

REFERENCE: BD-5112W

PROJECT: 17BP.12.R.53

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	17BP.12.R.53	1	7

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

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**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

COUNTY Cleveland

PROJECT DESCRIPTION DIVISION 12 LOW IMPACT  
BRIDGE REPLACEMENT

SITE DESCRIPTION BRIDGE NO. 022190 ON SR 1005  
(BALL PARK ROAD) OVER MAGNESS CREEK

**CONTENTS**

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND
3	BORING LOCATION MAP
4-7	BORE LOGS

PERSONNEL

P. Weaver

G. Skoglund

J. Justice

INVESTIGATED BY ESP Associates, P.A.

DRAWN BY P. Petrucci

CHECKED BY P. Weaver

SUBMITTED BY ESP Associates, P.A.

DATE March, 2015

**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) 707-6950. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

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

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NOTES:

- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
- BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

NORTH CAROLINA  
LICENSED  
SEAL  
1500  
GEOLOGIST  
PAUL M. WEAVER

*Paul M. Weaver*      3/27/2015  
SIGNATURE                      DATE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT

**SUBSURFACE INVESTIGATION**





SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS  
(PAGE 1 OF 2)

SOIL DESCRIPTION										GRADATION									
SOIL IS CONSIDERED 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 THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6										WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.									
SOIL LEGEND AND AASHTO CLASSIFICATION										ANGULARITY OF GRAINS									
GENERAL CLASS.										THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.									
GROUP CLASS.										MINERALOGICAL COMPOSITION									
SYMBOL										MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.									
% PASSING										COMPRESSIBILITY									
MATERIAL PASSING #40 LL PI										SLIGHTLY COMPRESSIBLE LL < 31 MODERATELY COMPRESSIBLE LL = 31 - 50 HIGHLY COMPRESSIBLE LL > 50									
GROUP INDEX										PERCENTAGE OF MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										ORGANIC MATERIAL GRANULAR SOILS SILT - CLAY SOILS OTHER MATERIAL									
GEN. RATING AS SUBGRADE										GROUND WATER									
CONSISTENCY OR DENSENESS										MISCELLANEOUS SYMBOLS									
PRIMARY SOIL TYPE										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION									
COMPACTNESS OR CONSISTENCY										SOIL SYMBOL									
RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)										ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT									
RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )										INFERRED SOIL BOUNDARY									
										INFERRED ROCK LINE									
										ALLUVIAL SOIL BOUNDARY									
TEXTURE OR GRAIN SIZE										RECOMMENDATION SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM)										UNDERCUT EXCAVATION									
BOULDER (BLDR.) COBBLE (COB.) GRAVEL (GR.) COARSE SAND (CSE. SD.) FINE SAND (F SD.) SILT (SL.) CLAY (CL.)										UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE									
GRAIN MM 305 75 2.0 0.25 0.075 0.05 0.005										UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK									
GRAIN IN. 12 3										UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL									
SOIL MOISTURE - CORRELATION OF TERMS										ABBREVIATIONS									
SOIL MOISTURE SCALE (ATTERBERG LIMITS)										MED. - MEDIUM									
FIELD MOISTURE DESCRIPTION										MICA - MICACEOUS									
GUIDE FOR FIELD MOISTURE DESCRIPTION										MOD. - MODERATELY									
LIQUID LIMIT										NP - NON PLASTIC									
WET - (W)										ORG. - ORGANIC									
PLASTIC LIMIT										PMT - PRESSUREMETER TEST									
MOIST - (M)										SAP. - SAPROLITIC									
DRY - (D)										SD. - SAND, SANDY									
										SL - SILT, SILTY									
										SLI. - SLIGHTLY									
										TCR - TRICONE REFUSAL									
										W - MOISTURE CONTENT									
										HL - HIGHLY									
										V - VERY									
PLASTICITY										EQUIPMENT USED ON SUBJECT PROJECT									
NON PLASTIC SLIGHTLY PLASTIC MODERATELY PLASTIC HIGHLY PLASTIC										DRILL UNITS:									
PLASTICITY INDEX (PI)										ADVANCING TOOLS:									
DRY STRENGTH										HAMMER TYPE:									
VERY LOW SLIGHT MEDIUM HIGH										AUTOMATIC MANUAL									
COLOR										CORE SIZE:									
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.										-B -H									
										-N									
										HAND TOOLS:									
										POST HOLE DIGGER									
										HAND AUGER									
										SOUNDING ROD									
										VANE SHEAR TEST									
										CME-45C									
										CLAY BITS									
										6" CONTINUOUS FLIGHT AUGER									
										CME-55									
										6" HOLLOW AUGERS									
										CME-550									
										HARD FACED FINGER BITS									
										VANE SHEAR TEST									
										TUNG.-CARBIDE INSERTS									
										CASING [X] W/ ADVANCER									
										PORTABLE MOIST									
										TRICONE * STEEL TEETH									
										TRICONE * TUNG.-CARB.									
										CORE BIT									
										[X] CME-550X									
										[X] 3/4" HOLLOW AUGER									

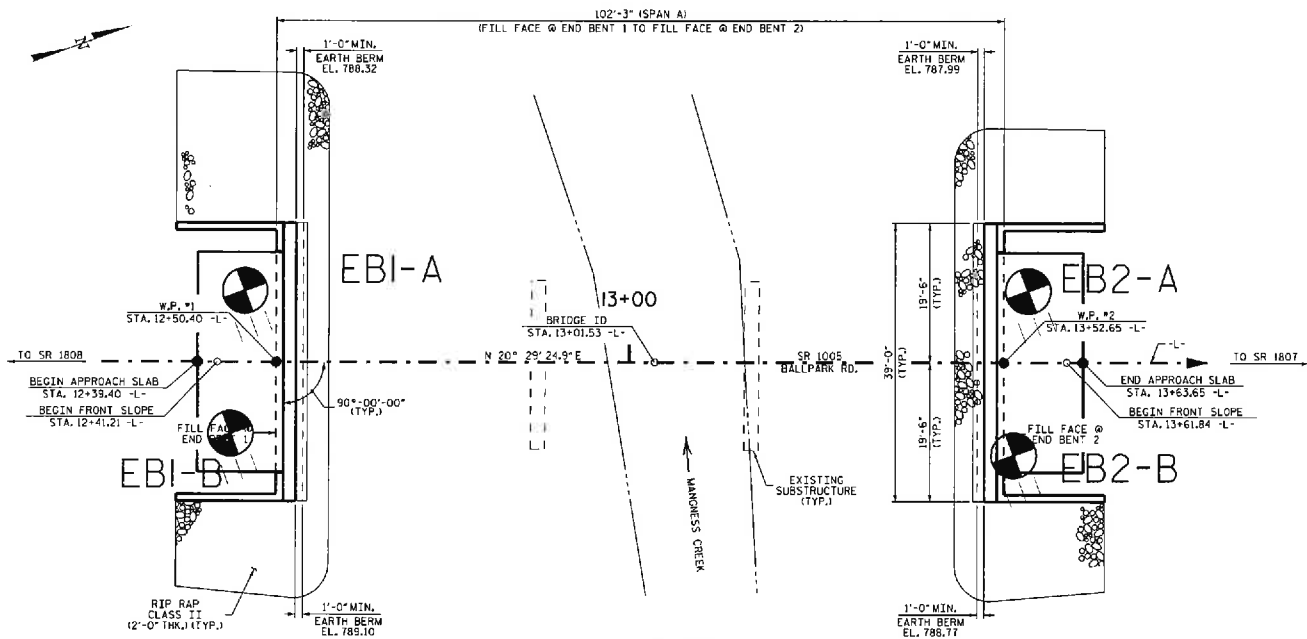
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**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**  
(PAGE 2 OF 2)

ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. 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><b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.  <b>ADUIFIER</b> - A WATER BEARING FORMATION OR STRATA.  <b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.  <b>ARGILLACEOUS</b> - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.  <b>ARTESIAN</b> - 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.  <b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.  <b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.  <b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.  <b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.  <b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.  <b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.  <b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.  <b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.  <b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.  <b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.  <b>FORMATION (FM)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.  <b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.  <b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.  <b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.  <b>MOTTLED (MOT.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.  <b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.  <b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.  <b>ROCK QUALITY DESIGNATION (RQD)</b> - 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.  <b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.  <b>SILL</b> - 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.  <b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.  <b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - NUMBER OF BLOWS IN 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.  <b>STRATA CORE RECOVERY (SREC)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.  <b>STRATA ROCK QUALITY DESIGNATION (SRQD)</b> - 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.  <b>TOPSOIL (TS)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>	
<p><b>WEATHERED ROCK (WR)</b></p> 	<p>NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES &gt; 100 BLOWS PER FOOT IF TESTED.</p>		
<p><b>CRYSTALLINE ROCK (CR)</b></p> 	<p>FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, ONEISS, GABBRO, SCHIST, ETC.</p>		
<p><b>NON-CRYSTALLINE ROCK (NCR)</b></p> 	<p>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><b>COASTAL PLAIN SEDIMENTARY ROCK (CPI)</b></p> 	<p>COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>		
WEATHERING			
<p>FRESH</p>	<p>ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.</p>		
<p>VERY SLIGHT (V SL.)</p>	<p>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.)</p>	<p>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.)</p>	<p>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.)</p>	<p>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.)</p>	<p>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, WOULD YIELD SPT N VALUES &gt; 100 BPF</i></p>		
<p>VERY SEVERE (V SEV.)</p>	<p>ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES &lt; 100 BPF</i></p>		
<p>COMPLETE</p>	<p>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>		
ROCK HARDNESS			
<p>VERY HARD</p>	<p>CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.</p>		
<p>HARD</p>	<p>CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.</p>		
<p>MODERATELY HARD</p>	<p>CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.</p>		
<p>MEDIUM HARD</p>	<p>CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.</p>		
<p>SOFT</p>	<p>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.</p>		
<p>VERY SOFT</p>	<p>CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.</p>		
FRACTURE SPACING		BEDDING	
	<p><b>SPACING</b></p>	<p><b>TERM</b></p>	<p><b>THICKNESS</b></p>
<p>VERY WIDE</p>	<p>MORE THAN 10 FEET</p>	<p>VERY THICKLY BEDDED</p>	<p>4 FEET</p>
<p>WIDE</p>	<p>3 TO 10 FEET</p>	<p>THICKLY BEDDED</p>	<p>1.5 - 4 FEET</p>
<p>MODERATELY CLOSE</p>	<p>1 TO 3 FEET</p>	<p>THINLY BEDDED</p>	<p>0.16 - 1.5 FEET</p>
<p>CLOSE</p>	<p>0.16 TO 1 FOOT</p>	<p>VERY THINLY BEDDED</p>	<p>0.03 - 0.16 FEET</p>
<p>VERY CLOSE</p>	<p>LESS THAN 0.16 FEET</p>	<p>THICKLY LAMINATED</p>	<p>0.008 - 0.03 FEET</p>
<p></p>	<p></p>	<p>THINLY LAMINATED</p>	<p>&lt; 0.008 FEET</p>
INDURATION			
<p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p>			
<p>FRIABLE</p>	<p>RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p>		
<p>MODERATELY INDURATED</p>	<p>GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p>		
<p>INDURATED</p>	<p>GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p>		
<p>EXTREMELY INDURATED</p>	<p>SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>		
		<p><b>BENCH MARK: BM#1: RR SPIKE IN A 24' POPLAR,</b>  <b>-L- STA 16+17.28, 34.91' RIGHT</b></p> <p style="text-align: right;"><b>ELEVATION: 800.82 FEET</b></p>	
<p><b>NOTES:</b>  F.I.A.D. = FILLED IMMEDIATELY AFTER DRILLING</p>			
<p>DATE: 8-15-14</p>			

PROJECT REFERENCE NO.	SHEET NO.
17BP.12.R.53	3
<b>SITE PLAN</b>	



**PLAN**  
PILES NOT SHOWN IN PLAN VIEW FOR CLARITY





# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 17BP.12.R.53	TIP BD-5112W	COUNTY CLEVELAND	GEOLOGIST Weaver, P.M.
SITE DESCRIPTION Bridge No. 022190 on SR 1005 (Ball Park Road) over Magness Creek			GROUND WTR (ft)
BORING NO. EB1-B	STATION 12+44	OFFSET 10 ft RT	ALIGNMENT -L-
COLLAR ELEV. 796.4 ft	TOTAL DEPTH 24.0 ft	NORTHING 610,073	EASTING 1,242,289
DRILL RIG/HAMMER EFF./DATE SDS1873 CME-550X 87% 09/05/2014		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER Skoglund, G.	START DATE 03/23/15	COMP. DATE 03/23/15	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE 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					ELEV. (ft)
800															
795														796.4	0.0
														795.3	1.1
790	792.9	3.5	2	1	2										
785	787.9	8.5	2	2	2									787.4	9.0
780	782.9	13.5	4	4	3									782.6	13.8
775	777.9	18.5	2	4	5									778.6	17.8
	772.9	23.5												773.1	23.3
	772.4	24.0												772.4	24.0

NCDOT BORE SINGLE BRIDGE 022190 GINT LOGS.GPJ NC\_DOT.GDT 3/27/15





# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 17BP.12.R.53	TIP BD-5112W	COUNTY CLEVELAND	GEOLOGIST Weaver, P.M.
SITE DESCRIPTION Bridge No. 022190 on SR 1005 (Ball Park Road) over Magness Creek			GROUND WTR (ft)
BORING NO. EB2-B	STATION 13+54	OFFSET 13 ft RT	ALIGNMENT -L-
COLLAR ELEV. 796.3 ft	TOTAL DEPTH 37.7 ft	NORTHING 610,175	EASTING 1,242,330
DRILL RIG/HAMMER EFF./DATE SDS1873 CME-550X 87% 09/05/2014		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER Skoglund, G.	START DATE 03/23/15	COMP. DATE 03/23/15	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)
800															
795														796.3 GROUND SURFACE 0.0	
790	792.8	3.5	1	2	1							M		<b>ROADWAY EMBANKMENT</b> Red, Soft, Fine Sandy SILT (A-4), Micaceous	
785	787.8	8.5	2	1	2							M			
780	782.8	13.5	WOH	2	1							W	782.3	Red, Very Loose, Silty, Fine SAND (A-3) with Little Mica and Trace Gravel 14.0	
775	777.8	18.5	3	4	12							M	777.3	<b>ALLUVIAL</b> Tan Brown, Medium Dense, Silty, Fine to Coarse SAND (A-1-b) with Some Gravel Note: Blow Count Influenced by Gravel 19.0	
770	772.8	23.5	5	3	3							M	773.7	<b>RESIDUAL</b> Tan, Gray, and Orange Brown: Medium Stiff to Hard; SILT (A-4) - SAPROLITE 22.6	
765	767.8	28.5	7	13	21							M			
760	762.8	33.5	20	47	53/0.2								762.3	<b>WEATHERED ROCK</b> Tan, Reddish Brown, and Gray MICA SCHIST 34.0	
	758.6	37.7												758.6	Boring Terminated with Standard Penetration Test Refusal at Elevation 758.6 ft on Crystalline Rock: Mica Schist 37.7
			60/0.0											60/0.0	

NCDOT BORE SINGLE BRIDGE 022190 GINT LOGS.GPJ NC\_DOT.GDT 3/27/15





Job No.:	17BP.12.R.53	Sheet		of	
Task:	Foundation Recs		Phase		
Job Name:	Bridge # 190 over Mangness Creek on SR 1005				
By:	grt	Date:	3/31/2015		
Checked By:	ab	Date:	4/1/2015		

## CALCULATIONS



Job No.:	17BP.12.R.53	Sheet		of	
Task:	Foundation Recs	Phase			
Job Name:	Bridge # 190 over Mangness Creek on SR 1005				
By:	grt	Date:	3/31/2015		
Checked By:	ab	Date:	4/1/2015		

**End Bent 1**

Bottom of Cap Elev = 789.32 ft left, 790.1 ft right

Number of Piles = 7 (5 vertical, 2 brace)

Pile Type = HP 12x53

Factored axial load = 226 k = 113 t, Use 113 tons

**Axial Capacity**

Top of weathered rock: EB1-A = 771', EB1-B = 773'

Average pile length to top of weathered rock = 17.5'

Assume piles will be driven 1' into weathered rock

Average pile length = 17.5 + 1 + 1 = 19.5', Say 20', length includes 1 foot embedment into cap

Based on APile analyses at end bent 2, skin resistance will be less than 10%

Remaining resistance derived from tip bearing in rock.

**Weap Analysis**

NCDOT Driven Pile Policy, 6th update:

Driving resistance factor = 0.6, Min blow count = 30 bpf, Max blow count = 180 to 240 bpf, Max comp. stress = 0.9 Fy = 45 ksi for 50 ksi steel

Required driving resistance = 226/0.6 = 377 k = 188 tons, Say 190 tons

Percent skin resistance = 10%, minimum for Weap analysis

Results:

Delmag D 19-32 (42.4 ft-kip): Max comp stress = 33.8 ksi, Blow counts = 144 bpf, OK

Since D 19-32 hammer works, no hammer energy range note required

**Miscellaneous**

End slopes of 1.5:1 are ok by inspection, based on low slope height and no fill placement

No downdrag due to no added embankment

No waiting periods before driving piles

Pile points are required due to rock fragments and shallow weathered rock



# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 17BP.12.R.53	TIP BD-5112W	COUNTY CLEVELAND	GEOLOGIST Weaver, P.M.
SITE DESCRIPTION Bridge No. 022190 on SR 1005 (Ball Park Road) over Magness Creek			GROUND WTR (ft)
BORING NO. EB1-A	STATION 12+46	OFFSET 10 ft LT	ALIGNMENT -L-
COLLAR ELEV. 796.5 ft	TOTAL DEPTH 27.8 ft	NORTHING N/A	EASTING N/A
DRILL RIG/HAMMER EFF. DATE SDS1873 CME-550X 87% 09/05/2014		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER Skoglund, G.	START DATE 03/23/15	COMP. DATE 03/23/15	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
800																
795																
	793.0	3.5														
			2	3	3											
790																
	788.0	8.5														
			2	2	3											
785																
	783.0	13.5														
			2	4	5											
780																
	778.0	18.5														
			4	5	4											
775																
	773.0	23.5														
			25	34	9											
770																
	768.7	27.8														
			60/0.0													

NCDOT BORE SINGLE BRIDGE 022190 GINT LOGS.GPJ NC\_DOT.GDT 3/25/15

*BOE = 789'*

*18'*

*771'*

*60/0.0*

Boring Terminated with Standard Penetration Test Refusal at Elevation 788.7 ft on Crystalline Rock: Mica Schist

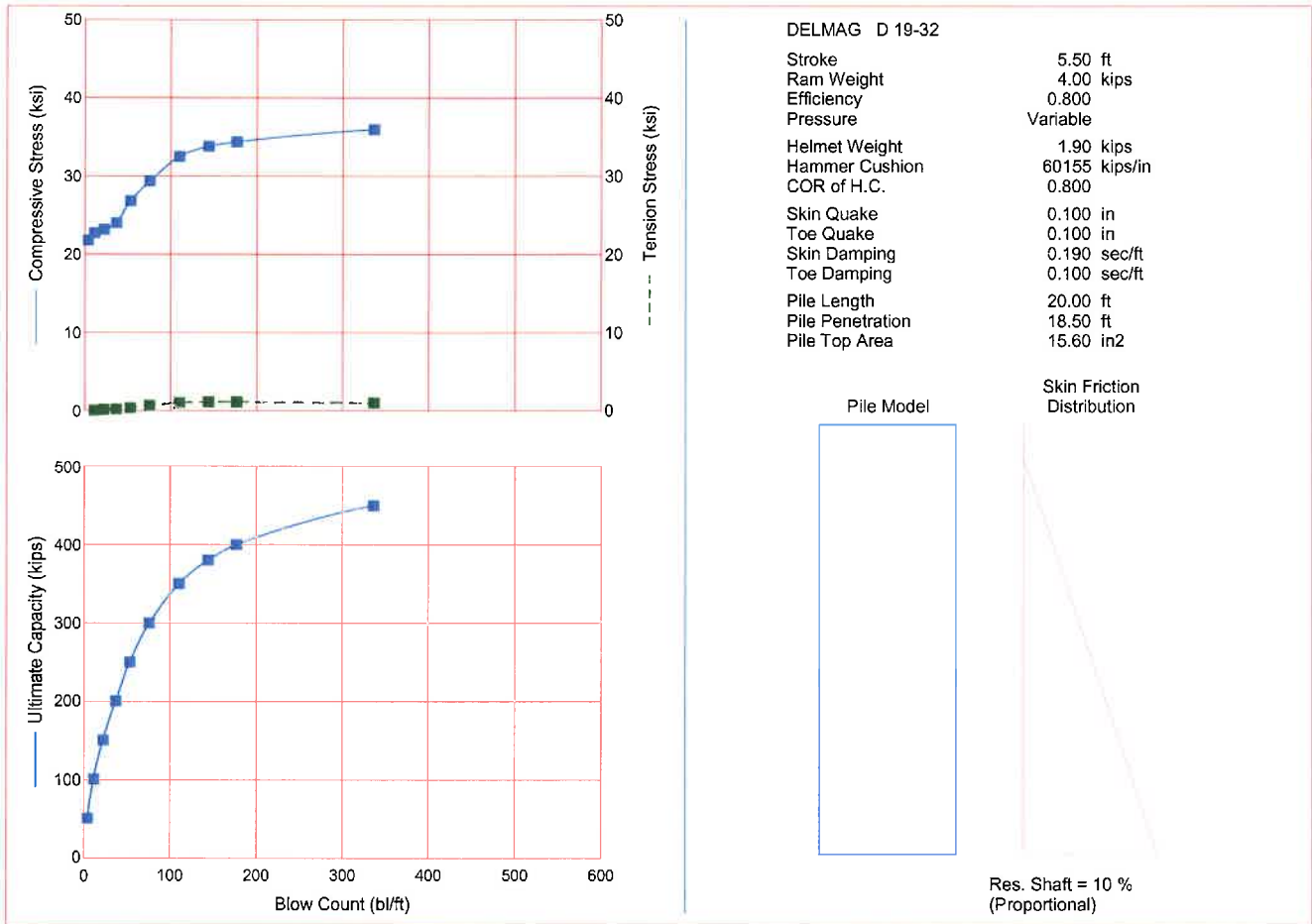


# NCDOT GEOTECHNICAL ENGINEERING UNIT BORELOG REPORT

WBS 17BP.12.R.53	TIP BD-5112W	COUNTY CLEVELAND	GEOLOGIST Weaver, P.M.
SITE DESCRIPTION Bridge No. 022190 on SR 1005 (Ball Park Road) over Magness Creek			GROUND WTR (ft)
BORING NO. EB1-B	STATION 12+44	OFFSET 10 ft RT	ALIGNMENT -L-
COLLAR ELEV. 796.4 ft	TOTAL DEPTH 24.0 ft	NORTHING N/A	EASTING N/A
DRILL RIG/HAMMER EFF/DATE SDS1873 CME-550X 87% 09/05/2014		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER Skoglund, G.	START DATE 03/23/15	COMP. DATE 03/23/15	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	L O MOI G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					ELEV. (ft)
800															
795															
	782.9	3.5	2	1	2							M	GROUND SURFACE	0.0	
													0.3' Asphalt over 0.8' Stone	1.1	
													ROADWAY EMBANKMENT		
													Tan and Reddish Brown, Soft, Fine Sandy SILT (A-4), Micaceous		
790															
	787.9	8.5	2	2	2							M	Red, Soft to Medium Stiff, Silty CLAY (A-6)	9.0	
785															
	782.9	13.5	4	4	3							M	RESIDUAL	13.8	
													Red and Tan, Loose, Silty, Fine SAND (A-3) with Trace Rock Fragments		
780															
	777.9	18.5	2	4	5							M	Tan and Brown, Stiff, Fine Sandy SILT (A-4), Micaceous, with Trace Rock Fragments	17.8	
775															
	772.9	23.5													
	772.4	24.0	100/0.4										WEATHERED ROCK	23.3	
			60/0.0										Brown and Gray, MICA SCHIST	24.0	
													Boring Terminated with Standard Penetration Test Refusal at Elevation 772.4 ft on Crystalline Rock: Mica Schist		

NCDOT BORE SINGLE BRIDGE 022190 GINT LOGS.GPJ NC\_DOT.GDT 3/25/15



Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
50.0	21.76	0.00	4.4	5.50	22.52
100.0	22.70	0.03	11.7	5.50	15.91
150.0	23.14	0.14	22.8	5.50	12.55
200.0	24.00	0.18	37.3	5.50	10.81
250.0	26.79	0.36	53.3	5.50	10.01
300.0	29.36	0.69	76.1	5.50	9.43
350.0	32.49	1.02	110.7	5.50	9.09
380.0	33.78	1.12	144.4	5.50	8.89
400.0	34.37	1.13	177.4	5.50	8.75
450.0	35.94	1.02	336.9	5.50	8.53



Job No.:	17BP.12.R.53	Sheet		of	
Task:	Foundation Recs	Phase			
Job Name:	Bridge # 190 over Mangness Creek on SR 1005				
By:	grt	Date:	3/31/2015		
Checked By:	ab	Date:	4/1/2015		

**End Bent 2**

Bottom of Cap Elev = 788.99 ft left, 789.77 ft right

Number of Piles = 7 (5 vertical, 2 brace)

Pile Type = HP 12x53

Factored axial load = 226 k = 113 t, Use 113 tons

**Axial Capacity**

Top of weathered rock: EB2-A = 761', EB2-B = 762'

Average pile length to top of weathered rock = 18'

Assume piles will be driven 1' into weathered rock

Pile length left = 28 + 1 + 1 = 30', Say 30, length includes 1 foot embedment into cap

Apile analysis, see output results, Length = 28' to weathered rock

Required skin friction = 226/0.5 = 252 k, Resistance factor = 0.5 (AASHTO Article 10.5.5.2.3)

Computed skin resistance = 45 k < 252 k

Remaining resistance derived from tip bearing in rock.

**Weap Analysis**

NCDOT Driven Pile Policy, 6th update:

Driving resistance factor = 0.6, Min blow count = 30 bpf, Max blow count = 180 to 240 bpf, Max comp. stress = 0.9 Fy = 45 ksi for 50 ksi steel

Required driving resistance = 226/0.6 = 377 k = 188 tons, Say 190 tons

Percent skin resistance from APile = 45/380 = .12 x 100 = 12%

Results:

Delmag D 19-32 (42.4 ft-kip): Max comp stress = 29.4 ksi, Blow counts = 196 bpf, OK

Since D 19-32 hammer works, no hammer energy range note required.

**Miscellaneous**

End slopes of 1.5:1 are ok by inspection, based on low slope height and no fill placement

No downdrag due to no added embankment

No waiting periods before driving piles

Pile points are required due to shallow weathered rock







# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 17BP.12.R.53	TIP BD-5112W	COUNTY CLEVELAND	GEOLOGIST Weaver, P.M.
SITE DESCRIPTION Bridge No. 022190 on SR 1005 (Ball Park Road) over Magness Creek			GROUND WTR (ft)
BORING NO. EB2-B	STATION 13+54	OFFSET 13 ft RT	ALIGNMENT -L-
COLLAR ELEV. 796.3 ft	TOTAL DEPTH 37.7 ft	NORTHING N/A	EASTING N/A
DRILL RIG/HAMMER EFF./DATE SDS1873 CME-550X 87% 09/05/2014		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER Skoglund, G.	START DATE 03/23/15	COMP. DATE 03/23/15	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
800															
795														795.3	0.0
790	792.8	3.5		1	2	1							M		
785	787.8	8.5		2	1	2							M		
780	782.8	13.5	WOH	2	1								W	782.3	14.0
775	777.8	18.5		3	4	12							M	777.3	19.0
770	772.8	23.5		5	3	3							M	773.7	22.6
765	767.8	28.5		7	13	21							M		
760	762.8	33.5		20	47	53/0.2							M	762.3	34.0
	758.6	37.7											M	758.6	37.7

NCDOT BORE SINGLE BRIDGE 022190 GINT LOGS.GPJ NC\_DOT\_GDT 3/25/15

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AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus  
 VERSION 5.0 - (C) COPYRIGHT ENSOFT, INC., 1987-2008.

Div 12 Br 190 EB2

DESIGNER : GRT

DATE : 3/31/2015

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION= 48.00 IN.  
 TIP AREA OF PILE WITH NONCIRCULAR SECTION = 0.11 SQF  
 OUTSIDE DIAMETER OF CIRCULAR PILE = 0.00 IN.  
 INTERNAL DIAMETER OF CIRCULAR PILE = 0.00 IN.  
 PILE LENGTH = 28.00 FT.  
 MODULUS OF ELASTICITY = 0.300E+08 PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION = 0.00 FT.  
 INCREMENT OF PILE LENGTH USED IN COMPUTATION = 0.50 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	120.00	27.00	0.00
12.00	SAND	0.00	120.00	27.00	0.00
12.00	SAND	0.00	60.00	30.00	0.00
32.00	SAND	0.00	60.00	30.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOVED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08	0.10E+08	0.00	0.00	0.00	0.00	0.00
0.10E+08	0.10E+08	0.00	0.00	0.00	0.00	0.00
0.10E+08	0.10E+08	0.00	0.00	0.00	0.00	0.00
0.10E+08	0.10E+08	0.00	0.00	0.00	0.00	0.00

SET MAXIMUM UNIT FRICTION AND MAXIMUM UNIT BEARING  
 TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO  
 LIMIT THE COMPUTED DATA.

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 \* COMPUTATION RESULT \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* FED. HWY. METHOD \*      \* ARMY CORPS METHOD \*      \* LAMBDA 2 METHOD \*  
 \*\*\*\*\*

PILE PENETR- ATION FT.	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC- ITY KIP	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC- ITY KIP	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC- ITY KIP
0.0	0.0	0.2	0.2	0.0	0.3	0.3	0.0	0.0	0.0
0.5	0.0	0.2	0.2	0.0	0.4	0.4	0.0	0.0	0.0
1.0	0.1	0.3	0.4	0.0	0.5	0.5	0.0	0.0	0.0
1.5	0.1	0.4	0.5	0.0	0.7	0.7	0.0	0.0	0.0
2.0	0.2	0.4	0.7	0.0	0.8	0.8	0.0	0.0	0.0
2.5	0.4	0.5	0.9	0.0	0.9	0.9	0.0	0.0	0.0
3.0	0.5	0.6	1.1	0.0	1.0	1.0	0.0	0.0	0.0
3.5	0.7	0.6	1.3	0.0	1.1	1.1	0.0	0.0	0.0
4.0	0.9	0.7	1.6	0.0	1.2	1.2	0.0	0.0	0.0

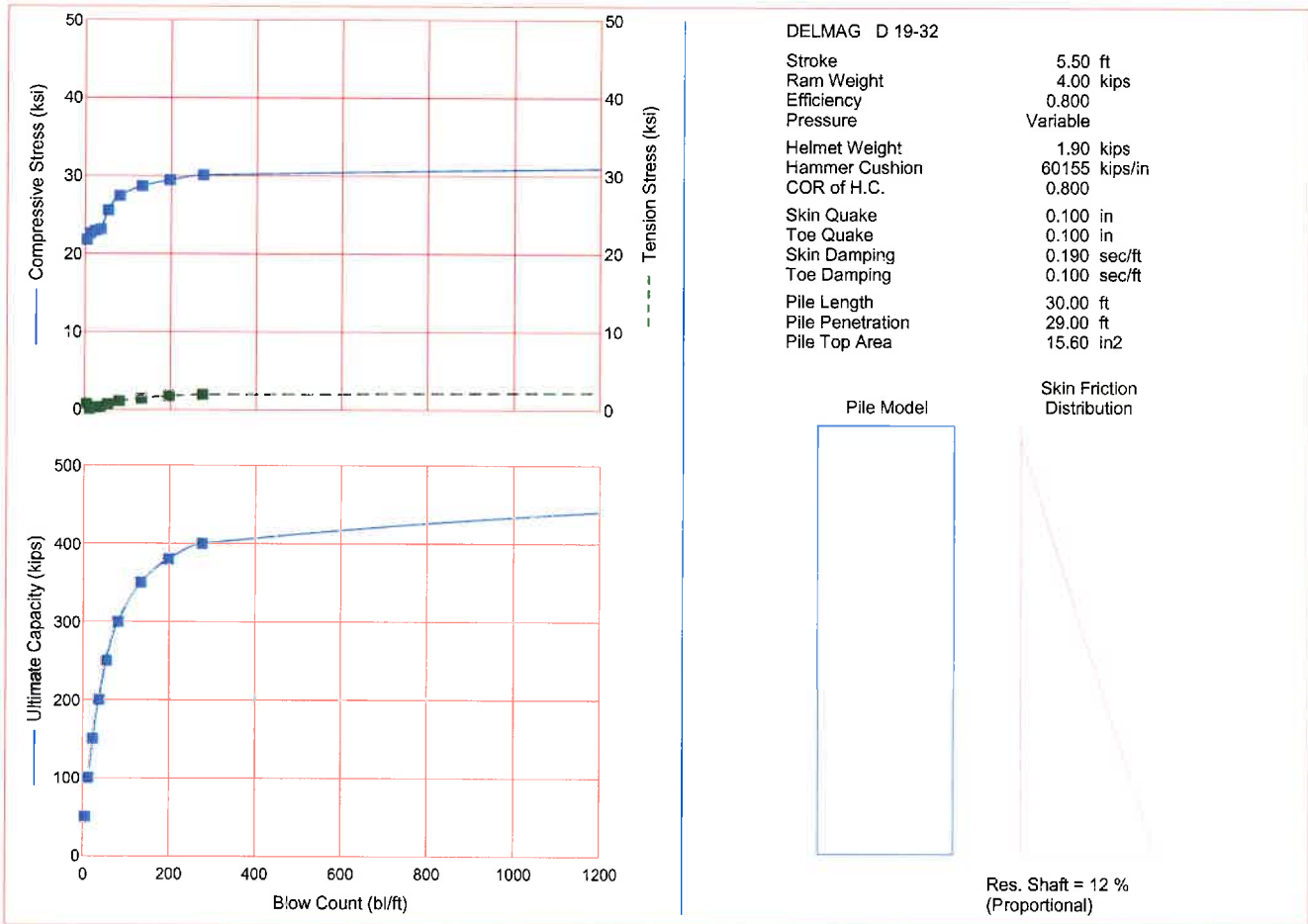
Br 190 EB2.apo

4.5	1.2	0.8	1.9	0.0	1.4	1.4	0.0	0.0	0.0
5.0	1.5	0.8	2.3	0.0	1.5	1.5	0.0	0.0	0.0
5.5	1.8	0.9	2.7	0.0	1.6	1.6	0.0	0.0	0.0
6.0	2.1	1.0	3.1	0.0	1.7	1.7	0.0	0.0	0.0
6.5	2.5	1.0	3.5	0.0	1.8	1.8	0.0	0.0	0.0
7.0	2.9	1.1	4.0	0.0	2.0	2.0	0.0	0.0	0.0
7.5	3.3	1.2	4.5	0.0	2.1	2.1	0.0	0.0	0.0
8.0	3.8	1.2	5.0	0.0	2.2	2.2	0.0	0.0	0.0
8.5	4.2	1.3	5.5	0.0	2.3	2.3	0.0	0.0	0.0
9.0	4.7	1.3	6.1	0.0	2.4	2.4	0.0	0.0	0.0
9.5	5.3	1.4	6.7	0.0	2.6	2.6	0.0	0.0	0.0
10.0	5.9	1.4	7.3	0.0	2.8	2.8	0.0	0.0	0.0
10.5	6.5	1.4	7.9	0.0	3.1	3.1	0.0	0.0	0.0
11.0	7.1	1.4	8.5	0.0	3.3	3.3	0.0	0.0	0.0
11.5	7.8	1.4	9.2	0.0	3.5	3.5	0.0	0.0	0.0
12.0	8.4	1.4	9.9	0.0	3.7	3.7	0.0	0.0	0.0
12.5	9.2	1.4	10.7	0.0	3.7	3.7	0.0	0.0	0.0
13.0	10.1	1.4	11.6	0.0	3.7	3.7	0.0	0.0	0.0
13.5	11.0	1.4	12.5	0.0	3.7	3.7	0.0	0.0	0.0
14.0	11.9	1.4	13.4	0.0	3.7	3.7	0.0	0.0	0.0
14.5	12.9	1.4	14.3	0.0	3.7	3.7	0.0	0.0	0.0
15.0	13.8	1.4	15.3	0.0	3.7	3.7	0.0	0.0	0.0
15.5	14.8	1.4	16.3	0.0	3.7	3.7	0.0	0.0	0.0
16.0	15.8	1.4	17.3	0.0	3.7	3.7	0.0	0.0	0.0
16.5	16.8	1.4	18.3	0.0	3.7	3.7	0.0	0.0	0.0
17.0	17.9	1.4	19.3	0.0	3.7	3.7	0.0	0.0	0.0
17.5	18.9	1.4	20.3	0.0	3.7	3.7	0.0	0.0	0.0
18.0	20.0	1.4	21.4	0.0	3.7	3.7	0.0	0.0	0.0
18.5	21.1	1.4	22.5	0.0	3.7	3.7	0.0	0.0	0.0
19.0	22.2	1.4	23.6	0.0	3.7	3.7	0.0	0.0	0.0
19.5	23.3	1.4	24.7	0.0	3.7	3.7	0.0	0.0	0.0
20.0	24.4	1.4	25.9	0.0	3.7	3.7	0.0	0.0	0.0
20.5	25.6	1.4	27.0	0.0	3.7	3.7	0.0	0.0	0.0
21.0	26.8	1.4	28.2	0.0	3.7	3.7	0.0	0.0	0.0
21.5	27.9	1.4	29.4	0.0	3.7	3.7	0.0	0.0	0.0
22.0	29.2	1.4	30.6	0.0	3.7	3.7	0.0	0.0	0.0
22.5	30.4	1.4	31.8	0.0	3.7	3.7	0.0	0.0	0.0
23.0	31.6	1.4	33.1	0.0	3.7	3.7	0.0	0.0	0.0
23.5	32.9	1.4	34.3	0.0	3.7	3.7	0.0	0.0	0.0
24.0	34.2	1.4	35.6	0.0	3.7	3.7	0.0	0.0	0.0
24.5	35.5	1.4	36.9	0.0	3.7	3.7	0.0	0.0	0.0
25.0	36.8	1.4	38.2	0.0	3.7	3.7	0.0	0.0	0.0
25.5	38.1	1.4	39.6	0.0	3.7	3.7	0.0	0.0	0.0
26.0	39.5	1.4	40.9	0.0	3.7	3.7	0.0	0.0	0.0
26.5	40.8	1.4	42.3	0.0	3.7	3.7	0.0	0.0	0.0
27.0	42.2	1.4	43.7	0.0	3.7	3.7	0.0	0.0	0.0
27.5	43.6	1.4	45.1	0.0	3.7	3.7	0.0	0.0	0.0
28.0	45.1	1.4	46.5	0.0	3.7	3.7	0.0	0.0	0.0

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.8961E-01	0.7639E-02
0.1792E+00	0.1528E-01
0.3584E+00	0.3056E-01
0.7169E+00	0.1986E+00
0.1075E+01	0.6417E+00
0.1290E+01	0.1115E+01
0.1434E+01	0.1528E+01
0.1434E+01	0.2292E+01
0.1434E+01	0.3056E+01

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.4889E-01	0.1226E-03	0.1173E-02	0.1000E-03
0.4889E+00	0.1226E-02	0.1173E-01	0.1000E-02
0.2444E+01	0.6132E-02	0.5865E-01	0.5000E-02
0.4889E+01	0.1226E-01	0.1173E+00	0.1000E-01
0.2425E+02	0.6118E-01	0.3999E+00	0.5000E-01
0.4608E+02	0.1215E+00	0.5065E+00	0.1000E+00
0.4653E+02	0.5219E+00	0.9607E+00	0.5000E+00
0.4681E+02	0.1022E+01	0.1238E+01	0.1000E+01
0.4701E+02	0.2022E+01	0.1434E+01	0.2000E+01



Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
50.0	21.78	0.76	4.4	5.50	22.14
100.0	22.59	0.10	11.7	5.50	15.93
150.0	22.92	0.30	22.6	5.50	12.81
200.0	23.12	0.35	36.5	5.50	11.24
250.0	25.53	0.71	53.8	5.50	10.48
300.0	27.41	1.11	80.4	5.50	10.03
350.0	28.66	1.46	132.5	5.50	9.66
380.0	29.42	1.77	196.3	5.50	9.50
400.0	30.09	1.97	274.8	5.50	9.42
450.0	31.10	2.26	1536.9	5.50	9.14