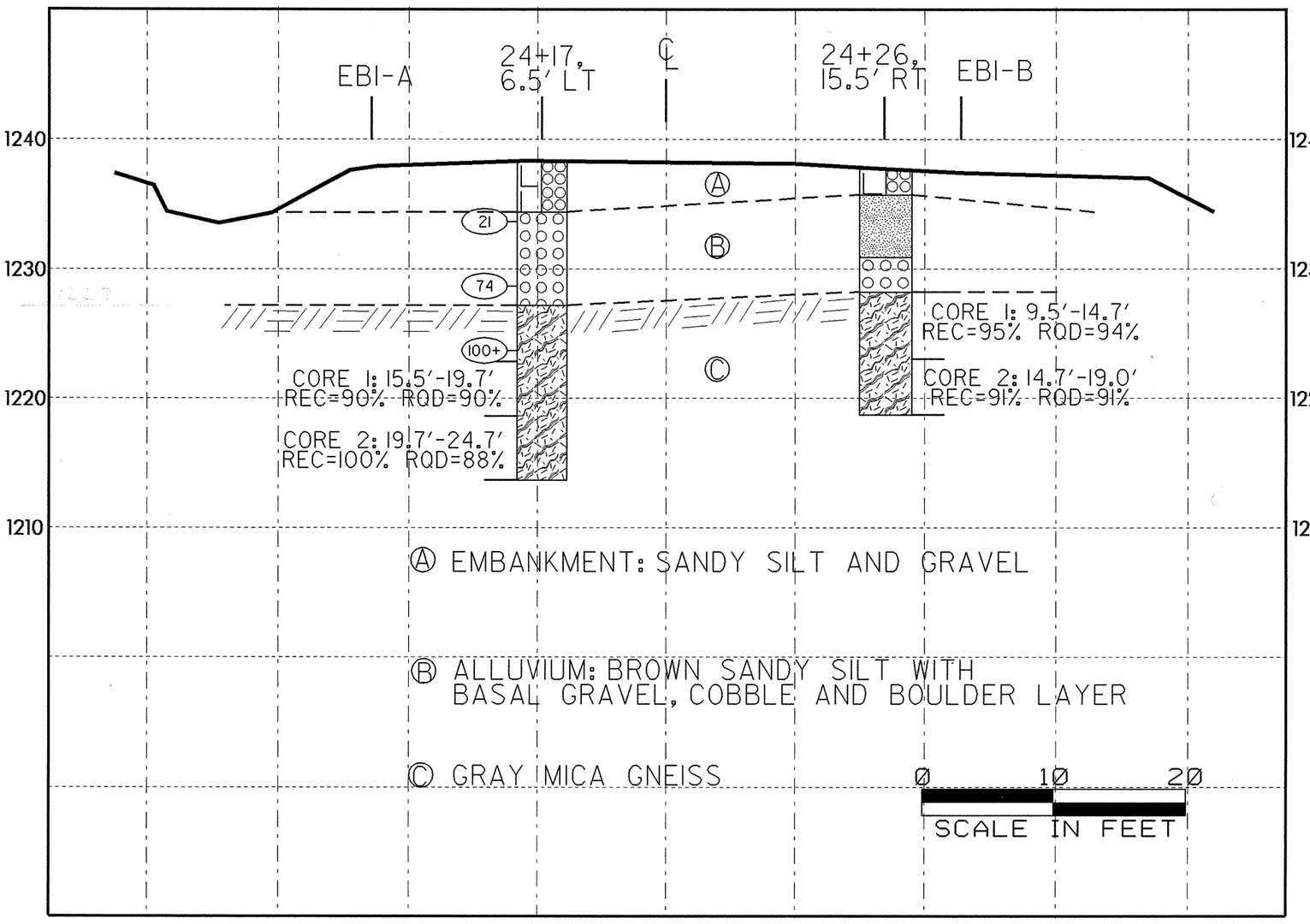
15

PROFILE THROUGH EBI-A TO EB2-A



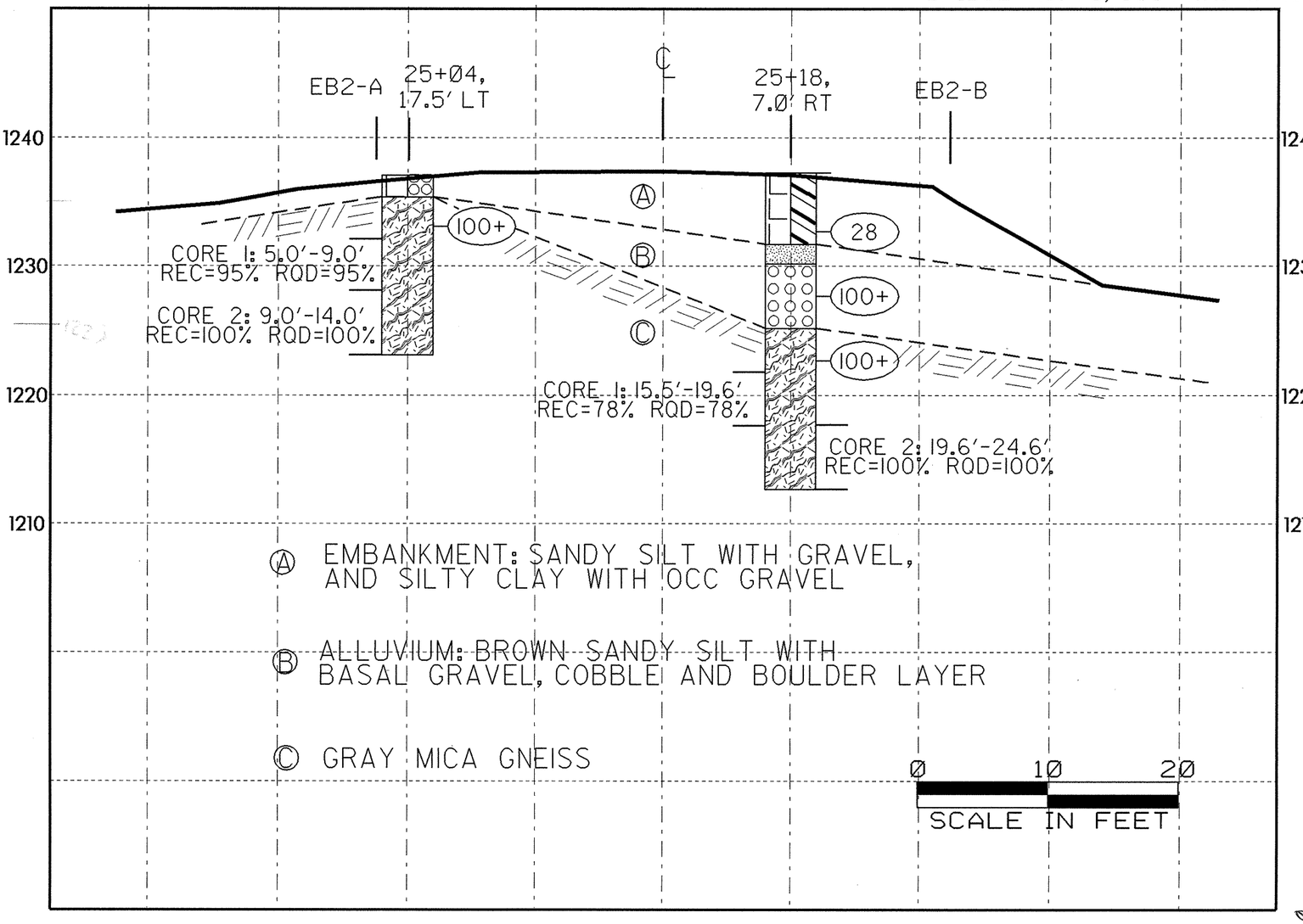
CROSS SECTION THROUGH END BENT ONE

BRIDGE NO. 73, 33544.1.1 (B-4197)



CROSS SECTION THROUGH END BENT TWO

BRIDGE NO. 73, 33544.1.1 (B-4197)



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL UNIT BORING LOG

PROJECT NO 33544.1.1	**ID** B-4197	**COUNTY** MCDOWELL	**GEOLOGIST** M M HAGER
SITE DESCRIPTION BRIDGE NO. 73 ON SR-1552 OVER DALES CREEK			**GND WATER**
BORING NO EB1-A	**NORTHING** 0.00	**EASTING** 0.00	**0 HR** N/A
ALIGNMENT -L-	**BORING LOCATION** 24+17.000	**OFFSET** 6.50ft LT	**24 HR** N/A
COLLAR ELEV 1238.28ft	**TOTAL DEPTH** 24.70ft	**START DATE** 1/04/06	**COMPLETION DATE** 01/04/06
DRILL MACHINE CME 550	**DRILL METHOD** SPT CORE BORING		**HAMMER TYPE** AUTOMATIC
SURFACE WATER DEPTH	**DEPTH TO ROCK** N/A		**Log EB1-A, Page 1 of 1**

ELEV	DEPTH	BLOW CT 6in	6in	6in	PEN (ft)	BLOWS PER FOOT 0 25 50 75 100	SAMPLE NO	MOI	LOG	SOIL AND ROCK DESCRIPTION
1238.28						Ground Surface				
	4.70	4	12	9	1.0	21				EMBANKMENT: SANDY SILT WITH GRAVEL AND BOULDERS
1230.00	9.70	17	12	62	1.0	74				ALLUVIUM: BROWN SAND, GRAVEL, COBBLES AND BOULDERS WITH MICA, SATURATED
	14.70	60			0.1	60				GRAY MICA GNEISS
1220.00										CORE 1: 15.5'- 19.7' REC=90% RQD=90%
										CORE 2: 19.7'- 24.7' REC=100% RQD=88%
1213.58						BORING TERMINATED AT ELEV 1213.58 IN ROCK				

7/13

SHEET 1 OE1

DATE 5-Jan-06

CORE BORING REPORT

PROJECT: 33544.1.1 I. D. NO: B-4197 BORING NO: EB1-A GEOLOGIST: C A Dunnagan

DESCRIPTION: Bridge No. 73 on SR-1552 over Dales Creek

COUNTY: McDowell COLLAR ELEVATION: 1238.3 FT. TOTAL DEPTH: 24.7 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET %	RQD. FEET %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
1222.8	15.5		4.2	3.8 / 90	3.8 / 90		Light gray mica gneiss. Hard, fresh with a trace of pyrite. Moderately weathered zone from 20.7ft to 20.8ft.
1218.6	19.7						
1218.6	19.7		5.0	5.0 / 100	4.4 / 88		a) Occasional parts along foliation @ 40°. b) Joint @ 10°.
1213.6	24.7						

CORING TERMINATED AT ELEVATION 1213.6 FT.

DRILLER: G K Rose CORE SIZE: NXWL EQUIPMENT: CME-550

8/13

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL UNIT BORING LOG

PROJECT NO 33544.1.1	**ID** B-4197	**COUNTY** MCDOWELL	**GEOLOGIST** M M HAGER
SITE DESCRIPTION BRIDGE NO. 73 ON SR-1552 OVER DALES CREEK			**GND WATER**
BORING NO EB1-B	**NORTHING** 0.00	**EASTING** 0.00	**0 HR** N/A
ALIGNMENT -L-	**BORING LOCATION** 24+26.000	**OFFSET** 15.50ft RT	**24 HR** N/A
COLLAR ELEV 1238.28ft	**TOTAL DEPTH** 19.00ft	**START DATE** 12/29/05	**COMPLETION DATE** 12/29/05
DRILL MACHINE CME 550	**DRILL METHOD** SPT CORE BORING		**HAMMER TYPE** AUTOMATIC
SURFACE WATER DEPTH	**DEPTH TO ROCK** N/A		**Log EB1-B, Page 1 of 1**

ELEV	DEPTH	BLOW CT 6in	6in	6in	PEN (ft)	BLOWS PER FOOT 0 25 50 75 100	SAMPLE NO	MOI	LOG	SOIL AND ROCK DESCRIPTION
1238.28						Ground Surface				
	4.90	0	0	0	1.0	0			FILL	EMBANKMENT: SILTY SAND AND GRAVEL
										ALLUVIUM: GRAY SANDY SILT WITH MICA
1230.00										ALLUVIUM: SAND, GRAVEL AND BOULDERS
										CORE 1: 9.5'- 14.7' REC=94% RQD=94%
1220.00										CORE 2: 14.7'- 19.0' REC=91% RQD=91%
1219.28						BORING TERMINATED AT ELEV 1219.28 IN ROCK				

SHEET 1 OF 1

DATE 30-Dec-05

CORE BORING REPORT

PROJECT: 33544.1.1 I. D. NO: B-4197 BORING NO: EB1-B GEOLOGIST: C A Dunnagan

DESCRIPTION: Bridge No. 73 on SR-1552 over Dales Creek

COUNTY: McDowell COLLAR ELEVATION: 1238.3 FT. TOTAL DEPTH: 19.0 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET	REC. %	RQD. FEET	RQD. %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
1228.8	9.5		5.2	4.9	94	4.9	94		Medium light gray mica gneiss. Hard and fresh with occasional slickensides. a) Occasional parts along foliation @ 60°.
1223.6	14.7								
1223.6	14.7		4.3	3.9	91	3.9	91		
1219.3	19.0								

CORING TERMINATED AT ELEVATION 1219.3 FT.

DRILLER: G K Rose CORE SIZE: NXWL EQUIPMENT: CME-550

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL UNIT BORING LOG

PROJECT NO 33544.1.1	**ID** B-4197	**COUNTY** MCDOWELL	**GEOLOGIST** M M HAGER
SITE DESCRIPTION BRIDGE NO. 73 ON SR-1552 OVER DALES CREEK			**GND WATER**
BORING NO EB2-A	**NORTHING** 0.00	**EASTING** 0.00	**0 HR** N/A
ALIGNMENT -L-	**BORING LOCATION** 25+04.000	**OFFSET** 17.50ft LT	**24 HR** N/A
COLLAR ELEV 1236.75ft	**TOTAL DEPTH** 14.00ft	**START DATE** 12/28/05	**COMPLETION DATE** 12/29/05
DRILL MACHINE CME 550	**DRILL METHOD** SPT CORE BORING		**HAMMER TYPE** AUTOMATIC
SURFACE WATER DEPTH	**DEPTH TO ROCK** N/A		**Log EB2-A, Page 1 of 1**

ELEV	DEPTH	BLOW CT 6in	6in	6in	PEN (ft)	BLOWS PER FOOT 0 25 50 75 100	SAMPLE NO	MOI	LOG	SOIL AND ROCK DESCRIPTION
1236.75						Ground Surface				
	4.00	60			0.1	60				EMBANKMENT: SANDY SILT WITH GRAVEL AND COBBLES
1230.00										GRAY MICA GNEISS
										CORE 1: 5.0'- 9.0' REC=95% RQD=95%
										CORE 2: 9.0'- 14.0' REC=100% RQD=100%
1222.75						BORING TERMINATED AT ELEV 1222.75 IN ROCK				

SHEET 1 OF 1

DATE 30-Dec-05

CORE BORING REPORT

PROJECT: 33544.1.1 I. D. NO: B-4197 BORING NO: EB2-A GEOLOGIST: C A Dunnagan

DESCRIPTION: Bridge No. 73 on SR-1552 over Dales Creek

COUNTY: McDowell COLLAR ELEVATION: 1236.8 FT. TOTAL DEPTH: 14.0 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET	REC. %	RQD. FEET	RQD. %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
1231.8	5.0		4.0	3.8	95	3.8	95		Gray mica gneiss with quartz/feldspar rich zones. a) Occasional parts along foliation @ 45°.
1227.8	9.0		5.0	5.0	100	5.0	100		
1222.8	14.0								

CORING TERMINATED AT ELEVATION 1222.8 FT.

DRILLER: G K Rose CORE SIZE: NXWL EQUIPMENT: CME-550

10/13

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL UNIT BORING LOG

PROJECT NO 33544.1.1	**ID** B-4197	**COUNTY** MCDOWELL	**GEOLOGIST** M M HAGER	
SITE DESCRIPTION BRIDGE NO. 73 ON SR-1552 OVER DALES CREEK				**GND WATER**
BORING NO EB2-B	**NORTHING** 0.00		**EASTING** 0.00	**0 HR** N/A
ALIGNMENT -L-	**BORING LOCATION** 25+18.000		**OFFSET** 7.00ft RT	**24 HR** N/A
COLLAR ELEV 1237.16ft	**TOTAL DEPTH** 24.60ft	**START DATE** 1/03/06		**COMPLETION DATE** 01/03/06
DRILL MACHINE CME 550	**DRILL METHOD** SPT CORE BORING			**HAMMER TYPE** AUTOMATIC
SURFACE WATER DEPTH	**DEPTH TO ROCK** N/A			**Log EB2-B, Page 1 of 1**

ELEV	DEPTH	BLOW CT 6in	BLOW CT 6in	BLOW CT 6in	PEN (ft)	BLOWS PER FOOT 0 25 50 75 100	SAMPLE NO	MOI	LOG	SOIL AND ROCK DESCRIPTION
1237.16						Ground Surface				
	4.60	0	3	25	1.0	28				EMBANKMENT: RED SILTY CALY WITH OCC GRAVEL, MOIST
1230.00										ALLUVIUM: BROWN SANDY SILT
	9.60	3	100		0.3	100				ALLUVIUM: GRAVEL, COBBLES AND BOULDERS
	14.60	60			0.1	60				GRAY MICA GNEISS
1220.00										CORE 1: 15.5'- 19.6' REC=95% RQD=95%
										CORE 2: 19.6'- 24.6' REC=100% RQD=100%
1212.56						BORING TERMINATED AT ELEV 1212.56 IN ROCK				

SHEET 1 OF 1

DATE 5-Jan-06

CORE BORING REPORT

PROJECT: 33544.1.1 I. D. NO: B-4197 BORING NO: EB2-B GEOLOGIST: C A Dunnagan

DESCRIPTION: Bridge No. 73 on SR-1552 over Dales Creek

COUNTY: McDowell COLLAR ELEVATION: 1237.2 FT. TOTAL DEPTH: 24.6 FT.

ELEV. (FEET)	DEPTH (FEET)	DRILL RATE MIN./FT.	RUN (FEET)	REC. FEET	REC. %	RQD. FEET	RQD. %	SAMP. #	FIELD CLASSIFICATION AND REMARKS
1221.7	15.5								
			4.1	3.9	95	3.9	95		
1217.6	19.6								Light gray mica gneiss. Hard, fresh with occasional quartz/feldspar veins.
1217.6	19.6								
			5.0	5.0	100	5.0	100		
1212.6	24.6								

CORING TERMINATED AT ELEVATION 1212.6 FT.

DRILLER: G K Rose CORE SIZE: NXWL EQUIPMENT: CME-550

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT

FIELD SCOUR REPORT

PROJECT: 33544.1.1 ID: B-4197 COUNTY: McDowell

DESCRIPTION(1): Bridge No. 73 on SR-1552 over Dales Creek.

EXISTING BRIDGE

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

Bridge No.: 73 Length. 63 ft Total Bents: 4 Bents in Channel: 1 Bents in Floodplain: 3
Foundation Type: Footings.

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: Minor amount at EB2.

Interior Bents: NE corner of B2-A no longer in contact with rock.

Channel Bed: None noted.

Channel Bank: Upstream west bank is undercut from existing bridge to small stream flowing in from the west- approximately 20 feet.

EXISTING SCOUR PROTECTION

Type(3): Concrete end-bent walls with wingwalls.

Extent(4): Wingwalls extend 5 feet frowm either end of the end-bent walls.

Effectiveness(5): Damn good!

Obstructions(6): Boulders to 3 feet in diameter are in the stream channel.

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.

DESIGN INFORMATION

Channel Bed Material(7): Gravel, cobbles and boulders.

Channel Bank Material(8): Sand with gravel, cobbles and boulders.

Channel Bank Cover(9): Trees and shrubs.

Floodplain Width(10): NW>100 feet; NE=50 feet; SW=0 feet; SE=0 feet.

Floodplain Cover(11): Trees.

Stream is(12): Aggrading Degrading X Static

Channel Migration Tendency(13): East.

Observations and Other Comments: Rock is exposed in the creek bed as well as in the existing road cuts.

GEOTECHNICALLY ADJUSTED SCOUR ELEVATIONS(14) Feet X Meters

	BENTS B1	B2	B3	B4							
SB Lanes, Lt											
SB Lanes, Rt											
NB Lanes, Lt											
NB Lanes, Rt											

Comparison of GASE to Hydraulics Unit theoretical scour:

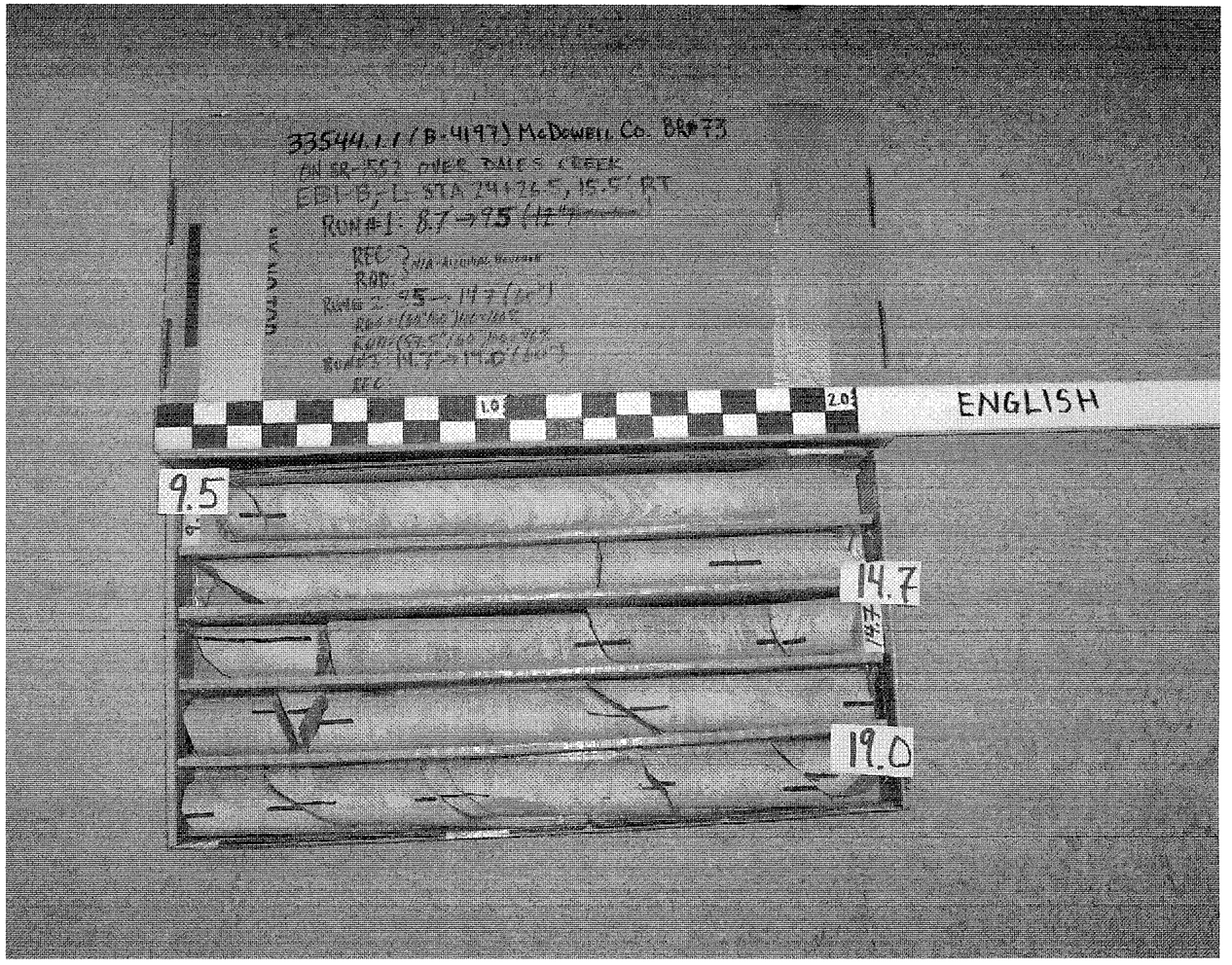
SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL

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

Reported by: C A Dunnagan **Date:** 12/19/2005

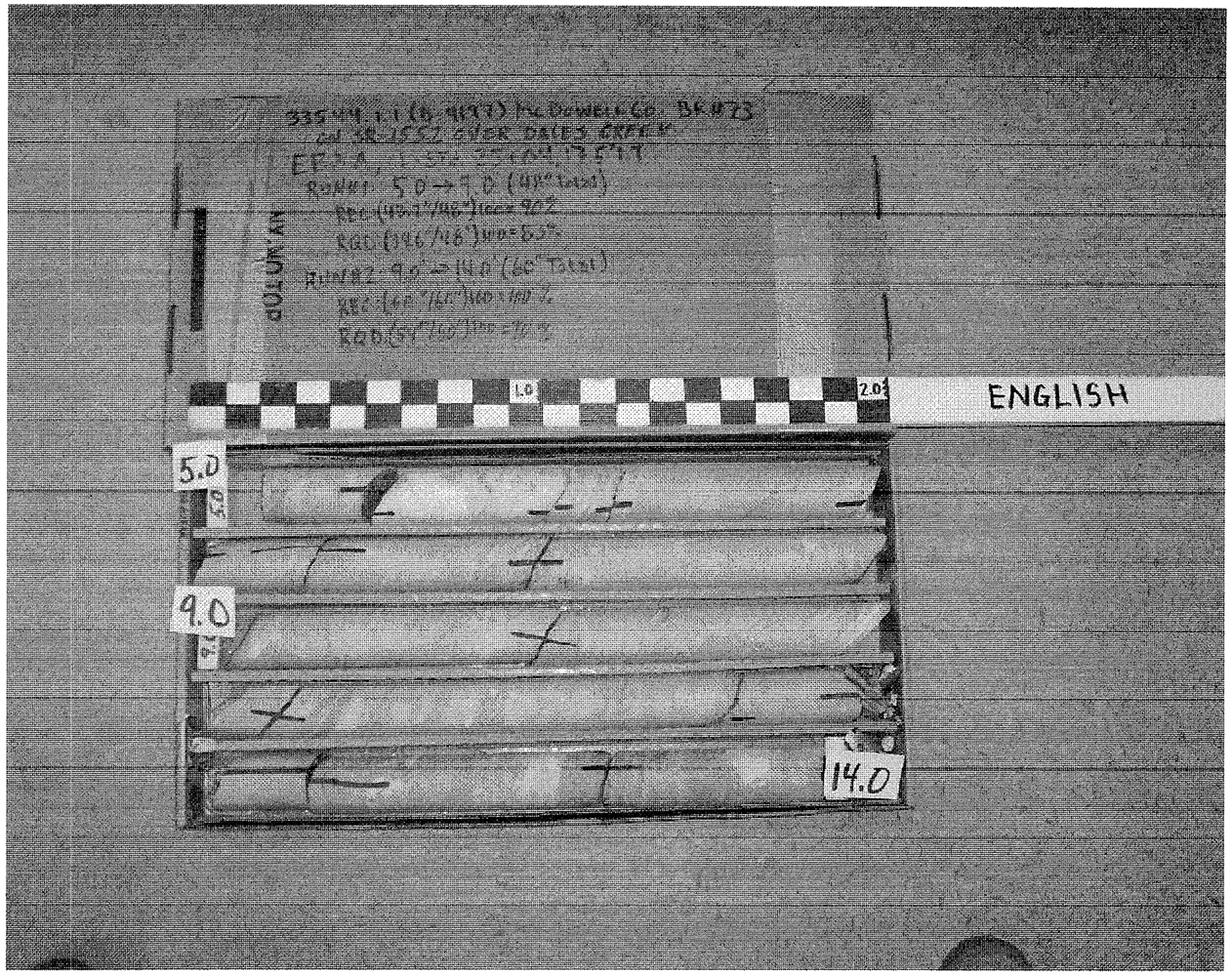
c

33544.1.1 (B-4197)
McDowell County
Bridge No. 73 on SR-1552 over Dales Creek
EB1-A
Box 1 of 1



33544.1.1 (B-4197)
McDowell County
Bridge No. 73 on SR-1552 over Dales Creek
EB1-B
Box 1 of 1

c



33544.1.1 (B-4197)
McDowell County
Bridge No. 73 on SR-1552 over Dales Creek
EB2-A
Box 1 of 1

c

33544.1.1 (B-4197)
McDowell County
Bridge No. 73 on SR-1552 over Dales Creek
EB2-B
Box 1 of 1