

PROJECT: MA9404B ID:

# STATE OF NORTH CAROLINA

## DEPARTMENT OF TRANSPORTATION

### DIVISION OF HIGHWAYS

### GEOTECHNICAL UNIT

# STRUCTURE SUBSURFACE INVESTIGATION

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	MA9404B	1	26
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
MA9404B		P.E.	
		CONST.	

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### CAUTION NOTICE

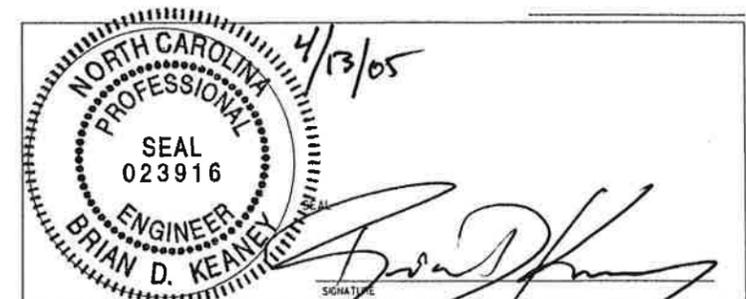
THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING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

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

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 MA9404B I.D. NO. \_\_\_\_\_  
 F.A. PROJECT \_\_\_\_\_  
 COUNTY ROWAN  
 PROJECT DESCRIPTION BRIDGE #163 ON SR  
SR 2343 (LOWER PALMER RD.) OVER  
TRIBUTARY TO SECOND CREEK  
 SITE DESCRIPTION \_\_\_\_\_

INVESTIGATED BY J. HOWARD PERSONNEL C. BRUNSMAN  
 CHECKED BY B. KEANEY, P.E. M. KORN  
 SUBMITTED BY TIERRA, INC.  
 DATE APRIL, 2004



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

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

DRAWN BY: E. WAGNER

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS  
GEOTECHNICAL UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
	MA9404B	2	26

SOIL DESCRIPTION		GRADATION		ROCK DESCRIPTION		TERMS AND DEFINITIONS							
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 (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: <i>VERY STIFF, GRAY SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGH PLASTIC, A-7-6</i>		WELL-GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED) GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES. <b>ANGULARITY OF GRAINS</b> THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.		HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:  NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.  FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.  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.  COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.		ALLOVIUM (ALLUV.) - SOILS WHICH HAVE BEEN TRANSPORTED BY WATER. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC. ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IS IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS WHICH CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SURFACES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. FLOOD PLAIN (F.P.) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS, MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. RESIDUAL SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (R.Q.D.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. SAPROLITE (SAP.) - RESIDUAL SOIL WHICH RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS. SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (IN OR B.P.F.) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS LESS THAN 0.1 FOOT PENETRATION WITH 60 BLOWS. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE. TOPSOIL (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.							
SOIL LEGEND AND AASHTO CLASSIFICATION		MINERALOGICAL COMPOSITION		WEATHERING									
GENERAL CLASS. GRANULAR MATERIALS (< 5% PASSING #200) SILT-CLAY MATERIALS (> 5% PASSING #200) ORGANIC MATERIALS		MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.		FRESH ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE. VERY SLIGHT (V. SL.) ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN. CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE. SLIGHT (SL.) ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS. MODERATE (MOD.) SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK. MODERATELY SEVERE (MOD. SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i> SEVERE (SEV.) ALL ROCKS EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &gt; 100 BPF</i> 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 &lt; 100 BPF</i> 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.		SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 30 MODERATELY COMPRESSIBLE LIQUID LIMIT 31-50 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 50		WEATHERING					
COMPRESSION		PERCENTAGE OF MATERIAL		GROUND WATER									
GROUP CLASS. A-1, A-2, A-3, A-4, A-5, A-6, A-7		ORGANIC MATERIAL GRANULAR SOILS SILT-CLAY SOILS OTHER MATERIAL		WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING. STATIC WATER LEVEL AFTER 24 HOURS. PERCHED WATER, SATURATED ZONE OR WATER BEARING STRATA SPRING OR SEEPAGE									
SYMBOL		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
% PASSING #10 #40 #200		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
LIQUID LIMIT PLASTIC INDEX		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
GROUP INDEX		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
USUAL TYPES OF MAJOR MATERIALS		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
GENERAL RATING AS A SUBGRADE		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
P.I. OF A-7-5 ≤ L.L. - 30 + P.I. OF A-7-6 > L.L. - 30		TRACE OF ORGANIC MATTER 2 - 3% LITTLE ORGANIC MATTER 3 - 5% MODERATELY ORGANIC 5 - 10% HIGHLY ORGANIC > 10%											
CONSISTENCY OR DENSENESS		MISCELLANEOUS SYMBOLS		ROCK HARDNESS									
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )		ROADWAY EMBANKMENT WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS INFERRED SOIL BOUNDARIES INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY DIP/DIP DIRECTION OF ROCK STRUCTURES SOUNDING ROD		SPT TEST BORING AUGER BORING CORE BORING MONITORING WELL PIEZOMETER INSTALLATION SLOPE INDICATOR INSTALLATION SPT N-VALUE SPT REFUSAL		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. GUGES 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 GROVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK. SOFT CAN BE 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 FINGER NAIL.		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 FCSS - FOSSILIFEROUS FRAC. - FRACTURED FRAGS. - FRAGMENTS MED. - MEDIUM PMT - PRESSUREMETER TEST SD - SAND, SANDY SL - SILT, SILTY SLI - SLIGHTLY TCR - TRICONE REFUSAL U - UNIT WEIGHT U <sub>d</sub> - DRY UNIT WEIGHT W - MOISTURE CONTENT V - VERY VST - VANE SHEAR TEST		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. GUGES 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 GROVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK. SOFT CAN BE 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 FINGER NAIL.			
GENERALLY GRANULAR MATERIAL (NON-COHESIVE) VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE		ROADWAY EMBANKMENT WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS INFERRED SOIL BOUNDARIES INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY DIP/DIP DIRECTION OF ROCK STRUCTURES SOUNDING ROD		SPT TEST BORING AUGER BORING CORE BORING MONITORING WELL PIEZOMETER INSTALLATION SLOPE INDICATOR INSTALLATION SPT N-VALUE SPT REFUSAL		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. GUGES 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 GROVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK. SOFT CAN BE 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 FINGER NAIL.							
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April 13, 2005

Mr. David Simpson, P.E.  
Simpson Engineers & Associates  
5520 Dillard Drive, Suite 120  
Cary, NC 27511

**Re: Geotechnical Subsurface Exploration Report**

Project No.: MA9404B  
County: Rowan County  
Description: Bridge No. 163 on SR-2343 over Unnamed Tributary  
to Second Creek  
Tierra Inc. Proj. No.: 6211-04-028

Dear Mr. Simpson:

As authorized, Tierra, Inc. has completed the geotechnical subsurface exploration for Bridge No. 163 on SR-2343 over Unnamed Creek. Our investigation was performed in general accordance with our proposal number TR-04-042. The purpose of this report is to present subsurface conditions at the locations tested and foundation design recommendations for the planned structure. Field and laboratory test results, site and boring location plans, and profile/cross sections depicting subsurface conditions may be found in this report.

**PROJECT DESCRIPTION**

According to the Bridge Survey and Hydraulic Design Report dated February 2005, the referenced project intends to replace the existing two span, three bent bridge over the Unnamed Tributary to Second Creek. The proposed replacement structure will be a two span, three bent bridge, approximately 90 feet long. The proposed bridge will be located between Station 12+83 and Station 13+73, with a skew angle of 75°. The bridge will be replaced along the same alignment with no proposed grade changes.

**SITE DESCRIPTION/GEOLOGY**

The proposed project site is located along SR 2343 in a rural area of Rowan County, approximately two miles northeast of Rockwell, NC. The area has rolling terrain with a relatively wide flood plain. In general this area is residential. It is estimated that the Unnamed Tributary to Second Creeks' floodplain is approximately 200 feet wide at the bridge site. Depth of water at the time of drilling was approximately 1.0 foot.

According to *The Geologic Map of North Carolina* (1985), the project site is part of the Piedmont Physiographic Providence and is located within the Charlotte Belt. Bedrock consists

of plutons ranging in composition from granites to gabbros. Specifically, this area lies within the Granite of Salisbury Plutonic Suite (**DSg**), which is Silurian to Devonian in age. Rock at the site consists mainly of granite; however due to the proximity of this location to the edge of the pluton, andesitic metavolcanic rock (**PzZm**) in small layers within the granite were also encountered.

**FIELD EVALUATION PROCEDURE**

The subsurface exploration consisted of performing (5) soil test borings near the centerlines of the proposed end bents and interior bents based on the Hydraulic Report dated September 2004. In February 2005, Tierra received a revised bridge location plan. After review of the new location we concluded that the original borings performed provided sufficient information for analysis of the bridge.

Original end bent borings were offset due to utilities and accessibility issues. Borings were performed with a Diedrich D-50 drill rig with a manual hammer. Standard Penetration Tests (SPT) and soil sampling were performed in general accordance with American Association of State Highway Transportation Officials (AASHTO T-206-87), and North Carolina Department of Transportation (NCDOT) latest Geotechnical Guidelines and Procedures Manual.

Groundwater measurement readings were taken within each borehole with a weighted 100-foot measuring tape from a survey reference location at the top of each boring. Readings were recorded immediately after boring termination and after a 24-hour waiting period. Surveyed borehole elevations at the site were based on a temporary benchmark (BL-4) at Station 12+84.45, approximately 13 feet left of the centerline, with a datum of 661.99 feet Mean Sea Level (MSL) (NAVD 1988).

In addition to our subsurface investigation, a visual scour evaluation was performed along the channel and banks of the Unnamed Creek to determine scour impact for foundation design purposes. The scour report is included in this report.

**SUBSURFACE AND GROUNDWATER CONDITIONS**

Due to the relocation of the proposed bent locations with the February 2005 Hydraulic Report, subsurface conditions were projected to new bent centerlines. Subsurface soils penetrated beneath the site consist of roadway embankment and alluvium deposits. Weathered and crystalline rock was penetrated beneath subsurface soils.

**End Bents**

Soils beneath End Bent 1 consist of roadway embankment and alluvium deposits. Roadway embankment soil consists of approximately 7 feet of soft silty clay (A-7-5). Alluvial soil encountered beneath the bent line consists of an average of 5 feet of very loose silty sand (A-2-4)

and dense and sandy gravel (A-1-a). Alluvium deposits directly overlie crystalline rock at an elevation of 651 feet (MSL).

Soils beneath End Bent 2 consist of roadway embankment and alluvium deposits. Roadway embankment soils consist of approximately 8.5 feet of medium stiff to soft sandy clay (A-7-5). Alluvial deposits consist of an average of 5 feet of soft sandy clay (A-6). Alluvial soils beneath EB2A directly overlie weathered rock at a depth of 13.5 feet. Weathered rock directly overlies crystalline rock at an elevation of 644 feet (MSL).

### Interior Bents

The projected subsurface conditions, at the new Interior Bent 1, consists of a one-foot layer of weathered rock, which directly overlies crystalline rock at an elevation of 651 (MSL).

Ground water across the site ranges in elevation between 657 (MSL) and 652 feet (MSL). Water elevation at the time of boring was approximately at 652.5 feet (MSL).

### LABORATORY TESTING

Representative split-spoon samples were selected from soil test borings to verify visual field classification and determine soil index properties. A total of 6 split-spoon samples were analyzed in our laboratory for natural moisture determination, Atterberg limits, and grain size analysis. A Representative bank sample was analyzed for grain size distribution. Two rock core samples were tested for compressive strength testing. All testing was performed in accordance with the following American Society for Testing and Materials (ASTM), (NCDOT) Modified and/or (AASHTO) procedures:

- AASHTO T-88-00 (As Modified) "Particle Size Analysis of Soil"
- AASHTO T-89-902(As Modified) "Determining the Liquid Limits of Soil"
- AASHTO T-90-00 "Determining the Plastic Limit and Plasticity of Soils"
- AASHTO T-265-93 "Laboratory Determination of Moisture Content of Soils"
- ASTM D 2938-95 "Unconfined Compressive Strength of Intact Rock Core"
- ASTM D 3148-02 "Elastic Moduli of Intact Rock Core in Uniaxial Compression"

### CONCLUSIONS

Based on the subsurface investigation, soils consist of roadway embankment and alluvium deposits. Weathered rock and crystalline rock were penetrated beneath alluvium deposits at approximately 650 feet (MSL) across the site. Based on the consistencies and relative densities of the subsurface soils, deep foundations will be required to support the proposed bridge. The upper 4 to 8 feet beneath the proposed end bent locations consist of soft clays, with a groundwater table typically 4.5 feet beneath existing site grades. Instability and high groundwater may affect construction of the end bents.

### FOUNDATION RECOMMENDATIONS

Based on the depth to competent bearing material, the end bents for the proposed bridge will be supported by driven HP 12x53 steel piles and 36-inch drilled piers for Interior Bent 1. The piles will develop ultimate capacity with a safety factor of 2 by end bearing on crystalline rock. For more information, refer to the attached "Summary of Foundation Recommendations".

According to the (NCDOT) Hydraulics Report, there are no proposed changes in grades; therefore, there are no anticipated embankment settlement or slope stability concerns at the bridge approaches.

### CLOSURE

Recommendations and evaluations provided by Tierra, Inc. are based on the Bridge Survey & Hydraulic Design Report dated February 2005. Modifications of our recommendations and evaluations may be required if there are changes to the design or location of the structure. Recommendations in this report are based on data obtained from soil and rock core borings. The nature and extent of variations between borings may not become evident until construction. Please note that the borings were located and drilled based upon previously provided Bridge Survey & Hydraulic Design Report dated September 2004.

Our professional services for this project have been performed in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made. Tierra, Inc. appreciates this opportunity to have provided you with geotechnical engineering services for this project. If you have any questions regarding this report, please contact our office.

Sincerely,  
**TIERRA, INC.**



Matthew A. Korn, E.I  
Staff Professional



Brian D. Keaney, P.E.  
Geotechnical Services Manager

No. MA09404B, Rowan County  
 Bridge # 163 on SR 2343 over Unnamed Tributary to Second Creek  
 6211-04-028

**SUMMARY OF FOUNDATION RECOMMENDATIONS**

NCDOT PROJ. NO.: MA-09404B PROJECT DESCRIPTION: Bridge # 163 on SR 2343 over  
 T.I.P. NO.: \_\_\_\_\_ Unnamed Tributary to Second Creek  
 COUNTY: Rowan  
 STATION: 13+28 -L-  
 \_\_\_\_\_  
 PREPARED BY: MAK DATE: 4/6/05  
 CHECKER: BDK DATE: 4/7/05



	STATION	FOUNDATION TYPE	ALLOWABLE LOAD	FOUNDATION DETAILS
END BENT 1	12+83 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 663 ft ± Recommended Length of Pile = 15 ft
BENT 1	13+13 -L-	36" Drilled Pier	150 tons/Pier	Assumed Bottom of Cap = 663 ft ± Assumed Top of Pier = 653 ft Tip Elevation No Higher Than = 642 ft Recommended Length of Pier = 11 ft
END BENT 2	13+73 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 662 ft ± Recommended Length of Pile = 15 ft

COMMENTS & NOTES (Attached)

**Note on Plans:**

1. Piles for End Bents No. 1 and 2 shall be driven to a minimum bearing capacity of 45 tons each.
2. When driving piles, the maximum blow counts shall not be exceeded.
3. The drilled piers at Bent No. 1 have been designed for tip bearing only. The required tip bearing capacity is 25 TSF.
4. The required tip bearing capacity at Bent No. 1 shall be verified.
5. The drilled piers for Bent No. 1 have been deigned for an applied load of 150 tons each at the top of the column.
6. Permanent steel casing may be required for drilled piers at Bent No.1. If required, the casing shall not extend below elevation 650 ft. without the engineer's permission. The need for permanent steel casing will be determined by the engineer.
7. For permanent steel casing, see special provision for drilled piers.
8. Drilled piers at Bent No. 1 shall extend to an elevation no higher than 642 ft. and satisfy the required tip bearing capacity.
9. The scour critical elevation for Bent No. 1 is 650 ft. The scour critical elevations are for use by maintenance forces to monitor possible scour problems during the life of the structure.
10. For drilled piers, see special provisions.
11. SPT testing is not required to determine the tip bearing capacity of the drilled piers at Bent No.1.
12. Slurry construction shall not be used for this project.
13. SID inspections are not required to determine the bottom cleanliness of the drilled piers at Bent No.1.

**Comments:**

1. 1.5 :1 (H:V) slope is Ok with Class II Rip Rap slope protection.
2. The elevation of the point of fixity for Bent No. 1 is 647 ft.
3. Design scour elevation is 651 ft.

# DRILLED PIER PAY ITEM QUANTITIES

PROJECT NO. MA-09404B DATE 4/7/2005  
 TIP NO. \_\_\_\_\_ DESIGNED BY MAK  
 COUNTY ROWAN CHECKED BY BDK  
 STATION 13+28 -L-

DESCRIPTION BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY TO SECOND CREEK

NUMBER OF BENTS WITH DRILLED PIERS 1  
 NUMBER OF PIERS PER BENT 3

BENT #	DRILLED PIER PAY ITEMS					
	PERMANENT STEEL CASING FOR 36 DIA. DRILLED PIER (yes/no/maybe)	36 DIA. DRILLED PIERS NOT IN SOIL (feet)	SPT TESTING (each)	SID INSPECTION (each)	CROSSHOLE SONIC LOGGING* (each)	CSL TUBES* (yes/no)
1	maybe	27	0	0	0	no
2						
3						
4						
5						
6						
7						
8						
9						
10						
<b>TOTALS</b>	<del>XXXX</del>	27	0	0	0	<del>XXXX</del>

\* Pay items, "Crosshole Sonic Logging" and "CSL Tubes" are not required unless CSL testing is required with a Note on Plans.

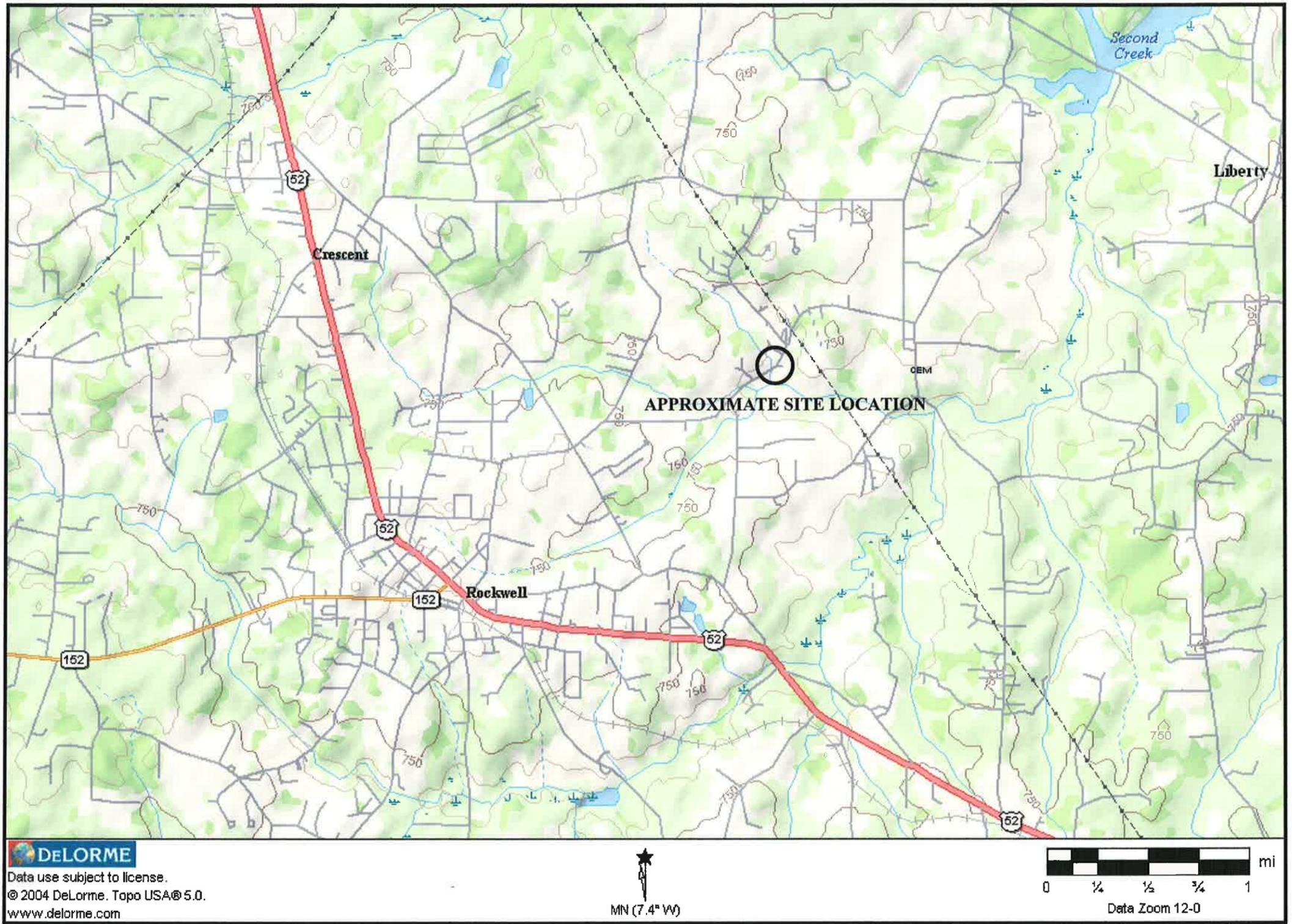
Notes:

Blanks or no represent quantity of zero.

If permanent steel casing is required or may be required, Structure Design should calculate the pay item quantity, "Permanent Steel Casing for \_\_\_ Dia. Drilled Pier", as the difference between the top of drilled pier elevation or the top of permanent steel casing elevation (whichever is lower) and the elevation the permanent steel casing can not extend below as shown with a Note on Plans.

Structure Design should determine the pay item quantity, "\_\_\_ Dia. Drilled Piers in Soil", based upon the total drilled pier length per bent minus the "\_\_\_ Dia. Drilled Piers not in Soil" per bent shown in the table above.

If CSL tubes are required, Structure design should calculate the pay item quantity, "CSL Tubes", as follows:  
 "CSL Tubes" per bent = (drilled pier length + 2.5 feet) x number of CSL tubes per pier  
 The number of CSL tubes per pier is dependent upon the drilled pier diameter. For drilled piers with a diameter of 5 feet or less, use 4 tubes. For drilled piers with a diameter greater than 5 feet, use 6 tubes.



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 www.delorme.com

★  
 MN (7.4° W)

0 1/4 1/2 3/4 1 mi  
 Data Zoom 12-0

North

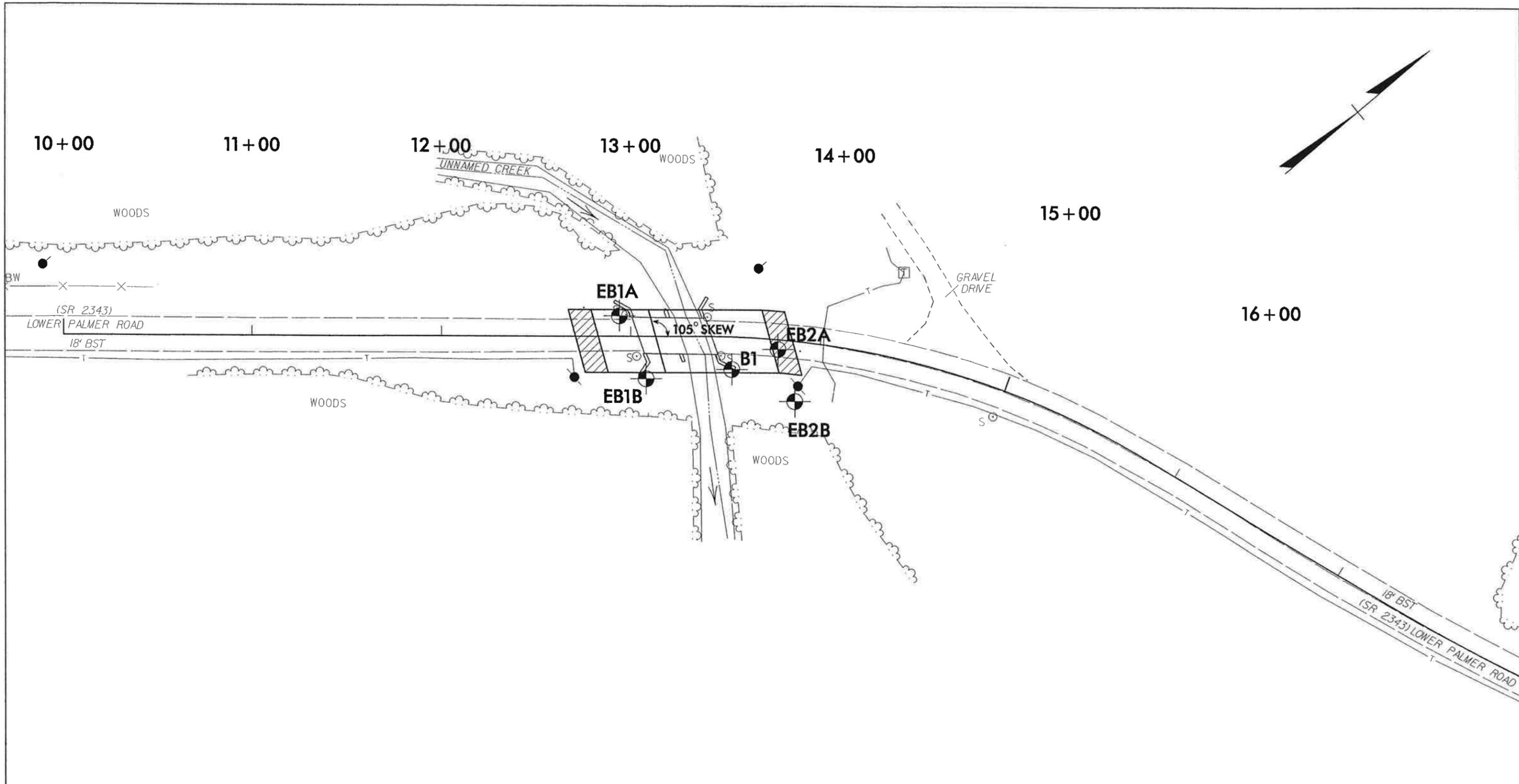
**SITE VICINITY MAP**

**NCMA Project: MA9404B**

**Bridge No. 163 on SR 2343 over Unnamed Tributary to Second Creek**

**Rowan County, North Carolina**

**Tierra Project: 6211-04-028**

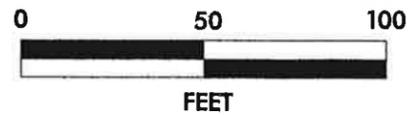


**NOTES:**

BENCHMARK: -BL-4, -L- STA. 12 + 84.45  
13.03' LEFT, ELEVATION 661.99'

PLAN ADOPTED FROM FILES PROVIDED  
BY ARCADIS, DATED FEB. 2005

BORINGS PERFORMED AT BENT LOCATIONS BASED  
UPON HYDRO REPORT DATED SEP. 2004

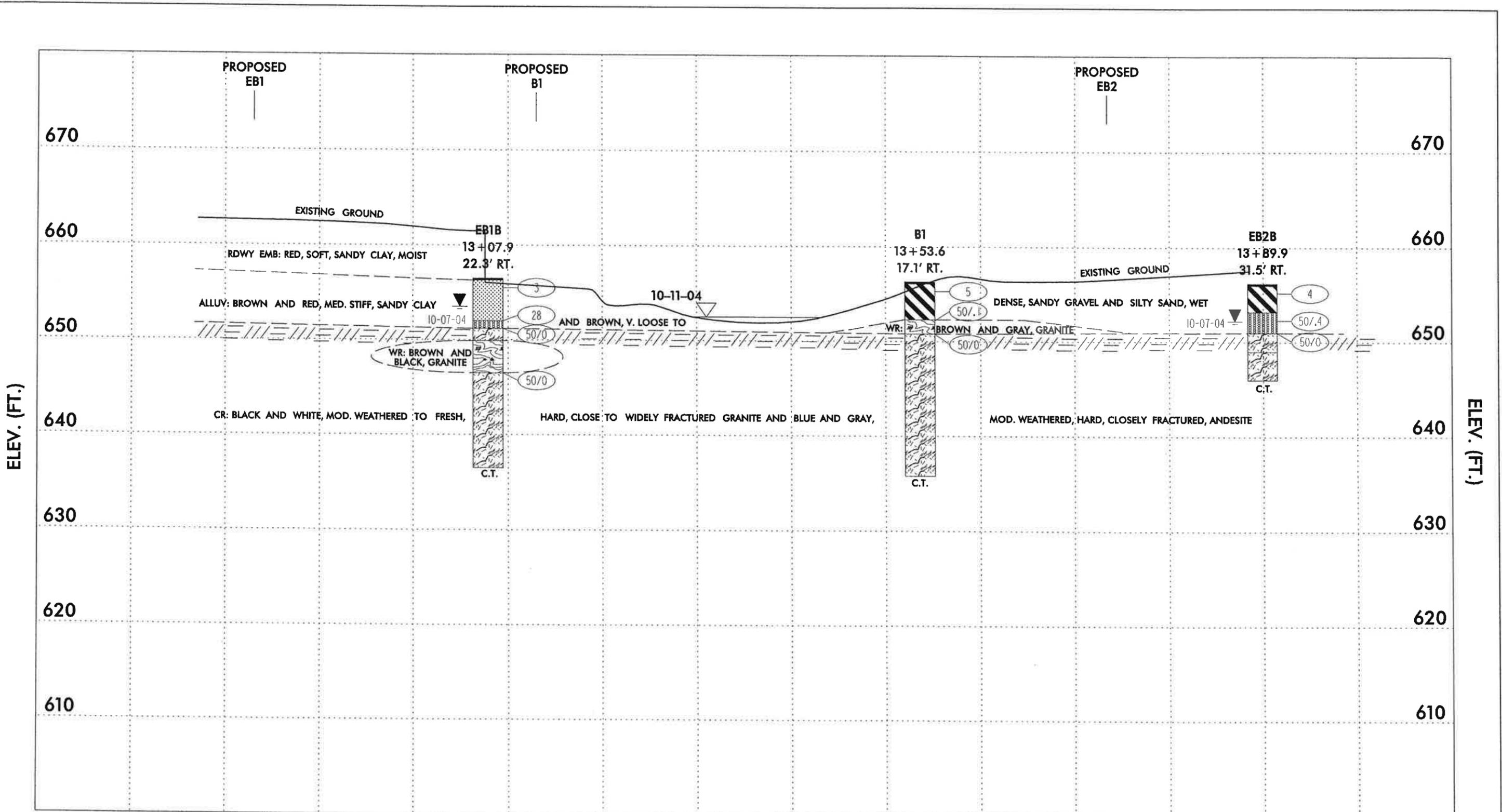


**BORING LOCATION PLAN**

NCDOT PROJECT #: MA9404B  
ROWAN CO., NC  
BRIDGE # 163 ON SR 2343 (LOWER PALMER RD.)  
OVER UNNAMED TRIBUTARY TO SECOND CREEK



TIERRA, INC.  
2736 ROWLAND RD.  
RALEIGH, NC 27615  
PHONE (919) 871-0800  
FAX (919) 871-0803



ELEV. (FT.)

ELEV. (FT.)

PROPOSED BENTS BASED UPON  
HYDRO REPORT DATED FEB., 2005

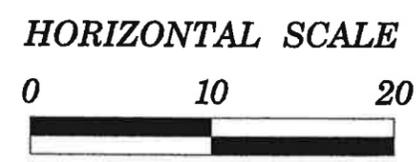
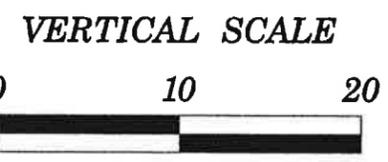
GROUNDLINE PROFILE WAS PERFORMED BASED  
UPON HYDRO REPORT DATED SEP., 2004

BENCH MARK: -BL-4, STA. 12+84.45,  
13.03' LEFT, ELEVATION 661.99 FT.

13+00

13+50

14+00



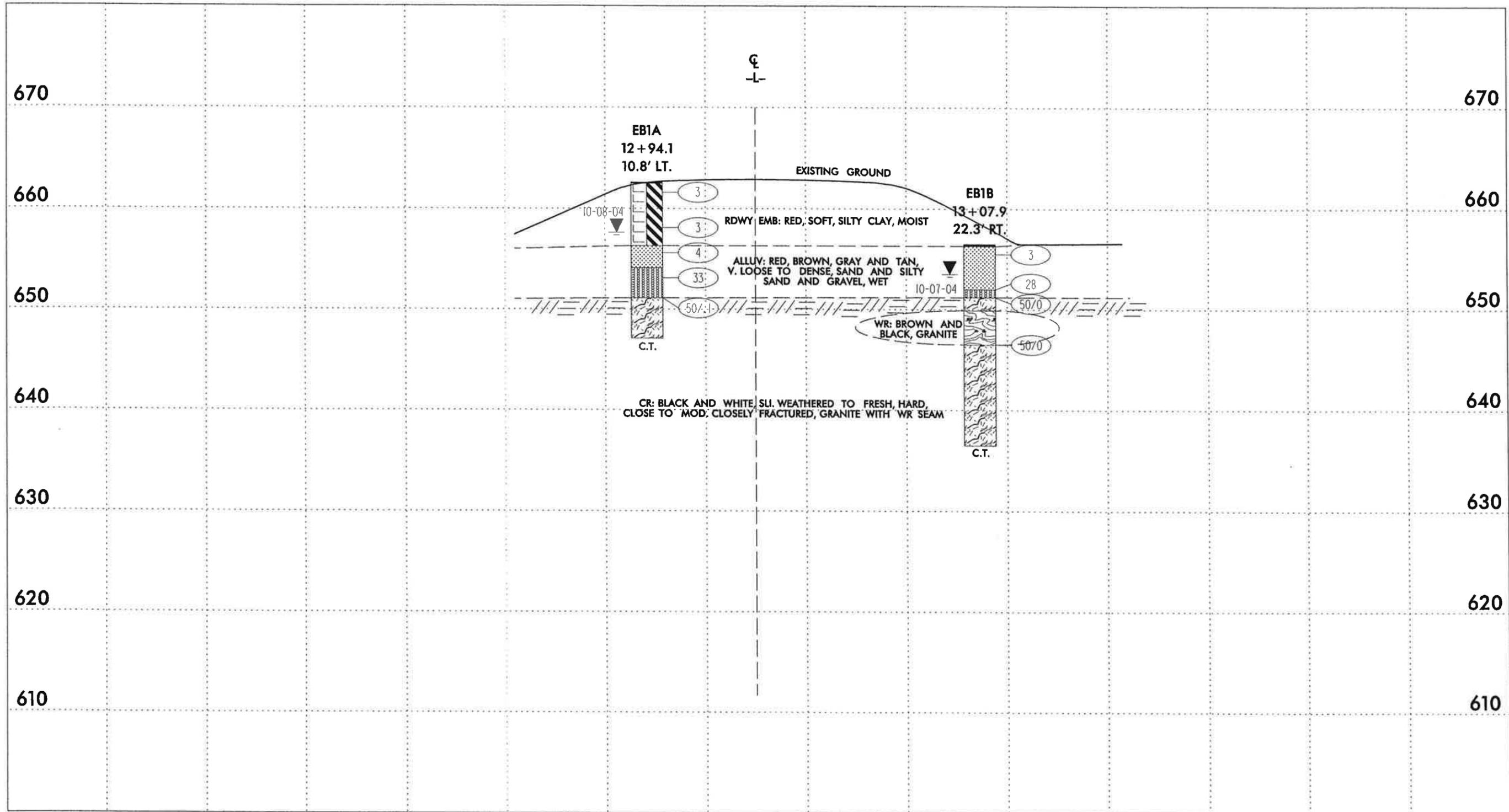
PROFILE RIGHT OF -L-

NCDOT PROJECT #: MA9404B  
ROWAN CO., NC  
BRIDGE #163 ON SR 2343 (LOWER PALMER  
RD.) OVER TRIBUTARY TO SECOND CREEK

TIERRA, INC.  
2736 ROWLAND RD.  
RALEIGH, NC 27605  
PHONE: (919) 878-0800  
FAX: (919) 878-0801

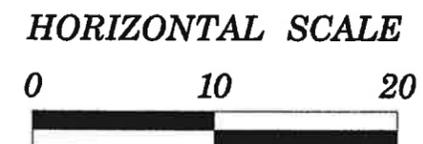
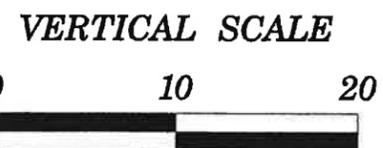
ELEV. (FT.)

ELEV. (FT.)



CROSS SECTION WAS PERFORMED ALONG PROPOSED EB1 BENT BASED UPON HYDRO REPORT DATED SEP. 2004

BENCH MARK: -BL-4, STA. 12 + 84.45, 13.03' LEFT, ELEVATION 661.99 FT.



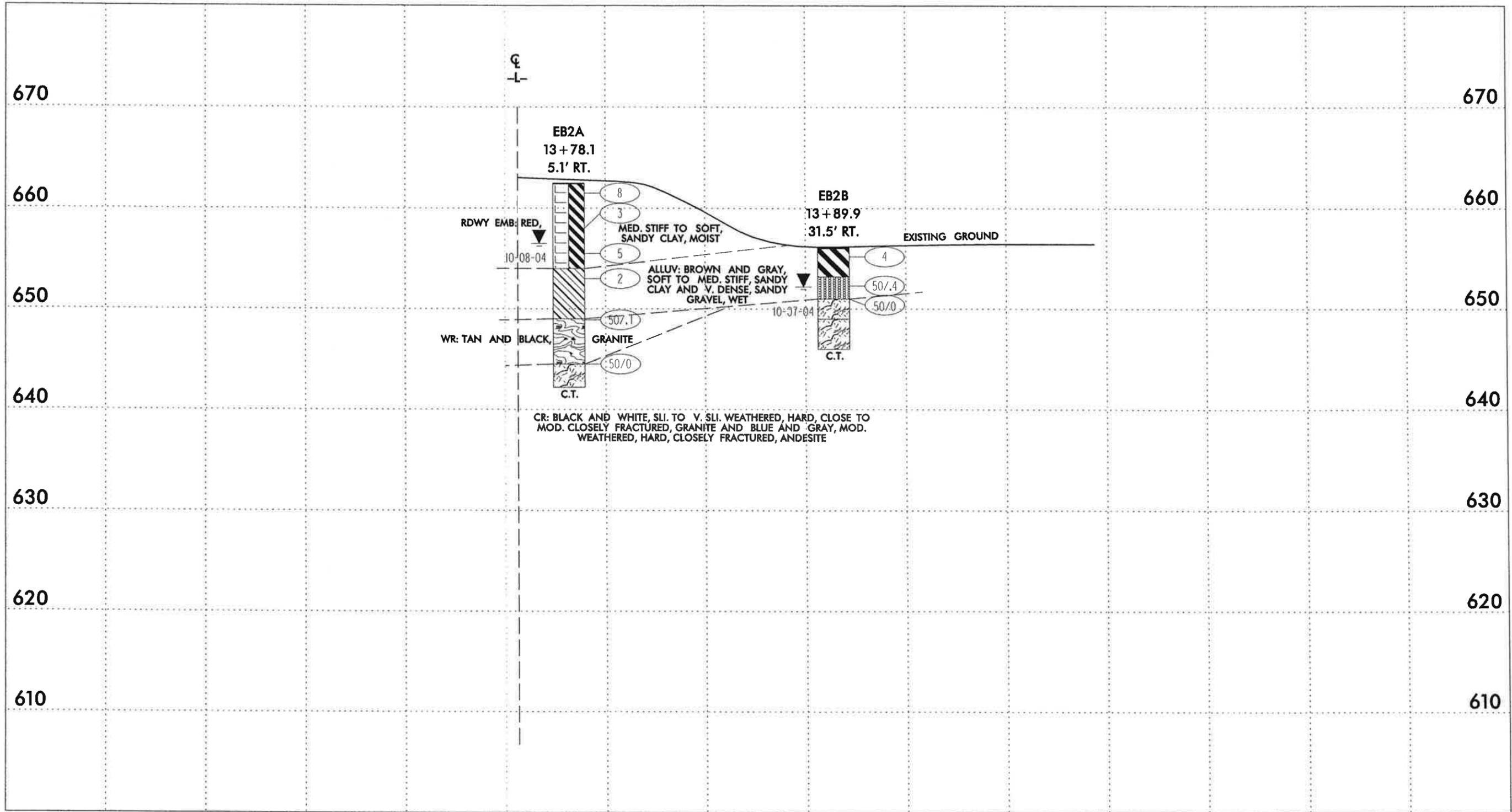
CROSS SECTION AT STATION 12 + 90

NCDOT PROJECT #: MA9404B  
 ROWAN CO., NC  
 BRIDGE #163 ON SR 2343 (LOWER PALMER RD.) OVER TRIBUTARY TO SECOND CREEK



ELEV. (FT.)

ELEV. (FT.)



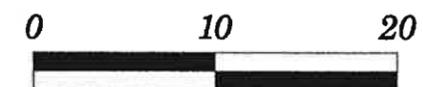
CROSS SECTION WAS PERFORMED ALONG PROPOSED  
 EB2 BENT BASED UPON HYDRO REPORT DATED SEP. 2004

BENCH MARK: -BL-4, STA. 12+84.45,  
 13.03' LEFT, ELEVATION 661.99 FT.

VERTICAL SCALE



HORIZONTAL SCALE

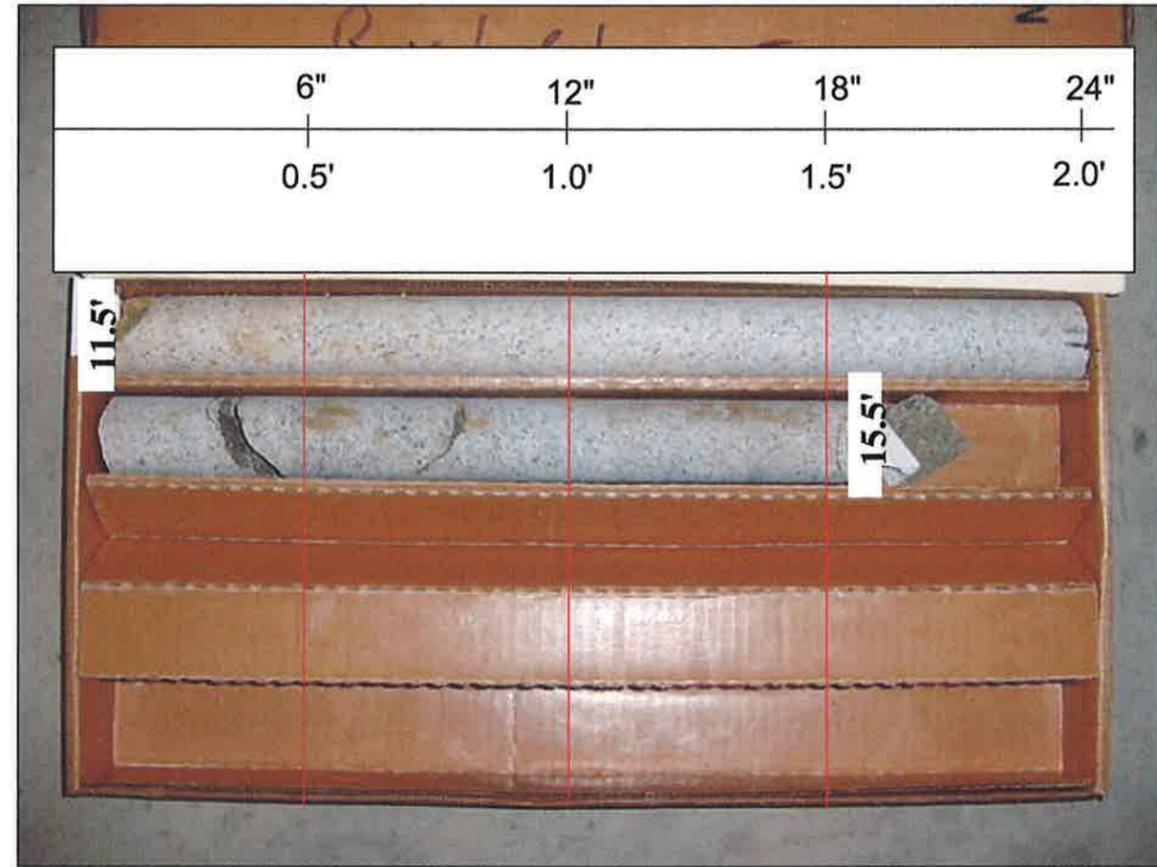


CROSS SECTION AT STATION 14+00

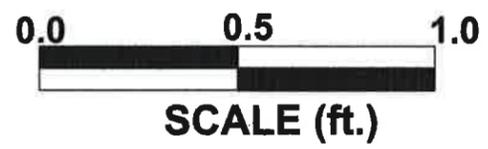
NCDOT PROJECT #: MA9404B  
 ROWAN CO., NC  
 BRIDGE #163 ON SR 2343 (LOWER PALMER  
 RD.) OVER TRIBUTARY TO SECOND CREEK





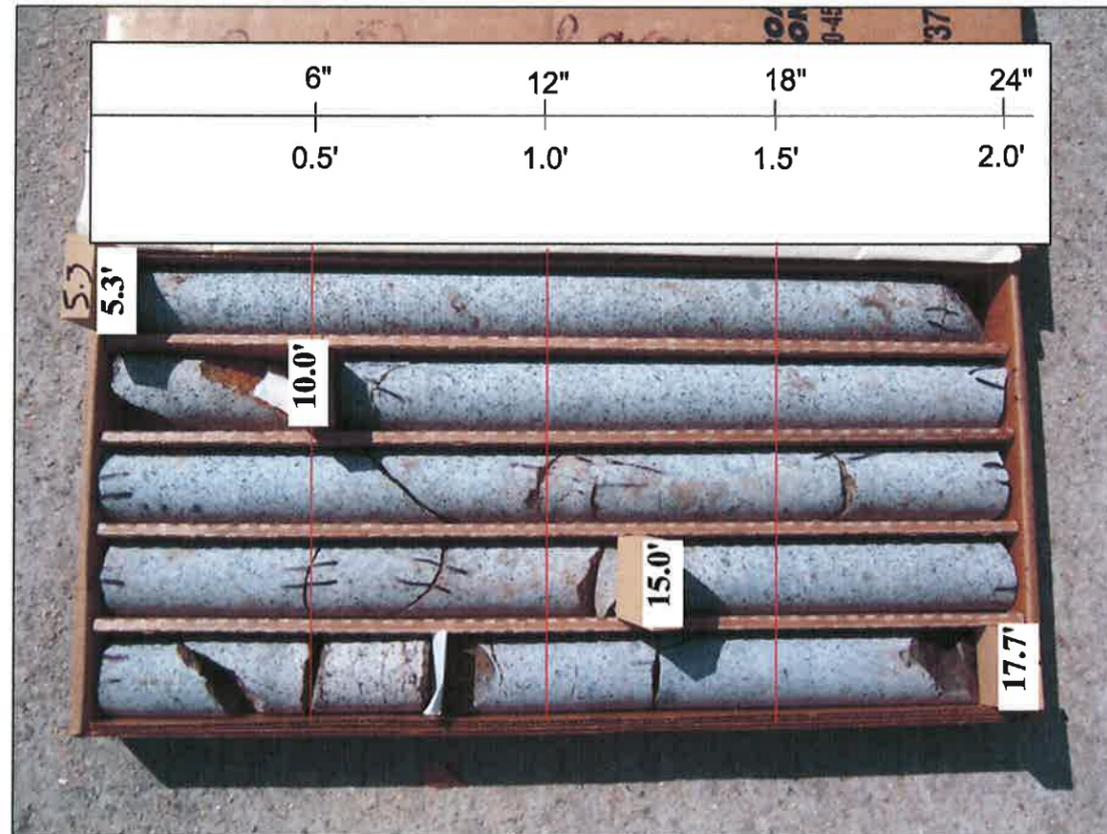


**EB1-A Box 1 of 1, 11.5 - 15.5 ft**

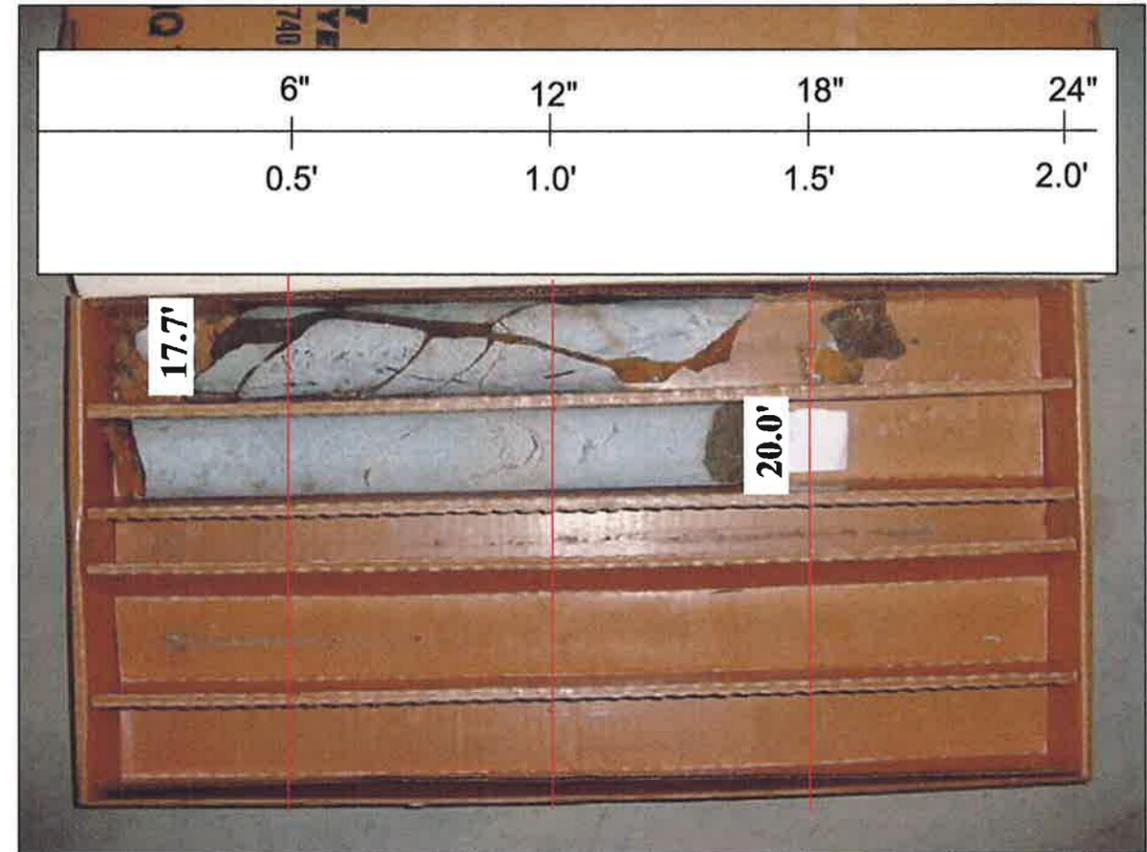


**Core Photos**  
**Bridge No. 163 on SR 2343 Over Unnamed Tributary to Second Creek**  
**Rowan County, North Carolina**  
**NCMA Project No.: MA9404B**  
**Tierra Project No.: 6211-04-028**

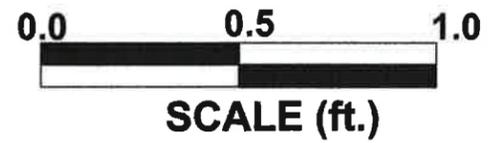




**EB1-B Box 1 of 2, 5.3 - 17.7 ft**



**EB1-B Box 2 of 2, 17.7 - 20.0 ft**



**Core Photos**

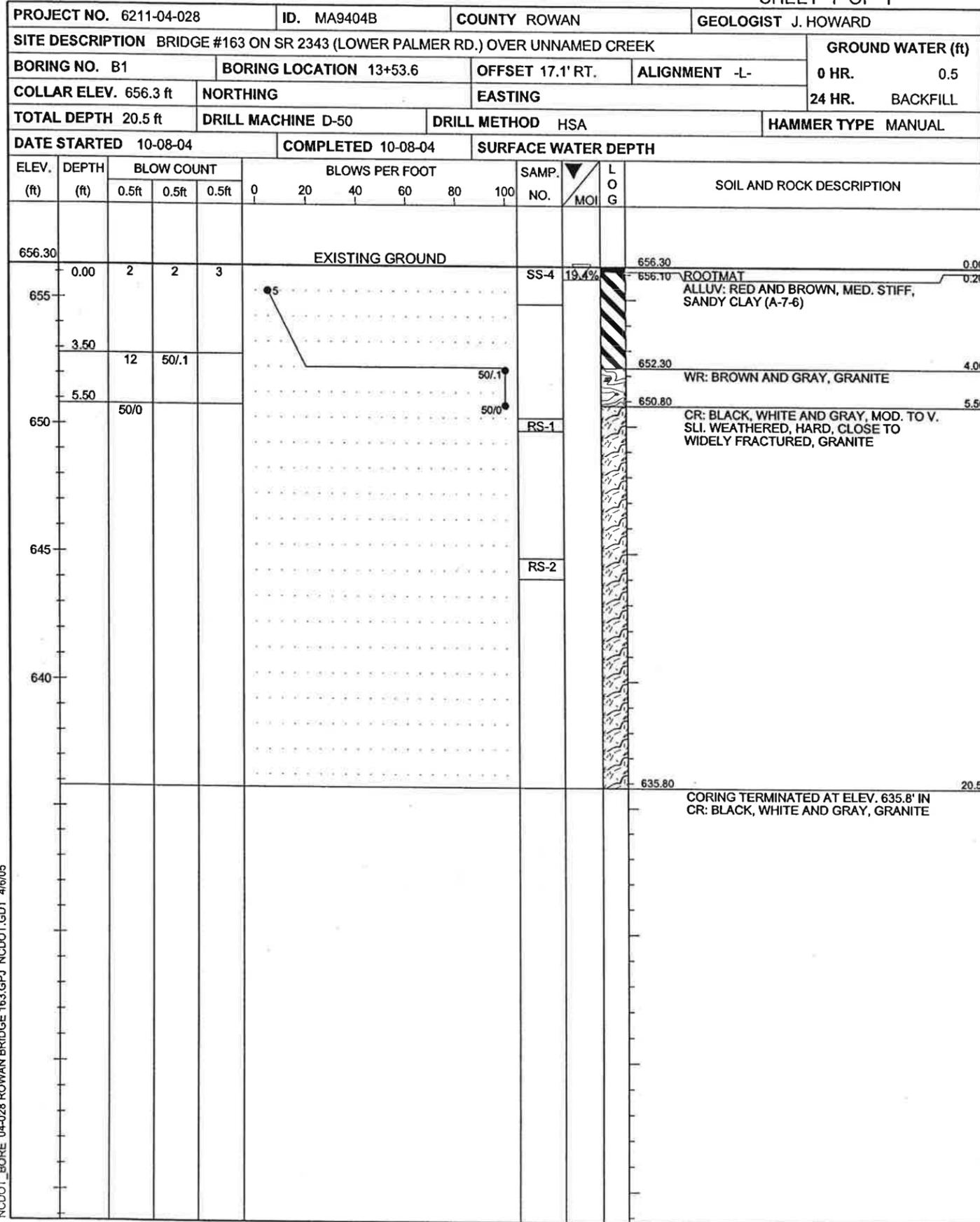
**Bridge No. 163 on SR 2343 Over Unnamed Tributary to Second Creek**  
**Rowan County, North Carolina**  
**NCMA Project No.: MA9404B**  
**Tierra Project No.: 6211-04-028**



2736 ROWLAND ROAD  
 RALEIGH, NORTH CAROLINA 27615  
 Phone (919) 871-0800 Fax (919) 871-0803

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

SHEET 1 OF 1



**CORE BORING REPORT**

DATE: 10-08-04

PROJECT: 6211-04-028 I.D. NO.: MA9404B BORING NO: B1 GEOLOGIST: J. HOWARD

DESCRIPTION: BRIDGE #163 ON SR 2343 (LOWER PALMER RD.) OVER UNNAMED CREEK

COUNTY: ROWAN COLLAR ELEV.: 656.3 FT TOTAL DEPTH: 20.5 FT

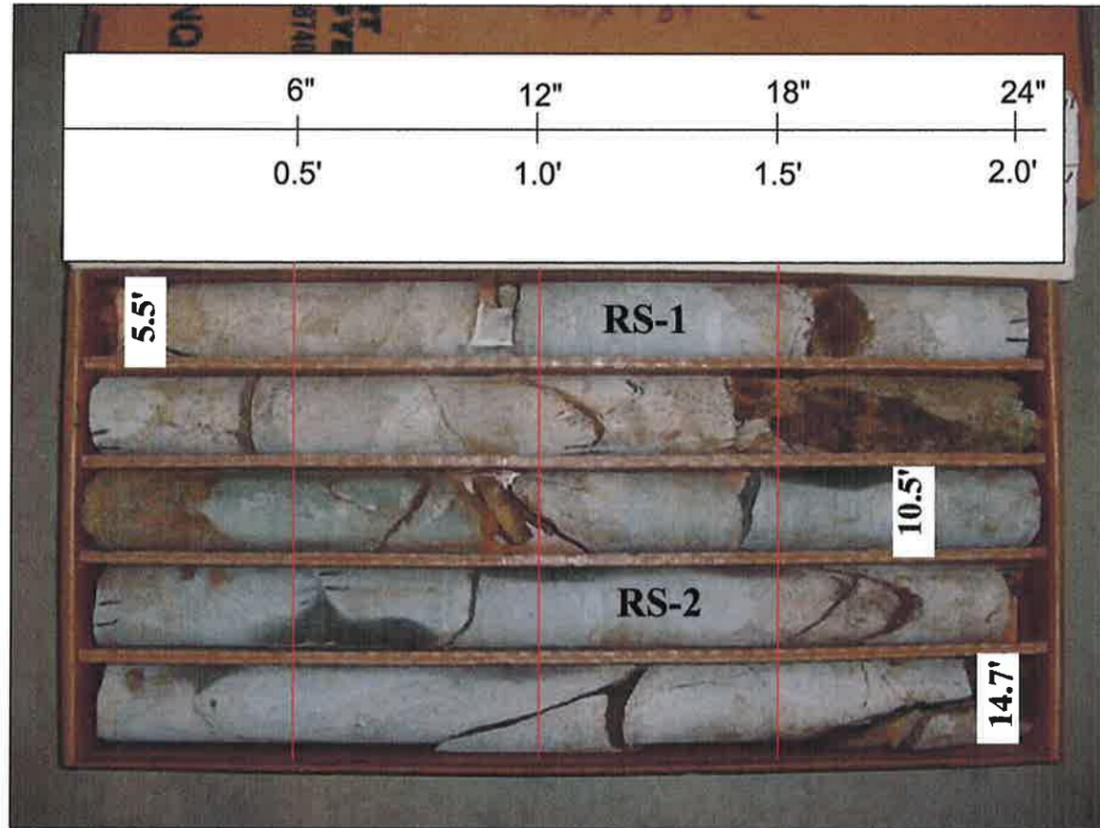
ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
650.8	5.5	2:15	5.0	100%	70%	RS-1	5.5-20.5 CR: BLACK, WHITE AND GRAY, MOD. TO V. SLI. WEATHERED, HARD, CLOSE TO WIDELY FRACTURED, GRANITE
		2:30					
		2:30					
		2:30					
645.8	10.5	3:45	5.0	98%	54%	RS-2	
		3:45					
		4:30					
640.8	15.5	2:45	5.0	100%	100%		
		4:45					
		6:30					
635.8	20.5	11:30					STRATA REC = 99% STRATA RQD = 95%
		11:45					

CORING TERMINATED AT 20.5 FT  
 ELEVATION 635.8 FT

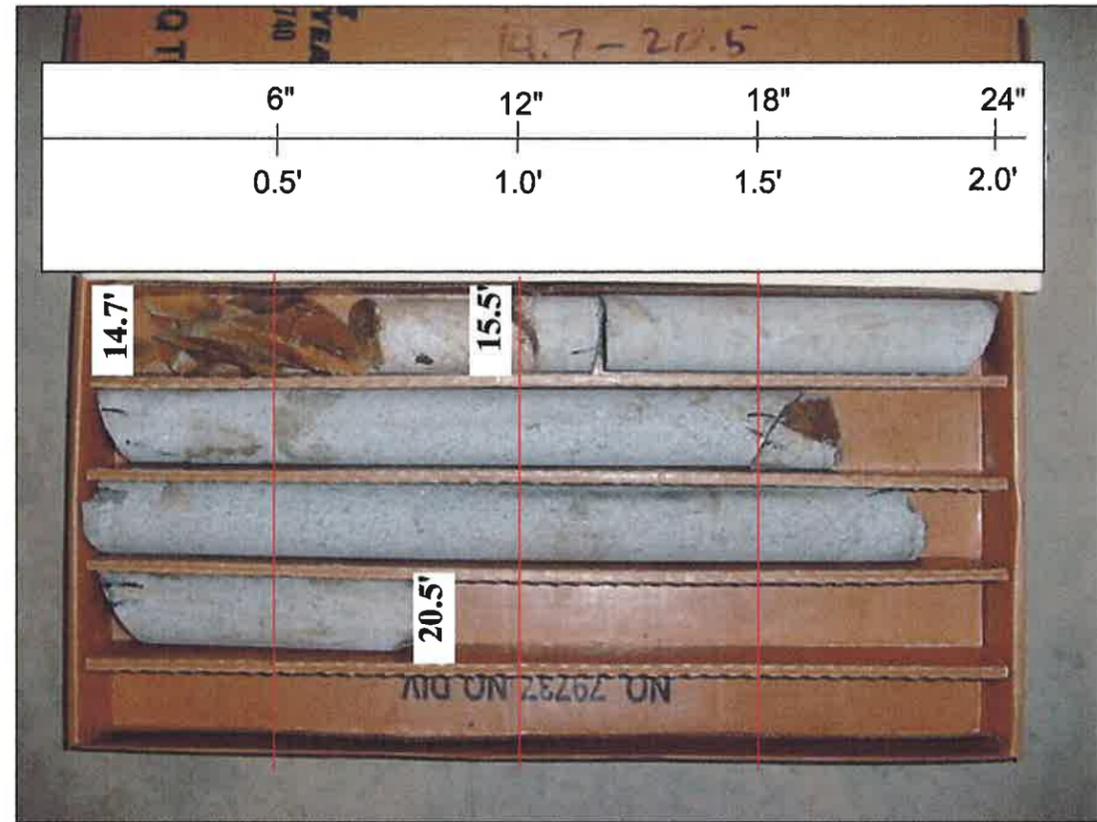
DRILLER: J. LITTLE

CORE SIZE: NQ

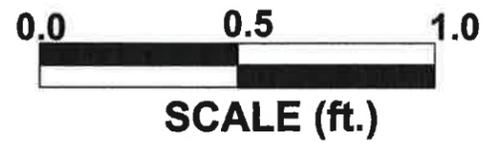
EQUIPMENT: D-50



**B1, Box 1 of 2, 5.5 - 14.7 ft**



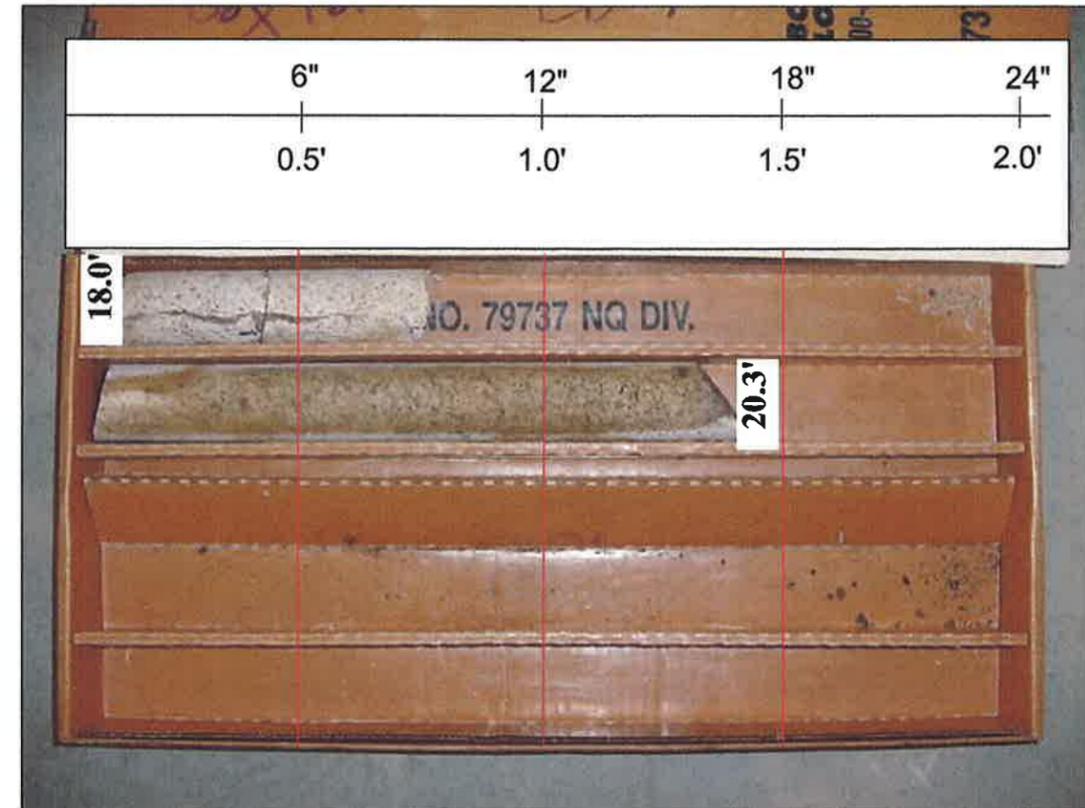
**B1 Box 2 of 2, 14.7 - 20.5 ft**



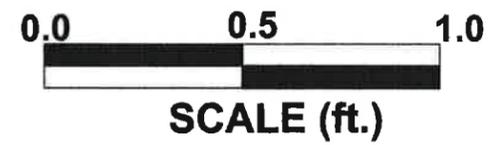
**Core Photos**

**Bridge No. 163 on SR 2343 Over Unnamed Tributary to Second Creek  
 Rowan County, North Carolina  
 NCMA Project No.: MA9404B  
 Tierra Project No.: 6211-04-028**



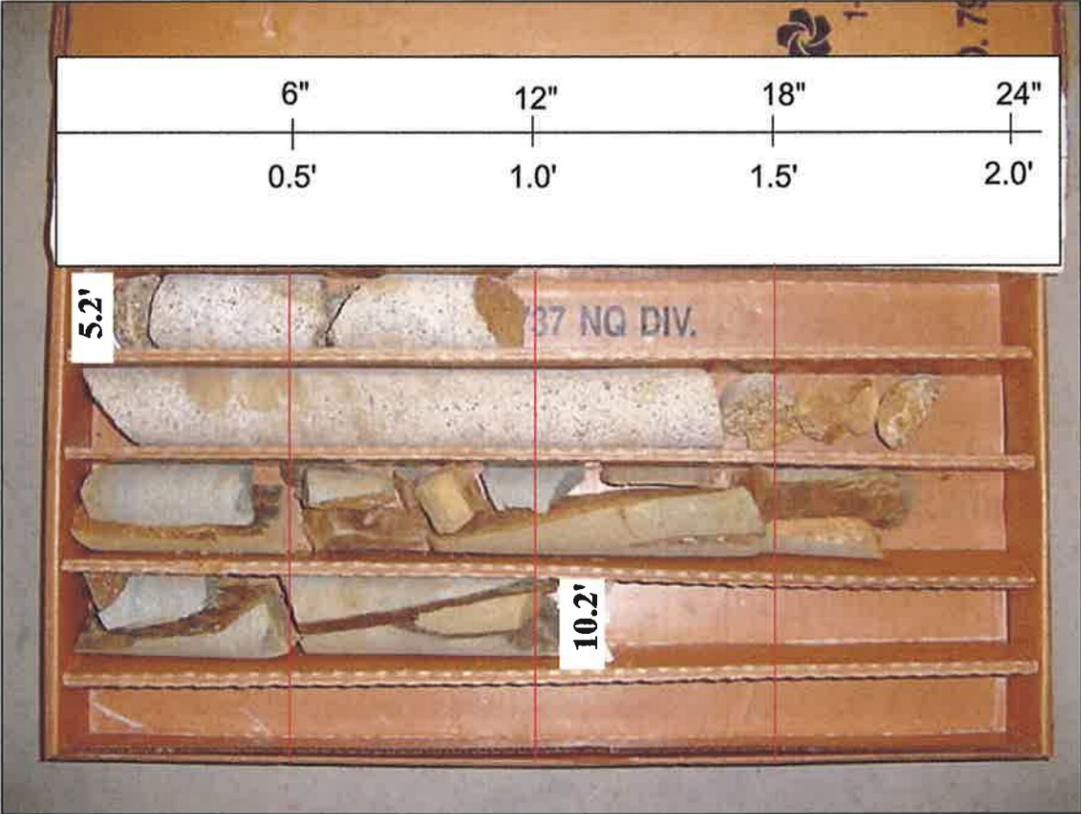


**EB2-A Box 1 of 1, 18.0 - 20.3 ft**

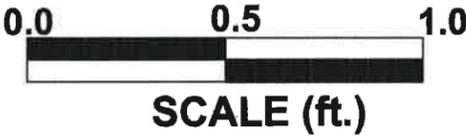


**Core Photos**  
**Bridge No. 163 on SR 2343 Over Unnamed Tributary to Second Creek**  
**Rowan County, North Carolina**  
**NCMA Project No.: MA9404B**  
**Tierra Project No.: 6211-04-028**





**EB2-B Box 1 of 1, 5.2 - 10.2 ft**



**Core Photos**  
**Bridge No. 163 on SR 2343 Over Unnamed Tributary to Second Creek**  
**Rowan County, North Carolina**  
**NCMA Project No.: MA9404B**  
**Tierra Project No.: 6211-04-028**

TIERRA, INC.

2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

SOIL CLASSIFICATION AND GRADATION SHEET

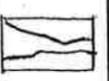
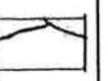
BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY TO SECOND CREEK  
NCMA Project No: MA9404B

ROWAN COUNTY

TIERRA, INC. PROJECT NO: 6211-04-028

BORING #		SAMPLE #	NATURAL MOISTURE CONTENT	TOTAL SAMPLE			ATTERBERG LIMIT		
AASHTO Classification				PERCENT PASSING			LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX
STATION #	OFFSET (FEET)	DEPTH (FEET)	#10	#40	#200				
EB1A		SS-1	37.1%	98	90	77	72	36	36
A-7-5									
12+94	10.8 LT	3.5-5.0							
EB1B		SS-2	N/A	93	56	13	NP	NP	NP
A-2-4									
13+08	22.3 RT	0.0-1.5							
EB1B		SS-3	N/A	45	29	14	NP	NP	NP
A-1-b									
13+08	22.3 RT	3.5-5.0							
B1		SS-4	19.4%	100	95	82	41	29	12
A-7-6									
13+54	17.1 RT	0.0-1.5							
EB2A		SS-5	20.6%	100	80	60	50	31	19
A-7-5									
13+78	5.1 RT	3.5-5.0							
EB2A		SS-6	34.4%	100	95	57	38	26	12
A-6									
13+78	5.1 RT	8.5-10.0							

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES  
BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY TO SECOND CREEK  
ROWAN COUNTY, NC  
PROJECT NO: MA09404B  
TIERRA No: 6211-04-028

Boring #	Sample #	Depth (ft)	Average Diameter (in)	Average Length (in)	L/D	Total Volume (ft <sup>3</sup> )	Total Core Weight (lb)	Core Moisture Content (%)	Core Dry Weight (lb)	Unit Weight (pcf)	Rate of Stress Increase (lbs/min)	Max Unconfined Compression (psi)	Remarks
B - 1	RS - 1	6.0 - 6.5	1.975	3.960	2.01	0.0070	1.1393	0.13	1.1378	162.2	5000	11,098	
B - 1	RS - 2	11.5 - 12.3	1.985	3.952	1.99	0.0071	1.1812	0.14	1.1795	166.7	5000	12,118	

### ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-04-028 Job Name: Br #163 on SR 2343 Over Unnamed Tributary to Second Creek

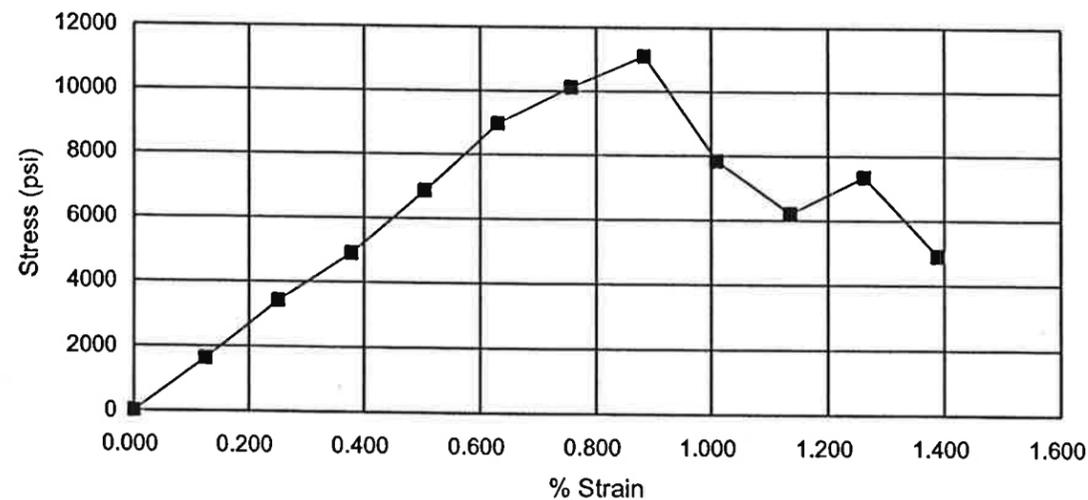
Project No. MA09404B  
 Date: 3/10/2005 Sample No.: RS - 1  
 Boring No.: B-1 Depth (ft): 6.0 - 6.5

Description: Black, white and gray moderately to very slightly weathered, hard, close to widely fractured granite

Length (in.): 3.960  
 Diameter (in.): 1.975  
 Area (sq. in.): 3.064

Compressive Strength (psi): 11098

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.126	5000	1632.1	1,292,621
0.010	0.253	10500	3427.4	1,357,252
0.015	0.379	15000	4896.3	1,292,621
0.020	0.505	21000	6854.8	1,357,252
0.025	0.631	27500	8976.5	1,421,883
0.030	0.758	31000	10119.0	1,335,708
0.035	0.884	34000	11098.3	1,255,689
0.040	1.010	24000	7834.1	775,572
0.045	1.136	19000	6202.0	545,773
0.050	1.263	22500	7344.4	581,679
0.055	1.389	15000	4896.3	352,533



### ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-04-028 Job Name: Br #163 on SR 2343 Over Unnamed Tributary to Second Creek

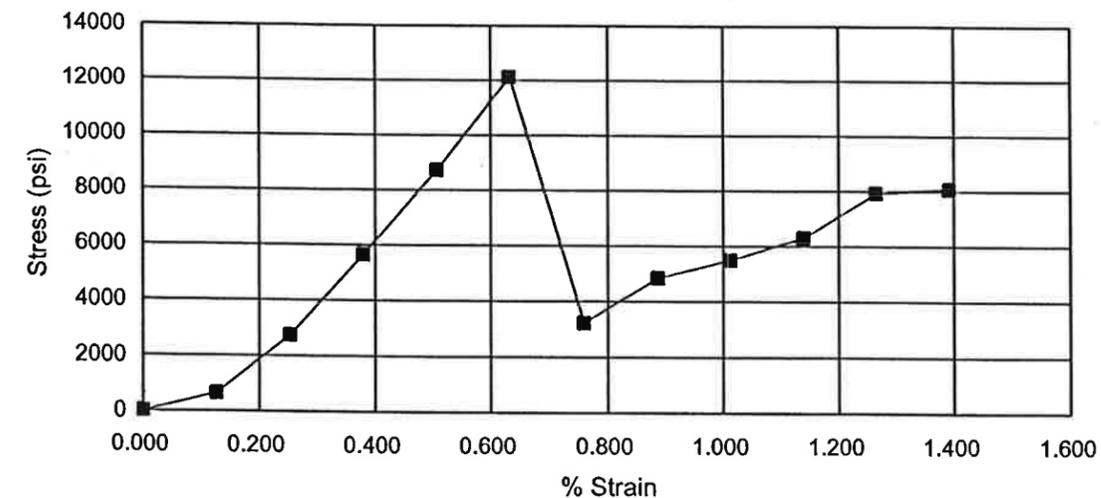
Project No. MA09404B  
 Date: 3/10/2005 Sample No.: RS - 2  
 Boring No.: B-1 Depth (ft): 11.5 - 12.3

Description: Black, white and gray moderately to very slightly weathered, hard, close to widely fractured granite

Length (in.): 3.952  
 Diameter (in.): 1.985  
 Area (sq. in.): 3.095

Compressive Strength (psi): 12118

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.127	2000	646.3	510,818
0.010	0.253	8500	2746.7	1,085,488
0.015	0.380	17500	5654.9	1,489,885
0.020	0.506	27000	8724.7	1,724,010
0.025	0.633	37500	12117.7	1,915,567
0.030	0.759	10000	3231.4	425,682
0.035	0.886	15000	4847.1	547,305
0.040	1.012	17000	5493.4	542,744
0.045	1.139	19500	6301.2	553,386
0.050	1.265	24500	7916.9	625,752
0.055	1.392	25000	8078.5	580,475
0.060	1.518	0	0.0	0



GEOTECHNICAL UNIT FIELD SCOUR REPORT

PROJECT: MA9404B ID: COUNTY: ROWAN

DESCRIPTION(1): BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY TO SECOND CREEK

INFORMATION ON EXISTING BRIDGES Information obtained from: X field inspection, microfilm(Reel: Pos: ), X other HYDRO

COUNTY BRIDGE NO. 163 BRIDGE LENGTH 37 NO. BENTS IN: CHANNEL 1 FLOOD PLAIN 2

FOUNDATION TYPE: Stone

EVIDENCE OF SCOUR(2):

ABUTMENTS OR END BENT SLOPES: Very little

INTERIOR BENTS: None visable

CHANNEL BED: Some on the east side

CHANNEL BANKS: Little to none

EXISTING SCOUR PROTECTION:

TYPE(3): Wing Walls

EXTENT(4): 12 feet in all directions

EFFECTIVENESS(5): Very

OBSTRUCTIONS(6) (DAMS,DEBRIS,ETC.): Boulders in Stream

DESIGN INFORMATION

CHANNEL BED MATERIAL(7) (SAMPLE RESULTS ATTACHED):

CHANNEL BANK MATERIAL(8) (SAMPLE RESULTS ATTACHED):

FOUNDATION BEARING MATERIAL(9): Bed Rock

CHANNEL BANK COVER(10): Grass and Shrubs

FLOOD PLAIN WIDTH(11): 100'+ East Side, 85' West side

FLOOD PLAIN COVER(12): Trees, Shrubs, Grasses

DESIGN INFORMATION CONT.

STREAM IS DEGRADING x AGGRADING (13)

OTHER OBSERVATIONS AND COMMENTS: A large flood happened recently but little evidence was found other than debri in trees and flattened grasses.

CHANNEL MIGRATION TENDENCY (14): East

REPORTED BY: [Signature] DATE: 10/18/2004 TIERRA, INC

GEOTECHNICALLY ADJUSTED SCOUR ELEVATION (15):

REPORTED BY: DATE:

NCDOT GEOTECHNICAL UNIT INSTRUCTIONS

- (1) GIVE THE DESCRIPTION OF THE SPECIFIC SITE GIVING ROUTE NUMBER AND BODY OF WATER CROSSED. (2) NOTE ANY EVIDENCE OF SCOUR AT THE EXISTING END BENTS OR ABUTMENTS (UNDERMINING, SLOUGHING, SCOUR LOCATIONS, DEGRADATIONS, ETC.) (3) NOTE ANY EXISTING SCOUR PROTECTION (RIP RAP, ETC.) (4) DESCRIBE THE EXTENT OF ANY EXISTING SCOUR PROTECTION. (5) DESCRIBE WHETHER OR NOT THE SCOUR PROTECTION APPEARS TO BE WORKING. (6) NOTE ANY DAMS, FALLEN TREES, DEBRIS AT BENTS, ETC. (7) DESCRIBE THE CHANNEL BED MATERIAL: A SAMPLE SHOULD BE TAKEN FOR GRAIN SIZE DISTRIBUTION, ATTACH LAB RESULTS. (8) DESCRIBE THE CHANNEL BANK MATERIAL: A SAMPLE SHOULD BE TAKEN FOR GRAIN SIZE DISTRIBUTION, ATTACH LAB RESULTS. (9) DESCRIBE THE FOUNDATION BEARING MATERIAL, (10) DESCRIBE THE BANK COVERING (GRASS, TREES, RIP RAP, NONE, ETC. (11) GIVE THE APPROXIMATE FLOOD PLAIN WIDTH (ESTIMATE). (12) DESCRIBE THE FLOOD PLAIN COVERING (GRASS, TREES, CROPS, ETC.) (13) CHECK THE APPROPRIATE SPACE AS TO WHETHER THE STREAM IS DEGRADING OR AGGRADING (14) DESCRIBE THE POTENTIAL OF THE BODY OF WATER TO MIGRATE Laterally DURING THE LIFE OF THE BRIDGE (APPROXIMATELY 100 YEARS). (15) GIVE THE GEOTECHNICALLY ADJUSTED SCOUR ELEVATION EXPECTED OVER THE LIFE OF THE BRIDGE (APPROXIMATELY 100 YEARS). THIS CAN BE GIVEN AS AN ELEVATION RANGE ACROSS THE SITE, OR ON A BENT BY BENT BASIS WHERE VARIATIONS EXIST. DISCUSS RELATIONSHIP BETWEEN THE HYDRAULICS THEORETICAL SCOUR AND THE GEOTECHNICALLY ADJUSTED SCOUR ELEVATION. THE GEOTECHNICALLY ADJUSTED SCOUR ELEVEVATION IS BASED ON THE ERODABILITY OF MATERIALS WITH CONSIDERATION FOR JOINTING, FOLIATION, BEDDING ORIENTATION AND FREQUENCY; CORE RECOVERY PERCENTAGE; PERCENTAGE RQD; DIFFERENTIAL WEATHERING, SHEAR STRENGTH; OBSERVATIONS AT EXISTING STRUCTURES; OTHER TESTS DEEMED APPROPRIATE; AND OVERALL GEOLOGIC CONDITIONS AT THE SITE.

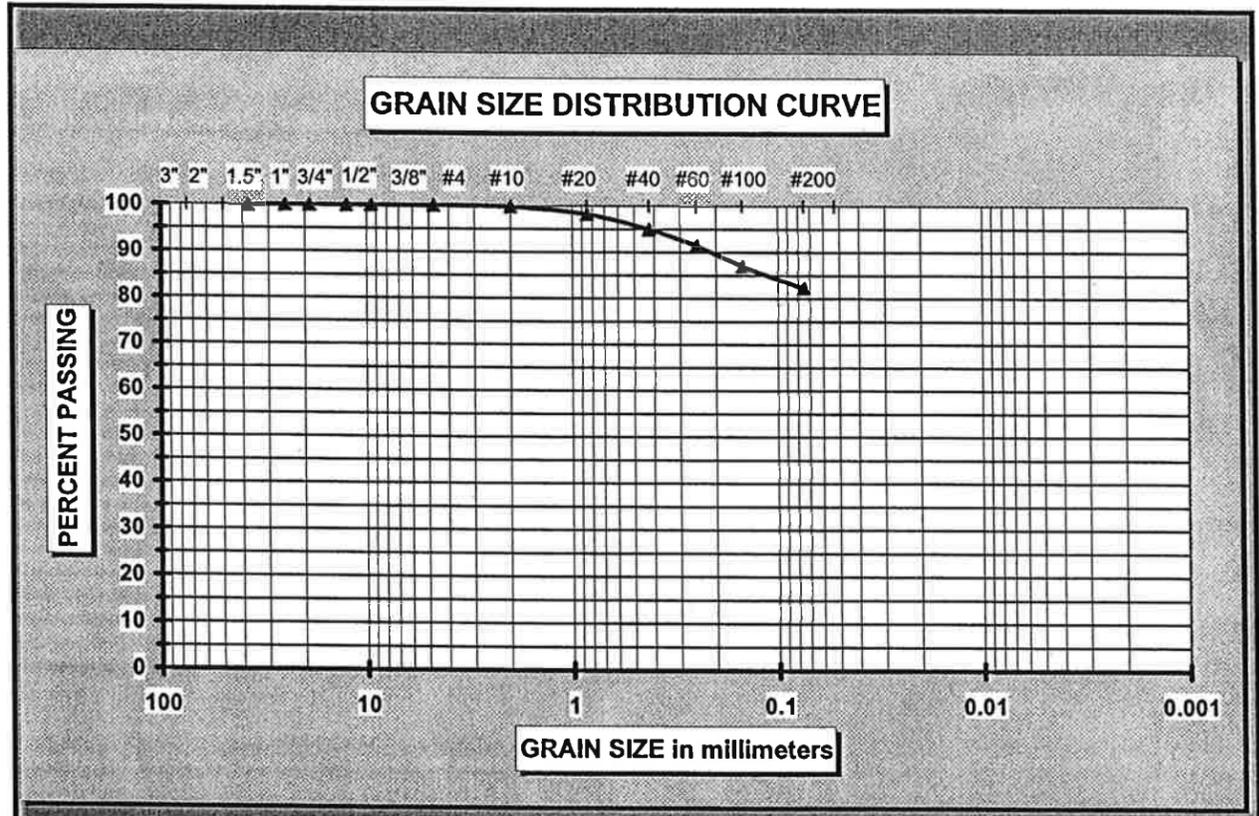
PROJECT #: MA9404B  
 COUNTY: ROWAN  
 DESCRIPTION: BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY  
 TO SECOND CREEK

	CHANNEL BED MATERIAL	CHANNEL BANK MATERIAL
SAMPLE #		SS-4
RETAINED #4		0
PASSING #10		99.8
PASSING #40		95.0
PASSING #200		82.2
SAND		17.8
SILT/CLAY		82.2
LL		41
PL		29
AASHTO		A-7-6
STATION		13+54
OFFSET		17.1 RT
DEPTH		0.0-1.5

TIERRA, INC.

2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

BRIDGE #163 ON SR 2343 OVER UNNAMED TRIBUTARY TO SECOND CREEK  
 ROWAN COUNTY  
 NCMA Project No: MA9404B



AASHTO M-145 Classification of Soil for Engineering Purposes

Gravel	< 3" and > #10	Coarse Sand	< #10 and > #40	Cu = D60 / D10
		Fine Sand	< #40 and > #200	Cc = (D30)^2 / (D10 x D60)

BORING #: B1      SAMPLE #: SS-4      DEPTH: 0.0-1.5

**BROWN SANDY CLAY (A-7-6)**

% PASSING #200 SIEVE: 82%

NATURAL MOISTURE CONTENT = 19.4%

ATTERBERG LIMIT ( - #40 Material )	
LIQUID LIMIT	41
PLASTIC LIMIT	29
PLASTIC INDEX	12



Unnamed Creek, looking upstream.



Unnamed Creek, looking downstream

**SITE PHOTOGRAPHS**

**NCMA Project: MA9404B**

**Bridge No. 163 on SR 2343 over Unnamed Tributary to Second Creek**

**Rowan County, North Carolina**

**Tierra Project: 6211-04-028**