

PROJECT: 33600.II ID: B-4258

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

STRUCTURE SUBSURFACE INVESTIGATION

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STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4258	1	29
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
33600.II	BRSTP-0064(I)	P.E.	
			CONST.

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) 250-4068. 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 UN-PLACED TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

STATE PROJECT 33600.II I.D. NO. B-4258
 F.A. PROJECT BRSTP-0064(I)
 COUNTY RUTHERFORD
 PROJECT DESCRIPTION BRIDGE No. 7 ON
US 64/74 OVER BROAD RIVER

 SITE DESCRIPTION _____

For Letting

INVESTIGATED BY D.M. Grogg PERSONNEL M. Johnson
 CHECKED BY S.P. Washer F. Woodard
 SUBMITTED BY S.P. Washer D. Kofron
 DATE 7-13-07 M. Brown

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 IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.



SEAL

 SIGNATURE Shawn P. Washer

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

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B-4258	33600.II	2	29

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION										GRADATION										ROCK DESCRIPTION										TERMS AND DEFINITIONS																																																																																																		
<p>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. EXAMPLES:</p> <p align="center"><i>VERY STIFF, GRAY SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i></p>										<p>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)</p> <p>GAP-GRADED- INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.</p> <p align="center">ANGULARITY OF GRAINS</p> <p>THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.</p>										<p>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.</p> <p>ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>										<p>ALLUVIUM (ALLUV.) - SOILS WHICH HAVE BEEN TRANSPORTED BY WATER.</p> <p>AQUIFER - A WATER BEARING FORMATION OR STRATA.</p> <p>ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.</p> <p>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.</p> <p>ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.</p> <p>CALCAREOUS (CALC.) - SOILS WHICH CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.</p> <p>COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.</p> <p>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.</p> <p>DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.</p> <p>DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.</p> <p>DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.</p> <p>FALLT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.</p> <p>FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.</p> <p>FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLOGGED FROM PARENT MATERIAL.</p> <p>FLOOD PLAIN (F.P.) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.</p> <p>FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.</p> <p>JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.</p> <p>LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.</p> <p>LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.</p> <p>MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.</p> <p>PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.</p> <p>RESIDUAL SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.</p> <p>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.</p> <p>SAPROLITE (SAP.) - RESIDUAL SOIL WHICH RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.</p> <p>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.</p> <p>SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.</p> <p>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.</p> <p>STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.</p> <p>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.</p> <p>TOPSOIL (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>																																																																																																		
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MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.																																																																																																																															
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.																																																																																																																															
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.																																																																																																																															
<p align="center">PLASTICITY</p> <table border="1"> <tr> <th>NONPLASTIC</th> <th>PLASTICITY INDEX (PI)</th> <th>DRY STRENGTH</th> </tr> <tr> <td>LOW PLASTICITY</td> <td>0-5</td> <td>VERY LOW</td> </tr> <tr> <td>MED. PLASTICITY</td> <td>6-15</td> <td>SLIGHT</td> </tr> <tr> <td>HIGH PLASTICITY</td> <td>16-25</td> <td>MEDIUM</td> </tr> <tr> <td></td> <td>26 OR MORE</td> <td>HIGH</td> </tr> </table>										NONPLASTIC	PLASTICITY INDEX (PI)	DRY STRENGTH	LOW PLASTICITY	0-5	VERY LOW	MED. PLASTICITY	6-15	SLIGHT	HIGH PLASTICITY	16-25	MEDIUM		26 OR MORE	HIGH	<p align="center">COLOR</p> <p>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.</p>																																																																																																							
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July 13, 2007

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. 7 on US 64 / 74 Over Broad River
 Rutherford County, North Carolina
 Project No. 33600.1.1
 ID B-4258**

Project Description:

The subsurface investigation for the referenced project has been completed and compiled into this geotechnical package. 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 US 64 approximately 0.6 mile northwest of Lake Lure NC, near the western most extent of the lake. US 64 will be re-aligned to accommodate approaches for a new three-span bridge over the French Broad River at this location. This new structure will have a width of 36', a length of 295' and a skew angle varying from 123° to 146° with -L-. Fill depths at the abutments range from 4 to 14 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 May 12 and May 17, 2007. Eight (8) total test borings were advanced using a skid-mounted CME 45C drill rig for the four (4) "land borings" and a barge-mounted CME 45C drill rig with NW casing for the four (4) "water borings" respectively. Upon auger refusal or 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 Broad River. Borings were surveyed and staked and additional field data provided by F&H surveyors, with survey control provided by NCDOT personnel.

The collected soil and rock samples were visually described in the field then documented on the field logs. The samples were then moved to the laboratory, tested and grouped into strata units. Laboratory testing consisted of liquid limit, plastic limit, sieve and hydrometer grain size analysis, unconfined compression, one-dimensional consolidation properties and rock unconfined compression. A representative sample of the material from the channel bed was also subjected to laboratory analysis. Rock core data including identified and described rock type, Core Recovery (REC) and Rock Quality Designation (RQD) determinations for each core run interval, and Strata Recovery and Strata Rock

Mr. Don Moore
 July 13, 2007

Quality Designation (SREC and SRQD) for each discrete rock unit were recorded. Rock core specimens were selected for laboratory testing of unconfined compressive strength.

Geology:

The project site is located within the Inner Piedmont block, near the eastern boundary of the Chauga Belt, as depicted by the *Geologic Map of North Carolina (1985)*. Lithologic units exposed are not assigned to a formal formation rather are described as "massive to foliated, granodioritic, migmatic, porphyroblastic gneiss". Nearby units include biotite gneiss and schist and Henderson Gneiss. Units are assigned to the Cambrian Period to Late Proterozoic Era.

Split spoon sampling, Shelby tube sampling and rock coring operations conducted at the bridge site intercepted alluvial, colluvial and residual origin materials. Alluvium materials consist of boulders, cobbles, gravel, sand, silt and clay deposited in irregular thickness across the site. Boulders are noted within alluvium units and exposed at the surface upstream from the proposed bridge site but likely were deposited from up slope through gravity movement. Colluvium units are intermingled with some of the alluvium units and consist of boulders and cobbles with finer gradation materials infilling between the boulders and cobbles. Residual units consist of silty sand and silt overlying the weathered rock and unweathered bedrock at End Bent 2.

Underlying rock recovered from core borings was described as predominately moderately weathered to fresh, hard to very hard granitic gneiss. Thin (0.1' to 0.5') moderately severe to completely weathered intervals, developed along horizontal fractures, were noted throughout cores recovered from the rock mass. Material interpreted as Alluvium was intercepted within core runs but was composed of granitic gneiss, granodiorite, and quartzite broken and rounded into gravel, cobbles and boulders. This strata unit underlies unconsolidated material described above and overlies in-situ granitic gneiss. Iron (Fe) oxide staining is prevalent throughout much of the recovered rock core with accumulations also on fracture faces. Fracturing ranges from open to healed with orientations ranging from horizontal (0°) to 85°. Advanced borings were terminated in granitic gneiss at elevations ranging from 975.0 feet to 950.0 feet. The inferred rock line is interpreted to range from 970.1 feet to 992.9 feet beneath the proposed structure footprint.

Two (2) in-situ rock outcrops were noted southeast of the site along US 64 / US 74 (-L-) at Station 22+00± to 23+50± and Chimney Cliffs Drive (-Y2-) at Station 10+20± to 10+40± respectively. The rock outcrop exposed along -L- is described as massive granodiorite with pegmatite veins, fresh and very hard. The rock outcrop exposed along -Y2- is described as foliated granitic gneiss, moderately weathered and hard to medium hard. Rock data collected from discontinuities in these outcrops is summarized below.

Outcrop along -L-

<u>Discontinuity</u>	<u>Dip / Dip Azimuth</u>
Fracture 1	74° / 017°
Foliation	21° / 000°
Fracture 2	21° / 090°
Fracture 3	69° / 020°
Fracture 4	34° / 022°

Outcrop along -Y2-

<u>Discontinuity</u>	<u>Dip / Dip Azimuth</u>
Foliation	26° / 062°
Foliation	14° / 054°

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The topography surrounding the site is mountainous with a relatively flat, narrow floodplain and lakeshore at the site location. The proposed site is located at the point where Broad River empties into Lake Lure with river current energy and sediment bed load dissipated into the lake. Lake Lure is a popular recreational and tourist location with moderate to heavy pleasure boat traffic.

Discussion of Subsurface Conditions:

Four (4) 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, fill, residual and bedrock. The alluvial materials were composed of silt, clay and silty sand as well as a wide variety of gravel, cobbles and boulders. Standard penetration testing in unconsolidated soils produced "N" values ranging from 2 to 100+ blows per foot throughout the proposed site. Unconfined compression testing performed on recovered Shelby tube samples produced values ranging from .39 Ksf to 1.34 Ksf. Samples of the colluvial material are interpreted to be intermixed with the alluvial material and primarily consisted of boulders, cobbles, and gravel. Fill material was recognized and described as silty, clayey sand and rock fragments at End Bent 2. Underlying residual material at End Bent 2 was composed of sandy clay, silt and rock fragments. Samples of recovered bedrock indicate a wide range of weathering, hardness and fracturing characteristics as described in the Geology section above and on the core logs included with this report. Rock unconfined compression testing on selected rock core specimens indicate strengths ranging from 1,299 psi to 15,005 psi for granitic gneiss specimens.

Rock recovered from coring operations was described as granitic gneiss in sizes ranging from boulders to gravel and also described as an in-situ rock mass. Weathering of the rock varied from fresh to moderate with intervals of moderately severe to severe (weathered rock) and very severe to completely weathered (soil). Rock hardness characteristics varied from very hard to soft generally mimicking the weathering deterioration. Fracture spacing was predominately recognized as very close to close with intervals in fresh rock reaching moderately close to wide spacing. Core examination revealed horizontal joints and high angle joints (65° to 85°). Iron oxide staining was noted on many fracture faces and throughout the upper intervals of the residual rock.

Groundwater:

Immediately following drilling operations, groundwater measurements were recorded in each end bent boring, however the presence of coring water/fluid makes these results questionable. A static groundwater level (24 hour) measurement in EB2-B suggested the boring did not intercept groundwater.

Scour:

A field scour report was conducted on the existing Bridge No. 7 over the Broad River as part of this project. The scour investigation was performed during the subsurface investigation and is included in this report.

Notes to Designer:

Potentially problematic materials in the form of gravel, cobbles and boulders (alluvium / colluvium) were encountered in the rock core samples. These materials must be considered when selecting and designing bridge foundations.

Mr. Don Moore
July 13, 2007


Closure:


This geotechnical investigation is based upon the Preliminary General Drawing dated April 25, 2007. 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.

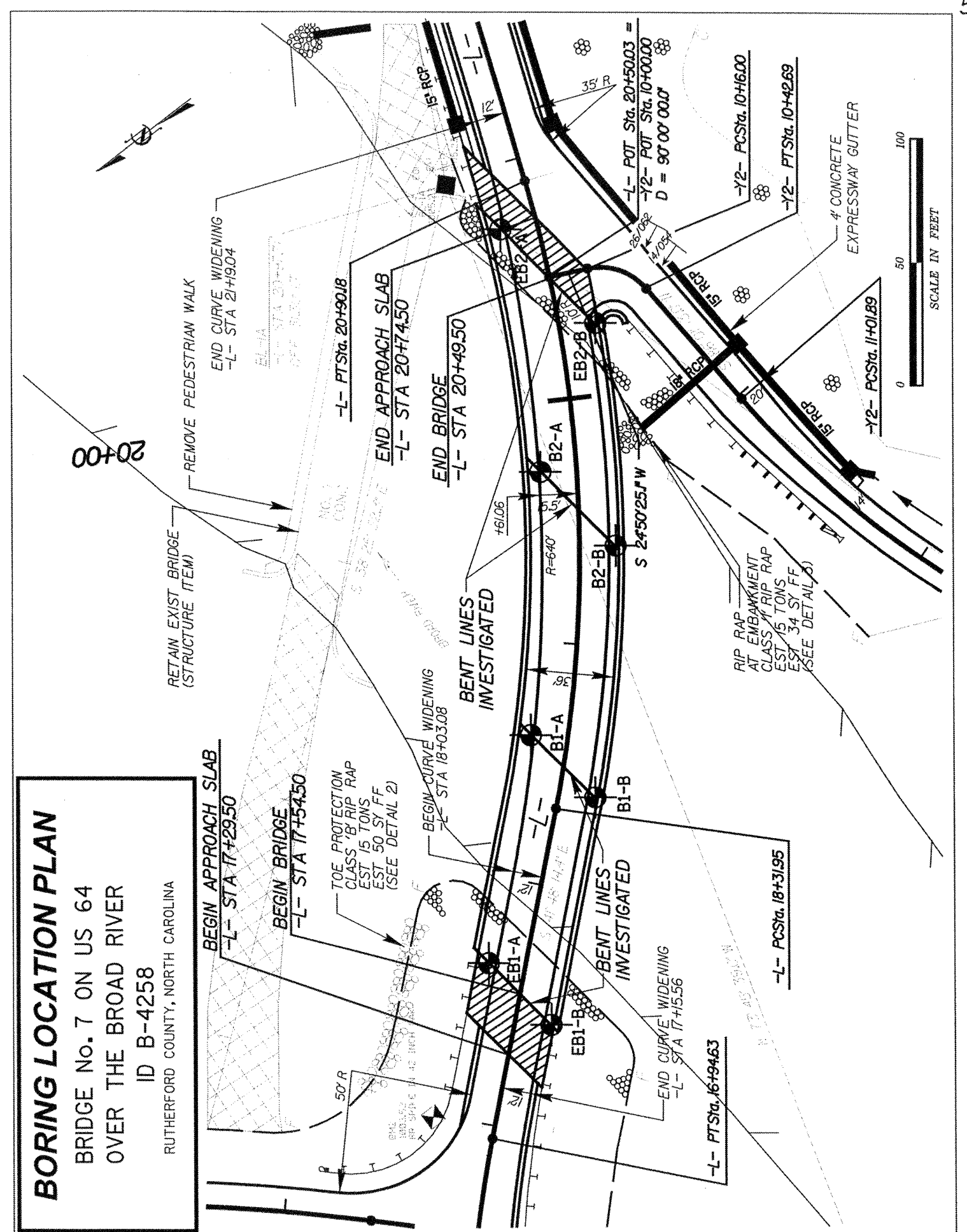
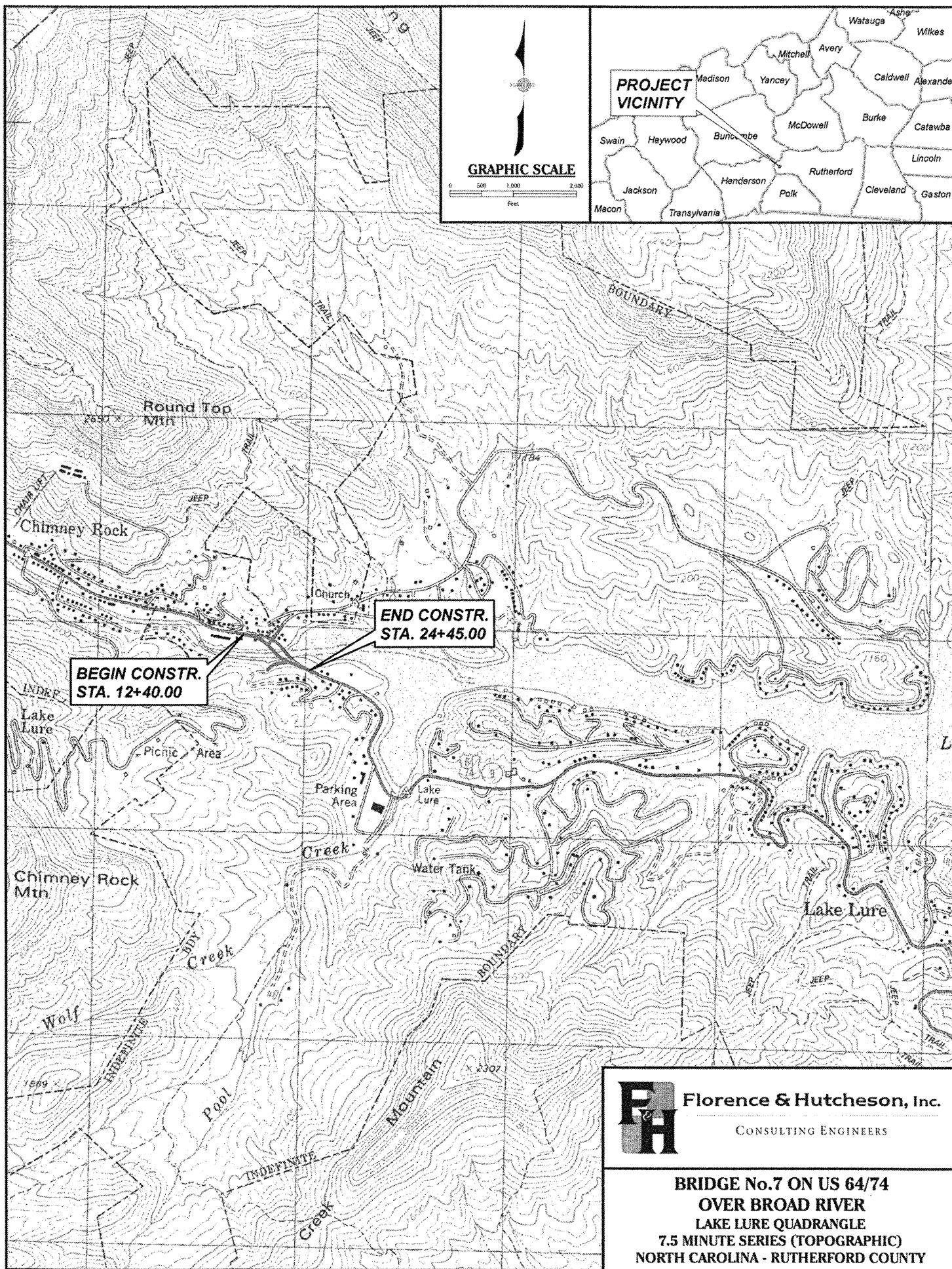
Thank you for the opportunity to provide geotechnical engineering services. Please contact our office if you have questions or comments.

Respectfully,

FLORENCE & HUTCHESON, INC.

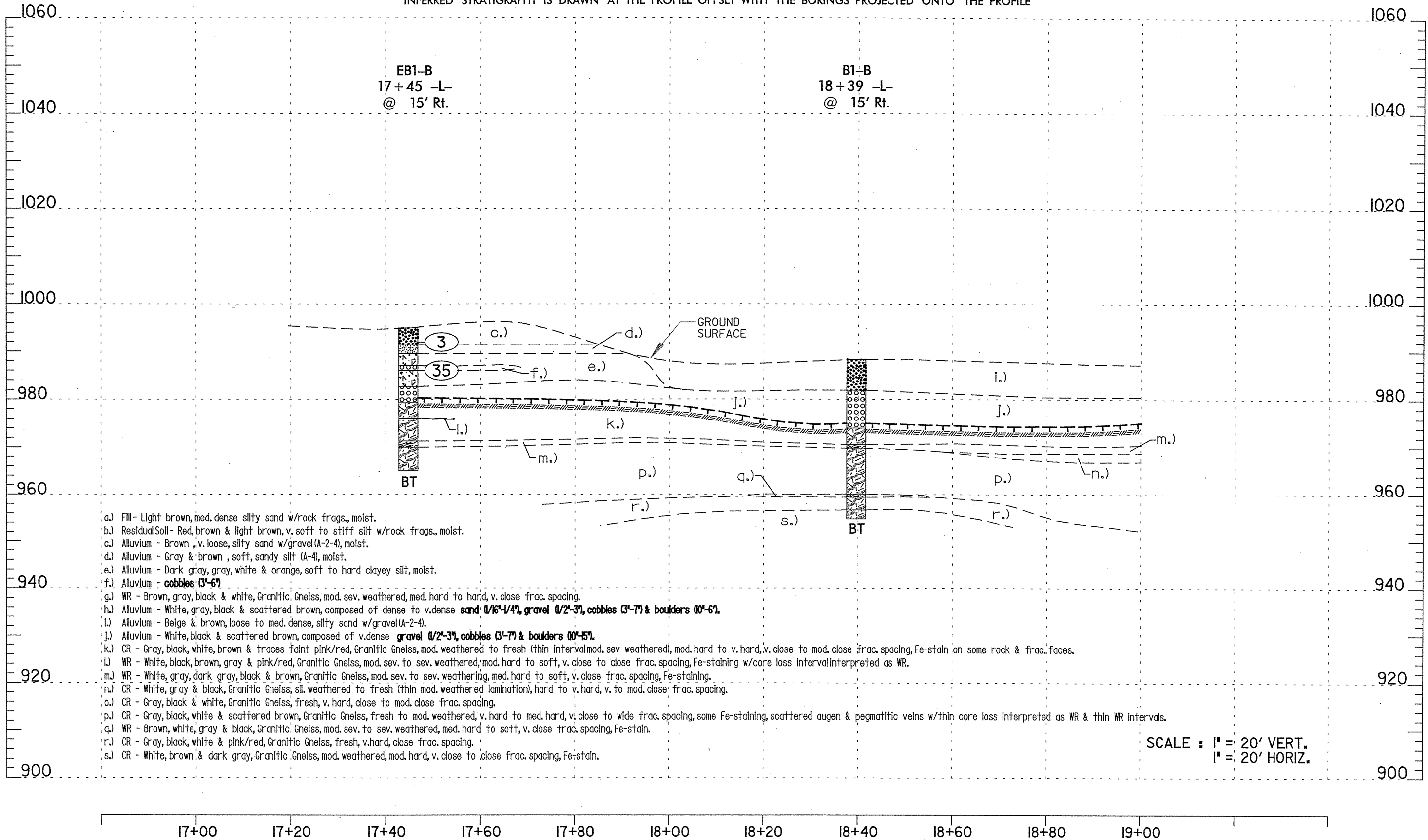

Shawn P. Washer, P.E.
Vice President


D. Michael Gragg, P.G.
Project Geologist



GENERALIZED SUBSURFACE PROFILE 15' Rt. of -L-

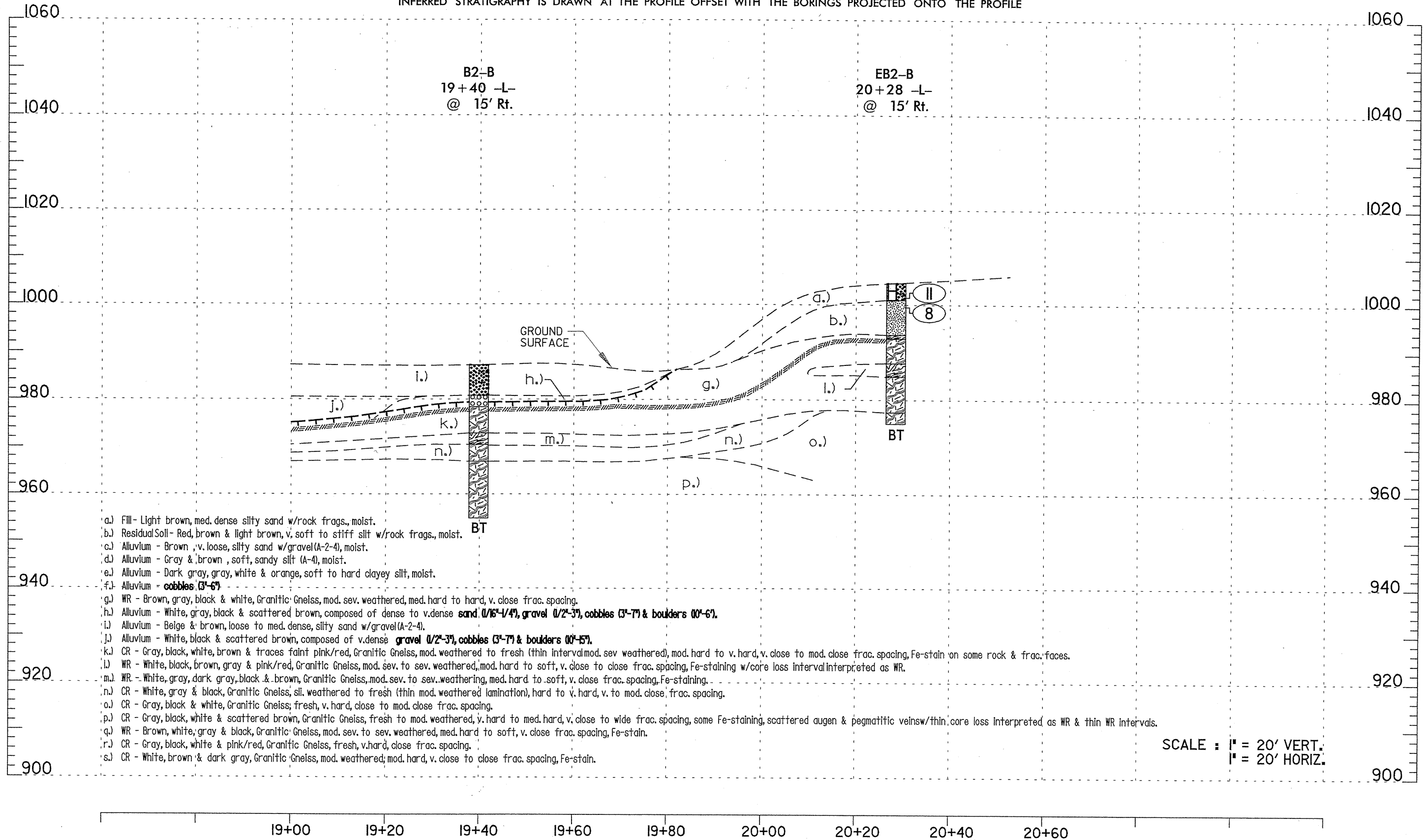
GROUNDLINE PROFILE SURVEYED BY FLORENCE & HUTCHESON, INC. AT 15' RT. OF -L- ON 5/9/07
 INFERRED STRATIGRAPHY IS DRAWN AT THE PROFILE OFFSET WITH THE BORINGS PROJECTED ONTO THE PROFILE



- a.) Fill - Light brown, med. dense silty sand w/rock frags., moist.
- b.) Residual Soil - Red, brown & light brown, v. soft to stiff silt w/rock frags., moist.
- c.) Alluvium - Brown, v. loose, silty sand w/gravel (A-2-4), moist.
- d.) Alluvium - Gray & brown, soft, sandy silt (A-4), moist.
- e.) Alluvium - Dark gray, gray, white & orange, soft to hard clayey silt, moist.
- f.) Alluvium - **cobbles (3"-6")**
- g.) WR - Brown, gray, black & white, Granitic Gneiss, mod. sev. weathered, med. hard to hard, v. close frac. spacing.
- h.) Alluvium - White, gray, black & scattered brown, composed of dense to v. dense **sand (1/16"-1/4"), gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-57")**.
- i.) Alluvium - Beige & brown, loose to med. dense, silty sand w/gravel (A-2-4).
- j.) Alluvium - White, black & scattered brown, composed of v. dense **gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-57")**.
- k.) CR - Gray, black, white, brown & traces faint pink/red, Granitic Gneiss, mod. weathered to fresh (thin interval mod. sev. weathered), mod. hard to v. hard, v. close to mod. close frac. spacing, Fe-stain on some rock & frac. faces.
- l.) WR - White, black, brown, gray & pink/red, Granitic Gneiss, mod. sev. to sev. weathered, mod. hard to soft, v. close to close frac. spacing, Fe-staining w/core loss interval interpreted as WR.
- m.) WR - White, gray, dark gray, black & brown, Granitic Gneiss, mod. sev. to sev. weathering, med. hard to soft, v. close frac. spacing, Fe-staining.
- n.) CR - White, gray & black, Granitic Gneiss; sil. weathered to fresh (thin mod. weathered lamination), hard to v. hard, v. to mod. close frac. spacing.
- o.) CR - Gray, black & white, Granitic Gneiss, fresh, v. hard, close to mod. close frac. spacing.
- p.) CR - Gray, black, white & scattered brown, Granitic Gneiss, fresh to mod. weathered, v. hard to med. hard, v. close to wide frac. spacing, some Fe-staining, scattered augen & pegmatitic veins w/thin core loss interpreted as WR & thin WR intervals.
- q.) WR - Brown, white, gray & black, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close frac. spacing, Fe-stain.
- r.) CR - Gray, black, white & pink/red, Granitic Gneiss, fresh, v. hard, close frac. spacing.
- s.) CR - White, brown & dark gray, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, Fe-stain.

GENERALIZED SUBSURFACE PROFILE 15' Rt. of -L-

GROUNDLINE PROFILE SURVEYED BY FLORENCE & HUTCHESON, INC. AT 15' RT. OF -L- ON 5/9/07
 INFERRED STRATIGRAPHY IS DRAWN AT THE PROFILE OFFSET WITH THE BORINGS PROJECTED ONTO THE PROFILE

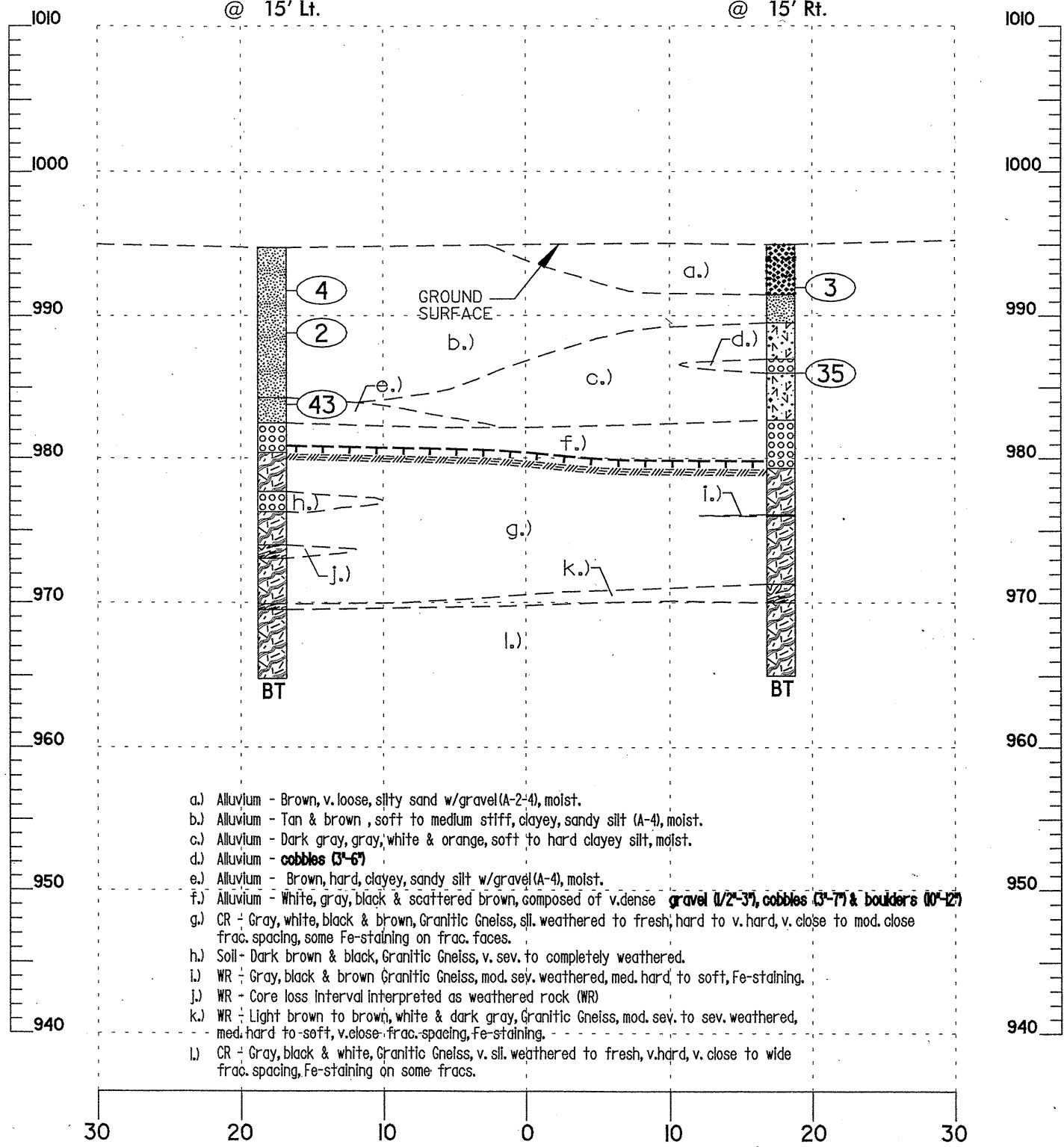


- a.) Fill - Light brown, med. dense silty sand w/rock frags., moist.
- b.) Residual Soil - Red, brown & light brown, v. soft to stiff silt w/rock frags., moist.
- c.) Alluvium - Brown, v. loose, silty sand w/gravel (A-2-4), moist.
- d.) Alluvium - Gray & brown, soft, sandy silt (A-4), moist.
- e.) Alluvium - Dark gray, gray, white & orange, soft to hard clayey silt, moist.
- f.) Alluvium - **cobbles (3'-6')**
- g.) WR - Brown, gray, black & white, Granitic Gneiss, mod. sev. weathered, med. hard to hard, v. close frac. spacing.
- h.) Alluvium - White, gray, black & scattered brown, composed of dense to v. dense **sand (1/16'-1/4')**, **gravel (1/2'-3')**, **cobbles (3'-7')** & **boulders (10'-6')**.
- i.) Alluvium - Beige & brown, loose to med. dense, silty sand w/gravel (A-2-4).
- j.) Alluvium - White, black & scattered brown, composed of v. dense **gravel (1/2'-3')**, **cobbles (3'-7')** & **boulders (10'-15')**.
- k.) CR - Gray, black, white, brown & traces faint pink/red, Granitic Gneiss, mod. weathered to fresh (thin interval mod. sev. weathered), mod. hard to v. hard, v. close to mod. close frac. spacing, Fe-stain on some rock & frac. faces.
- l.) WR - White, black, brown, gray & pink/red, Granitic Gneiss, mod. sev. to sev. weathered, mod. hard to soft, v. close to close frac. spacing, Fe-staining w/core loss interval interpreted as WR.
- m.) WR - White, gray, dark gray, black & brown, Granitic Gneiss, mod. sev. to sev. weathering, med. hard to soft, v. close frac. spacing, Fe-staining.
- n.) CR - White, gray & black, Granitic Gneiss, sil. weathered to fresh (thin mod. weathered lamination), hard to v. hard, v. to mod. close frac. spacing.
- o.) CR - Gray, black & white, Granitic Gneiss, fresh, v. hard, close to mod. close frac. spacing.
- p.) CR - Gray, black, white & scattered brown, Granitic Gneiss, fresh to mod. weathered, v. hard to med. hard, v. close to wide frac. spacing, some Fe-staining, scattered augen & pegmatitic veins/thin, core loss interpreted as WR & thin WR intervals.
- q.) WR - Brown, white, gray & black, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close frac. spacing, Fe-stain.
- r.) CR - Gray, black, white & pink/red, Granitic Gneiss, fresh, v. hard, close frac. spacing.
- s.) CR - White, brown & dark gray, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, Fe-stain.

SCALE : 1" = 20' VERT.
 1" = 20' HORIZ.

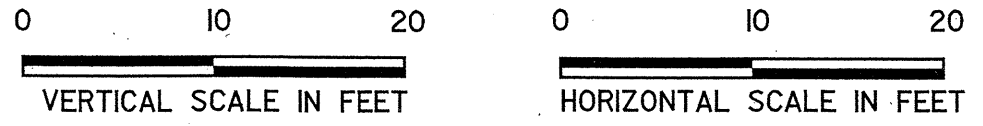
EB1-A
17+64 -L-
@ 15' Lt.

EB1-B
17+45 -L-
@ 15' Rt.



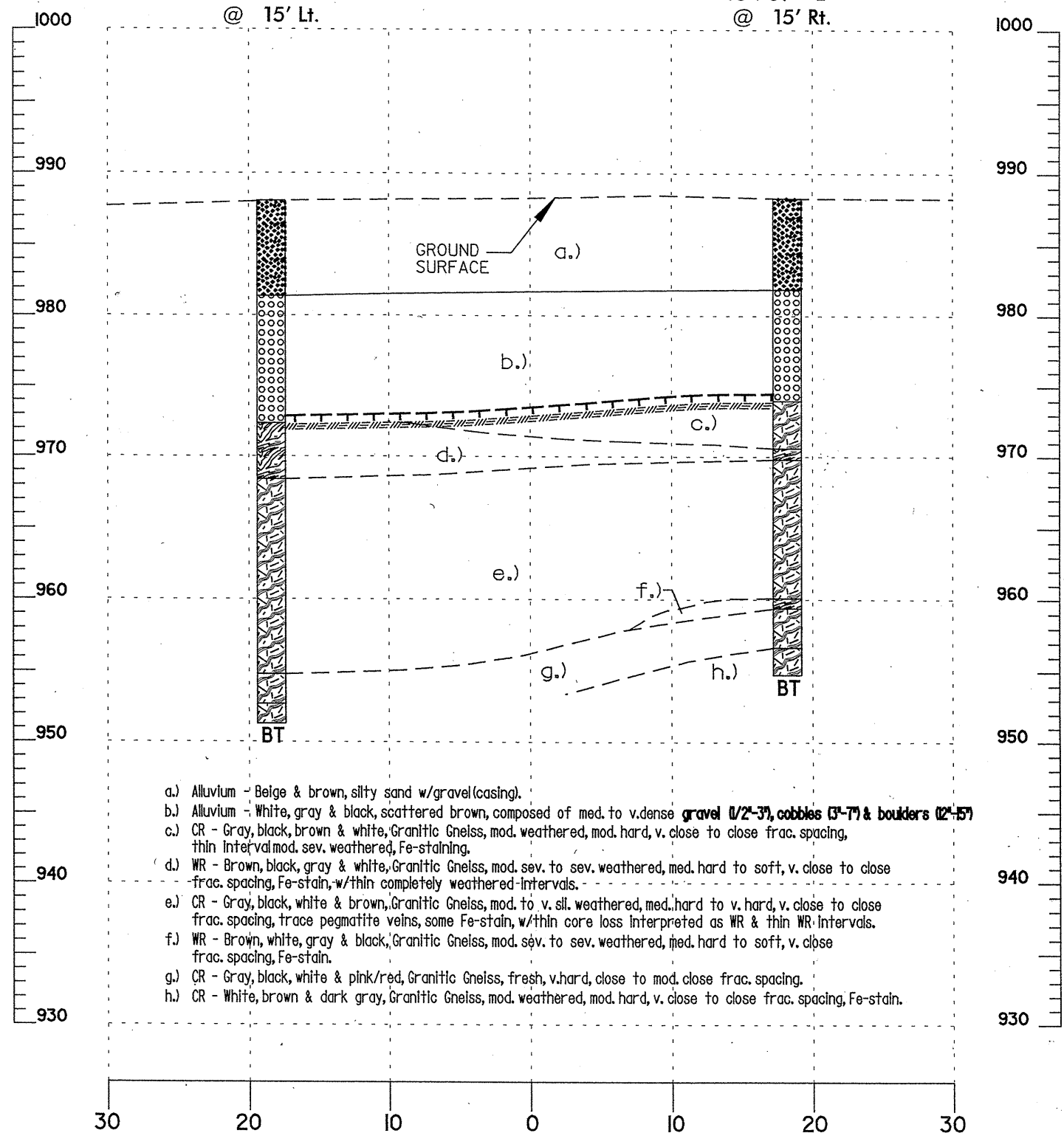
- a.) Alluvium - Brown, v. loose, silty sand w/gravel(A-2-4), moist.
- b.) Alluvium - Tan & brown, soft to medium stiff, clayey, sandy silt (A-4), moist.
- c.) Alluvium - Dark gray, gray, white & orange, soft to hard clayey silt, moist.
- d.) Alluvium - **cobbles (3'-6')**
- e.) Alluvium - Brown, hard, clayey, sandy silt w/gravel(A-4), moist.
- f.) Alluvium - White, gray, black & scattered brown, composed of v.dense **gravel (1/2'-3'), cobbles (3'-7') & boulders (10'-2')**
- g.) CR - Gray, white, black & brown, Granitic Gneiss, sil. weathered to fresh, hard to v. hard, v. close to mod. close frac. spacing, some Fe-staining on frac. faces.
- h.) Soil - Dark brown & black, Granitic Gneiss, v. sev. to completely weathered.
- i.) WR - Gray, black & brown Granitic Gneiss, mod. sev. weathered, med. hard to soft, Fe-staining.
- j.) WR - Core loss interval interpreted as weathered rock (WR)
- k.) WR - Light brown to brown, white & dark gray, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close frac. spacing, Fe-staining.
- l.) CR - Gray, black & white, Granitic Gneiss, v. sil. weathered to fresh, v. hard, v. close to wide frac. spacing, Fe-staining on some fracs.

CROSS SECTION @ END BENT 1



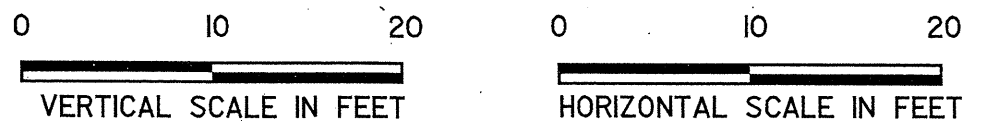
B1-A
18+60 -L-
@ 15' Lt.

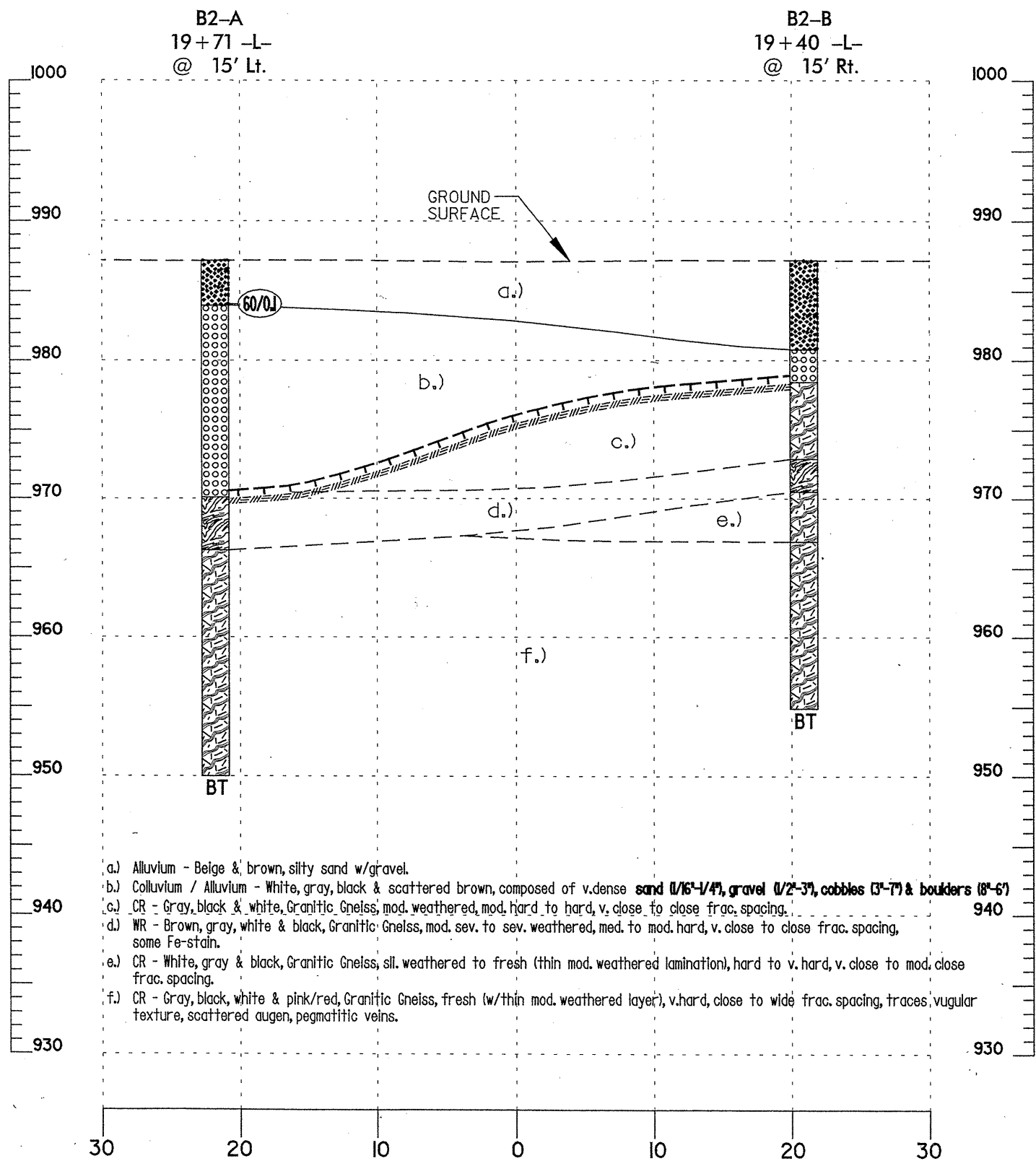
B1-B
18+39 -L-
@ 15' Rt.



- a.) Alluvium - Beige & brown, silty sand w/gravel(casing).
- b.) Alluvium - White, gray & black, scattered brown, composed of med. to v.dense **gravel (1/2'-3'), cobbles (3'-7') & boulders (12'-15')**
- c.) CR - Gray, black, brown & white, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, thin interval mod. sev. weathered, Fe-staining.
- d.) WR - Brown, black, gray & white, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close to close frac. spacing, Fe-stain, w/thin completely weathered intervals.
- e.) CR - Gray, black, white & brown, Granitic Gneiss, mod. to v. sil. weathered, med. hard to v. hard, v. close to close frac. spacing, trace pegmatite veins, some Fe-stain, w/thin core loss interpreted as WR & thin WR intervals.
- f.) WR - Brown, white, gray & black, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close frac. spacing, Fe-stain.
- g.) CR - Gray, black, white & pink/red, Granitic Gneiss, fresh, v. hard, close to mod. close frac. spacing.
- h.) CR - White, brown & dark gray, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, Fe-stain.

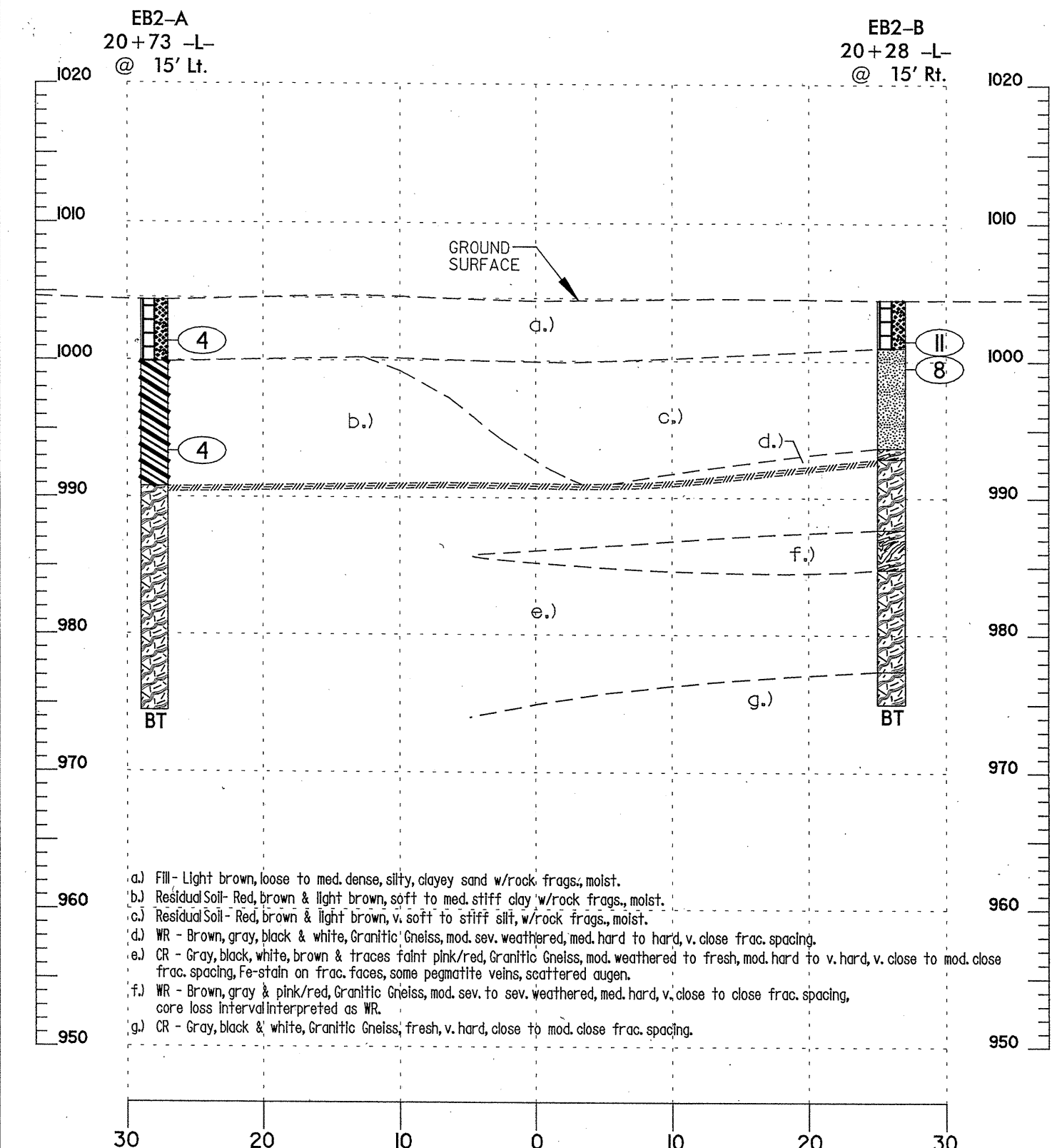
CROSS SECTION @ BENT 1





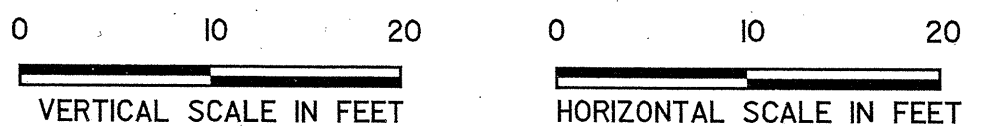
- a.) Alluvium - Beige & brown, silty sand w/gravel.
- b.) Colluvium / Alluvium - White, gray, black & scattered brown, composed of v.dense sand (1/16"-1/4"), gravel (1/2"-3"), cobbles (3"-7") & boulders (8"-6')
- c.) CR - Gray, black & white, Granitic Gneiss, mod. weathered, mod. hard to hard, v. close to close frac. spacing.
- d.) WR - Brown, gray, white & black, Granitic Gneiss, mod. sev. to sev. weathered, med. to mod. hard, v. close to close frac. spacing, some Fe-stain.
- e.) CR - White, gray & black, Granitic Gneiss, sil. weathered to fresh (thin mod. weathered lamination), hard to v. hard, v. close to mod. close frac. spacing.
- f.) CR - Gray, black, white & pink/red, Granitic Gneiss, fresh (w/thin mod. weathered layer), v. hard, close to wide frac. spacing, traces vugular texture, scattered augen, pegmatitic veins.

CROSS SECTION @ BENT 2



- a.) Fill - Light brown, loose to med. dense, silty, clayey sand w/rock frags., moist.
- b.) Residual Soil - Red, brown & light brown, soft to med. stiff clay w/rock frags., moist.
- c.) Residual Soil - Red, brown & light brown, v. soft to stiff silt, w/rock frags., moist.
- d.) WR - Brown, gray, black & white, Granitic Gneiss, mod. sev. weathered, med. hard to hard, v. close frac. spacing.
- e.) CR - Gray, black, white, brown & traces faint pink/red, Granitic Gneiss, mod. weathered to fresh, mod. hard to v. hard, v. close to mod. close frac. spacing, Fe-stain on frac. faces, some pegmatite veins, scattered augen.
- f.) WR - Brown, gray & pink/red, Granitic Gneiss, mod. sev. to sev. weathered, med. hard, v. close to close frac. spacing, core loss interval interpreted as WR.
- g.) CR - Gray, black & white, Granitic Gneiss, fresh, v. hard, close to mod. close frac. spacing.

CROSS SECTION @ END BENT 2



PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson									
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River						GROUND WTR (ft)									
BORING NO. EB1-A		STATION 17+64		OFFSET 15ft LT		ALIGNMENT -L-									
COLLAR ELEV. 994.8 ft		TOTAL DEPTH 30.0 ft		NORTHING 629,383		EASTING 1,036,439									
DRILL MACHINE CME-45C		DRILL METHOD SPT Core Boring		HAMMER TYPE Manual											
START DATE 05/12/07		COMP. DATE 05/12/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 14.4 ft									
ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
		0.5ft	0.5ft	0.5ft	0	25	50	75	100						
995														994.8	0.0
992.8	2.0										SS-2	M	Alluvium - Tan & brown, soft to med. stiff clayey, sandy silt.		
989.8	5.0										M	M	Alluvium - Brown, soft, sandy, clayey silt.	4.7	
984.8	10.0										M	M	Alluvium - Brown, hard, clayey, sandy silt w/gravel. Begin coring at Elev. 982.5.	10.5	
		5	23	20									Alluvium - White, gray, black & brown, composed of v. dense gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-12").	12.3	
													CR - Gray, black, white & brown, Granitic Gneiss.	14.4	
													Soil - Dark brown & black, Granitic Gneiss, v. sev. to completely weathered.	17.1	
											RS-1		CR - Gray, black & white, Granitic Gneiss.	18.5	
													CR - Gray, black & white, Granitic Gneiss.	20.8	
													Core loss interval.	21.7	
													CR - Gray, black & white, Granitic Gneiss.	24.9	
													WR - White, gray, light brown, Granitic Gneiss.	25.3	
													CR - Gray, black & white, Granitic Gneiss.	30.0	
Boring Terminated at Elevation 964.8 ft in CR (Gneiss)															

PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson					
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River						GROUND WTR (ft)					
BORING NO. EB1-A		STATION 17+64		OFFSET 15ft LT		ALIGNMENT -L-					
COLLAR ELEV. 994.8 ft		TOTAL DEPTH 30.0 ft		NORTHING 629,383		EASTING 1,036,439					
DRILL MACHINE CME-45C		DRILL METHOD SPT Core Boring		HAMMER TYPE Manual							
START DATE 05/12/07		COMP. DATE 05/12/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 14.4 ft					
CORE SIZE NQ2		TOTAL RUN 17.7 ft		DRILLER Contract Driller							
ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
				REC. (%)	RQD (%)		REC. (%)	RQD (%)			
982.5											
982.5	12.3	2.7	1:21	(1.6)	N/A		(1.0)	N/A		Begin Coring @ 12.3 ft	12.3
979.8	15.0	5.0	1:18	59%			(2.7)	(1.8)		Alluvium - White, gray, black & brown, composed of v. dense gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-12").	14.4
			0.59/0.7				(2.7)	(1.8)		CR - Gray, black, white & brown, Granitic Gneiss, sli. weathered to fresh, hard to v. hard, v. close to mod. close frac. spacing.	17.1
			1:38	(4.9)	(3.1)		100%	65%			17.1
			2:10	97%	62%						18.5
			1:46			RS-1	(1.2)	(0.0)		Soil - Dark brown & black, Granitic Gneiss, v. sev. to completely weathered, soft to v. soft, close frac. spacing.	18.5
			1:58				(2.3)	(1.9)		CR - Gray, black & white, Granitic Gneiss, v. sli. weathered to fresh, v. hard, close to mod. close frac. spacing, some Fe-staining on joints.	20.8
			1:21				(2.3)	(1.9)		CR - Gray, black & white, Granitic Gneiss, v. sli. weathered to fresh, v. hard, close to mod. close frac. spacing, some Fe-staining on joints.	20.8
			1:36	(4.1)	(4.0)		100%	83%		Core loss interval interpreted as weathered rock.	21.7
			1:27	82%	80%		(0.0)	(0.0)		CR - Gray, black & white, Granitic Gneiss, v. sli. weathered to fresh, v. hard, v. close to mod. close frac. spacing, some Fe-staining on joints.	24.9
			2:01				0%	0%			24.9
			1:07				(3.2)	(3.2)		WR - White, gray, light brown, Granitic Gneiss, mod. sev. weathering, med. hard, v. close frac. spacing.	25.3
			1:48	(4.6)	(4.0)		100%	100%		CR - Gray, black & white, Granitic Gneiss, v. sli. weathered to fresh, v. hard, v. close to mod. close frac. spacing, some Fe-staining on frac.	25.3
			2:36	92%	80%		(0.4)	(0.0)			25.3
			1:03				100%	0%			25.3
			1:49				(4.4)	(4.0)			25.3
			1:51				94%	85%			30.0
Boring Terminated at Elevation 964.8 ft in CR (Gneiss)											

NCDOT CORE SINGLE BROAD RIVER.GPJ NC_DOT_GDT_7/12/07

NCDOT BORE SINGLE BROAD RIVER.GPJ NC_DOT_GDT_7/12/07



Boring EB1-A – Station 17+64 @ 15' Left – Box 1 of 2



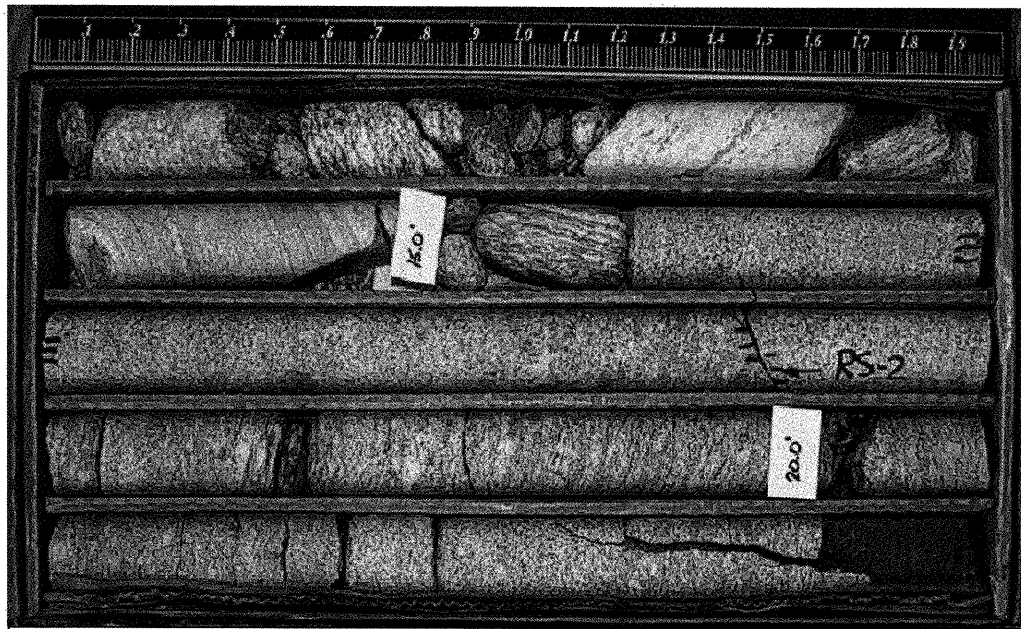
Boring EB1-A – Station 17+64 @ 15' Left – Box 2 of 2

PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson						
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River						GROUND WTR (ft)						
BORING NO. EB1-B		STATION 17+45		OFFSET 15ft RT		ALIGNMENT -L-						
COLLAR ELEV. 995.0 ft		TOTAL DEPTH 30.0 ft		NORTHING 629,378		EASTING 1,036,404						
DRILL MACHINE CME-45C		DRILL METHOD SPT Core Boring		HAMMER TYPE Manual								
START DATE 05/12/07		COMP. DATE 05/12/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 15.7 ft						
ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT				SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
		0.5ft	0.5ft	0.5ft	0	25	50	75				
995.0												995.0 GROUND SURFACE 0.0
993.0	2.0											991.5 Alluvium - Brown, v. loose, silty sand w/gravel. 3.5
		2	2	1								989.5 Alluvium - Gray/brown, soft, sandy silt. 5.5
												987.0 Alluvium - Dark gray, soft, sandy, clayey silt. 8.0
985.0	10.0											986.0 Cobbles (3"-6"). 9.0
		13	18	17								982.7 Alluvium - Gray, white & orange, hard, clayey silt. Begin coring at Elev. 982.7. 12.3
												979.3 Alluvium - Composed of white, black & scattered brown, v. dense, gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-12"). 15.7
												976.1 CR - Gray, white & black, Granitic Gneiss. 18.9
												975.0 WR - Gray, white, black & brown, Granitic Gneiss. 19.0
												971.3 CR - Gray, white, black & brown, Granitic Gneiss. 23.7
												970.0 WR - Brown, white, dark gray, Granitic Gneiss. 25.0
												CR - Gray, black & white Granitic Gneiss.
												965.0 Boring Terminated at Elevation 965.0 ft in CR (Gneiss) 30.0
Other Samples: ST-3 (5.0 - 5.5) ST-4 (5.5 - 6.9)												

NCDOT BORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07

PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson					
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River						GROUND WTR (ft)					
BORING NO. EB1-B		STATION 17+45		OFFSET 15ft RT		ALIGNMENT -L-					
COLLAR ELEV. 995.0 ft		TOTAL DEPTH 30.0 ft		NORTHING 629,378		EASTING 1,036,404					
DRILL MACHINE CME-45C		DRILL METHOD SPT Core Boring		HAMMER TYPE Manual							
START DATE 05/12/07		COMP. DATE 05/12/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 15.7 ft					
CORE SIZE NQ2		TOTAL RUN 17.7 ft		DRILLER Contract Driller							
ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
				REC. (%)	ROD (%)		REC. (%)	ROD (%)			
982.7											
982.7	12.3	2.7	0:38	(2.3)	(0.7)		(2.4)	N/A		982.7 Alluvium - Composed of white, black & scattered brown, v. dense, gravel (1/2"-3"), cobbles (3"-7") & boulders (10"-12"). 12.3	
980.0	15.0		1:21	85%	27%		70%			979.3 CR - Gray, white & black, Granitic Gneiss, v. sil. weathered to fresh, v. hard, v. close to mod. close frac. spacing, some Fe-staining on frac. 15.7	
		5.0	1:36	(4.7)	(3.8)		(3.2)	(3.1)		976.1 CR - Gray, white, black & brown, Granitic Gneiss, mod. sev. weathered, mod. hard to soft, Fe-staining. 18.9	
975.0	20.0		1:42	94%	76%		100%	97%		976.0 WR - Gray, white, black & brown, Granitic Gneiss, mod. sev. weathered, mod. hard to soft, Fe-staining. 19.0	
		5.0	1:38	(3.7)	(0.7)		(4.7)	(1.1)		971.3 CR - Gray, white, black & brown, Granitic Gneiss, sil. weathered to fresh, v. hard, v. close to mod. close frac. spacing, Fe-staining on joint faces, 80° frac. @ 21.4'-22.3' heavily Fe-stained. 23.7	
970.0	25.0		2:01	94%	90%		(0.1)	(0.0)		970.0 WR - Brown, white, dark gray, Granitic Gneiss, sev. weathering, med. hard to soft, v. close frac. spacing, heavy Fe-staining. 25.0	
		5.0	1:49	(4.7)	(4.5)		(4.7)	(4.5)		CR - Gray, black & white Granitic Gneiss, fresh, v. hard, close to wide frac. spacing, Fe-staining on one frac., 45° frac. @ 29.7' w/Fe-staining.	
965.0	30.0		2:11							Boring Terminated at Elevation 965.0 ft in CR (Gneiss)	
			1:20							Other Samples: ST-3 (5.0 - 5.5) ST-4 (5.5 - 6.9)	
			1:33								

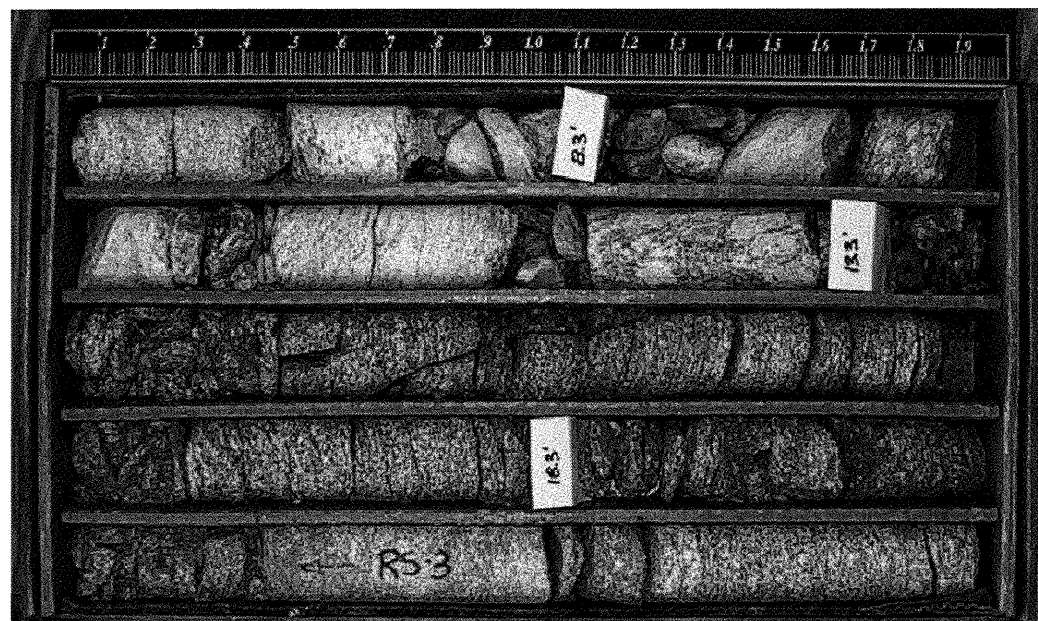
NCDOT CORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07



Boring EB1-B – Station 17+45 @ 15' Right – Box 1 of 2



Boring EB1-B – Station 17+45 @ 15' Right – Box 2 of 2



Boring B1-A – Station 18+60 @ 15' Left – Box 1 of 3

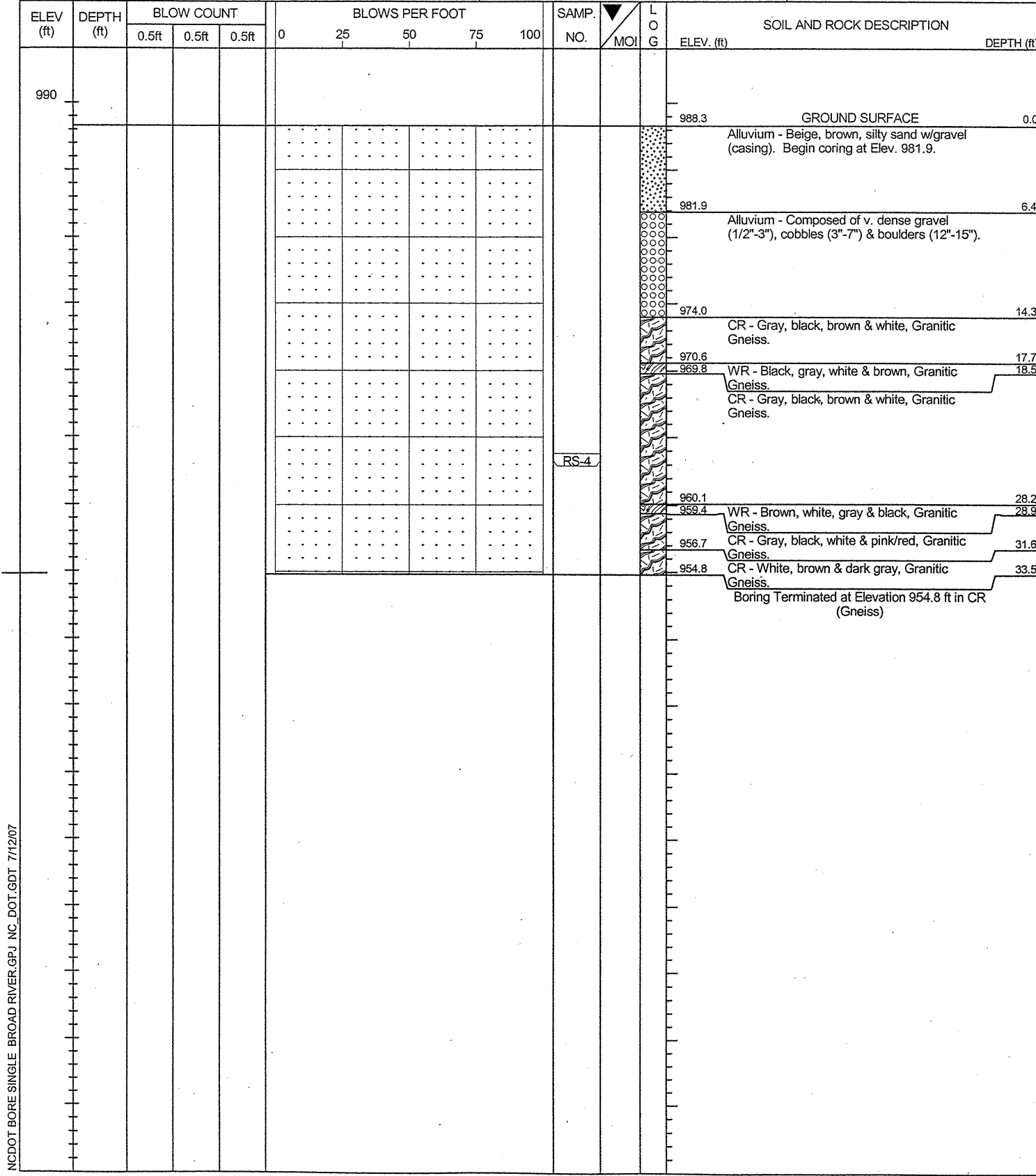


Boring B1-A – Station 18+60 @ 15' Left – Box 3 of 3



Boring B1-A – Station 18+60 @ 15' Left – Box 2 of 3

PROJECT NO. 33600.1.1	ID. B-4258	COUNTY Rutherford	GEOLOGIST M. Gragg / M. Johnson
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River			GROUND WTR (ft)
BORING NO. B1-B	STATION 18+39	OFFSET 15ft RT	ALIGNMENT -L-
COLLAR ELEV. 988.3 ft	TOTAL DEPTH 33.5 ft	NORTHING 629,307	EASTING 1,036,467
DRILL MACHINE CME-45C	DRILL METHOD NW Casing w/ Core	HAMMER TYPE Manual	
START DATE 05/17/07	COMP. DATE 05/17/07	SURFACE WATER DEPTH N/A	DEPTH TO ROCK 14.3 ft



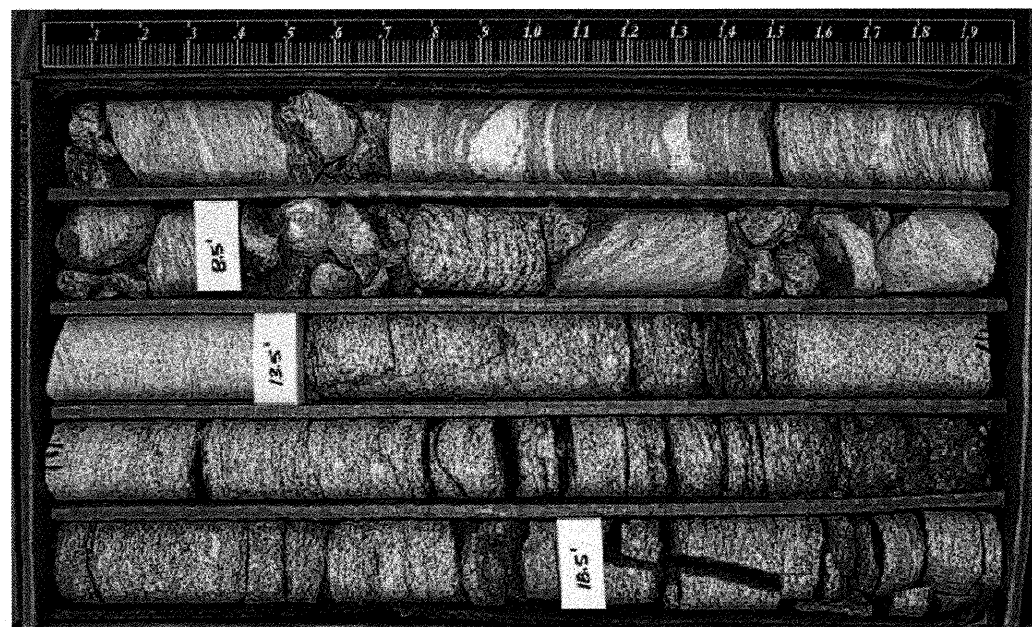
NCDOT BORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07

PROJECT NO. 33600.1.1	ID. B-4258	COUNTY Rutherford	GEOLOGIST M. Gragg / M. Johnson
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River			GROUND WTR (ft)
BORING NO. B1-B	STATION 18+39	OFFSET 15ft RT	ALIGNMENT -L-
COLLAR ELEV. 988.3 ft	TOTAL DEPTH 33.5 ft	NORTHING 629,307	EASTING 1,036,467
DRILL MACHINE CME-45C	DRILL METHOD NW Casing w/ Core	HAMMER TYPE Manual	
START DATE 05/17/07	COMP. DATE 05/17/07	SURFACE WATER DEPTH N/A	DEPTH TO ROCK 14.3 ft

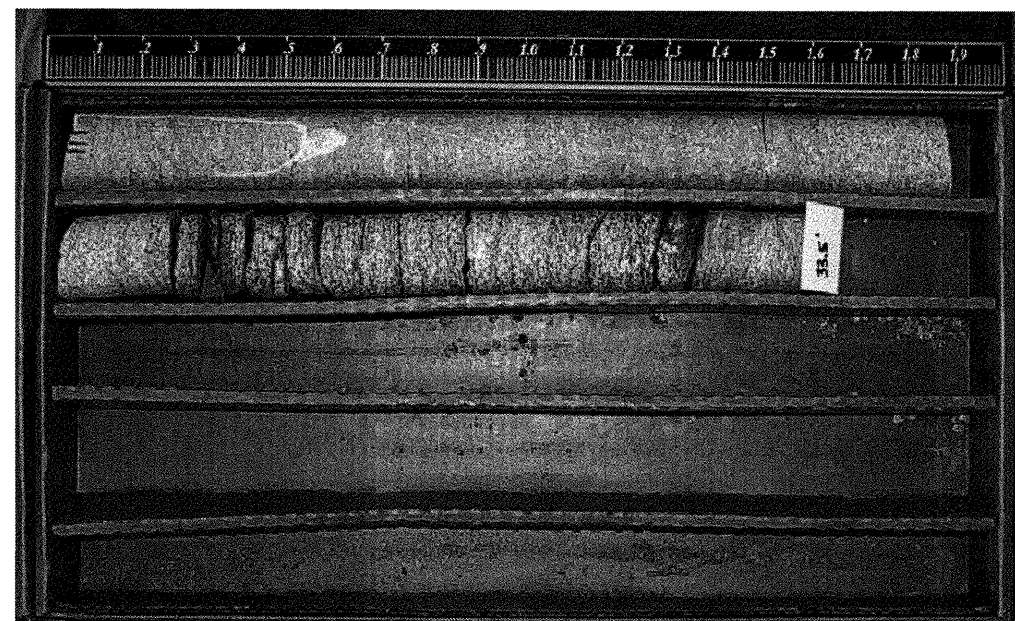
ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
				REC. (%)	RQD (%)		REC. (%)	RQD (%)			
981.9										Begin Coring @ 6.4 ft	
981.9	6.4	2.1	1:59	(2.1)	N/A		(4.7)	N/A		Alluvium - Composed of v. dense gravel (1/2"-3"), cobbles (3"-7") & boulders (12"-15").	6.4
979.8	8.5		2:27	100%			59%				
		5.0	0:15/0.1	(2.1)	N/A						
			2:18	42%							
			2:52								
			2:41								
			2:58								
974.8	13.5		2:39								
		5.0	2:12	(4.2)	(0.7)		(3.4)	(1.0)		CR - Gray, black, brown & white, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, thin interval mod. sev. weathered, heavily Fe-stained.	14.3
			2:02	84%	14%		100%	28%			
			2:34								
			2:48								
969.8	18.5		2:56				(0.8)	(0.0)		WR - Black, gray, white & brown, Granitic Gneiss, mod. sev. to sev. weathered, v. close to close frac. spacing, Fe-stain.	17.7
		5.0	2:48	(4.4)	(1.4)		100%	0%			18.5
			2:56	88%	28%		(4.7)	(1.4)		CR - Gray, black, brown & white, Granitic Gneiss, mod. to v. slightly weathered, med. hard to v. hard, v. close to close frac. spacing, heavily Fe-stained, decreasing w/depth, 80° frac. @ 18.5', 20.0' & 22.1'-22.6', 80° partially healed frac. @ 21.5'-21.9', core loss interval 19.1'-19.7' interpreted as WR, mod. sev. weathered 26.7'-27.1'.	
			3:07				48%	14%			
964.8	23.5		3:19								
		5.0	2:58	(4.8)	(1.3)	RS-4					
			2:51	98%	26%						
			3:46								
			3:44								
959.8	28.5		3:51								
		5.0	1:21	(4.8)	(2.9)		(0.5)	(0.0)		WR - Brown, white, gray & black, Granitic Gneiss, mod. sev. to sev. weathered, med. hard to soft, v. close frac. spacing, Fe-stain.	28.2
			3:01	96%	58%		71%	0%			28.9
			3:29				(2.7)	(2.7)		CR - Gray, black, white & pink/red, Granitic Gneiss, fresh, v. hard, close frac. spacing, vert. frac. @ 28.9'-30.8' - healed to partially healed.	
			3:40				100%	100%			31.6
954.8	33.5		2:51				(1.6)	(0.0)		CR - White, brown & dark gray, Granitic Gneiss, mod. weathered, mod. hard, v. close to close frac. spacing, Fe-stain.	
							84%	0%			33.5

Boring Terminated at Elevation 954.8 ft in CR (Gneiss)

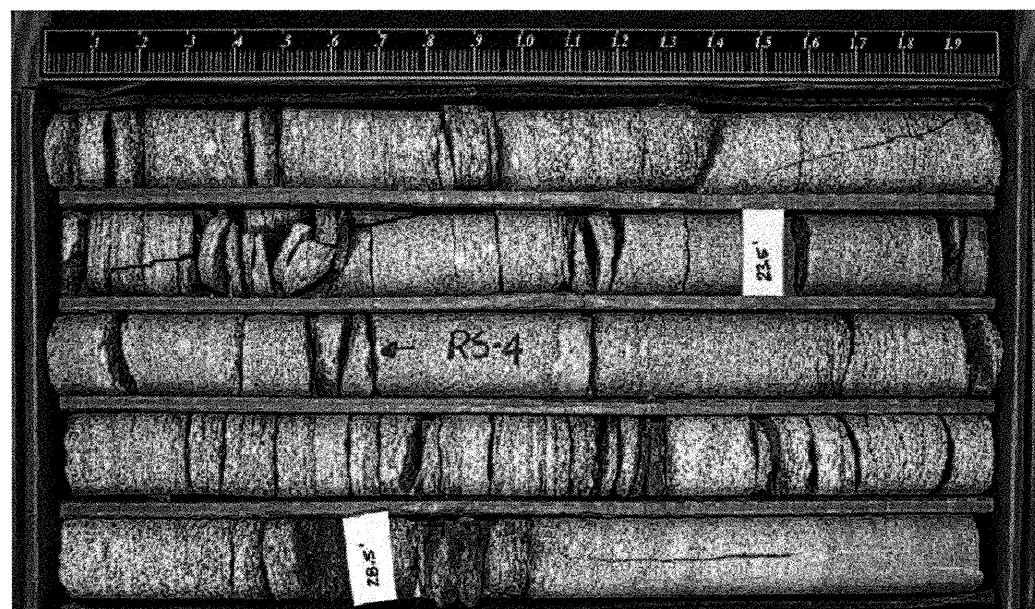
NCDOT BORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07



Boring B1-B – Station 18+39 @ 15' Right – Box 1 of 3



Boring B1-B – Station 18+39 @ 15' Right – Box 3 of 3



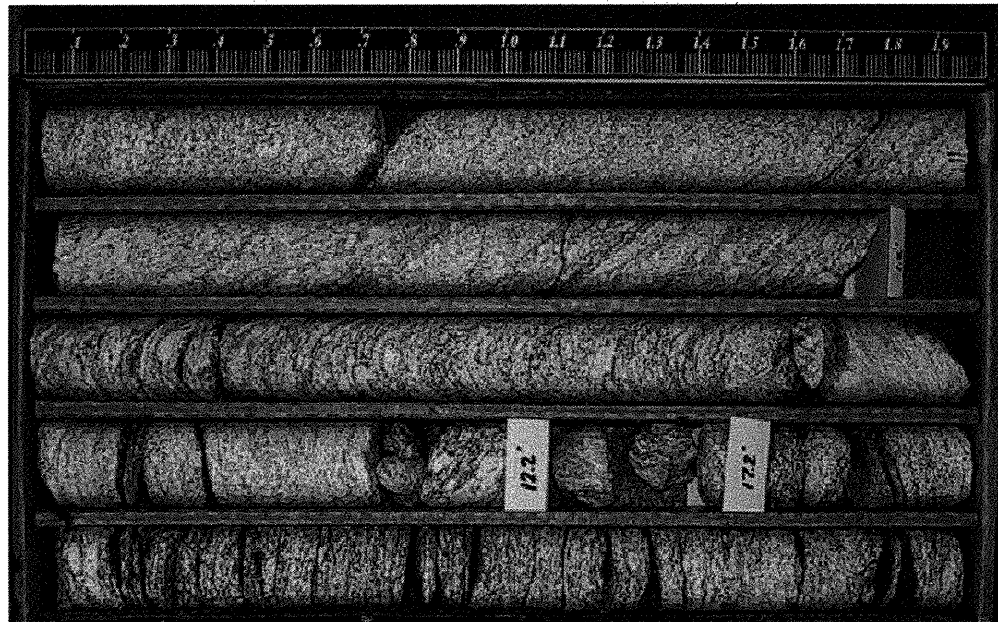
Boring B1-B – Station 18+39 @ 15' Right – Box 2 of 3

PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson								
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River							GROUND WTR (ft)							
BORING NO. B2-A		STATION 19+71		OFFSET 15ft LT		ALIGNMENT -L-								
COLLAR ELEV. 987.2 ft		TOTAL DEPTH 37.2 ft		NORTHING 629,245		EASTING 1,036,586								
DRILL MACHINE CME-45C		DRILL METHOD NW Casing w/ SPT Core			HAMMER TYPE Manual									
START DATE 05/15/07		COMP. DATE 05/15/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 20.9 ft								
ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
		0.5ft	0.5ft	0.5ft	0	25	50	75	100					
990														
987.2													GROUND SURFACE	0.0
985.2	2.0	6	15	60/0.1									Alluvium - Beige, brown, silty sand w/gravel. Begin coring at Elev. 984.0.	
													Colluvium/alluvium - White, gray, black & scattered brown, composed of v. dense sand (1/16"-1/4"), gravel (1/2"-3"), cobbles (3"-7"), & boulders (8"-6").	3.2
													WR - Brown, gray, white & black, Granitic Gneiss.	17.1
													CR - Gray, white, black & pink/red, Granitic Gneiss.	20.9
													Boring Terminated at Elevation 950.0 ft in CR (Gneiss)	37.2

PROJECT NO. 33600.1.1		ID. B-4258		COUNTY Rutherford		GEOLOGIST M. Gragg / M. Johnson					
SITE DESCRIPTION Bridge No. 7 on US 64/74 over Broad River							GROUND WTR (ft)				
BORING NO. B2-A		STATION 19+71		OFFSET 15ft LT		ALIGNMENT -L-					
COLLAR ELEV. 987.2 ft		TOTAL DEPTH 37.2 ft		NORTHING 629,245		EASTING 1,036,586					
DRILL MACHINE CME-45C		DRILL METHOD NW Casing w/ SPT Core			HAMMER TYPE Manual						
START DATE 05/15/07		COMP. DATE 05/15/07		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 20.9 ft					
CORE SIZE NQ2		TOTAL RUN 34.0 ft		DRILLER Contract Driller							
ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
				REC. (ft)	ROD (ft)		REC. (ft)	ROD (ft)			
984											
984.0	3.2	4.0	1:46 2:21 2:36 2:51	(3.7) 92%	N/A		(7.0) 50%	N/A		Begin Coring @ 3.2 ft	
980.0	7.2	5.0	2:16 2:21 2:34 2:15 2:07	(3.0) 60%	N/A					Colluvium/alluvium - White, gray, black & scattered brown, composed of v. dense sand (1/16"-1/4"), gravel (1/2"-3"), cobbles (3"-7"), & boulders (8"-6").	3.2
975.0	12.2	5.0	0:48 1:21 0:37 1:12 1:13	(0.4) 8%	N/A						
970.0	17.2	5.0	2:11 1:56 2:21 2:04 2:19	(4.7) 94%	(1.3) 26%		(3.6) 95%	(0.0) 0%		WR - Brown, gray, white & black, Granitic Gneiss, mod. sev. weathered, med. hard to mod. hard, v. close to close frac. spacing, some Fe-staining.	17.1
965.0	22.2	5.0	2:19 2:16 3:27 3:20 3:28	(4.7) 94%	(4.7) 94%	RS-5	(15.5) 95%	(13.5) 83%		CR - Gray, white, black & pink/red, Granitic Gneiss, fresh w/mod. weathered interval 34.7'-35.1', v. hard, close to wide frac. spacing, 4 high angle frags. 70°-80° between 32.6' & 35.6', 15° frac. 22.2', healed frags. throughout, traces vugular texture.	20.9
960.0	27.2	5.0	15:02 26:12 17:08 12:16 18:21	(5.0) 100%	(5.0) 100%						
955.0	32.2	5.0	10:30 9:40 9:52 10:21 8:16	(4.5) 90%	(2.5) 50%						
950.0	37.2									Boring Terminated at Elevation 950.0 ft in CR (Gneiss)	37.2

NCDOT BORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07

NCDOT CORE SINGLE BROAD RIVER.GPJ NC_DOT.GDT 7/12/07



Boring B2-A – Station 19+71 @ 15' Left – Box 1 of 3



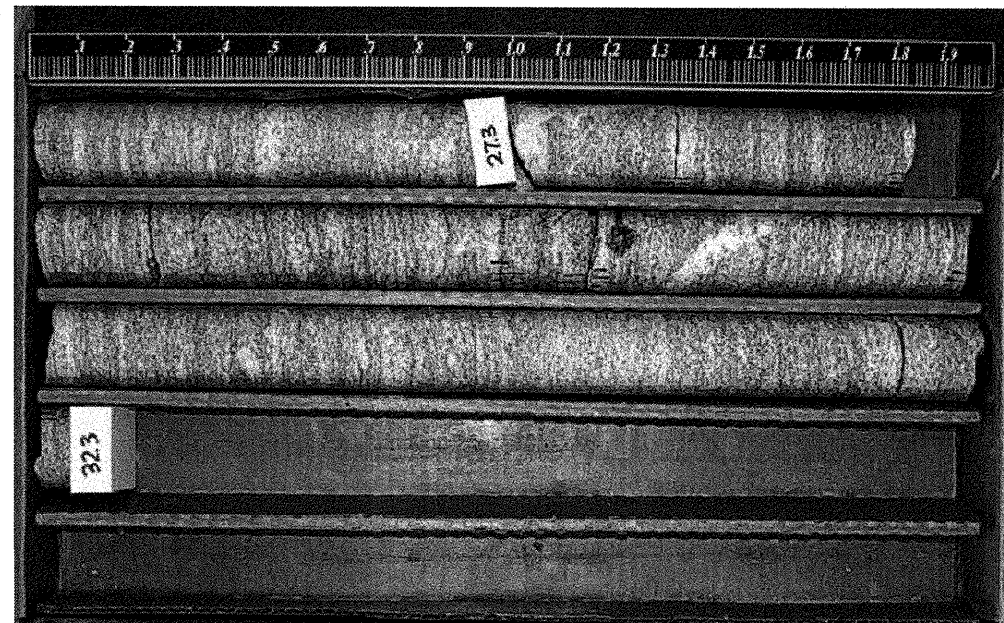
Boring B2-A – Station 19+71 @ 15' Left – Box 3 of 3



Boring B2-A – Station 19+71 @ 15' Left – Box 2 of 3



Boring B2-B – Station 19+40 @ 15' Right – Box 1 of 3



Boring B2-B – Station 19+40 @ 15' Right – Box 3 of 3



Boring B2-B – Station 19+40 @ 15' Right – Box 2 of 3



Boring EB2-A – Station 20+73 @ 15' Left – Box 1 of 2



Boring EB2-A – Station 20+73 @ 15' Left – Box 2 of 2



Boring EB2-B – Station 20+28 @ 15' Right – Box 1 of 2



Boring EB2-B – Station 20+28 @ 15' Right – Box 2 of 2

STATE PROJECT NO.: 33600.1.1
TIP NO.: B-4258
COUNTY: Rutherford
PROJECT DESC.: Bridge No. 7 on US 64 / 74 over Broad River

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				
EB2-B	SS-1	2.0'-3.5'	A-2-4 (0)	11	1	94	81	27	38	34	40	16	10	27	NP	NP	18.6
EB1-A	SS-2	5.0'-6.5'	A-4 (0)	2	2	100	89	36	20	20	51	19	10	29	NP	NP	36.4
EB1-B	ST-3	5.0'-5.5'	A-4 (0)	N/A	3	99	93	47	19	18	40	30	12	33	NP	NP	50.0
EB1-B	ST-4	5.5'-6.9'	A-5 (11)	N/A	4	100	98	85	2	2	18	51	29	47	9	38	65.8
EB2-A	ST-1	5.8'-6.9'	A-6 (3)	N/A	5	95	81	50	27	23	28	16	33	30	13	17	21.7
EB2-B	ST-2	9.0'-10.3'	A-4 (0)	N/A	6	96	80	44	29	26	32	20	22	27	7	20	19.2
Bed	S-1	N/A	A-2-4 (0)	N/A	7	99	58	4	72	72	26	0	2	29	NP	NP	N/A

STATE PROJECT NO.: 33600.1.1
TIP NO.: B-4258
COUNTY: Rutherford
PROJECT DESC.: Bridge No. 7 on US 64 / 74 over Broad River

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	EB1-A	17.1'-17.5'	Granitic Gneiss	62	2.56	1.98	148.2	1818	N/A	N/A	
RS-2	EB1-B	17.9'-18.4'	Granitic Gneiss	76	4.08	1.99	163.6	12474	N/A	N/A	
RS-3	B1-A	19.7'-20.1'	Granitic Gneiss	26	4.25	1.98	153.1	2088	N/A	N/A	
RS-4	B1-B	24.5'-25.0'	Granitic Gneiss	26	4.05	1.99	163.3	7283	N/A	N/A	
RS-5	B2-A	21.7'-22.2'	Granitic Gneiss	26	4.02	1.99	163.8	15006	N/A	N/A	
RS-6	B2-B	11.3'-11.9'	Granitic Gneiss	35	4.00	1.99	158.4	6140	N/A	N/A	
RS-7	EB2-A	13.6'-14.2'	Granitic Gneiss	46	4.00	1.99	159.7	6449	N/A	N/A	
RS-8	EB2-B	19.1'-19.4'	Granitic Gneiss	24	3.21	1.99	141.4	1299	N/A	N/A	



FIELD SCOUR REPORT

WBS: 33600.1.1 TIP: B-4258 COUNTY: Rutherford

DESCRIPTION(1): Bridge No. 7 on US 64 / 74 over Broad River

EXISTING BRIDGE

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

Bridge No.: 7 Length: 295' Total Bents: 4 Bents in Channel: 2 Bents in Floodplain: 4
 Foundation Type: Vertical Concrete Abutments on Concrete Footings

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: Minor Bank Sloughing @ EB2 Upstream

Interior Bents: Very Little Undermining

Channel Bed: Very Little Undermining

Channel Bank: Some Sloughing Upstream, Downstream is Protected

EXISTING SCOUR PROTECTION

Type(3): Boulders

Extent(4): None @ EB1, Immediate Upstream of EB2, Downstream very Extensive

Effectiveness(5): Very Effective

Obstructions(6): Small Trees @ Interior Bent 2

INSTRUCTIONS

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

DESIGN INFORMATION

Channel Bed Material(7): Sample results attached, material also includes Alluvium: boulders (12") to gravel (0.75").

Channel Bank Material(8): Sample results attached, material also includes Alluvium: boulders (12") to gravel (0.75").

Channel Bank Cover(9): Grass with small trees and brush

Floodplain Width(10): 250'

Floodplain Cover(11): Grass, trees and brush

Stream is(12): Aggrading _____ Degrading _____ Static

Channel Migration Tendency(13): To the East

Observations and Other Comments: River is upstream end of Lake Lure, appears Town of Lake Lure trying to control migration and flow.

Reported by: Shawn P. Washer Date: 6/8/2007
 Shawn P. Washer, P.E.

DESIGN SCOUR ELEVATIONS(14)

Feet Meters _____

	BENTS									
	B1	B2								
100 Year	981.6	980.3								
500 Year	980.9	979.7								

Comparison of DSE to Hydraulics Unit theoretical scour:
 We agree with the scour computations presented in the Bridge Survey and Hydraulic Design Report for B-4258, dated 5/9/2006.

DSE determined by: Chad M. Whalen Date: 6/18/2007
 C. M. Whalen

SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL

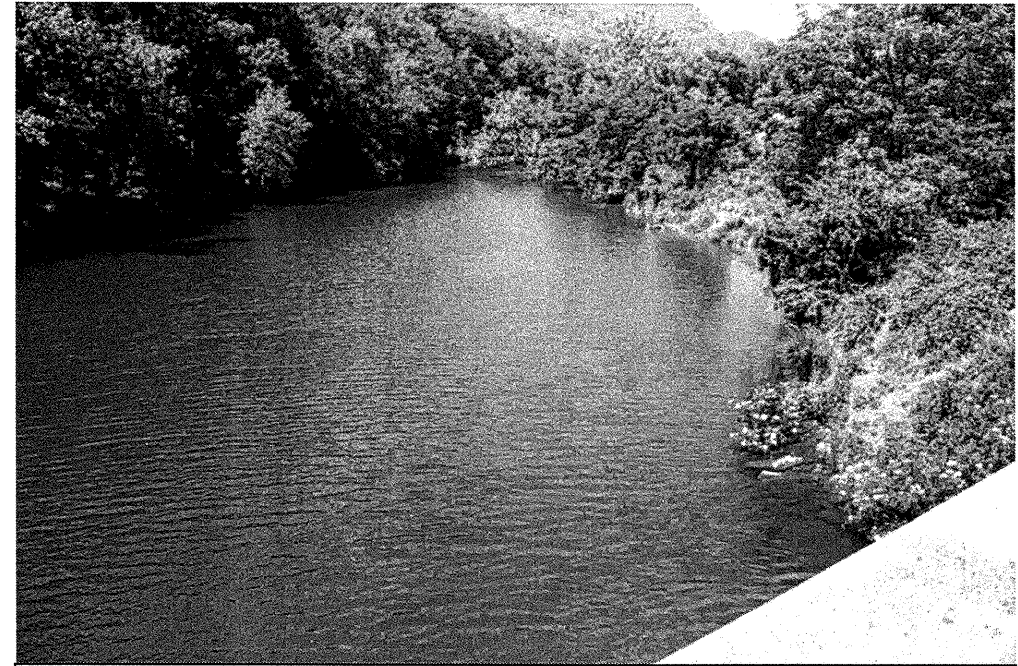
Bed or Bank	Bed	Bank	Bank	Bank		
Sample No.	S-1	SS-2	ST-3	ST-4		
Retained #4	1	0	0	0		
Passed #10	99	100	99	100		
Passed #40	58	89	93	98		
Passed #200	4	36	47	85		
Coarse Sand	72	20	19	2		
Fine Sand	25	50	40	18		
Silt	1	20	29	51		
Clay	2	10	12	29		
LL	29	29	33	47		
PI	NP	NP	NP	9		
AASHTO	A-2-4 (0)	A-4 (0)	A-4 (0)	A-5 (11)		
Station	N/A	17+64	17+45	17+45		
Offset	N/A	15' Lt.	15' Rt.	15' Rt.		
Depth	N/A	5.0'-6.5'	5.0'-5.5'	5.5'-6.9'		

PHOTOGRAPHIC RECORD

Replacement of Bridge No. 7 on US 64 / 74 over Broad River



Photograph No. 1 - This photograph was taken from Boring EB1-B looking at Borings EB2-A and EB2-B and the existing bridge.



Photograph No. 3 - This photograph was taken from the deck of the existing bridge looking upstream.



Photograph No. 2 - This photograph was taken from Boring EB1-A looking at Boring EB1-B.



Photograph No. 4 - This photograph was taken from Boring EB2-B looking at Boring EB2-A and the existing bridge.

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	33600.1.1 (B-4258)	1	

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

STRUCTURE
SUBSURFACE INVESTIGATION

CONTENTS

<u>SHEET</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	LEGEND
3	SITE PLAN
4	CROSS SECTION(S)

PROJ. REFERENCE NO. 33600.1.1 (B-4258) F.A. PROJ. BRSTP-0064(6)
COUNTY RUTHERFORD
PROJECT DESCRIPTION APPROACHES TO BRIDGE NO. 7
ON US-64 OVER BROAD RIVER

SITE DESCRIPTION PROPOSED RETAINING WALL RIGHT OF CENTERLINE -L-
AND LEFT OF CENTERLINE -Y2-

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION, AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

PROJECT: 33600.1.1 ID: B-4258

PERSONNEL

T B DANIEL

C J COFFEY

R D CHILDERS

INVESTIGATED BY C A DUNNAGAN

CHECKED BY W D FRYE, Jr

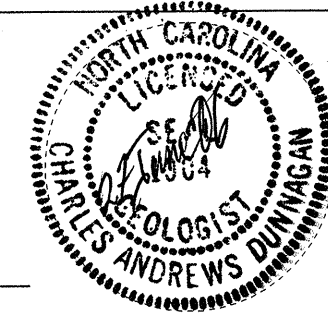
SUBMITTED BY W D FRYE, Jr

DATE JUNE 2006

DRAWN BY: C A DUNNAGAN

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

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.



C A Dunnagan

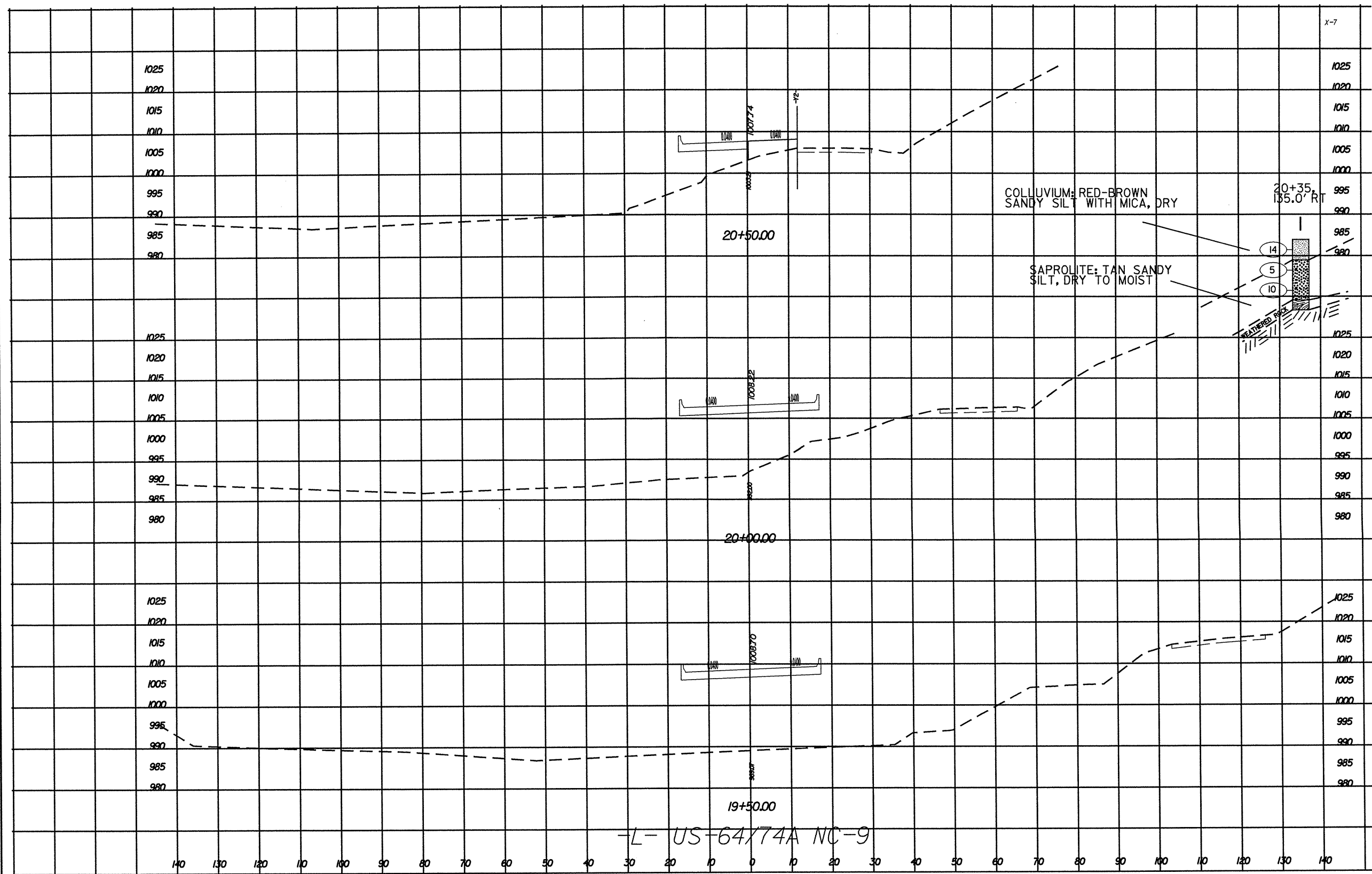
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

PROJECT REFERENCE NO. 33600.II (B-4258) SHEET NO. 2

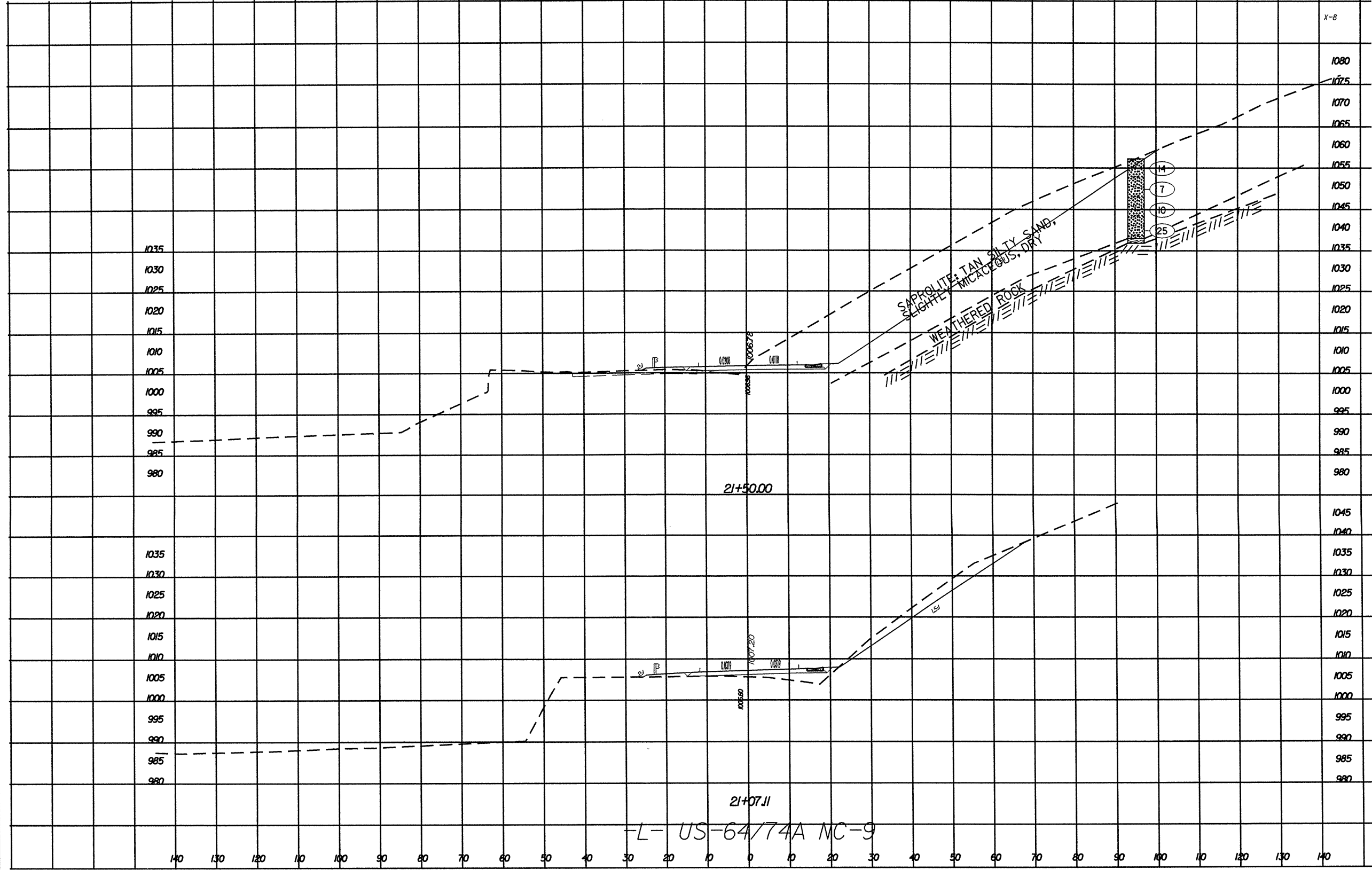
SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

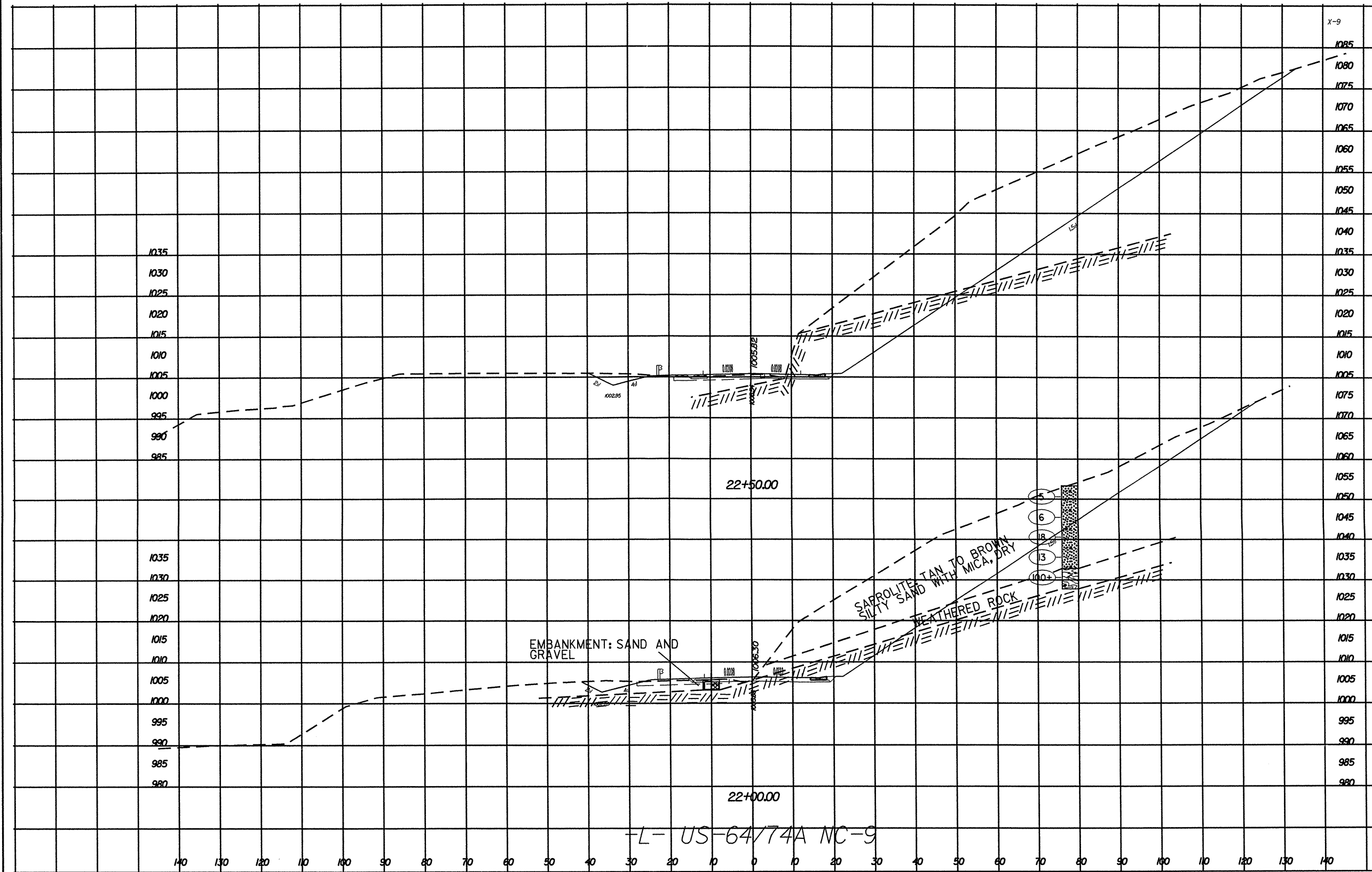
SOIL DESCRIPTION		GRADATION		ROCK DESCRIPTION		TERMS AND DEFINITIONS																																																																																																							
<p>SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS 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:</p> <p style="text-align: center;"><i>VERY STIFF, GRAY, SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i></p>		<p>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)</p> <p>GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.</p> <p style="text-align: center;">ANGULARITY OF GRAINS</p> <p>THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.</p>		<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>		<p>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.</p> <p>AQUIFER - A WATER BEARING FORMATION OR STRATA.</p> <p>ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.</p> <p>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.</p> <p>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.</p> <p>CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.</p> <p>COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.</p> <p>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.</p> <p>DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.</p> <p>DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.</p> <p>DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.</p> <p>FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.</p> <p>FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.</p> <p>FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLOGGED FROM PARENT MATERIAL.</p> <p>FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.</p> <p>FORMATION (FM) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.</p> <p>JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.</p> <p>LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.</p> <p>LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.</p> <p>MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.</p> <p>PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.</p> <p>RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.</p> <p>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.</p> <p>SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.</p> <p>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.</p> <p>SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.</p> <p>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.</p> <p>STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.</p> <p>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.</p> <p>TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>																																																																																																							
SOIL LEGEND AND AASHTO CLASSIFICATION		MINERALOGICAL COMPOSITION		WEATHERING		ROCK HARDNESS																																																																																																							
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>GENERAL CLASS.</th> <th colspan="2">GRANULAR MATERIALS (≤ 35% PASSING #200)</th> <th colspan="2">SILT-CLAY MATERIALS (> 35% PASSING #200)</th> <th colspan="2">ORGANIC MATERIALS</th> </tr> <tr> <th>GROUP CLASS.</th> <th>A-1</th> <th>A-3</th> <th>A-2</th> <th>A-4</th> <th>A-5</th> <th>A-6</th> </tr> <tr> <th>SYMBOL</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </thead> <tbody> <tr> <td>% PASSING #10</td> <td>50 MX</td> <td>50 MX</td> <td>40 MX</td> <td>40 MX</td> <td>40 MX</td> <td>40 MX</td> </tr> <tr> <td>% PASSING #40</td> <td>30 MX</td> <td>50 MX</td> <td>41 MN</td> <td>40 MX</td> <td>41 MN</td> <td>40 MX</td> </tr> <tr> <td>% PASSING #200</td> <td>15 MX</td> <td>25 MX</td> <td>10 MX</td> <td>10 MX</td> <td>11 MN</td> <td>11 MN</td> </tr> </tbody> </table>		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	SYMBOL							% PASSING #10	50 MX	50 MX	40 MX	40 MX	40 MX	40 MX	% PASSING #40	30 MX	50 MX	41 MN	40 MX	41 MN	40 MX	% PASSING #200	15 MX	25 MX	10 MX	10 MX	11 MN	11 MN	<p>MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.</p>		<p>WEATHERED ROCK (WR) - NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.</p> <p>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.</p> <p>NON-CRYSTALLINE ROCK (NCR) - FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.</p> <p>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.</p>		<p>FRESH - ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING, ROCK RINGS UNDER HAMMER IF CRYSTALLINE.</p> <p>VERY SLIGHT (V SL.) - ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY, ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.</p> <p>SLIGHT (SL.) - ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.</p> <p>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.</p> <p>MODERATELY SEVERE (MOD. SEV.) - ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i></p> <p>SEVERE (SEV.) - ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED, ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, YIELDS SPT N VALUES > 100 BPF</i></p> <p>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. <i>IF TESTED, YIELDS SPT N VALUES < 100 BPF</i></p> <p>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.</p>																																																													
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<p style="text-align: center;">COLOR</p> <p>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.</p>		<p style="text-align: center;">INDURATION</p> <p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TERM</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>FRIABLE</td> <td>RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</td> </tr> <tr> <td>MODERATELY INDURATED</td> <td>GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</td> </tr> <tr> <td>INDURATED</td> <td>GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</td> </tr> <tr> <td>EXTREMELY INDURATED</td> <td>SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</td> </tr> </tbody> </table>		TERM	DESCRIPTION	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.																																																																																																
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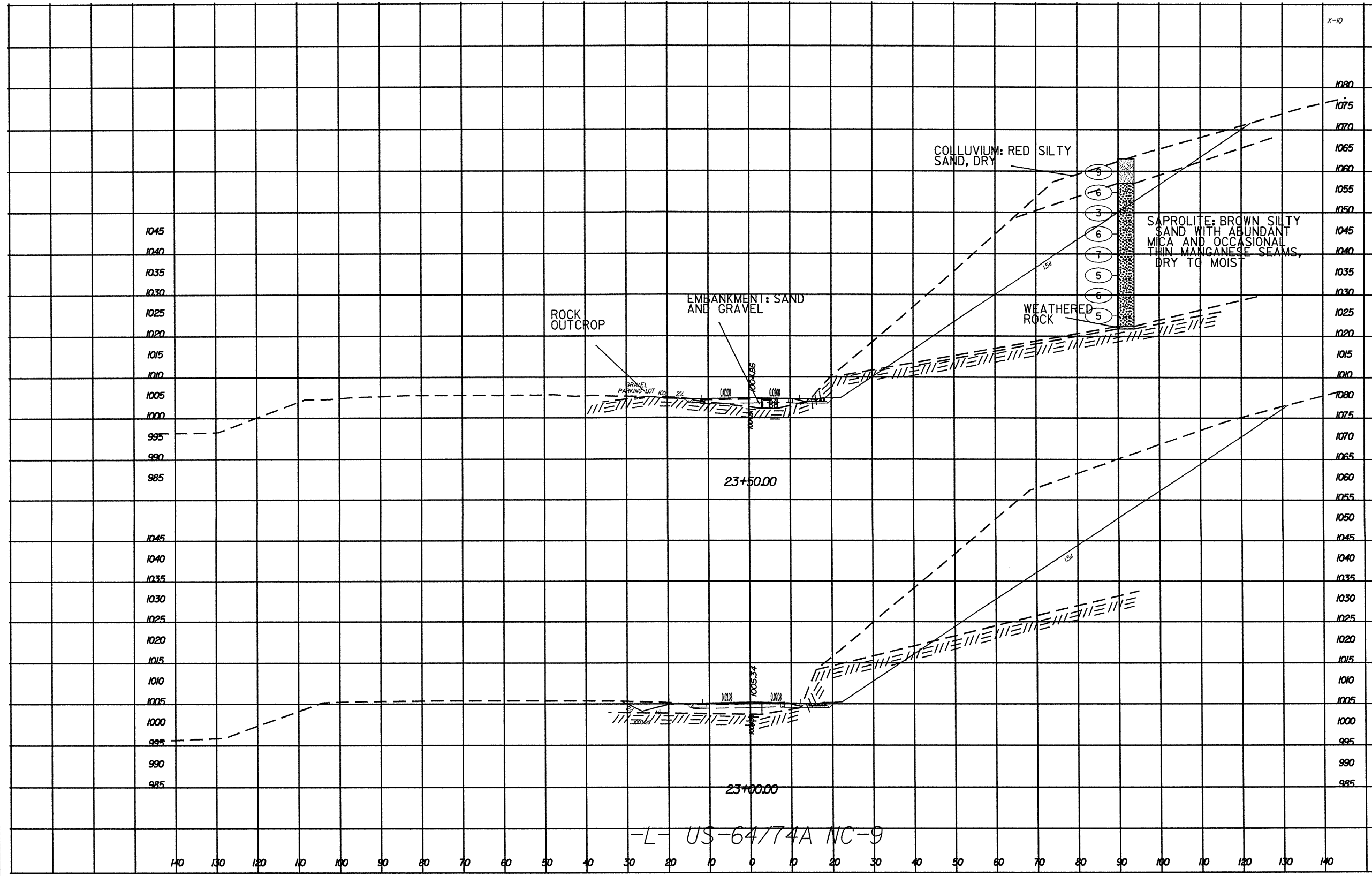
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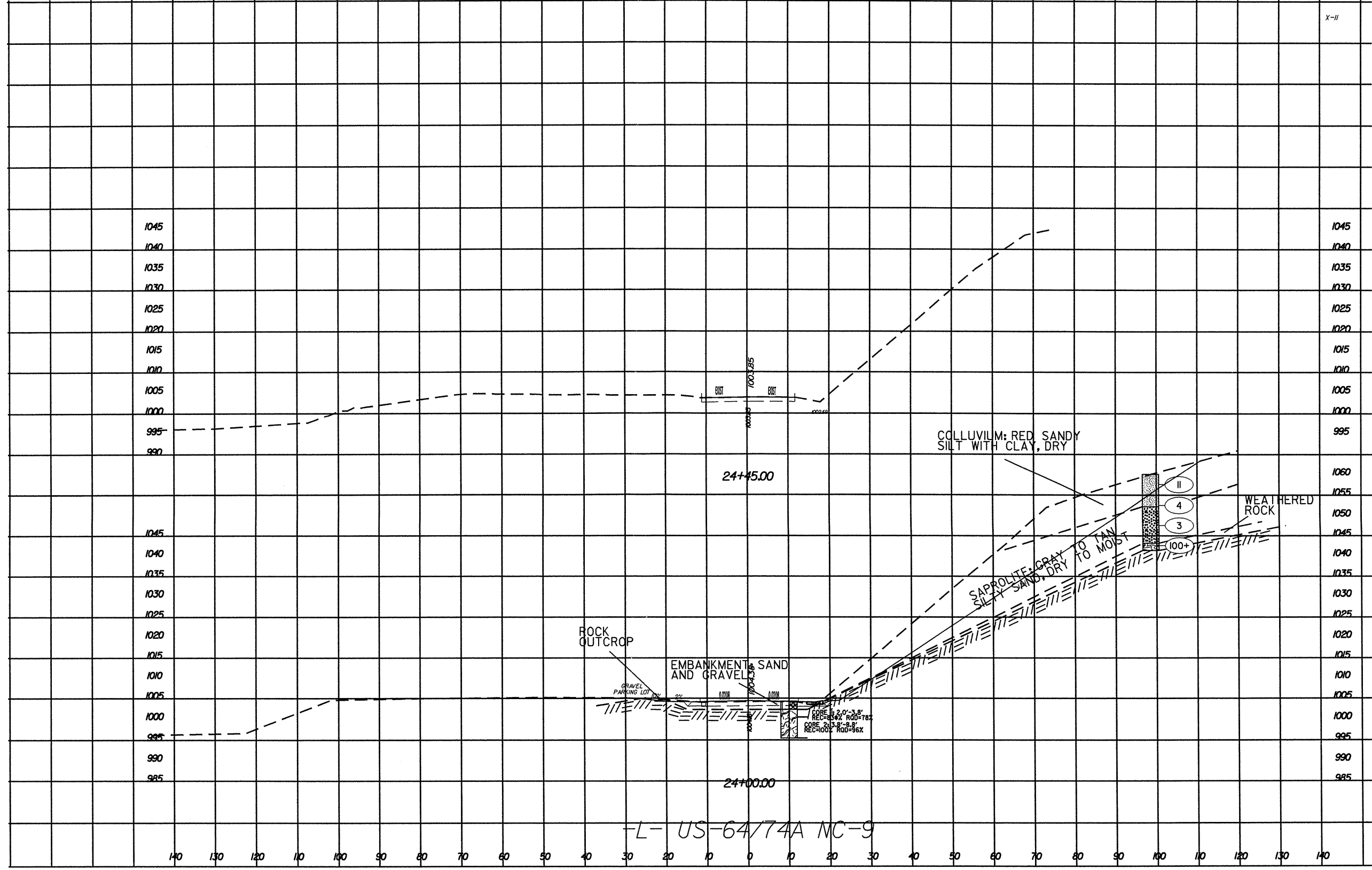


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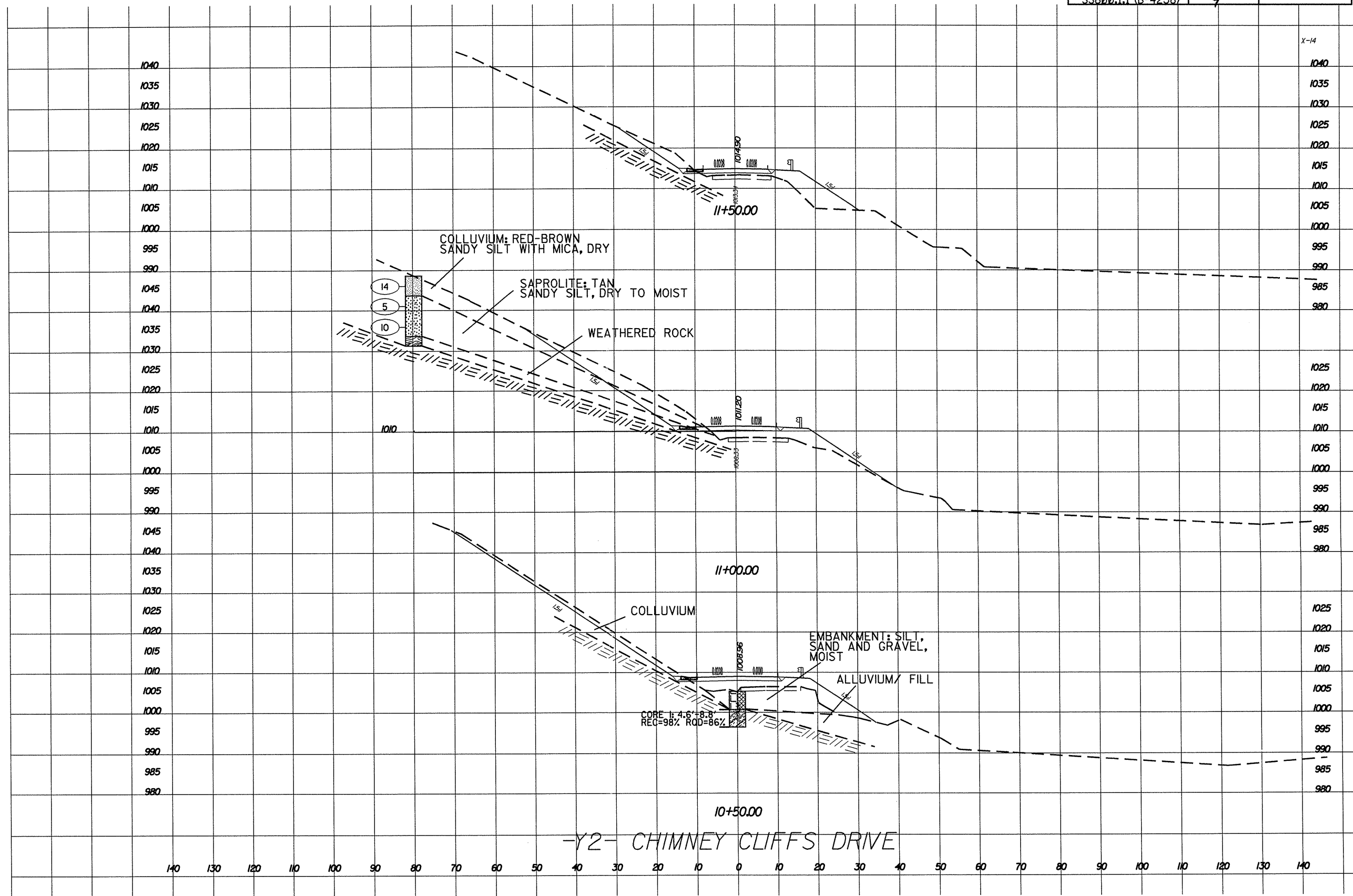


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-Y2- CHIMNEY CLIFFS DRIVE