

PROJECT: MA-4124 ID:

# STATE OF NORTH CAROLINA

## DEPARTMENT OF TRANSPORTATION

### DIVISION OF HIGHWAYS

### GEOTECHNICAL UNIT

# STRUCTURE SUBSURFACE INVESTIGATION

STATE PROJECT MA-4124 I.D. NO. \_\_\_\_\_  
 F.A. PROJECT \_\_\_\_\_  
 COUNTY NASH  
 PROJECT DESCRIPTION BRIDGE #32 ON NC  
231 OVER TURKEY CREEK  
 \_\_\_\_\_  
 SITE DESCRIPTION \_\_\_\_\_  
 \_\_\_\_\_

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	MA-4124	1	23
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
MA-4124		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.

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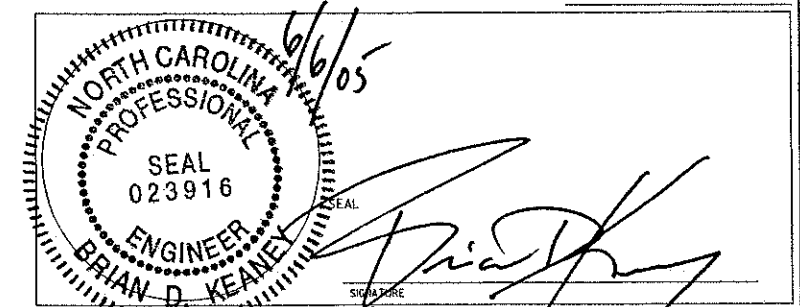
THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT 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.

INVESTIGATED BY J. HOWARD PERSONNEL S. HAN  
 CHECKED BY B. KEANEY, P.E.  
 SUBMITTED BY TIERRA, INC.  
 DATE JUNE, 2005

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.

DRAWN BY: E. WAGNER





June 3, 2005

Mr. Kevin Austin, P.E.  
Mulkey Engineers & Consultants  
6750 Tryon Road  
Cary, NC 27511

**Re: Geotechnical Subsurface Exploration Report**

Project No.: MA-4124  
County: Nash County  
Description: Bridge No. 32 on NC 231 over Turkey Creek  
Tierra Inc. Proj. No.: 6211-05-011

Dear Mr. Austin:

As authorized, Tierra, Inc. has completed the geotechnical subsurface exploration for Bridge No. 32 on NC 231 over Turkey Creek. Our investigation was performed in general accordance with our proposal number TR-05-008. 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 January 14, 2005, the referenced project intends to replace the existing one span bridge, currently spanning Turkey Creek. The proposed replacement structure will be a three span, four bent bridge, approximately 150 feet long. The proposed bridge will be located between Station 14+53.67 and Station 16+03.67, with a skew angle of 60°. The bridge will be placed along the same alignment with a slight proposed grade change.

**SITE DESCRIPTION/GEOLOGY**

The proposed project site is located along NC 231 in a rural area of Nash County, approximately 0.5 miles north of Samaria, NC. The area has rolling terrain with a wide flood plain. In general this area is residential to agricultural in land usage. It is estimated that the Turkey Creek floodplain is approximately 600 feet wide. Depth of water at the time of drilling was approximately 4 feet.

According to *The Geologic Map of North Carolina* (1985), the project site is part of the Piedmont Physiographic Providence and is located within the Eastern Slate Belt. Bedrock consists of metamorphosed felsic volcanic rocks (Czfv). Specifically, this site is located within the Spring Hope Terrain; rock encountered consists of a light tan crystalline felsic tuff.

**FIELD EVALUATION PROCEDURE**

The subsurface exploration consisted of performing (6) soil test borings near the centerlines of the proposed end bents and interior bents. Some borings were offset due to utilities and accessibility issues. Borings were performed with a track-mounted CME 45 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 benchmark (BM #1) at -BL- Station 14+53, approximately 67 feet left of the base line, with a datum of 213.72 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 Turkey Creek to determine scour impact for foundation design purposes. The scour report is included in this report.

**SUBSURFACE AND GROUNDWATER CONDITIONS**

Subsurface soils penetrated beneath the site consist of roadway embankment, alluvium, and residual materials.

**End Bents**

Soils beneath End Bent 1 consist of roadway embankment and residual materials. Roadway embankment soil consists of up to 3.5 feet of stiff sandy silt (A-4). Residual soil consists of 9.5 to 20.5 feet of very stiff to hard sandy silt (A-4). Residual soil overlies weathered rock at elevations between 212.4 and 197.4 feet (MSL). A 2.5 foot residual layer is imbedded in the weathered rock at an elevation of 208.4 feet (MSL) at EB1B.

Soils beneath End Bent 2 consist of roadway embankment, alluvial and residual materials. Roadway embankment soil consists of up to 6.0 feet of soft sandy clay (A-6). Alluvial deposits consist of 6.0 to 10 feet of soft sandy silt and very loose to medium dense silty and gravelly sand (A-4, A-2-4, A-1-b). Alluvial soils overlie weathered rock at an elevation of 203.5 feet (MSL) at

EB2B. Residual soils were encountered at EB2A, consisting of 10 feet of medium dense silty sand and very stiff sandy silt (A-2-4, A-4). Residual soils overlie weathered rock at an elevation of 195.7 feet (MSL).

### Interior Bents

Soils beneath Bent 1 consist of alluvial and residual materials. Alluvial deposits consist of loose silty sand and stiff to very stiff sandy silt (A-2-4, A-4). Alluvial soils overlie residual hard sandy silt (A-4). Residual soil overlies weathered rock at an elevation of 201.3 feet (MSL).

Soils beneath Bent 2 consist of alluvial and residual materials. Alluvial deposit consists of medium stiff sandy silt (A-4). Alluvial soil overlies loose to medium dense residual silty sand (A-2-4). Residual soils overlie weathered rock at an elevation of 196.5 feet (MSL). Crystalline rock was encountered at an elevation of 189.3 feet (MSL).

Ground water across the site ranges in elevation between 207.2 (MSL) and 215.9 feet (MSL). Water elevation at the time of boring was approximately at 208.4 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 12 split-spoon samples were analyzed in our laboratory for natural moisture determination, Atterberg limits, and grain size analysis. Channel sample could not be taken due to high water level. Representative bank and channel samples were selected from the split-spoon samples and analyzed for grain size distribution. One 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-89-90(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, alluvium, and residual soils. Based on the subsurface condition, deep foundations will be required to support the proposed bridge. The upper 6 feet beneath the proposed End Bent 2 location consist of soft clays

and silts, with a groundwater table ranging from 4.5 to 11 feet beneath existing site grades. Instability may affect construction of End Bent 2.

### 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 a 42-inch drilled piers for the interior bents. The piles will develop ultimate capacity with a safety factor of 2 by end bearing on partially weathered rock. The piers will develop ultimate capacity with a safety factor of 2.5 from side skin friction and tip bearing on weathered or hard rock. For more information, refer to the attached "Summary of Foundation Recommendations".

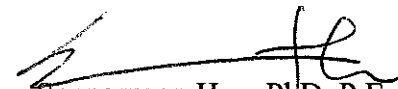
According to the NCDOT Hydraulics Report, there are minor changes in grades; therefore, there are no anticipated embankment settlements at the bridge approaches. The end bent slopes are proposed to be 1.5 Horizontal: 1 Vertical (1.5H: 1V). Based upon our experience, slope stability concerns will not be anticipated if slopes are configured at (1.5H: 1V), with rip rap slope protection.

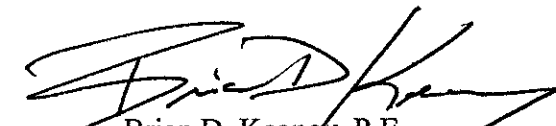
### CLOSURE

Recommendations and evaluations provided by Tierra, Inc. are based on the Bridge Survey & Hydraulic Design Report dated January 14, 2005. It is important to note that our recommendations are presented with regard to a three span, four bent prestressed cored slab structure. 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.

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.**

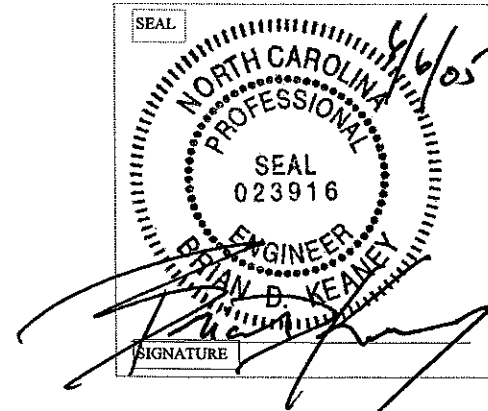
  
Seungwoon Han, PhD, P.E.  
Staff Geotechnical Engineer

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

## SUMMARY OF FOUNDATION RECOMMENDATIONS

NCDOT PROJ. NO.: MA-4124 PROJECT DESCRIPTION: Bridge # 32 on NC 231  
 T.I.P. NO.: \_\_\_\_\_ over Turkey Creek  
 COUNTY: Nash  
 STATION: 15+28.67 -L-

PREPARED BY: SWH DATE: 5/5/05  
 CHECKER: BDK DATE: 5/6/05



**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 Bents No. 1 and 2 have been designed for both skin friction and tip bearing. The required tip bearing capacity is 15 tsf.
4. The required tip bearing capacity at Bents No. 1 and 2 shall be verified.
5. Drilled piers for Bents No. 1 and 2 have been designed for an applied load of 190 tons each at the top of the column.
6. Drilled piers at Bent No. 1 shall extend to an elevation no higher than 186 feet and satisfy the required tip bearing capacity.
7. Drilled piers at Bent No. 2 shall extend to an elevation no higher than 183 feet and satisfy the required tip bearing capacity.
8. Permanent steel casing is required for drilled piers at Bent No. 1 and the casing shall not extend below elevation 201 feet without the engineer's permission.
9. Permanent steel casing is required for drilled piers at Bent No. 2 and the casing shall not extend below elevation 196 feet without the engineer's permission.
10. SPT testing is not required to determine the tip bearing capacity of the drilled piers at Bents No. 1 and 2.
11. Slurry construction shall not be used for this project.
12. SID inspections are not required to determine the bottom cleanliness of the drilled piers at Bents No. 1 and 2.
13. For drilled piers, see special provisions.
14. The scour critical elevations for Bents No. 1 and 2 are 200 feet and 195 feet respectively. The scour critical elevations are for use by maintenance forces to monitor possible scour problems during the life of the structure.

	STATION	FOUNDATION TYPE	ALLOWABLE LOAD	FOUNDATION DETAILS
END BENT 1	14+53.67 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 221.5 ft ± Recommended Length of Pile = 25 ft (LT) = 10 ft (RT)
BENT 1	14+98.67 -L-	42 inch Drilled Pier	190 tons/Pier	Assumed Bottom of Cap = 221 ft ± Assumed Top of Pier = 208 ft ± Recommended Length of Pier = 22 ft Tip Elevation No Higher Than = 186 ft
BENT 2	15+58.67 -L-	42 inch Drilled Pier	190 tons/Pier	Assumed Bottom of Cap = 220 ft ± Assumed Top of Pier = 205 ft ± Recommended Length of Pier = 22 ft Tip Elevation No Higher Than = 183 ft
END BENT 2	16+03.67 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 220 ft ± Recommended Length of Pile = 25 ft

**Comments:**

1. The elevation of the point of fixity for Bent No. 1 is 193 ft.
2. The elevation of the point of fixity for Bent No. 2 is 187 ft.
3. Design scour elevations for Bents No. 1 and 2 are 202 ft and 196 ft respectively.
4. 1.5:1 (H:V) slope at end bents is Ok with rip rap slope protection.

COMMENTS & NOTES (Attached)

## DRILLED PIER PAY ITEM QUANTITIES

PROJECT NO. MA-4124 DATE 5/11/2005  
 TIP NO. \_\_\_\_\_ DESIGNED BY SWH  
 COUNTY Nash CHECKED BY BDK  
 STATION 15+28.67 -L-

DESCRIPTION Bridge # 32 on NC 231 over Tureky Creek

NUMBER OF BENTS WITH DRILLED PIERS 2  
 NUMBER OF PIERS PER BENT 3

BENT #	DRILLED PIER PAY ITEMS					
	PERMANENT STEEL CASING FOR 42 INCH DIA. DRILLED PIER (yes/no/maybe)	42INCH DIA. DRILLED PIERS NOT IN SOIL (feet)	SPT TESTING (each)	SID INSPECTION (each)	CROSSHOLE SONIC LOGGING* (each)	CSL TUBES* (yes/no)
1	Yes	23	0	0	0	No
2	Yes	30	0	0	0	No
3						
4						
5						
6						
7						
8						
9						
10						
<b>TOTALS</b>		53	0	0	0	

\* 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.

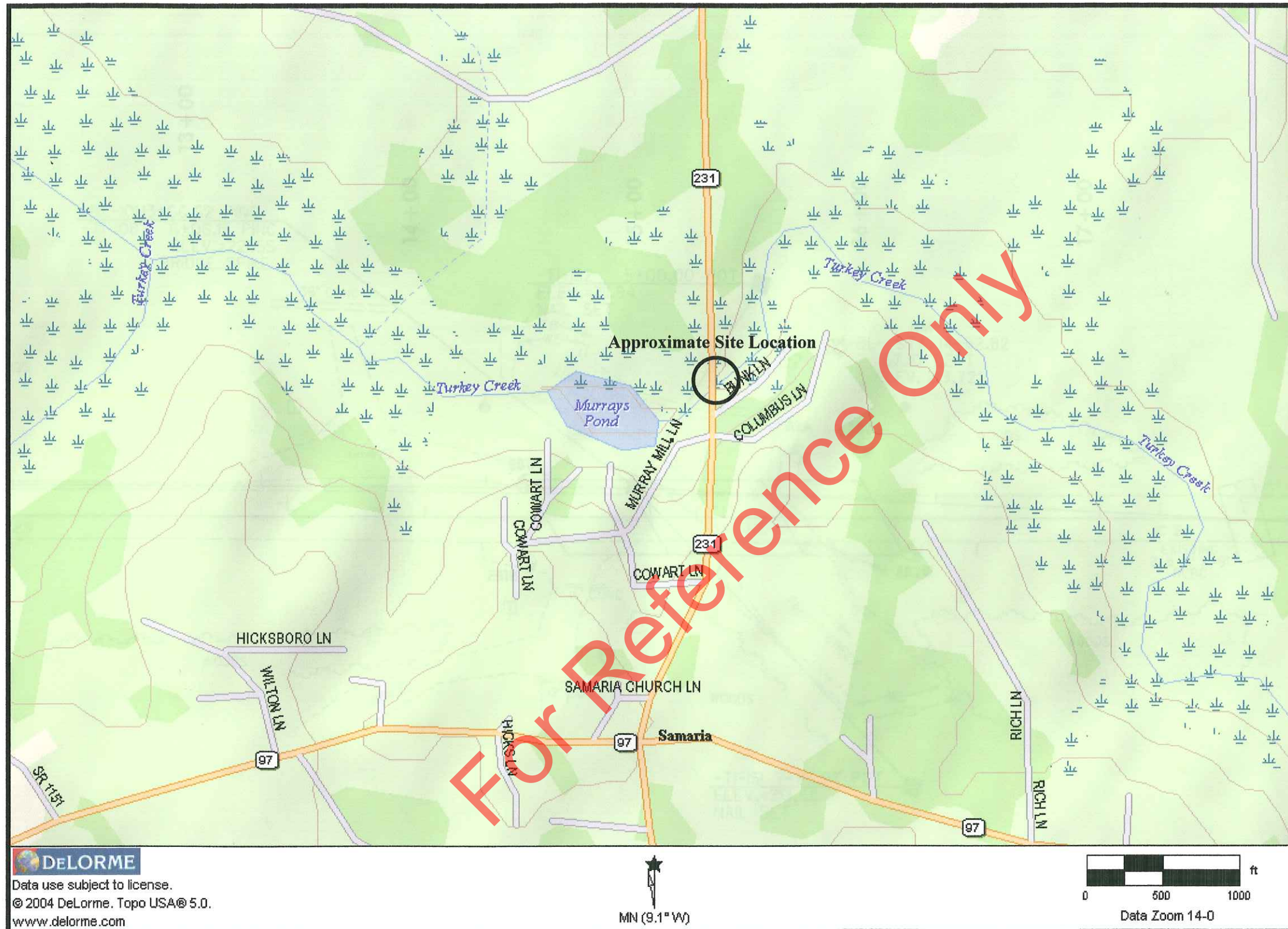
Structure Design should determine the pay item quantity, "\_\_\_ Dia. Drilled Piers in Soil", based upon the total drilled pier length per bent minus the "\_\_\_ Dia. Drilled Piers not in Soil" per bent shown in the table above.

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

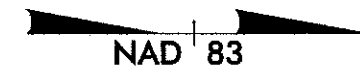
The number of CSL tubes per pier is dependent upon the drilled pier diameter. For drilled piers with a diameter of 5 feet or less, use 4 tubes. For drilled piers with a diameter greater than 5 feet, use 6 tubes.

For Reference Only



**SITE VICINITY MAP**

**Bridge No. 32 on NC 231 over Turkey Creek**  
**Nash County, North Carolina**  
**NCMA Project: MA4124**  
**Tierra Project: 6211-05-011**



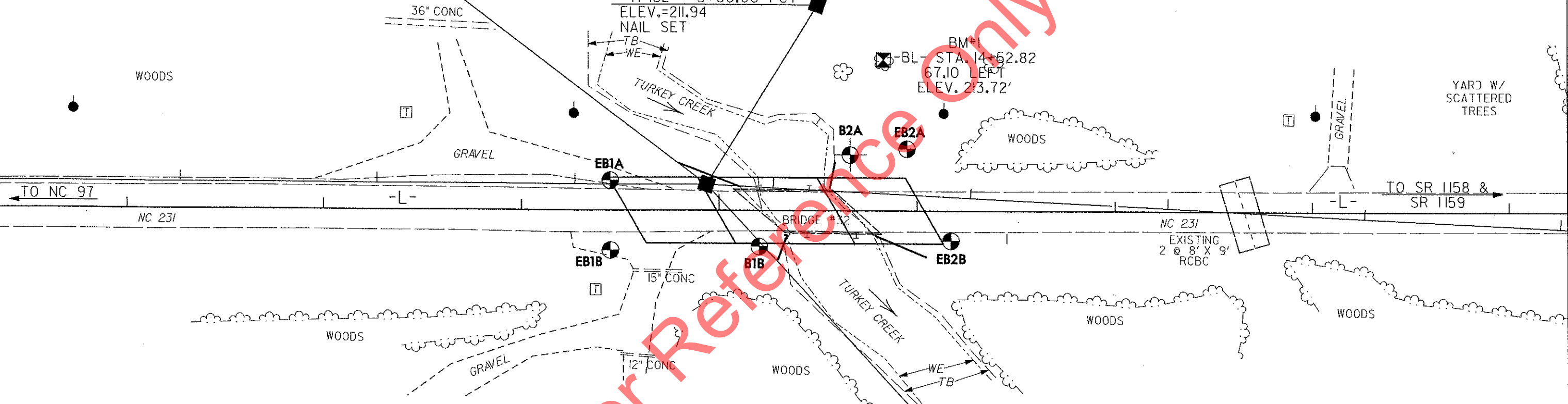
12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00

-BL-10113+66.62 PINC  
-TI-108 6+06.15 PINC  
ELEV.=221.55  
BRIDGE SPIKE

-TI-152 5+00.00 POT  
ELEV.=211.94  
NAIL SET

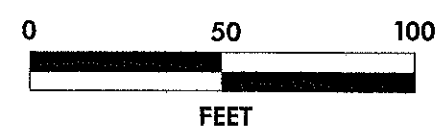
BM#1  
-BL- STA. 14+52.82  
67.10' LEFT  
ELEV. 213.72'

-TI-151 7+85.97 POT  
ELEV.=213.68  
NAIL SET



For Review Only

BENCH MARK: -BL-, STA. 14+52.82,  
67.10' LEFT, ELEVATION 213.72 FT.



**BORING LOCATION PLAN**

NCDOT PROJECT #: MA-4124  
NASH CO., NC  
BRIDGE #32 ON NC 231  
OVER TURKEY CREEK



**TIERRA**  
GEOTECHNICAL • MATERIALS  
ENGINEERING

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



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

PROJECT NO. 6211-05-011		ID. MA-4124		COUNTY NASH		GEOLOGIST J. HOWARD							
SITE DESCRIPTION BRIDGE #32 ON NC 231 OVER TURKEY CREEK						GROUND WATER (ft)							
BORING NO. EB1A		BORING LOCATION 14+45		OFFSET 15' LT.		ALIGNMENT -L-							
COLLAR ELEV. 221.4 ft		NORTHING		EASTING		24 HR. 10.0							
TOTAL DEPTH 31.6 ft		DRILL MACHINE CME 45		DRILL METHOD MUD ROTARY		HAMMER TYPE MANUAL							
DATE STARTED 5-02-05		COMPLETED 5-03-05		SURFACE WATER DEPTH N/A									
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	L O G	SOIL AND ROCK DESCRIPTION	
		0.5ft	0.5ft	0.5ft	0	20	40	60	80				100
221.4													EXISTING GROUND
220	1.0	5	5	5							SS-1	19%	221.3 ROOTMAT RDWY EMB: TAN, STIFF, SANDY SILT (A-4)
	3.5	5	8	10							SS-2	21%	217.9 RES: TAN AND WHITE, V. STIFF TO HARD, SANDY SILT (A-4)
215	6.0	8	12	15									
	8.5	7	13	20									
210	13.5	12	12	16									
	18.5	26	25	38									
205	23.5	38	50/5										
	28.5	50/0											
200	31.6	50/0											
													197.4 WR: TAN AND BROWN, META CRYSTALLINE FELSIC TUFF
													189.8 SPT REFUSAL AT ELEV. 189.8' ON FELSIC TUFF

NCDOT\_BORE\_VARIABLE\_DEPTH\_05-011\_BR\_32\_NASH\_CO.GPJ\_NCDOT.GDT\_6/9/05



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

PROJECT NO. 6211-05-011		ID. MA-4124		COUNTY NASH		GEOLOGIST J. HOWARD							
SITE DESCRIPTION BRIDGE #32 ON NC 231 OVER TURKEY CREEK						GROUND WATER (ft)							
BORING NO. EB1B		BORING LOCATION 14+45		OFFSET 20' RT.		ALIGNMENT -L-							
COLLAR ELEV. 221.9 ft		NORTHING		EASTING		24 HR. 6.0							
TOTAL DEPTH 24.9 ft		DRILL MACHINE CME 45		DRILL METHOD MUD ROTARY		HAMMER TYPE MANUAL							
DATE STARTED 5-02-05		COMPLETED 5-02-05		SURFACE WATER DEPTH N/A									
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	L O G	SOIL AND ROCK DESCRIPTION	
		0.5ft	0.5ft	0.5ft	0	20	40	60	80				100
221.9													EXISTING GROUND
220	1.0	6	6	9									221.8 ROOTMAT RES: TAN AND GRAY, V. STIFF TO HARD, SANDY SILT (A-4)
	3.5	10	12	8									
215	6.0	12	25	33									
	8.5	21	40	50/4									
210	13.5	12	18	29									
	18.5	50/4											
205	23.5	15	34	50/4									
													212.4 WR: BROWN, META FELSIC TUFF
													208.4 RES: BROWN, HARD, SANDY SILT (A-5)
													205.9 WR: BROWN, CRYSTALLINE FELSIC TUFF
													197.0 BORING TERMINATED AT ELEV. 197.0' IN META CRYSTALLINE FELSIC TUFF

NCDOT\_BORE\_VARIABLE\_DEPTH\_05-011\_BR\_32\_NASH\_CO.GPJ\_NCDOT.GDT\_5/20/05

For Reference Only



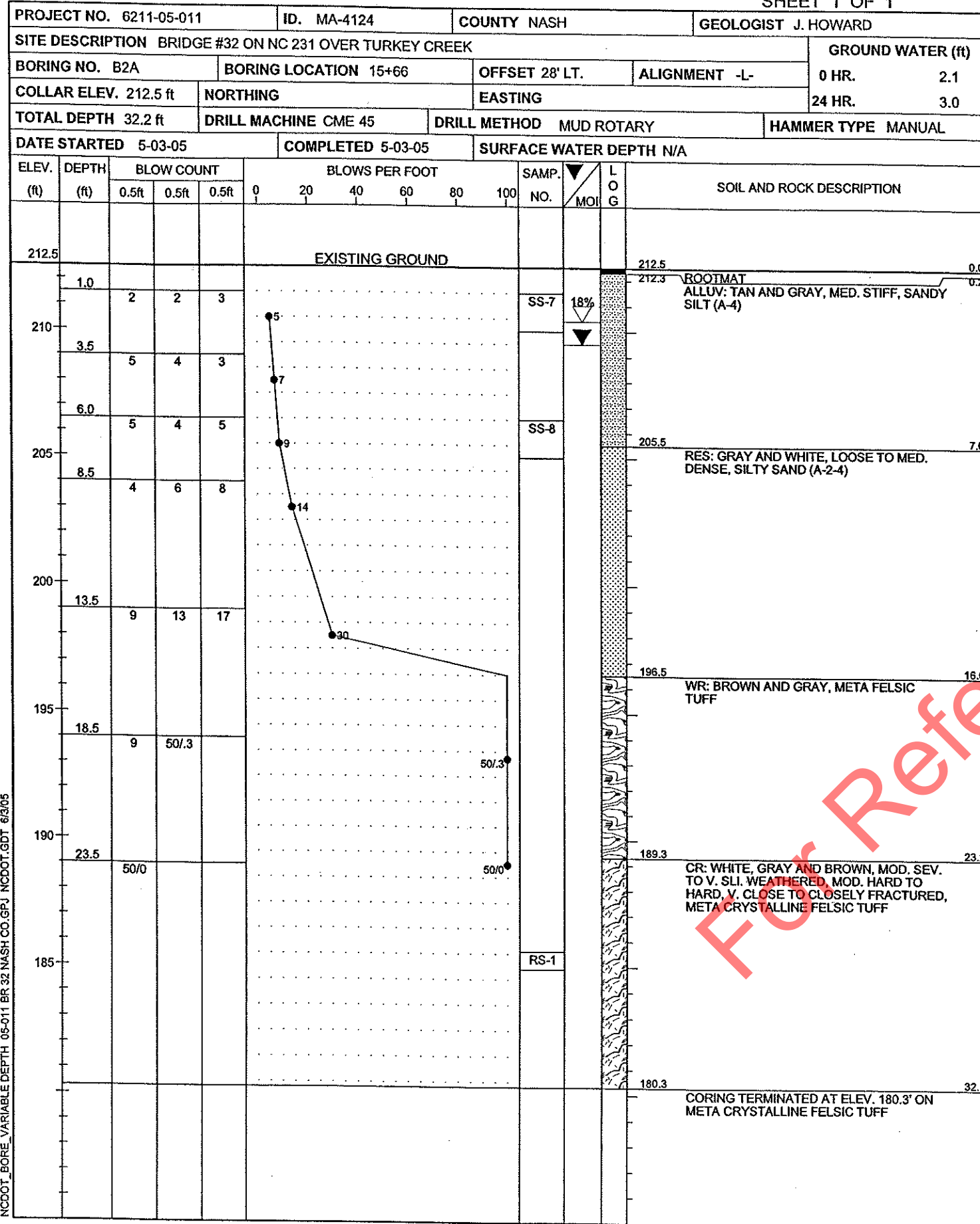


2736 ROWLAND ROAD  
 RALEIGH, NORTH CAROLINA 27615  
 Phone (919) 871-0800 Fax (919) 871-0803

PROJECT NO. 6211-05-011		ID. MA-4124		COUNTY NASH		GEOLOGIST J. HOWARD							
SITE DESCRIPTION BRIDGE #32 ON NC 231 OVER TURKEY CREEK							GROUND WATER (ft)						
BORING NO. B1B		BORING LOCATION 15+20		OFFSET 18' RT.	ALIGNMENT -L-	0 HR. 12.0	24 HR. CAVE						
COLLAR ELEV. 217.3 ft		NORTHING		EASTING									
TOTAL DEPTH 44.0 ft		DRILL MACHINE CME 45		DRILL METHOD MUD ROTARY		HAMMER TYPE MANUAL							
DATE STARTED 5-02-05		COMPLETED 5-02-05		SURFACE WATER DEPTH N/A									
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	
		0.5ft	0.5ft	0.5ft	0	20	40	60	80				100
217.3													EXISTING GROUND
	1.0	4	3	3									217.1 ROOTMAT
215	3.5	2	4	7							SS-4	21%	217.1 ALLUV: RED AND ORANGE, LOOSE, SILTY SAND (A-2-4) WITH GRAVEL
	6.0	3	8	11									213.8 ALLUV: TAN, STIFF TO V. STIFF, SANDY SILT (A-4)
210	8.5	8	25	34									210.0 RES: GRAY, HARD, SANDY SILT (A-4)
	13.5	10	17	31									
205	18.5	4	50/5										201.3 WR: BLUE, GRAY AND BROWN, META MUDSTONE
	23.5	30	50/5										
190	28.5	30	50/3										
	33.5	50/4											
180	38.5	21	29	50									
	43.5	50/5											
													173.3 BORING TERMINATED AT ELEV. 173.3' IN META MUDSTONE

For Reference Only

NCDOT\_BORE\_VARIABLE DEPTH 05-011 BR 32 NASH CO.GPJ NCDOT.GDT 5/20/05



NCCOT\_BORE\_VARIABLE DEPTH 05-011 BR 32 NASH CO.GPJ NCDOT.GDT 6/3/05

**CORE BORING REPORT**

DATE: 5-03-05

PROJECT: 6211-05-011 I.D. NO.: MA-4124 BORING NO: B2A GEOLOGIST: J. HOWARD

DESCRIPTION: BRIDGE #32 ON NC 231 OVER TURKEY CREEK

COUNTY: NASH COLLAR ELEV.: 212.5 FT TOTAL DEPTH: 32.2 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
189.3	23.2	1:45	5.0	4.2/5.0	2.2/5.0	RS-1	23.2-32.2 CR: WHITE, GRAY AND BROWN, MOD. SEV. TO V. SLI. WEATHERED, MOD. HARD TO HARD, V. CLOSE TO CLOSELY FRACTURED, META CRYSTALLINE FELSIC TUFF
		1:00					
		2:00					
184.3	28.2	2:00	4.0	3.7/4.0	23./4.0		
184.3	28.2	2:30					
		1:45					
		2:30					
180.3	32.2						STRATA REC = 88% STRATA RQD = 50%

CORING TERMINATED AT 32.2 FT  
 ELEVATION 180.3 FT

DRILLER: P. BRIDGER CORE SIZE: NQ EQUIPMENT: CME-45

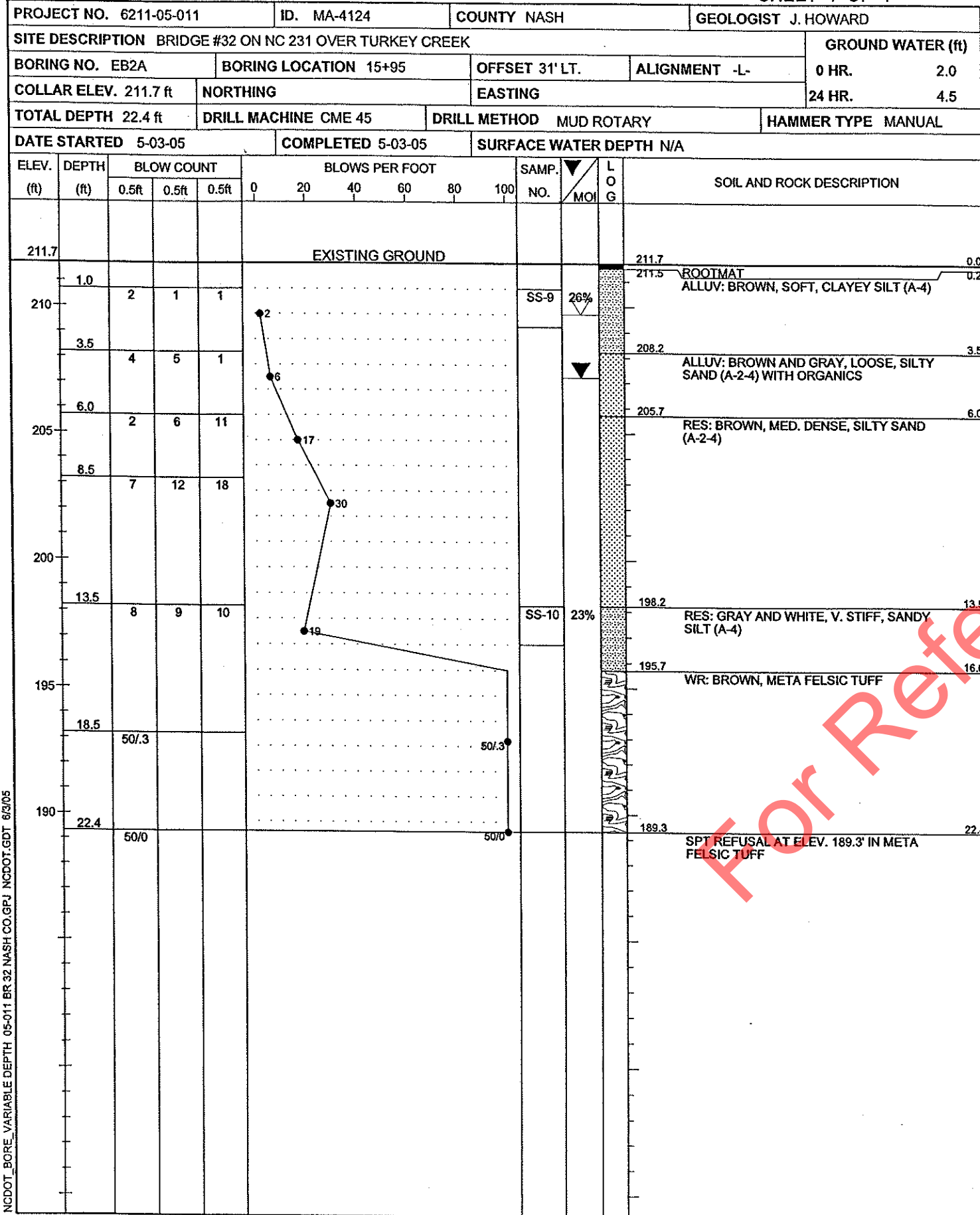
For Reference



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



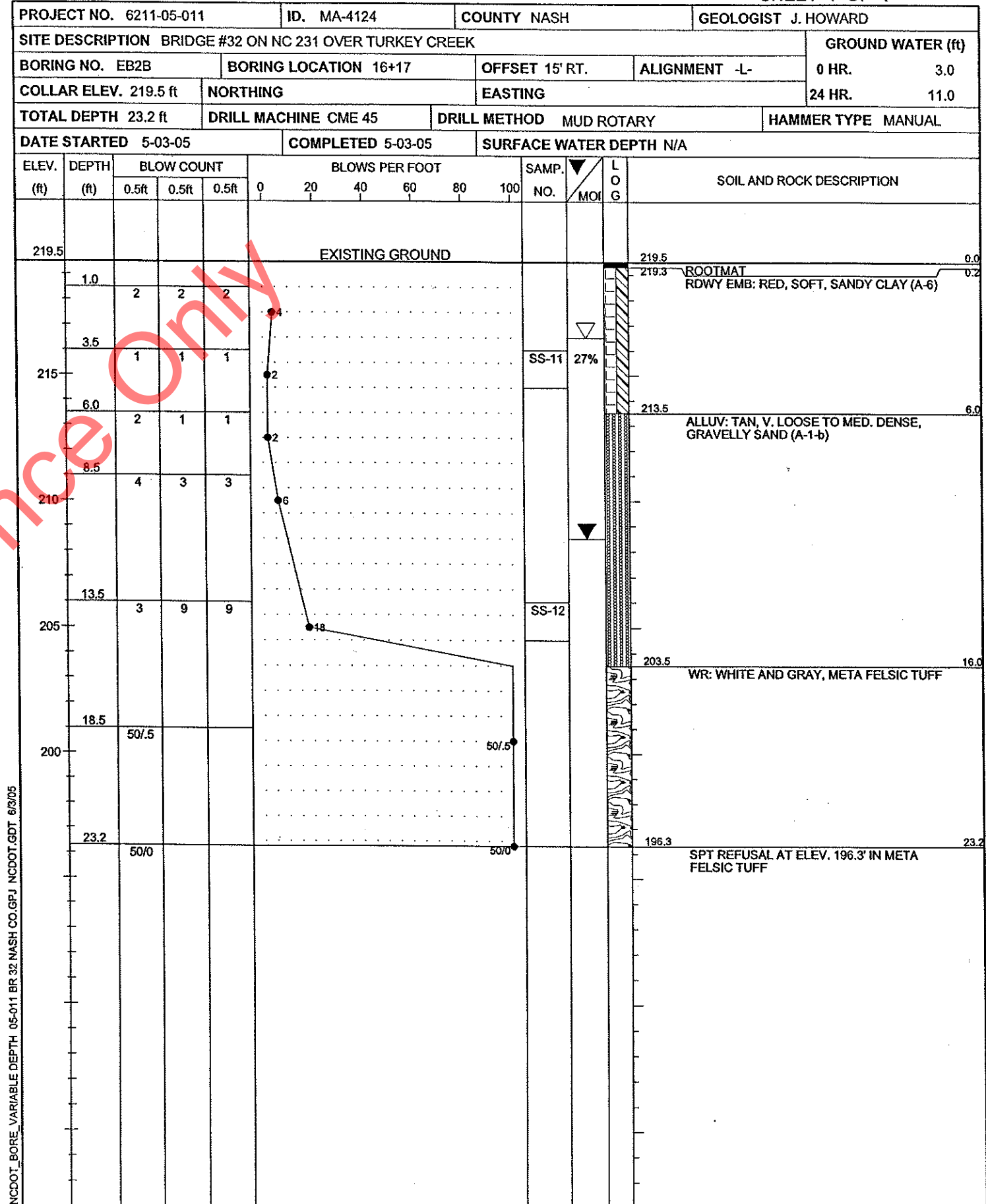
NCDOT\_BORE\_VARIABLE\_DEPTH\_05-011 BR 32 NASH CO.GPJ NCDOT.GDT 6/3/05



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SHEET 1 OF 1



NCDOT\_BORE\_VARIABLE\_DEPTH\_05-011 BR 32 NASH CO.GPJ NCDOT.GDT 6/3/05

SELECTED SITES, PG. 48 (TURKEY CR. AT NC 231 NEAR SAMARIA)		SITE DATA	
Drainage Area ... 19.2 MI <sup>2</sup>	Source ... NEAR SAMARIA	Character ... RURAL ROLLING HILLS	Historical Flood Information: UPSTREAM HOME IS FLOODED DURING LARGE STORMS
Stream Classification (Such as Trout, High Quality Water, etc.) ... CLASS C NSW	Date ... 9/96 ... Elev. ... 219.5 ... Est. Freq. ... 25 YR ... Source ... LIFETIME RESIDENT ... Period of Knowledge ... 80 YRS		
Data on Existing Structure: 1 @ 45' O.C. GIRDERS W/ R.C. FULL HEIGHT ABUTMENTS; 20' CLEAR ROADWAY	Date ... .. Elev. ... .. Est. Freq. ... .. Source ... NCDOT BRIDGE MAIN SUPERVISOR ... Period of Knowledge ... 7 YRS		
Waterway Opening ... 330 FT	Historical Scour Info.: General ... NONE ... Channel Slope ... 0.10% ... Source ... USGS QUAD MAP ... Normal Water Surface Elev. ... 208.60		
Data on Structures Up and Down Stream: 0.05 MI. UPSTREAM: MURRAY'S MILLPOND; 2.1 MI. DOWNSTREAM: BR # 31 ON NC 97; 1 @ 40' O.C. I @ 45' O.C. I @ 40' O.C. R.C. FLOOR / P.P.C. GIRDERS ON R.C. CAPS / H-PILES; 32' CLEAR ROADWAY	Manning's n : Left O.B. ... 0.12 ... Channel ... 0.055 ... Right O.B. ... 0.12 ... Source ... FIELD REVIEW		
Design Control Elev. 217.1 (F.F. OF U/S HOME)	Flood Study / Status ... NONE ... Floodway Established? ... NO		
Waterway Opening (US/DS) ... N/A / 340 FT	Flood Study 100 yr. Discharge ... N/A ... W.S. Elev. : With Floodway ... N/A ... Without Floodway ... N/A		
Gage Station No. ... NONE	Bench Mark Is ... BM #1, 'BENCHLITE' NAIL SET IN 20' GUM TREE; -BL- STA. 14+52.82, 67.10' LEFT (N77.1092,086, E2243716.831) ... Elev. ... 213.72' ... Datum ... NAVD 88		
Period of Records ... N/A	Frequency ... N/A		
Max. Discharge ... N/A	Date ... N/A		
Bed Material ... SAND & MUCK	Bank Condition ... UPSTREAM -- UNSTABLE, ERODING; DOWNSTREAM -- STABLE, VEGETATED		
Debris Potential ... MODERATE	UPSTREAM HOME IS FLOODED DURING LARGE STORMS		

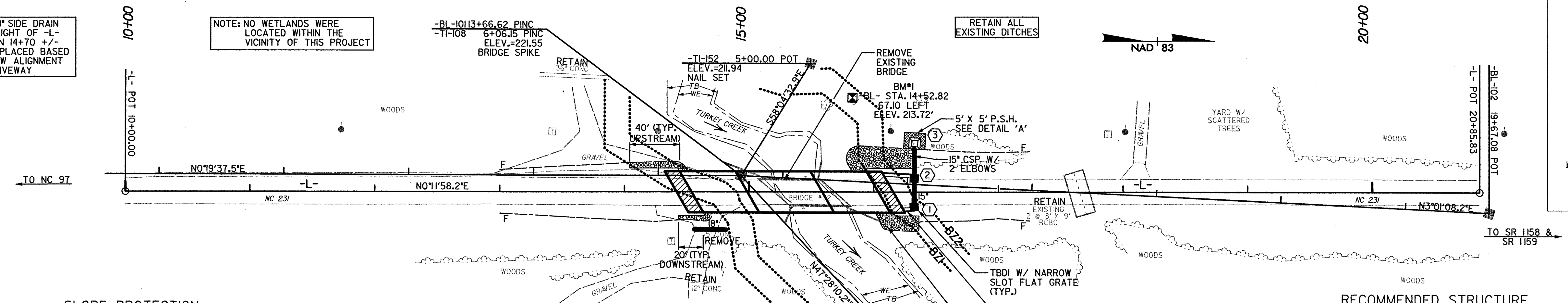
DESIGN DATA																																											
Hydrological Method ... USGS RURAL REGRESSION, FACT. SHEET 007-00	Hydraulic Design Method ... HEC-RAS 3.1.2																																										
Floods Evaluated:	<table border="1"> <thead> <tr> <th>Q OR TOTAL (cfs)</th> <th>Natural Elev (ft)</th> <th>Existing Elev (ft)</th> <th>Proposed Elev (ft)</th> <th>Backwater</th> <th>Bridge Opening Velocity (fps)</th> </tr> </thead> <tbody> <tr> <td>10-YR 1922 / 2400</td> <td>215.9</td> <td>218.7</td> <td>216.4</td> <td>0.5</td> <td>3.4</td> </tr> <tr> <td>25-YR 2592 / 3200</td> <td>217.0</td> <td>219.2</td> <td>217.5</td> <td>0.5</td> <td>3.7</td> </tr> <tr> <td>(DESIGN YEAR) 50-YR 3178 / 3900</td> <td>217.8</td> <td>219.9</td> <td>218.4</td> <td>0.6</td> <td>4.0</td> </tr> <tr> <td>(BASE FLOOD) 100-YR 3930 / 4700</td> <td>218.6</td> <td>220.5</td> <td>219.3</td> <td>0.7</td> <td>4.4</td> </tr> <tr> <td>200-YR 4664 / 5600</td> <td>218.3</td> <td>221.2</td> <td>220.1</td> <td>0.8</td> <td>4.8</td> </tr> <tr> <td>500-YR 5059 / 6900</td> <td>220.3</td> <td>222.0</td> <td>221.1</td> <td>0.8</td> <td>4.8</td> </tr> </tbody> </table>	Q OR TOTAL (cfs)	Natural Elev (ft)	Existing Elev (ft)	Proposed Elev (ft)	Backwater	Bridge Opening Velocity (fps)	10-YR 1922 / 2400	215.9	218.7	216.4	0.5	3.4	25-YR 2592 / 3200	217.0	219.2	217.5	0.5	3.7	(DESIGN YEAR) 50-YR 3178 / 3900	217.8	219.9	218.4	0.6	4.0	(BASE FLOOD) 100-YR 3930 / 4700	218.6	220.5	219.3	0.7	4.4	200-YR 4664 / 5600	218.3	221.2	220.1	0.8	4.8	500-YR 5059 / 6900	220.3	222.0	221.1	0.8	4.8
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Proposed Waterway Opening Provided: ... 1165 FT <sup>2</sup>	Average Channel Velocity (Design) ... 1.7 FPS																																										
Average Overbank Velocity (Design) ... 0.7 FPS	NOTE: ALL WSEL SHOWN IN ABOVE CHART WERE TAKEN FROM HEC-RAS SECTION 5175																																										

HAZARDOUS SPILL BASIN CHECKLIST	
River Basin: ... TAR-PAMLICO	WATER QUALITY CRITERIA:
Stream Crossing Blue Line on USGS ORW <input type="checkbox"/> <input type="checkbox"/>	WSI <input type="checkbox"/> <input type="checkbox"/>
WS II, III OR IV, Crossing Within 0.5 mi of W.S. Critical Area <input type="checkbox"/> <input type="checkbox"/>	ROADWAY CRITERIA:
ROUTE DESIGNATION: Arterial Urban <input type="checkbox"/> <input type="checkbox"/>	Arterial Rural <input checked="" type="checkbox"/> <input type="checkbox"/>
Is a Hazardous Spill Basin Required? <input type="checkbox"/> <input checked="" type="checkbox"/>	

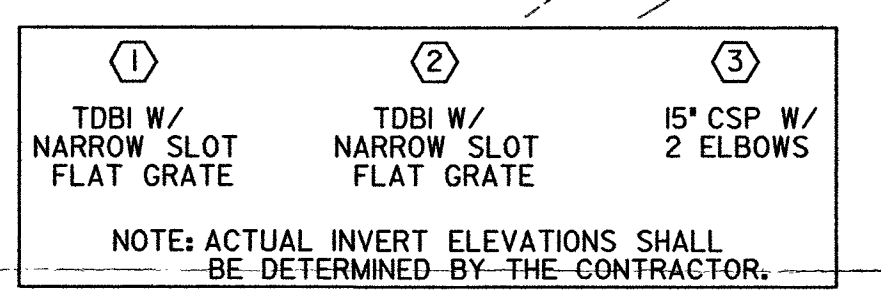
SCALE:  
 1" = 50' HORIZONTAL  
 1" = 10' VERTICAL

NOTE: THE NEW 18" SIDE DRAIN LOCATED RIGHT OF L- AT STATION 14+70 +/- SHALL BE PLACED BASED ON THE NEW ALIGNMENT OF THE DRIVEWAY

NOTE: NO WETLANDS WERE LOCATED WITHIN THE VICINITY OF THIS PROJECT

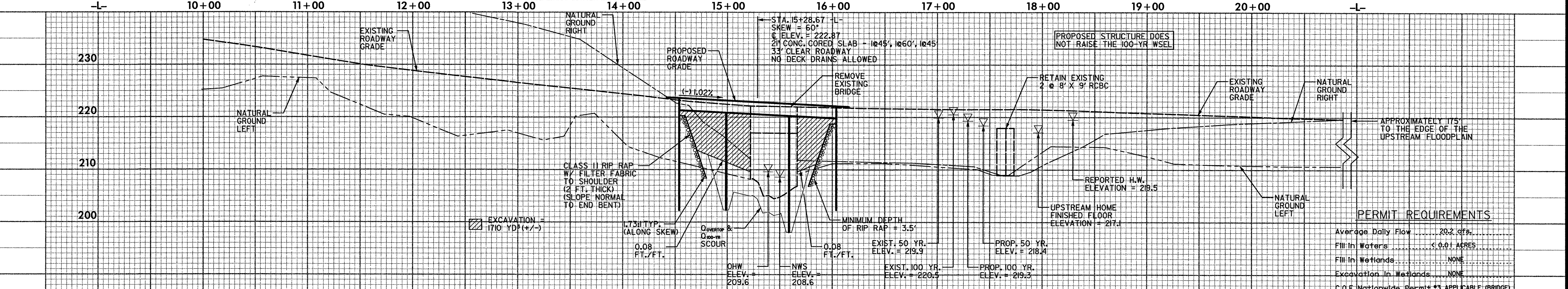


**SLOPE PROTECTION**  
 V = 0.7 FPS, WHICH IS LESS THAN THE SCOURABLE VELOCITY FOR THE PROPOSED FILL. THEREFORE USE 40 FT ON UPSTREAM SIDE & 20 FT ON DOWNSTREAM SIDE ON FILL SLOPES UP TO ELEV. 219.4 OR SHOULDER PT.



**RECOMMENDED STRUCTURE**

Recommended Structure: 3 SPAN: 1@45', 1@60', 1@45'; 21" CONCRETE CORED SLAB  
 NO DECK DRAINS ALLOWED  
 Recommended Width of Roadway: 33' CLEAR ROADWAY. Skew: 60°  
 Recommended Location Is (Up, @, Down) Stream from Existing Crossing.



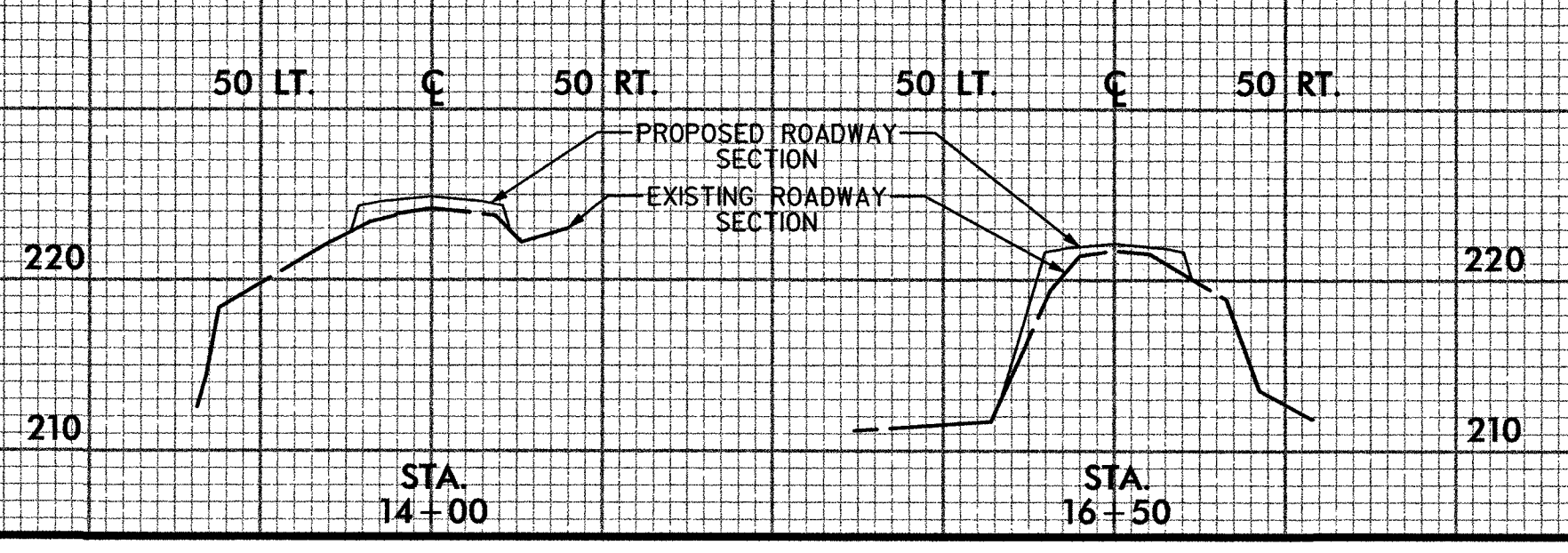
**SCOUR COMPUTATIONS**

LIVE-BED CONTRACTION SCOUR PREDICTION  
 $Y_s = Y_o \left[ 1 + \left( \frac{Q}{Q_c} - 1 \right)^2 \right]$  -  $Y_o$  = ASSUMED  $D_{50} = 0.0015$   
 $Y_{s 100-YR} = 11.91 \left[ \left( \frac{1384}{850} \right)^2 \right] - 14.94 = 3.15$  FT  
 $Y_{s OVERTOP} = 12.18 \left[ \left( \frac{1490}{885} \right)^2 \right] - 15.31 = 3.30$  FT

LOCAL SCOUR PREDICTION  
 $Y_s = Y_o \left[ 1 + \left( \frac{V}{V_c} - 1 \right)^2 \right]$   
 $Y_{s 100-YR} = 9.3 \left[ \left( \frac{2.0}{1.0} \right)^2 \right] - 14.94 = 4.6$   
 $Y_{s OVERTOP} = 10.5 \left[ \left( \frac{2.0}{1.0} \right)^2 \right] - 15.31 = 3.16$

PIER #1 (Ys) = 9.3  
 PIER #2 (Ys) = 10.5  
 OVERTOP =  
 PIER #1 (Ys) = 9.6  
 PIER #2 (Ys) = 10.8  
 NOTE:  $Y_{s 100-YR}$  =  $Y_{s OVERTOP}$

**CROSS SECTIONS**



**DISCHARGE DATA**  
 USGS Regression Equations From USGS Water Resources Investigation (Report # 007-00)  
 Drainage Area = 19.2 MI<sup>2</sup>  
 (Blue Ridge - Piedmont Hydrologic Region)

$Q_{10} = 334(9.2)^{0.88} = 2400$ CFS
$Q_{25} = 476(9.2)^{0.88} = 3200$ CFS
$Q_{50} = 602(9.2)^{0.88} = 3900$ CFS
$Q_{100} = 745(9.2)^{0.88} = 4700$ CFS
$Q_{200} = 908(9.2)^{0.88} = 5600$ CFS
$Q_{500} = 1160(9.2)^{0.88} = 6900$ CFS

Prepared by:  
**MULKEY ENGINEERS & CONSULTANTS**  
 4028 W. 10TH ST. SUITE 200  
 RALEIGH, NC 27604  
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For NCDOT Division of Highways  
**MA-4124**  
 Bridge # 32 on NC 231  
 Over Turkey Creek  
 Nash County

Survey By: RAM, KBA  
 Design By: KBA  
 Checked By: JKS, RAM  
 Date: January 14, 2005