STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	54000.1.STR03T1B	1	7

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

STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. *54000.1.STR03T1B (U-4716B)* F.A. PROJ. *N/A*

COUNTY *DURHAM*

PROJECT DESCRIPTION *PIEDMONT CORRIDOR – EXTEND CHURCH STREET (SR 1980) TO HOPSON ROAD (SR 1978)*

SITE DESCRIPTION *NC RAIL UTILITY BORINGS*

CONTENTS

PERSONNEL

F. COX

D. RHODES

J. HOWARD

INVESTIGATED BY *AMEC E&I. Inc.*

CHECKED BY *J. HOWARD*

SUBMITTED BY *B. DEOBALD*

DATE *JUNE 2012*

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) 707-6850. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

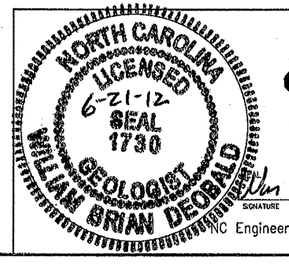
GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND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

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

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: *R. RAHIE*



amec

AMEC E&I, Inc.
4021 STIRRUP CREEK DRIVE, SUITE 100
DURHAM, NORTH CAROLINA 27703
(919) 381-9900

SIGNATURE

NC Engineering F-1253 NC Geology C-247

PROJECT REFERENCE NO.	SHEET NO.
54000.1.STR03TIB	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6			
SYMBOL														
% PASSING #10 #40 #200	50 MX 30 MX 15 MX		51 MN 10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
LIQUID LIMIT	6 MX		NP	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

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

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%
MODERATELY ORGANIC	5 - 10%	12 - 20%
HIGHLY ORGANIC	>10%	>20%

OTHER MATERIAL	
TRACE	1 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW - PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/026 DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT / DPT / DMT / VST / PMT TEST BORING
- AUGER BORING
- CORE BORING
- MW MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING W/ CORE
- SPT N-VALUE
- REF SPT REFUSAL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT
w - MOISTURE CONTENT

SAMPLE ABBREVIATIONS
S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

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

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

HAMMER TYPE:
- [X] AUTOMATIC
- [ ] MANUAL

CORE SIZE:
- [ ] -B_____
- [ ] -N_____
- [ ] -H_____

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

REVISED 09/23/09

Earthwork Balance Sheet

Volumes in Cubic Yards

PROJECT: U-4716 COUNTY: Durham DATE: 5/15/2012 COMPILED BY: BLP SHEET__ OF __ SHEETS

STATION	STATION	EXCAVATION					EMBANKMENT				BORROW	WASTE			
		TOTAL UNCLASS.	ROCK	UNDERCUT	UNSUIT. UNCLASS.	SUITABLE UNCLASS.	TOTAL	ROCK	EARTH	EMBANK. +20%		ROCK	SUITABLE	UNSUIT.	TOTAL
-L- 11+70	-L- 26+28.08	3,264				3,264	4,408		4,408	5,290	2,026				
-L1- 10+00	-L1- 17+40.00	491				491	560		560	672	181				
-Y- 13+50	-Y- 24+00.00	2,364				2,364	1,010		1,010	1,212			1,152		1,152
-DR- 10+10	-DR- 10+94.22						216		216	259	259				
	SUBTOTAL	6,119				6,119	6,194		6,194	7,433	2,466		1,152		1,152
	SUBTOTAL														
	SUBTOTAL														
	SUBTOTAL														
TOTAL		6,119				6,119	6,194		6,194	7,433	2,466		1,152		1,152
MATERIAL FOR SHOULDER CONSTRUCTION							70		70	84	84				
WASTE IN LIEU OF BORROW											-1,152		-1,152		-1,152
PROJECT TOTAL		6,119				6,119	6,264		6,264	7,517	1,398				
EST. 5% TO REPLACE TOP SOIL ON BORROW PIT											70				
GRAND TOTAL		6,119				6,119	6,264		6,264	7,517	1,468				
SAY		6,600									1,580				

NOTE: EARTHWORK QUANTITIES ARE CALCULATED BY THE ROADWAY DESIGN UNIT. THESE EARTHWORK QUANTITIES ARE BASED IN PART ON SUBSURFACE DATA PROVIDED BY THE GEOTECHNICAL ENGINEERING UNIT.

EST. DDE = 94 CUBIC YARDS

PROJECT REFERENCE NO.	SHEET NO.
54000.1.STR03TIB	2A

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

ROCK DESCRIPTION

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

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES 'CLUNK' SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

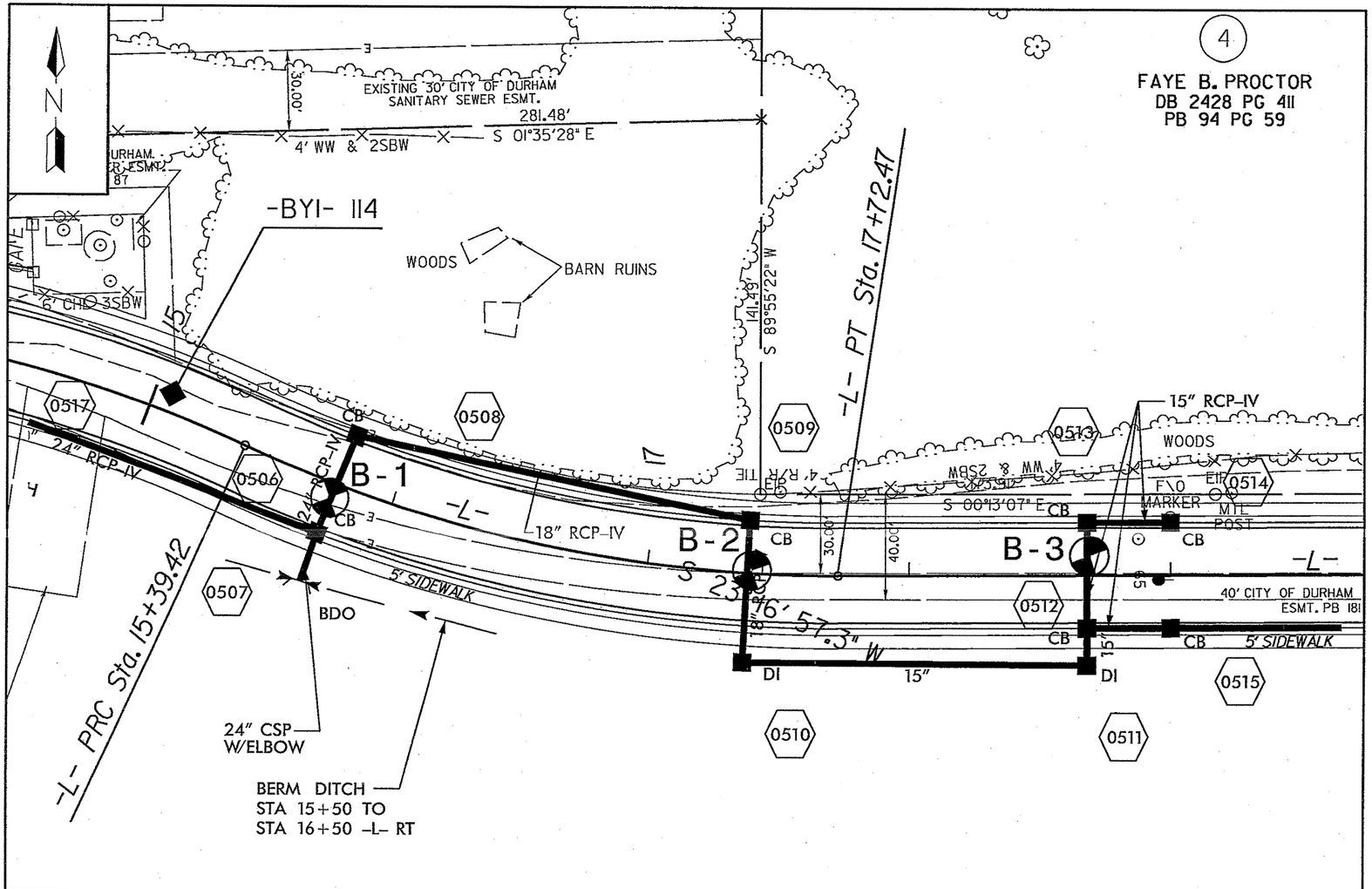
BENCH MARK: -BYI-114 N. 773106 E. 2042517

ELEVATION: 383.36 FT.

NOTES:

BENCHMARK

REVISED 09/23/09



SITE PLAN ***NC RAIL UTILITY BORINGS*** ***NCDOT PROJECT NO. 54000.1.STR03TIB (U-4716B)*** ***F.A. NO. N/A*** ***DURHAM, NORTH CAROLINA***	50' 0 50' GRAPHIC SCALE - IN FEET	***AMEC ENVIRONMENT AND INFRASTRUCTURE, INC.*** ***DURHAM, NORTH CAROLINA***	***SHEET:*** 3

REVISIONS	***DRAWN:*** R.R.	***DATE:*** JUNE 2012
	DFT CHECK: J.P.H.	***JOB No.:*** 6468-12-1148
	ENG CHECK: W.B.D.	***DWG No:*** 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 54000.1.STR03T1B	**TIP** U-4716B	**COUNTY** DURHAM	**GEOLOGIST** Howard, J	
SITE DESCRIPTION NC Rail Utility Borings - Piedmont Corridor - Extend Church St. (SR 1980) to Hopson Rd (SR 1978)				**GROUND WTR (ft)**
BORING NO. B-1	**STATION** 15+77	**OFFSET** 6 ft RT	**ALIGNMENT** -L-	**0 HR.** Cave@14.1
COLLAR ELEV. 386.7 ft	**TOTAL DEPTH** 22.1 ft	**NORTHING** 773,166	**EASTING** 2,042,556	**24 HR.** 9.7
DRILL RIG/HAMMER EFF./DATE MAC9354 CME-45C 88% 05/30/2012		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER Cox, F	**START DATE** 06/11/12	**COMP. DATE** 06/11/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
390											
	386.7	0.0	4	3	4	7		D		386.7 GROUND SURFACE	0.0
385										**ARTIFICIAL FILL** Tan-brown, sandy SILT (A-4), with trace gravel	
	383.2	3.5	85	15/0.1		100/0.6				383.7 **WEATHERED ROCK** Tan-brown, red-brown, Triassic Sandstone	3.0
380											
	378.2	8.5	100/0.4			100/0.4					
375											
	373.2	13.5	23	39	61/0.4	100/0.9				374.2 Red-brown, purple, Triassic Siltstone	12.5
370											
	368.2	18.5	70	30/0.2		100/0.7					
365											
	364.7	22.0	60/0.1			60/0.1				364.7 364.6 **NON-CRYSTALLINE ROCK** Triassic Siltstone	22.0 22.1
										Boring Terminated with Standard Penetration Test Refusal at Elevation 364.6 ft in Non-Crystalline Rock: Triassic Siltstone	

NCDOT BORE SINGLE PIEDMONT CORRIDOR.GPJ NC_DOT.GDT 6/21/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 54000.1.STR03T1B	**TIP** U-4716B	**COUNTY** DURHAM	**GEOLOGIST** Howard, J	
SITE DESCRIPTION NC Rail Utility Borings - Piedmont Corridor - Extend Church St. (SR 1980) to Hopson Rd (SR 1978)				**GROUND WTR (ft)**
BORING NO. B-2	**STATION** 17+40	**OFFSET** 1 ft LT	**ALIGNMENT** -L-	**0 HR.** 7.0
COLLAR ELEV. 388.6 ft	**TOTAL DEPTH** 20.4 ft	**NORTHING** 773,327	**EASTING** 2,042,583	**24 HR.** 4.9
DRILL RIG/HAMMER EFF./DATE MAC9354 CME-45C 88% 05/30/2012		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Cox, F	**START DATE** 06/11/12	**COMP. DATE** 06/11/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
390											
	388.6	0.0	3	1	3	4		D		388.6 GROUND SURFACE	0.0
385	385.1	3.5	1	1	1	2		M		**ARTIFICIAL FILL** Red-brown, tan, sandy SILT (A-4)	
										382.6	6.0
380	380.1	8.5	60/0.1			60/0.1				**TRIASSIC RESIDUAL** Red-brown, sandy SILT (A-4) 380.1	8.5
										379.1 **NON-CRYSTALLINE ROCK** Red-brown, Triassic Siltstone	9.5
375	375.1	13.5	100/0.2			100/0.2				**WEATHERED ROCK** Red-brown, Triassic Siltstone	
370											
	368.6	20.0	100/0.4			100/0.4				368.2	20.4
										Boring Terminated at Elevation 368.2 ft in Weathered Rock: Triassic Siltstone	

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 54000.1.STR03T1B	**TIP** U-4716B	**COUNTY** DURHAM	**GEOLOGIST** Howard, J
SITE DESCRIPTION NC Rail Utility Borings - Piedmont Corridor - Extend Church St. (SR 1980) to Hopson Rd (SR 1978)			**GROUND WTR (ft)**
BORING NO. B-3	**STATION** 18+69	**OFFSET** 7 ft LT	**ALIGNMENT** -L-	**0 HR.** 3.7
COLLAR ELEV. 389.2 ft	**TOTAL DEPTH** 19.3 ft	**NORTHING** 773,456	**EASTING** 2,042,577	**24 HR.** 1.1
DRILL RIG/HAMMER EFF./DATE MAC9354 CME-45C 88% 05/30/2012		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Cox, F	**START DATE** 06/11/12	**COMP. DATE** 06/11/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
390											
	389.2	0.0	2	2	5	7		D		389.2 GROUND SURFACE	0.0
385	385.7	3.5	1	WOH	WOH	0		M		**ARTIFICIAL FILL** Brown-red, sandy SILT (A-4), with trace gravel, trace organics	
										383.2	6.0
380	380.7	8.5	14	8	25	33		M		**TRIASSIC RESIDUAL** Red-brown, sandy SILT (A-4)	
375	375.7	13.5	23	29	71/0.4	100/0.9		M		374.7	14.5
370	370.2	19.0	100/0.3			100/0.3				**WEATHERED ROCK** Purple, red-brown, Triassic Siltstone	
										369.9	19.3
										Boring Terminated at Elevation 369.9 ft in Weathered Rock: Triassic Siltstone	

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	-	1	29

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

STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. _____ F.A. PROJ. _____

COUNTY ***DURHAM***

PROJECT DESCRIPTION ***PROPOSED RAILROAD ALIGNMENT AT HOPSON ROAD GRADE SEPARATION***

SITE DESCRIPTION ***BRIDGE ON NCRR MAINLINE OVER HOPSON ROAD BETWEEN DAVIS DRIVE (SR 1999) AND S. MIAMI BLVD (NC 54)***

PROJECT: ID: U-4716

CONTENTS

CAUTION NOTICE

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

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

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

PERSONNEL

M. BAHIRADHAN

J. HAMM

T. EVANS

C. NORVILLE

INVESTIGATED BY ***T. EVANS***

CHECKED BY ***M. BAHIRADHAN***

SUBMITTED BY ***FALCON ENG.***

DATE ***SEPTEMBER 14, 2012***

NORTH CAROLINA PROFESSIONAL SEAL 036072 ENGINEER MAHALINGAM BAHIRADHAN

09/14/2012

DRAWN BY: ***T. EVANS /J. HAMM***

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.

PROJECT REFERENCE NO.	SHEET NO.
-	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)						SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2			A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6 A-2-7				A-7-5 A-7-6			
SYMBOL													
% PASSING #10 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 10 MX	35 MX	35 MX	35 MX 35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
LIQUID LIMIT	6 MX		NP	40 MX	41 MN	40 MX 41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN 11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX	8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND			SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD						FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

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

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	<4 4 TO 10 10 TO 30 30 TO 50 >50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	<2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 >30	<0.25 0.25 TO 0.50 0.5 TO 1.0 1 TO 2 2 TO 4 >4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL — SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%
MODERATELY ORGANIC	5 - 10%	12 - 20%
HIGHLY ORGANIC	>10%	>20%

OTHER MATERIAL	
TRACE	1 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT, DPT, DMT, VST, PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING W/ CORE
- SPT N-VALUE
- REF — SPT REFUSAL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B-___
- [ ] BK-51
- [ ] CME-45C
- [ ] CME-550
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [X] TRICONE 3 " STEEL TEETH
- [ ] TRICONE _____ " TUNG.-CARB.
- [ ] CORE BIT
- [X] 4" DRAG BIT

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B_____
- [X] -N 02
- [ ] -H_____

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

ROCK DESCRIPTION

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

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELOSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BENCH MARK:

ELEVATION: FT.

NOTES:
FIAD - FILLED-IN AFTER DRILLING

REVISED 09/23/09

FALCON ENGINEERING

September 14, 2012

Mr. Corey Vernier, P.E.
HNTB North Carolina, P.C.
343 East Six Forks Rd, Suite 200
Raleigh, NC 27609

Re: **Structure Subsurface Investigation Report**

TIP No.: U-4716
County: Durham
Project Description: Proposed Railroad Alignment at Hopson Road Grade Separation
Site Description: Bridge on NCRR Mainline over Hopson Road between Davis Drive (SR 1999) and S. Miami Blvd (NC 54)
Falcon Project No.: G10018.00

Dear Mr. Vernier,

As authorized, Falcon Engineering, Inc. (Falcon) has completed the geotechnical subsurface investigation for the proposed new grade separation on the NCRR Mainline over Hopson Road in Durham County, North Carolina. A site vicinity map is shown on Sheet 8. Our investigation was performed in general accordance with our proposal number F9070R, dated May 10, 2010. This report includes the results of our field and laboratory testing, geotechnical recommendations for foundations, site and boring location plans, and profiles and cross sections showing subsurface conditions.

PROJECT DESCRIPTION

The existing at-grade crossing between the NCRR Mainline tracks and Hopson Road will be replaced with a new bridge structure. The existing railroad will also be realigned between Station 3298+92 and Station 3343+16, for a total of approximately 4,424 feet. Our Railroad Subsurface Investigation Report will be submitted under a separate cover. The realigned mainline track will cross Hopson Road approximately 152 feet north of the existing at-grade crossing. The proposed structure will be an approximately 165-foot-long, 39-foot-wide, four-span, five-bent, ballast deck bridge. The structure is planned from approximate Station 3314+94 to Station 3316+59 and will cross Hopson Road at a skew angle of approximately 85°. Information provided by HNTB indicates the finished grade elevations at the approaches will be approximately 407 feet at both End Bent1 and End Bent 2 with reference to North American Vertical Datum, 1988 (NAVD). The End Bents will be supported by two rows of piles; one vertical and one battered. Interior Bents will be supported by four (4) 60-inch diameter drilled shaft foundations. A brief summary of the design data provided by HNTB is given in Table 1.

Table 1: Summary of Proposed Foundation System

Bent	Station	Total Number of Piles/Shafts	Foundation Type and Size	Pile/Shaft Spacing (Center to Center)	Bottom of Pile Cap Elevation (feet, NAVD)
End Bent 1	3314+94	20 (two rows)	HP14x73 Steel Piles	± 4'-6"	398.2
Bent 1	3315+24	4	60-inch diameter Drilled Shafts	11'-11"	397.2
Bent 2	3315+77	4	60-inch diameter Drilled Shafts	11'-11"	397.1
Bent 3	3316+30	4	60-inch diameter Drilled Shafts	11'-11"	397.0
End Bent 2	3316+59	20 (two rows)	HP14x73 Steel Piles	± 4'-6"	397.8

Notes: 1. Top of Drilled Shaft elevation is approximately 385 feet for all interior bents. Column diameter is 54 inches.

We understand two rows of 10 evenly-spaced piles (for a total of 20 piles) will be driven at each end bent. The back row (away from the bridge) will be driven vertically, and the front row (towards the bridge) will be battered. Design loads were not provided for end bent piles. Loads for drilled shaft foundations were provided for our use in foundation design calculations. We understand the provided loads are based on the American Railway Engineering and Maintenance-of-way Association (AREMA) Service Load Design (SLD), with allowable overstress factors accounted for. The provided loads are summarized in Table 2 below.

Table 2: Interior Bent Drilled Shaft Foundation Loads (Left Two Columns)

Load Case	Axial (Kips)	F_y (Kips)	F_z (Kips)	M_y (ft-K)	M_z (ft-K)	Torsion, M_x (ft-K)
SLD_I	776	22	2	73	355	3
SLD_II	181	9	69	173	87	46
SLD_III	618	16	60	318	271	74
SLD_VI	158	25	2	39	356	1
SLD_IV	137	22	62	155	311	41

Notes: 1. Loads are based on 5'-0" diameter drilled shaft with point of fixity at 360 ft. Loads are applied at the top of the column.
2. Fz and My act in opposing directions.
3. Torsion forces act in the clockwise direction as viewed from the top of the column.

Table 3: Interior Bent Drilled Shaft Foundation Loads (Right Two Columns)

Load Case	Axial (Kips)	F_y (Kips)	F_z (Kips)	M_y (ft-K)	M_z (ft-K)	Torsion, M_x (ft-K)
SLD_I	417	46	3	56	816	7
SLD_II	844	38	3	60	636	6
SLD_III	679	29	92	60	495	118
SLD_VI	338	36	79	257	644	134

Notes: 1. Loads are based on 5'-0" diameter drilled shaft with point of fixity at 364 ft. Loads are applied at the top of the column.

2. Fz and My act in opposing directions.

3. Torsion forces act in the clockwise direction as viewed from the top of the column.

Slopes at the end bents are proposed at 2 Horizontal (H) to 1 Vertical (V). The end bent slopes will be protected by concrete slope protection.

SITE DESCRIPTION/GEOLOGY

The general site topography consists of gentle slopes and shallow ravines, typical of the eastern piedmont of North Carolina where the site is located. The proposed structure location is relatively flat, with a small roadway embankment and drainage ditches (generally less than 5 feet of relief). The bridge site is predominantly grassy, with a few trees present and wooded areas bordering the site. The bridge will cross an active state-owned roadway (Hopson Road) and is located in close proximity to the existing NCRR/NS rail corridor. The entire project will be constructed on lands owned by NCRR and is therefore subject to NCRR/NS Right of Entry (ROE) requirements.

According to the ***Geologic Map of North Carolina*** (1985), the proposed site is located within the Triassic Basin in the eastern piedmont region. The Triassic basin is a large, northeast-southwest trending rift basin which opened along the Jonesboro Fault and subsequently filled with upland piedmont sediments. Over the passing of Geologic time, these sediments have since been consolidated into sedimentary rocks varying from fine-grained mudstones to conglomerate, containing coal and shale beds and dikes and sills of intrusive diabase. Specifically, Triassic sedimentary rocks at the site are noted to be of the Chatham Group, undivided **(TRc)**. This group typically consists of varying compositions of sedimentary rock including conglomerate, fanglomerate, sandstone and mudstone.

FIELD EVALUATION PROCEDURE

Evaluation of the subsurface conditions for the project consisted of drilling ten (10) Standard Penetration Test (SPT) borings. Two (2) borings were drilled near each bent location. Rock coring was performed in the six (6) interior bent borings in order to verify the presence, quality, and composition of rock and to assist in the design of drilled shaft foundations. Borings were performed with a Diedrich D-50 rubber-track-mounted drill rig equipped with 2 ¼-inch inside diameter hollow-stem augers, mud rotary drilling equipment, an automatic hammer, and NQ2 sized, wire-line type diamond-impregnated rock coring equipment. SPT borings and soil/rock core sampling were performed in general accordance with the American Association of State Highway Transportation Officials (AASHTO T-206 and T-225).

Soil and rock core samples were obtained from the borings and visually classified in the field before being placed in moisture-proof containers and transported to our laboratory. Groundwater measurement readings were taken within each borehole with a weighted 100-foot measuring tape from a reference location at the top of each boring. Readings were recorded immediately after boring termination, and again after a waiting period of at least 24 hours before being backfilled.

SUBSURFACE AND GROUNDWATER CONDITIONS

Based on the results of our borings, subsurface conditions generally consist of residual soil, underlain by weathered rock and non-crystalline rock materials of Triassic Sedimentary origin.

Topsoil and rootmat was encountered in the majority of the borings and ranged in thickness from 3 to 9 inches. All borings encountered Triassic residual soils near the ground surface, ranging in thickness from approximately 4 to 15 feet, and consisting of soft to hard fine sandy and silty clay (A-6, A-7) and loose to very dense, silty and clayey sands (A-2-4, A-2-6). Weathered rock (WR) was encountered beneath the residual soils and consisted of approximately 4 to 20 feet of Triassic siltstone and sandstone. Auger and/or SPT refusal was encountered at depths ranging from approximately 19 to 24 feet below existing ground surface. Approximately 12.5 feet of non-crystalline rock (NCR) was cored from each interior bent boring, consisting of Triassic siltstone and sandstone, with isolated occurrences of conglomerate.

Groundwater measurements were obtained immediately after boring termination. The measured groundwater ranged in elevation from approximately 3 to 7 feet below ground surface.

LABORATORY TESTING

Representative split-spoon and bulk samples were selected from soil test borings to verify visual field classifications and determine soil index properties. A total of eight (8) samples were analyzed in our laboratory for natural moisture content, grain size analysis, and Atterberg limits. Additionally, five (5) representative rock core samples were subjected to unconfined compressive strength testing. The results of these laboratory tests can be found on Sheet 27 of this report. All testing was performed in accordance with the following American Society for Testing and Materials (ASTM) and AASHTO procedures:

- AASHTO T-88 (as modified by NCDOT) "Particle Size Analysis of Soil"
- AASHTO T-89 (as modified by NCDOT) "Determining the Liquid Limits of Soil"
- AASHTO T-90 "Determining the Plastic Limit and Plasticity of Soils"
- AASHTO T-265 "Laboratory Determination of Moisture Content of Soils"
- ASTM D-2938-86 "Standard Test Method for Unconfined Compressive Strength of Intact Rock"

FOUNDATION RECOMMENDATIONS

The foundation recommendations presented below are based on the AREMA SLD load scenarios provided by HNTB. Our foundation analysis and design was performed in general accordance with NCDOT LFD/ASD design methodology, with modifications and considerations where necessary to comply with AREMA SLD and pile and drilled shaft foundation requirements.

End bent piles will be tipped into weathered rock/rock at both end bents to satisfy a minimum of 15 feet of embedment in native ground. End bent piles are designed for an allowable load of 80 tons, A factor of safety of 2.0 was used on this allowable load. We understand the total number of piles and pile spacing has not been determined. However, we anticipate the pile spacing will exceed 3 times the diameter of the piles. Assuming the HP 14x73 piles are spaced at least 42 inches center-to-center, the group axial capacities of the piles will be the sum of the individual capacities of the piles in a group. We understand a row of end bent piles will be battered to provide resistance against lateral forces. Therefore, vertical end bent piles are not anticipated to carry lateral forces or moments. End bent piles are not otherwise designed to resist lateral forces. We understand selection of batter angle(s)/direction(s) and number of battered piles will the responsibility of others based on the allowable pile loads recommended in this report. Please refer to Sheet 6 for pile foundation recommendations and plan notes. Pile pay item quantities are presented on Sheet 7.

Required drilled shaft axial capacity will be achieved by a combination of side friction and end bearing in WR and NCR. Since torsion forces (M_x) on the shafts are relatively small, the forces will be carried by the skin friction of the drilled shafts. However, drilled shafts will require a socket into competent rock materials to achieve lateral capacity and shaft fixity. Drilled shafts are designed for an allowable load of 422 tons, socketed into competent, non-crystalline sedimentary rock, with a factor of safety exceeding 2.5. Based on our LPILE analysis using the provided loads and bridge geometry, the maximum pile deflection at the top of the columns is less than one inch. LPILE analysis results for each boring are included in Appendix A of this report. Please refer to Sheet 6 for detailed drilled shaft foundation recommendations and plan notes. Drilled shaft pay item quantities are presented on Sheet 7.

All drilled shaft foundations should be inspected in accordance with the NCDOT *Drilled Pier Inspection Manual*, applicable AREMA or other railway associated guidance documents, or both. We understand this will be the responsibility of others. However, Falcon can provide geotechnical design support during construction if requested in order to ensure compliance with the design.

Due to the presence of thick, variable weathered rock and soft layers within the competent rock below, we recommend a single pay item be included in the contract for drilled shaft excavation, to include penetration of all subsurface materials to the required depth.

Based on the preliminary plans we received in October, 2011, end bent slopes are proposed at 2H:1V with concrete slope protection. Approach embankment fills shall be placed in accordance with NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications).

CLOSURE

If any of the project information contained in this report is incorrect or has changed, please inform Falcon so that we may amend the contents of this report as appropriate.

Recommendations and evaluations provided by Falcon are based on the information provided by HNTB. Modifications of our recommendations and evaluations may be required if there are changes to the design or location of the structure or roadway. Recommendations in this report are based on data obtained from soil 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. Falcon appreciates the 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,
FALCON ENGINEERING, INC.

Jeremy R. Hamm, EI
Geotechnical Designer

Mahalingam Bahiradhan (Bahi), PE
Senior Geotechnical Project Manager

FOUNDATION RECOMMENDATIONS

WBS #

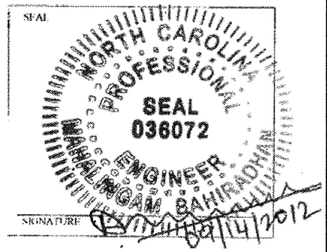
T.I.P. NO. U-4716

COUNTY Durham

STATION 3314+94 TO 3316+59

DESCRIPTION Bridge on NCRR mainline over Hopson Rd. between Davis Dr. (SR 1999) and S. Miami Blvd. (NC 54)

	INITIALS	DATE
DESIGN	MB	09/14/12
CHECK	CN	09/14/12
APPROVAL		



	STATION	FOUNDATION TYPE	DESIGN LOAD	MISCELLANEOUS DETAILS*
END BENT 1	-L- 3314+93.76	Cap on HP14x73 Steel Piles	80 tons/pile	Bottom of Cap Elev. = 398.2 ft Length of Pile = 30 ft Tip Elev. No Higher Than = 369.0 ft. Number of Vertical Piles = 10 Number of Battered Piles = 10 Pile Spacing = ±4 feet 6 inches
BENT 1 (Left of Centerline)	-L- 3315+24.26	60-inch Diameter Drilled Piers	422 tons/pier	Bottom of Cap Elev. = 397.2 ft Point of Fixity Elev. = 360.0 ft. Tip Elev. No Higher Than = 350.0 ft. Number of Drilled Piers = 2 Pier Spacing = 11 feet 11 inches
BENT 1 (Right of Centerline)				Bottom of Cap Elev. = 397.2 ft Point of Fixity Elev. = 364.0 ft. Tip Elev. No Higher Than = 354.0 ft. Number of Drilled Piers = 2 Pier Spacing = 11 feet 11 inches
BENT 2 (Left of Centerline)	-L- 3315+77.26	60-inch Diameter Drilled Piers	422 tons/pier	Bottom of Cap Elev. = 397.1 ft Point of Fixity Elev. = 358.0 ft. Tip Elev. No Higher Than = 348.0 ft. Number of Drilled Piers = 2 Pier Spacing = 11 feet 11 inches
BENT 2 (Right of Centerline)				Bottom of Cap Elev. = 397.1 ft Point of Fixity Elev. = 364.0 ft. Tip Elev. No Higher Than = 354.0 ft. Number of Drilled Piers = 2 Pier Spacing = 11 feet 11 inches
BENT 3	-L- 3316+30.26	60-inch Diameter Drilled Piers	422 tons/pier	Bottom of Cap Elev. = 397.0 ft Point of Fixity Elev. = 363.0 ft. Tip Elev. No Higher Than = 353.0 ft. Number of Drilled Piers = 4 Pier Spacing = 11 feet 11 inches
END BENT 2	-L- 3316+58.76	Cap on HP14x73 Steel Piles	80 tons/pile	Bottom of Cap Elev. = 397.8 ft Length of Pile = 35 ft Tip Elev. No Higher Than = 368.0 ft. Number of Vertical Piles = 10 Number of Battered Piles = 10 Pile Spacing = ±4 feet 6 inches

TIP # U-4716 **County** Durham

FOUNDATION RECOMMENDATION NOTES ON PLANS

1. Piles at End Bent 1 are designed for an allowable load of 80 Tons per pile
2. Drive piles at End Bent 1 to a required bearing capacity of 160 Tons per pile. The required bearing capacity is equal to the allowable bearing capacity with the minimum factor of safety of 2.0
3. Piles at End Bent 2 are designed for an allowable load of 80 Tons per pile
4. Drive piles at End Bent 2 to a required bearing capacity of 160 Tons per pile. The required bearing capacity is equal to the allowable bearing capacity with the minimum factor of safety of 2.0
5. Install piles at End Bent 1 to a tip elevation no higher than 369.0 feet
6. Install piles at End Bent 2 to a tip elevation no higher than 368.0 feet
7. Pile excavation is required to install piles at End Bent 1. Excavate holes at pile locations to elevation 369.0 feet. For pile excavation, see Section 450 of the Standard Specifications
8. Pile excavation is required to install piles at End Bent 2. Excavate holes at pile locations to elevation 368.0 feet. For pile excavation, see Section 450 of the Standard Specifications
9. Concrete or grout is required to fill holes for pile excavations at End Bent 1 and End Bent 2
10. For Piles, See Section 450 of the Standard Specification
11. Drilled piers at Bent No. 1 are designed for both skin friction and end bearing. Check field conditions for the required end bearing capacity of 20 TSF
12. Install drilled piers at Bent No. 1 (left of centerline) that extend to an elevation no higher than 350.0 ft, and satisfy the required end bearing capacity
13. Permanent steel casings may be required for drilled piers at Bent No.1 (left of centerline). If required, do not extend permanent casings below elevation 377 feet without prior approval from the engineer
14. Install drilled piers at Bent No. 1 (right of centerline) that extend to an elevation no higher than 354.0 ft, and satisfy the required end bearing capacity
15. Permanent steel casings may be required for drilled piers at Bent No.1 (right of centerline). If required, do not extend permanent casings below elevation 370 feet without prior approval from the engineer
16. Drilled piers at Bent No. 2 are designed for both skin friction and end bearing. Check field conditions for the required end bearing capacity of 20 TSF
17. Install drilled piers at Bent No. 2 (left of centerline) that extend to an elevation no higher than 348.0 ft, and satisfy the required tip resistance
18. Permanent steel casings may be required for drilled piers at Bent No. 2 (left of centerline). If required, do not extend permanent casings below elevation 378 feet without prior approval from the engineer
19. Install drilled piers at Bent No. 2 (right of centerline) that extend to an elevation no higher than 354.0 ft, and satisfy the required tip resistance
20. Permanent steel casings may be required for drilled piers at Bent No. 2 (right of centerline). If required, do not extend permanent casings below elevation 378 feet without prior approval from the engineer
21. Drilled piers at Bent No. 3 are designed for both skin friction and end bearing. Check field conditions for the required end bearing capacity of 20 TSF
22. Install drilled piers at Bent No. 3 that extend to an elevation no higher than 353.0 ft, and satisfy the required tip resistance
23. Permanent steel casings may be required for drilled piers at Bent No.3. If required, do not extend permanent casings below elevation 378 feet without prior approval from the engineer
24. SID inspections may be required for drilled piers. The Engineer will determine the need for SID inspections. For SID inspection, see Section 411 of the Standard Specifications
25. CSL tubes are required and CSL testing may be required for drilled piers. The Engineer will determine the need for CSL testing For Crosshole Sonic Logging, see Section 411 of the Standard Specifications
26. For drilled piers, see Section 411 of the Standard Specifications

FOUNDATION RECOMMENDATION COMMENTS

1. A waiting period of two weeks is required for the approach at End Bent 2
2. End slopes of 2:1(H:V) are OK with slope protection
3. Top of drilled pier elevation is assumed at 385 ft
4. Single pay item for drilled pier excavation is recommended
5. Pile spacing (center to center) for the end bent piles should be geater than 42 inches
6. Do not drive piles at End Bent 2 prior to the completion of waiting period
7. Do not drive piles at End Bent 1 prior to completing the approach fills
8. Minimum pile embedment of 10 feet is required at End Bent 1 and End Bent 2

DRILLED PIER PAY ITEM QUANTITIES

WBS ELEMENT _____ DATE 9/14/2012

TIP NO. U-4716 DESIGNED BY MB

COUNTY Durham CHECKED BY CN

STATION 3314+94 TO 3316+59

DESCRIPTION Bridge on NCRR mainline over Hopson Rd. between Davis Dr. (SR 1999) and S. Miami Blvd.

NUMBER OF BENTS WITH DRILLED PIERS 3
NUMBER OF DRILLED PIERS PER BENT 4
NUMBER OF END BENTS WITH DRILLED PIERS
NUMBER OF DRILLED PIERS PER END BENT

	DRILLED PIER PAY ITEMS				
BENT # OR END BENT #	PERMANENT STEEL CASING FOR 60" DIA. DRILLED PIER (yes/no/maybe)	60" DIA. DRILLED PIERS NOT IN SOIL (per linear ft/m)	SPT TESTING (per each)	SID INSPECTION* (per each)	CROSSHOLE SONIC LOGGING (per each)
Bent 1	Maybe				
Bent 2	Maybe				
Bent 3	Maybe				
TOTALS		0	0	1	3

* If SID inspections are required with a Note on Plans, show "SID Inspection" pay item per bent or end bent. If SID inspections may be required with a Note on Plans, show "SID Inspection" pay item as a total per structure only (do not show per bent or end bent).

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 or end bent minus the "___ Dia. Drilled Piers not in Soil" per bent or end bent shown in the table above.

Show "Crosshole Sonic Logging" pay item as a total only equal to the anticipated number of drilled piers to be CSL tested. Crosshole Sonic Logging (CSL) tests are required for most bridges with drilled piers. CSL tests and tubes may be omitted by not including the CSL provision in the Contract if, based on the subsurface conditions, there is a low risk of drilled pier construction problems.

PILE PAY ITEMS

(For 2012 Lettings and Later - Revised 4/18/11)

WBS ELEMENT _____ DATE 9/14/2012

TIP NO. U-4716 DESIGNED BY MB

COUNTY Durham CHECKED BY CN

STATION 3314+94 TO 3316+59

DESCRIPTION Bridge on NCRR mainline over Hopson Rd. between Davis Dr. (SR 1999) and S. Miami Blvd.

NUMBER OF BENTS WITH PILES
NUMBER OF PILES PER BENT
NUMBER OF END BENTS WITH PILES
NUMBER OF PILES PER END BENT

} Only required for "Predrilling for Piles" & "Pile Excavation" Pay

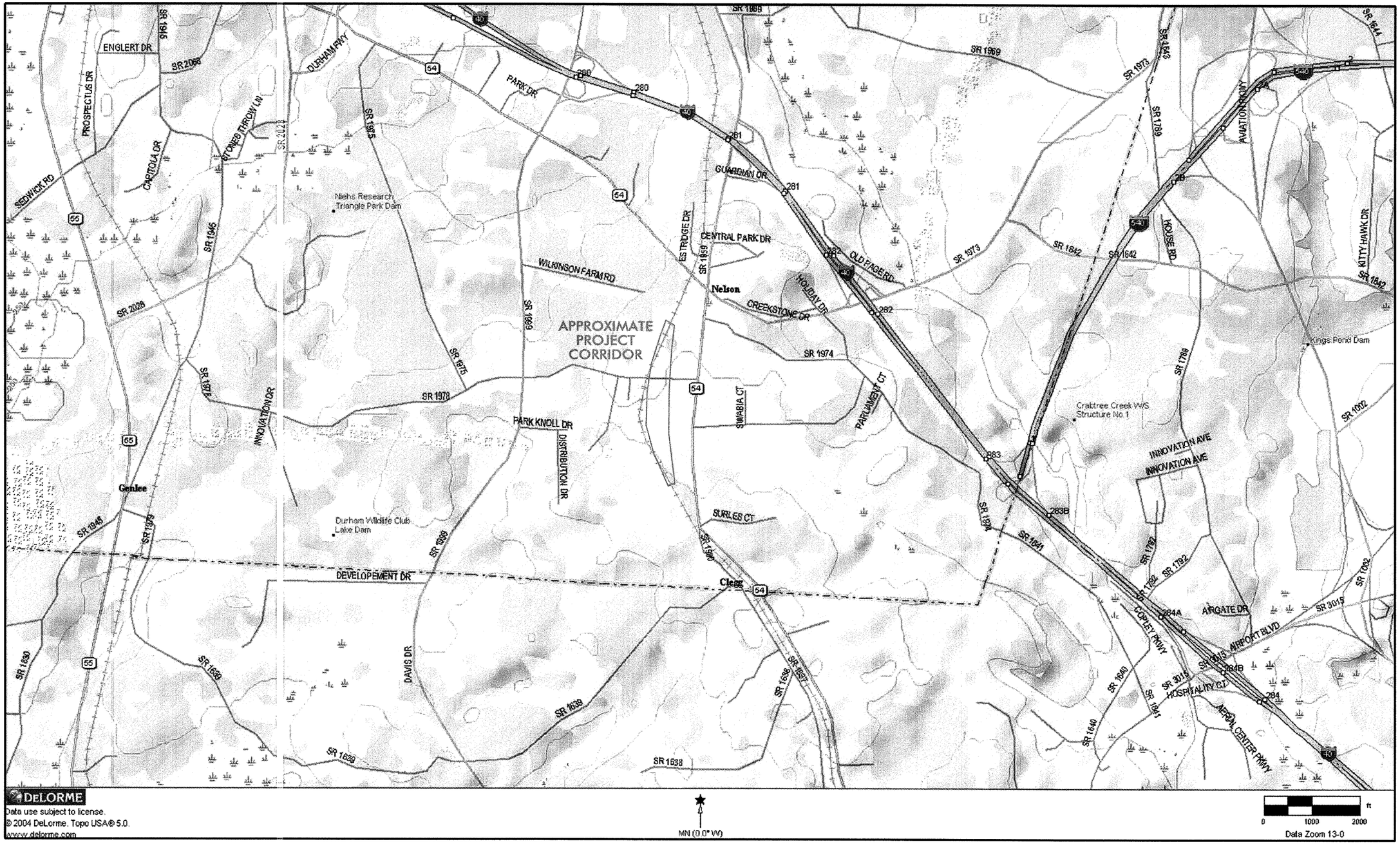
	PILE PAY ITEM QUANTITIES						
					Pile Excavation (per linear ft)		
Bent # or End Bent #	**Steel Pile Points (yes/no)**	**Pipe Pile Plates (yes/no/maybe**	**Predrilling For Piles (per linear ft)**	**Pile Redrives (per each)**	**In Soil**	**Not In Soil**	**PDA Testing (per each)**
End Bent 1	no				510	50	
End Bent 2	no				415	200	
TOTALS			0	0	925	250	0

Notes:
Blanks or "no" represent quantity of zero.

If steel pile points are required, calculate quantity of "Steel Pile Points" as equal to the number of steel piles.

If pipe pile plates are or may be required, calculate the quantity of "Pipe Pile Plates" as equal to the number of pipe piles.

If PDA testing may be required, show quantities of "PDA Testing" on the substructure plans as totals only. If PDA testing is required, show quantities of "PDA Testing" on the substructure plans for each bent or end bent.



FALCON ENGINEERING

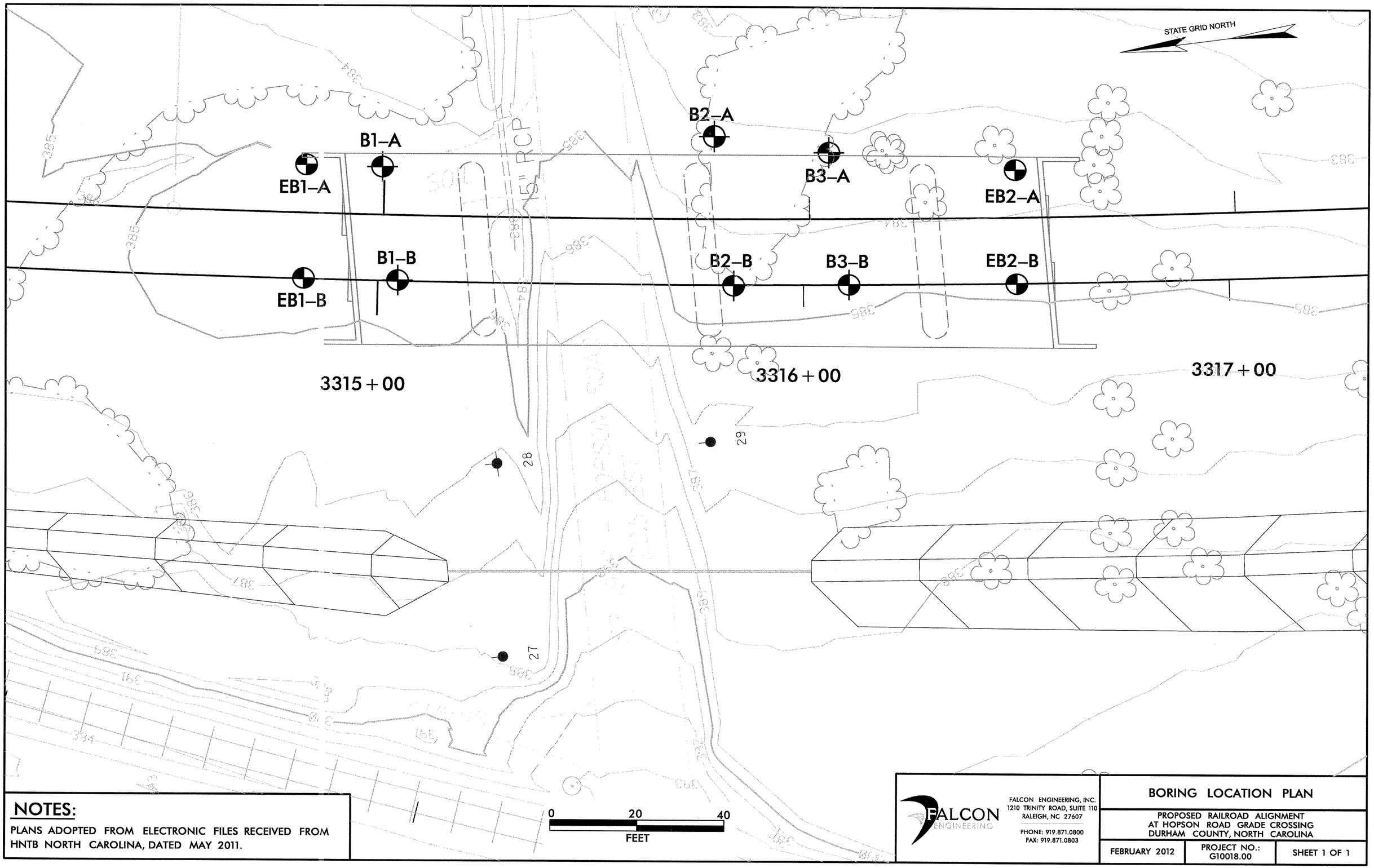
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

SITE VICINITY MAP

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

OCTOBER, 2011	PROJECT NO.: G10018.00	SHEET 1



NOTES:

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM HNTB NORTH CAROLINA, DATED MAY 2011.

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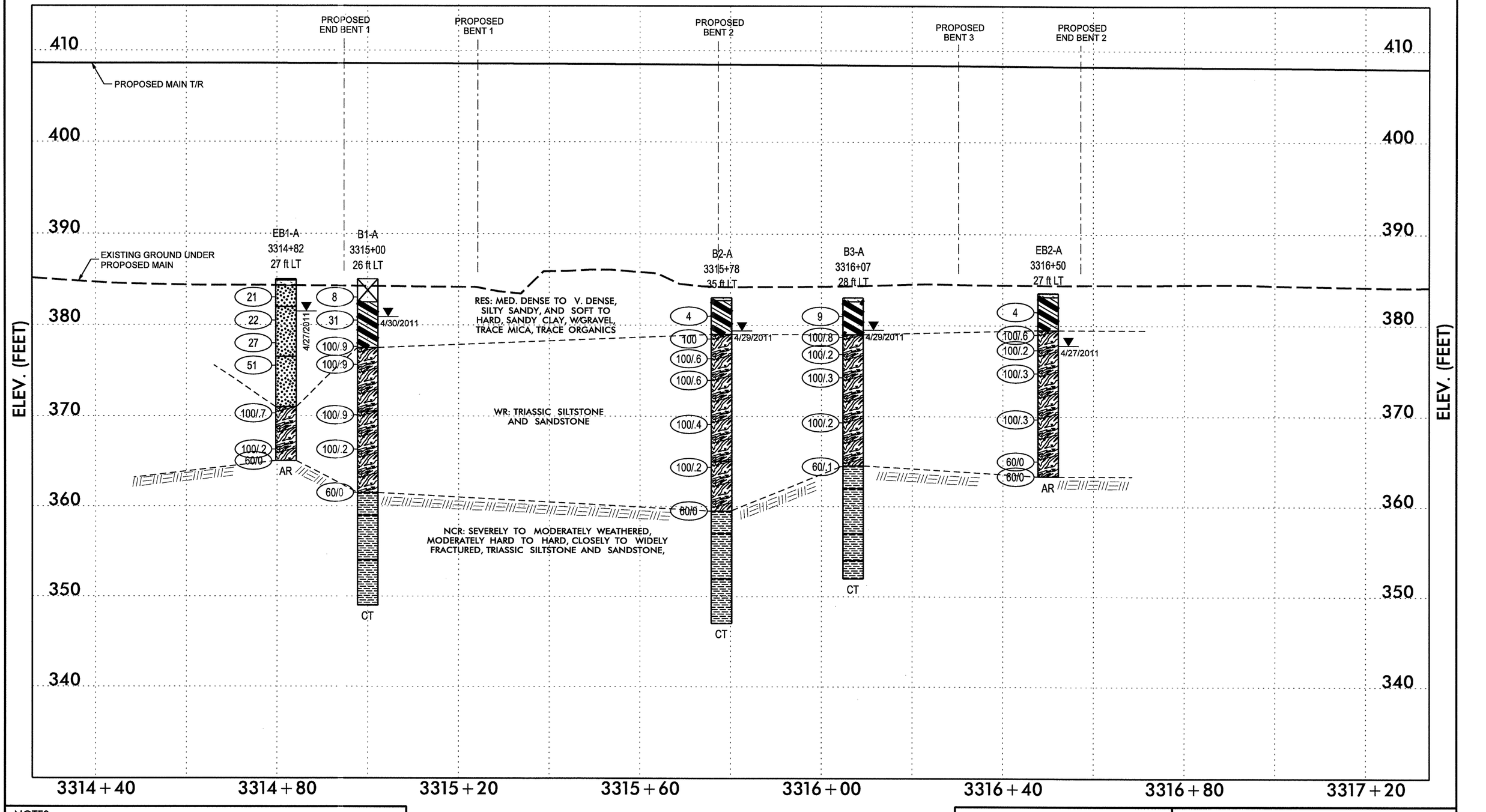
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

BORING LOCATION PLAN

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE CROSSING
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1



NOTES:

- GROUNDLINE PROFILE OF –L– TAKEN FROM ROADWAY PLANS PROVIDED BY HNTB NORTH CAROLINA, DATED SEPTEMBER 2011.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.
- BRIDGE SKEW: 85 DEGREES

VERTICAL SCALE
0 10 20
FEET

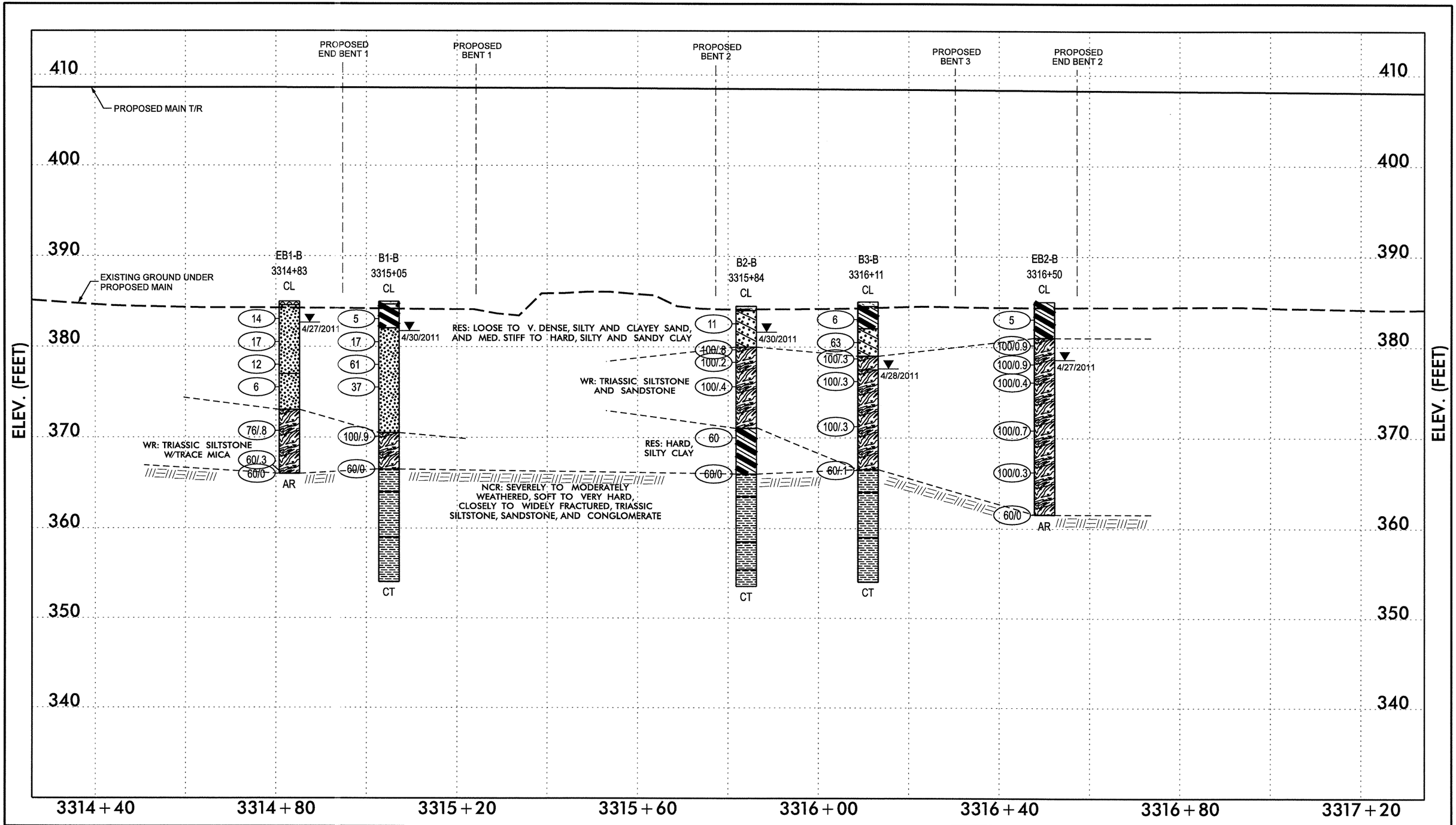
HORIZONTAL SCALE
0 20 40
FEET

FALCON ENGINEERING
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607
PHONE: 919.871.0800
FAX: 919.871.0803

SUBSURFACE PROFILE BRIDGE LEFT

PROPOSED RAIL ALIGNMENT AT
HOPSON ROAD GRADE CROSSING
DURHAM COUNTY, NORTH CAROLINA

OCTOBER, 2011	PROJECT NO.: G10018.00	SHEET 1 OF 2



NOTES:

- GROUNDLINE PROFILE OF –L– TAKEN FROM ROADWAY PLANS PROVIDED BY HNTB NORTH CAROLINA, DATED SEPTEMBER 2011.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.
- BRIDGE SKEW: 85 DEGREES

VERTICAL SCALE
0 10 20
FEET

HORIZONTAL SCALE
0 20 40
FEET

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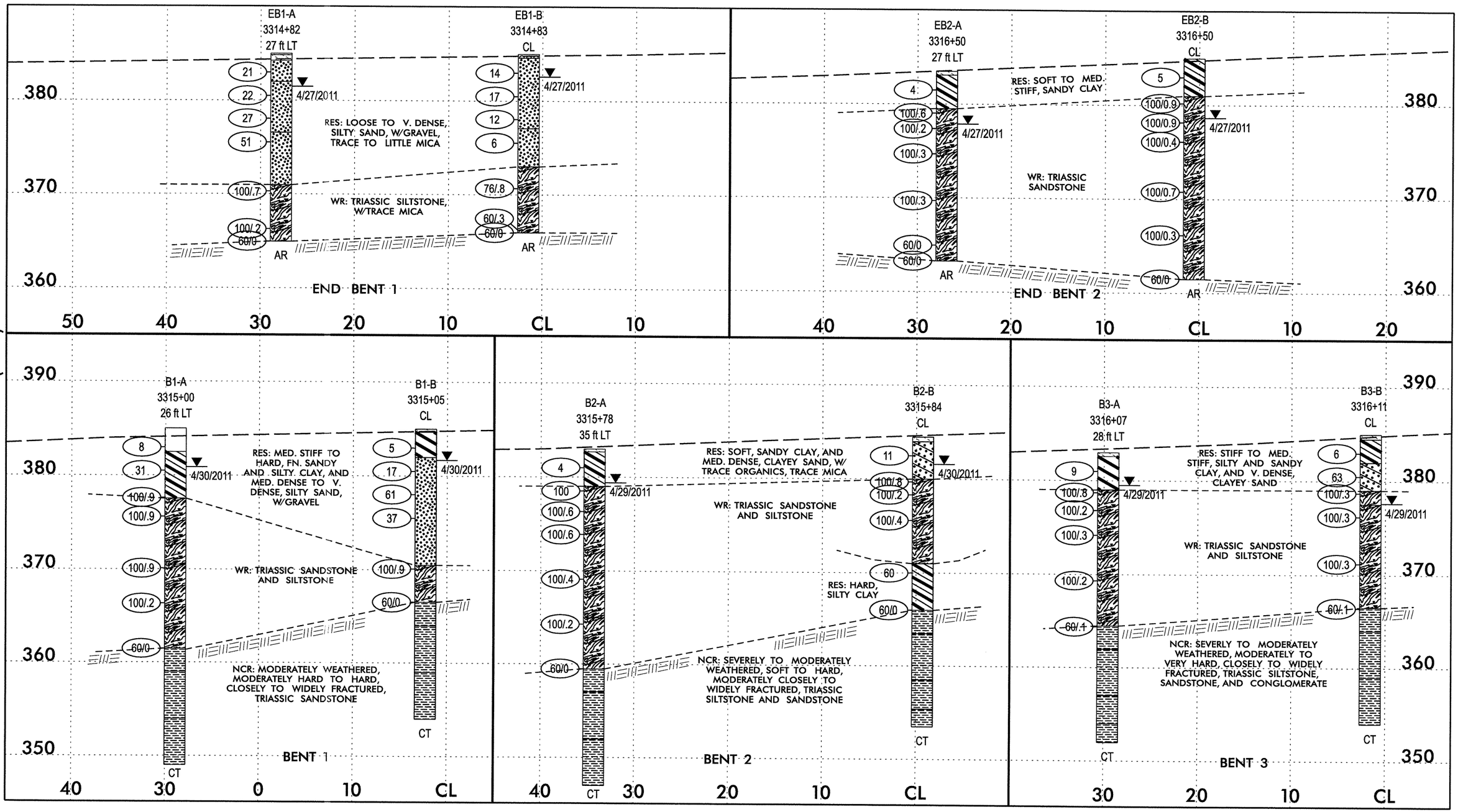
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607
PHONE: 919.871.0800
FAX: 919.871.0803

SUBSURFACE PROFILE BRIDGE RIGHT

PROPOSED RAIL ALIGNMENT AT
HOPSON ROAD GRADE CROSSING
DURHAM COUNTY, NORTH CAROLINA

OCTOBER, 2011	PROJECT NO.: G10018.00	SHEET 2 OF 2



NOTES:

- GROUNDLINE PROFILE OF –L– TAKEN FROM ROADWAY PLANS PROVIDED BY HNTB NORTH CAROLINA, DATED SEPTEMBER 2011.
  INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTIONS.
- BRIDGE SKEW: 85 DEGREES

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

BRIDGE BENT CROSS SECTIONS

PROPOSED RAIL ALIGNMENT AT
HOPSON ROAD GRADE CROSSING
DURHAM COUNTY, NORTH CAROLINA

OCTOBER, 2011	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 3316+50	**OFFSET** 27 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 383.5 ft	**TOTAL DEPTH** 20.2 ft	**NORTHING** 774,112	**EASTING** 2,043,245	**24 HR.** 5.7
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/26/11	**COMP. DATE** 04/26/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
385										383.5 GROUND SURFACE	0.0
	382.5	1.0								383.1 TOPSOIL	0.4
			3	2	2	4	SS-8	16%		**TRIASSIC RESIDUAL** GRAY AND TAN, SOFT, SANDY CLAY (A-6)	
380	380.0	3.5								379.5	4.0
			31	64	36/.1	100/.6				**WEATHERED ROCK** RED-BROWN BLACK GRAY AND PURPLE, TRIASSIC SANDSTONE	
	377.5	6.0	100/.2			100/.2					
375	375.0	8.5	100/.3			100/.3					
370	370.0	13.5	100/.3			100/.3					
365	365.0	18.5	60/0			60/0					
	363.3	20.2	60/0			60/0				363.3	20.2

Boring Terminated by Auger Refusal at Elevation 363.3 ft

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 3316+50	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** Cl@15.8
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 23.5 ft	**NORTHING** 774,115	**EASTING** 2,043,219	**24 HR.** 6.4
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/26/11	**COMP. DATE** 04/26/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	
385										385.0 GROUND SURFACE	0.0
	384.0	1.0	3	2	3	5				**TRIASSIC RESIDUAL** GRAY AND TAN, MED. STIFF, SANDY CLAY (A-6)	
	381.5	3.5	14	46	54/.3					381.0	4.0
380	379.0	6.0	29	71/.4		100/.9				**WEATHERED ROCK** PURPLE GRAY AND RED-BROWN, TRIASSIC SANDSTONE	
	376.5	8.5	100/.4			100/.9					
375						100/.4					
	371.5	13.5	67	33/.2		100/.7					
370											
	366.5	18.5	100/.3			100/.3					
365											
	361.5	23.5	60/0			60/0				361.5	23.5

Boring Terminated by Auger Refusal at Elevation 361.5 ft

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 3315+00	**OFFSET** 26 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 36.0 ft	**NORTHING** 774,260	**EASTING** 2,043,264	**24 HR.** 4.1
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/29/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
385										385.0 GROUND SURFACE	0.0
	384.0	1.0	4	3	5	8				NO SAMPLE RECOVERY, GRAVEL IN SHOE	
	381.5	3.5	13	16	15	31	SS-2	18%		382.5 **RESIDUAL** GRAY AND WHITE, HARD, FN. SANDY CLAY (A-6) W/ GRAVEL	2.5
380	379.0	6.0	4	14	86/.4						
	376.5	8.5	36	64/.4		100/.9				377.5 **WEATHERED ROCK** GRAY RED-BROWN AND BLACK, TRIASSIC SANDSTONE	7.5
375						100/.9					
	371.5	13.5	12	32	68/.4						
370						100/.9				370.5 **WEATHERED ROCK** RED-BROWN, TRIASSIC SILTSTONE	14.5
	366.5	18.5	100/.2			100/.2					
365											
	361.5	23.5	60/0			60/0				361.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	23.5
360										359.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	26.0
355										354.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	31.0
350										349.0 Boring Terminated at Elevation 349.0 ft in NCR: Triassic Sandstone	36.0

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

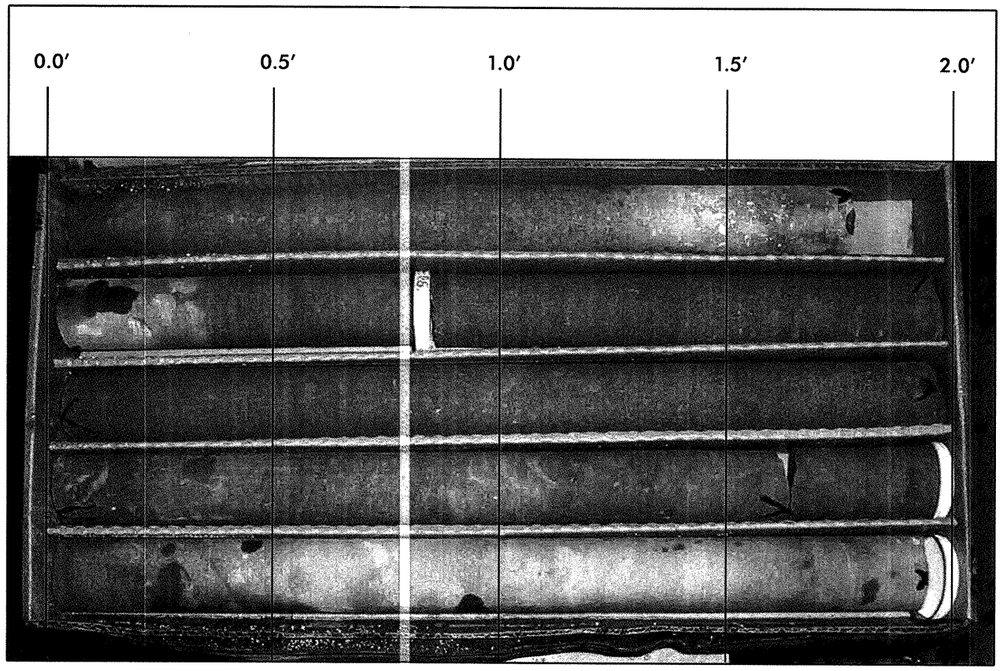
NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET □□

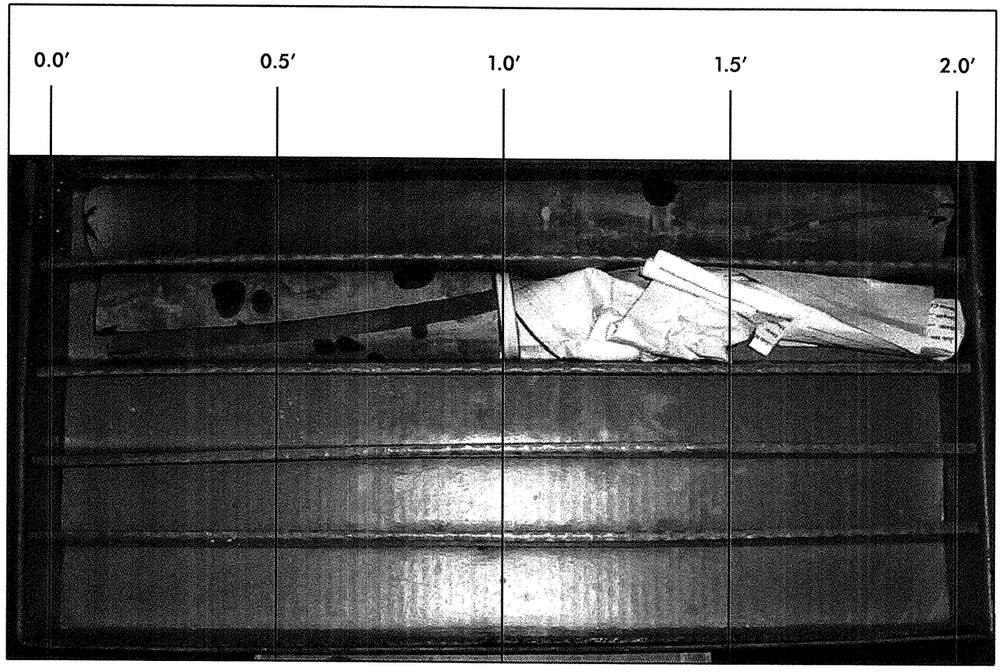
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 3315+00	**OFFSET** 26 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 36.0 ft	**NORTHING** 774,260	**EASTING** 2,043,264	**24 HR.** 4.1
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/29/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.5 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
361.49											Begin Coring @ 23.5 ft	
	361.5	23.5	2.5	1:54/1.0	(2.5) 100%	(2.5) 100%		(2.5) 100%	(2.5) 100%		361.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	23.5
360				1:45/1.0								
	359.0	26.0		0:26/0.5							359.0	26.0
			5.0	1:23/1.0	(5.0) 100%	(5.0) 100%		(5.0) 100%	(5.0) 100%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	
				1:05/1.0								
				1:16/1.0								
355				1:18/1.0								
	354.0	31.0		1:18/1.0							354.0	31.0
			5.0	1:44/1.0	(4.8) 96%	(3.5) 70%		(4.8) 96%	(3.5) 70%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD TO HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SANDSTONE	
				1:10/1.0								
				1:46/1.0								
350				2:28/1.0								
	349.0	36.0		2:13/1.0							349.0	36.0
											Boring Terminated at Elevation 349.0 ft in NCR: Triassic Sandstone	

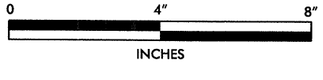
NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–1A, BOX 1 OF 2, 23.5 FEET TO 33.0 FEET.



BORING B–1A, BOX 2 OF 2, 33.0 FEET TO 36.0 FEET.



FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 3315+05	**OFFSET** N/A	**ALIGNMENT** -L- — **0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,260	**EASTING** 2,043,237 — **24 HR.** 3.3
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/29/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION (ELEV. (ft) / DEPTH (ft))
385										385.0 GROUND SURFACE 0.0
	384.0	1.0								384.7 TOPSOIL/GRAVEL 0.3
			3	1	4	5	SS-3	24%		**TRIASSIC RESIDUAL** GRAY AND TAN, MED. STIFF, SILTY CLAY (A-7-6)
	381.5	3.5								382.0 3.0
380			7	7	10	17		D		**TRIASSIC RESIDUAL** GRAY PURPLE RED-BROWN AND BLACK, MED. DENSE TO V. DENSE, SILTY SAND (A-2-4)
	379.0	6.0	40	39	22	61		D		
	376.5	8.5	27	17	20	37		D		
375										
	371.5	13.5	17	42	58/.4					370.5 14.5 **WEATHERED ROCK** RED-BROWN, TRIASSIC SILTSTONE
370						100/.9				
	366.5	18.5	60/0			60/0				366.5 18.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
365										364.0 21.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD,WIDELY FRACTURED, TRIASSIC SANDSTONE
360										359.0 26.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD,WIDELY FRACTURED, TRIASSIC SANDSTONE
							RS-1			
355										354.0 31.0 Boring Terminated at Elevation 354.0 ft in NCR: Triassic Sandstone

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

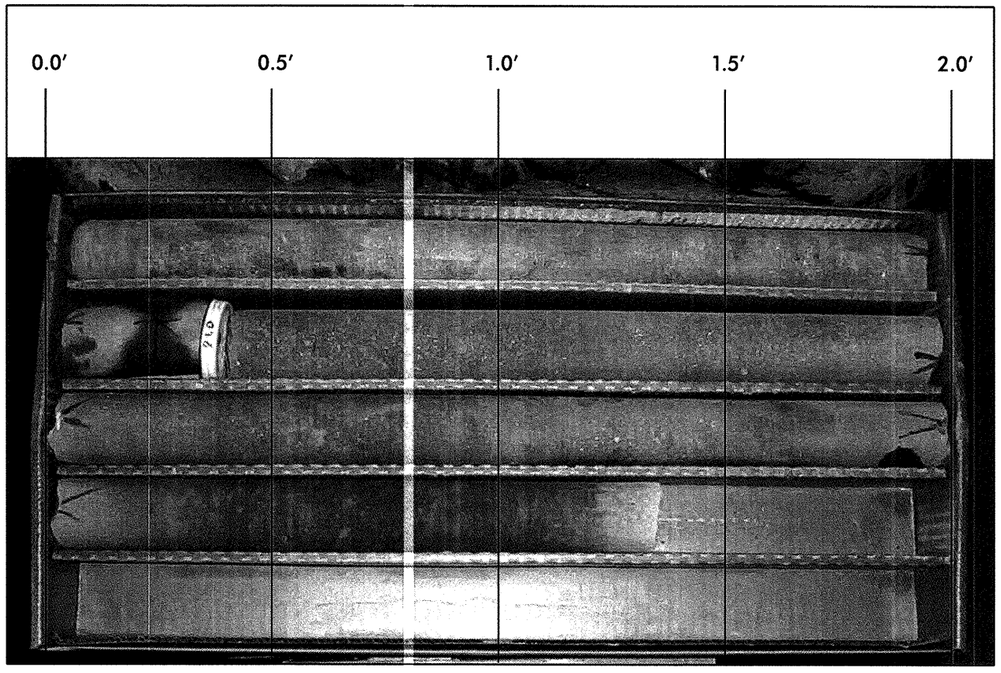
NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET □□

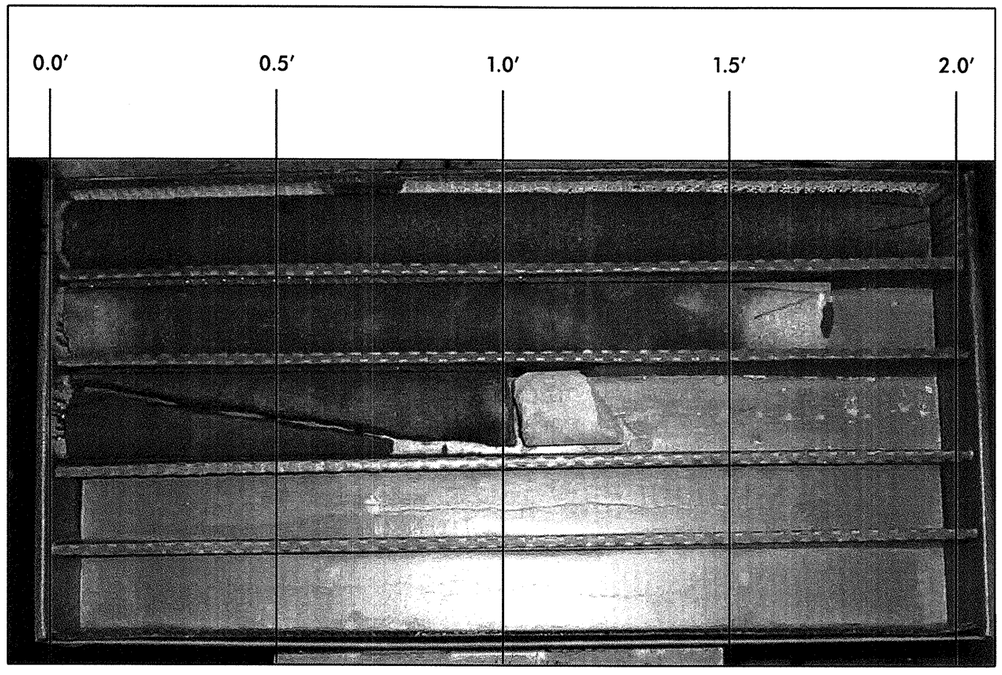
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 3315+05	**OFFSET** N/A	**ALIGNMENT** -L- — **0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,260	**EASTING** 2,043,237 — **24 HR.** 3.3
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/29/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 12.5 ft		

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS (ELEV. (ft) / DEPTH (ft))
366.49											Begin Coring @ 18.5 ft
	366.5	18.5	2.5	2:11/1.0	(2.3) 92%	(2.3) 92%		(2.3) 92%	(2.3) 92%		366.5 18.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
365				1:31/1.0							
	364.0	21.0		0:34/0.5							364.0 21.0
			5.0	2:25/1.0	(5.0) 100%	(5.0) 100%		(5.0) 100%	(5.0) 100%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD,WIDELY FRACTURED, TRIASSIC SANDSTONE
				1:55/1.0							
				1:58/1.0							
360				2:23/1.0							
	359.0	26.0		1:34/1.0							359.0 26.0
			5.0	1:30/1.0	(4.8) 96%	(3.6) 72%		(4.8) 96%	(3.6) 72%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD,WIDELY FRACTURED, TRIASSIC SANDSTONE
				1:17/1.0							
				1:52/1.0			RS-1				
355				1:30/1.0							
	354.0	31.0		1:19/1.0							354.0 31.0
											Boring Terminated at Elevation 354.0 ft in NCR: Triassic Sandstone

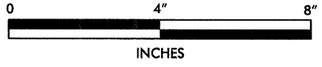
NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–1B, BOX 1 OF 2, 18.5 FEET TO 26.0 FEET.



BORING B–1B, BOX 2 OF 2, 26.0 FEET TO 31.0 FEET.



FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 3315+78	**OFFSET** 35 ft LT	**ALIGNMENT** -L- / **0 HR.** N/A
COLLAR ELEV. 383.0 ft	**TOTAL DEPTH** 36.0 ft	**NORTHING** 774,182	**EASTING** 2,043,261 / **24 HR.** 3.6
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/28/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
385										
	383.0	0.0								GROUND SURFACE
	382.7	0.3								TOPSOIL
	382.0	1.0	2	2	2		SS-4	19%		**TRIASSIC RESIDUAL** GRAY AND TAN, SOFT, SANDY CLAY (A-6) W/ TRACE ORGANICS
380	379.5	3.5	10	10	90					
	379.0	4.0								**WEATHERED ROCK** ORANGE GRAY TAN AND RED-BROWN, TRASSIC SANDSTONE
	377.0	6.0	75	25/.1		100/.6				
375	374.5	8.5	75	25/.1		100/.6				
370	369.5	13.5	100/.4			100/.4				
365	365.0	18.0								**WEATHERED ROCK** RED-BROWN, TRIASSIC SILTSTONE
	364.5	18.5	100/.2			100/.2				
360	359.5	23.5	60/0			60/0				**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
	357.0	26.0					RS-2			**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
355	352.0	31.0								**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE
350	347.0	36.0								Boring Terminated at Elevation 347.0 ft in NCR: Triassic Siltstone

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

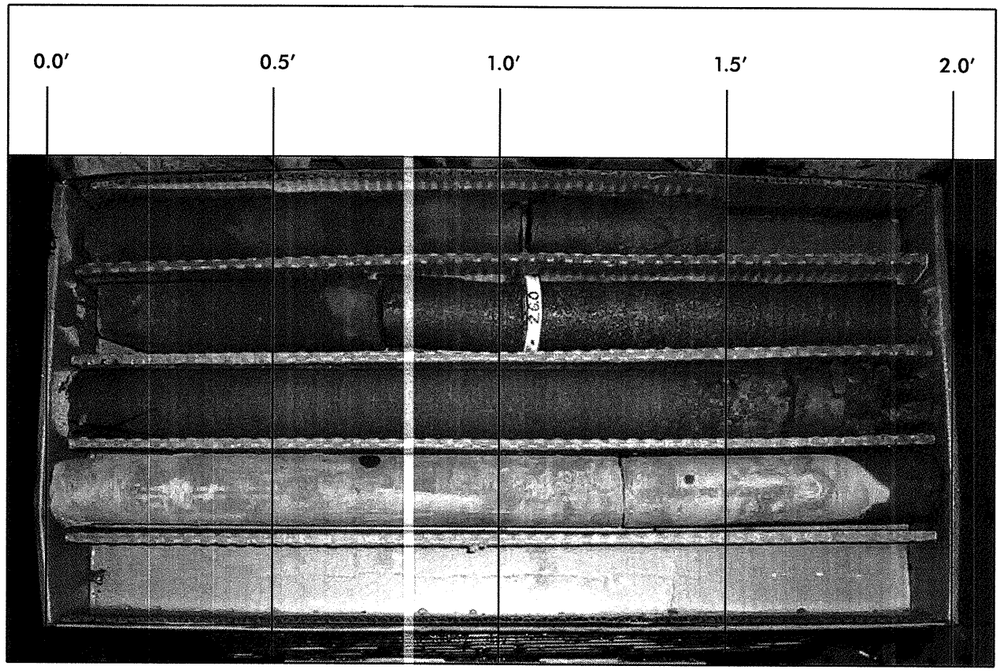
NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET □□

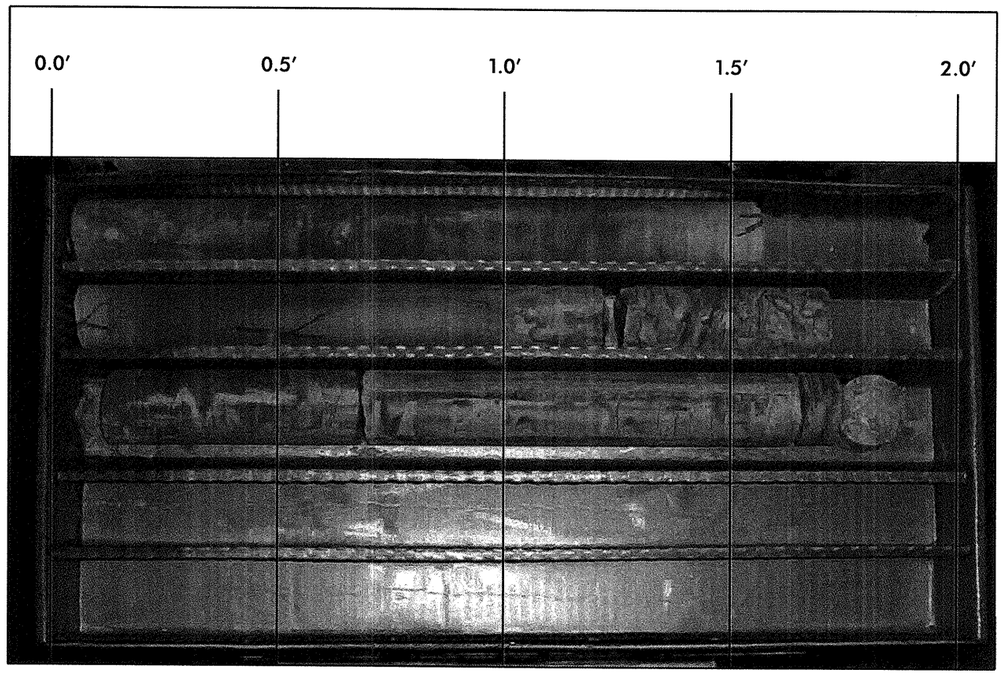
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 3315+78	**OFFSET** 35 ft LT	**ALIGNMENT** -L- / **0 HR.** N/A
COLLAR ELEV. 383.0 ft	**TOTAL DEPTH** 36.0 ft	**NORTHING** 774,182	**EASTING** 2,043,261 / **24 HR.** 3.6
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/28/11	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 12.5 ft		

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft) / DEPTH (ft)
359.49											Begin Coring @ 23.5 ft
	359.5	23.5	2.5	1:50/1.0	(2.5) 100%	(2.5) 100%		(2.5) 100%	(2.5) 100%		359.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE 23.5
				1:39/1.0							
	357.0	26.0		0:22/0.5							357.0 26.0
355			5.0	1:11/1.0	(5.0) 100%	(4.7) 94%	RS-2	(5.0) 100%	(4.7) 94%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
				1:17/1.0							
				1:35/1.0							
				2:39/1.0							
				3:41/1.0							
	352.0	31.0									352.0 31.0
350			5.0	2:52/1.0	(4.9) 98%	(4.7) 94%		(4.9) 98%	(4.7) 94%		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE
				1:37/1.0							
				2:07/1.0							
				3:00/1.0							
				3:17/1.0							
	347.0	36.0									347.0 36.0
											Boring Terminated at Elevation 347.0 ft in NCR: Triassic Siltstone

NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–2A, BOX 1 OF 2, 23.5 FEET TO 31.0 FEET.



BORING B–2A, BOX 2 OF 2, 31.0 FEET TO 36.0 FEET.

0 4″ 8″
INCHES

FALCON ENGINEERING
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607
PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012 | PROJECT NO.: G10018.00 | SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 3315+84	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 384.5 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,181	**EASTING** 2,043,226	**24 HR.** 2.9
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
385										384.5 GROUND SURFACE	0.0
	383.5	1.0	3	5	6	11		M		384.0 TOPSOIL	0.5
										TRIASSIC RESIDUAL GRAY AND TAN, MED. DENSE, CLAYEY SAND (A-2-6), TRACE MICA	
	381.0	3.5	13	18	82/.3						
380										380.0	4.5
	378.5	6.0	100/.2			100/.8 / 100/.2				**WEATHERED ROCK** RED-BROWN AND GRAY, TRIASSIC SANDSTONE	
	376.0	8.5	100/.4			100/.4					
375											
	371.0	13.5	15	15	45	60	SS-5	13%		371.0 **TRIASSIC RESIDUAL** RED-BROWN AND BLACK, HARD, SILTY CLAY (A-6)	13.5
370											
	366.0	18.5	60/0			60/0				366.0 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE	18.5
365										363.5 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD,WIDELY FRACTURED, TRIASSIC SILTSTONE	21.0
360										358.5 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE	26.0
							RS-3				
355										355.4 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE	29.1
										353.5 Boring Terminated at Elevation 353.5 ft in NCR: Triassic Siltstone	31.0

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

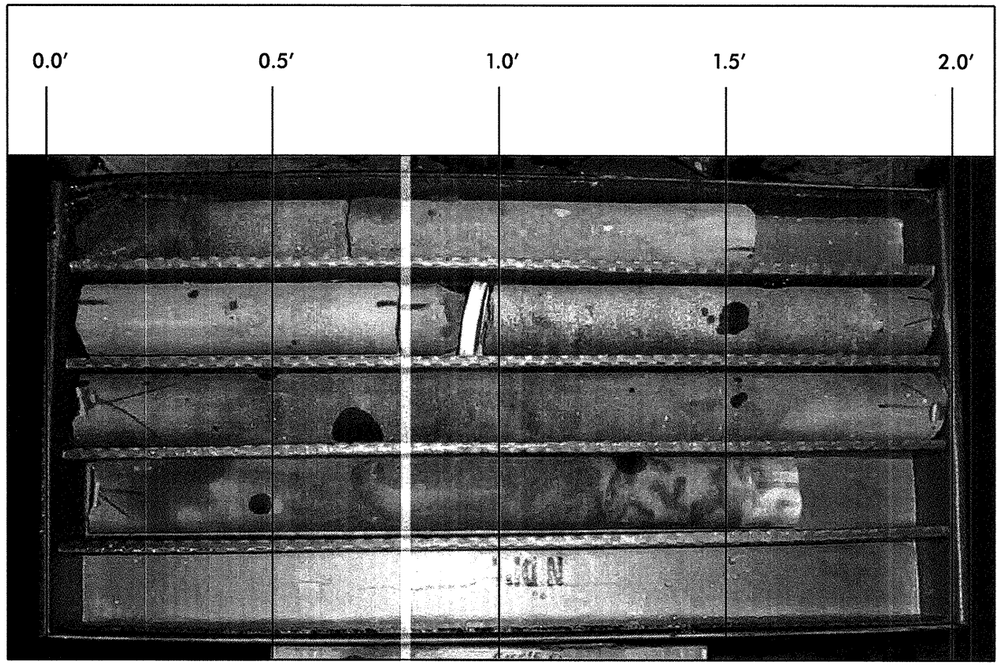
NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET □□

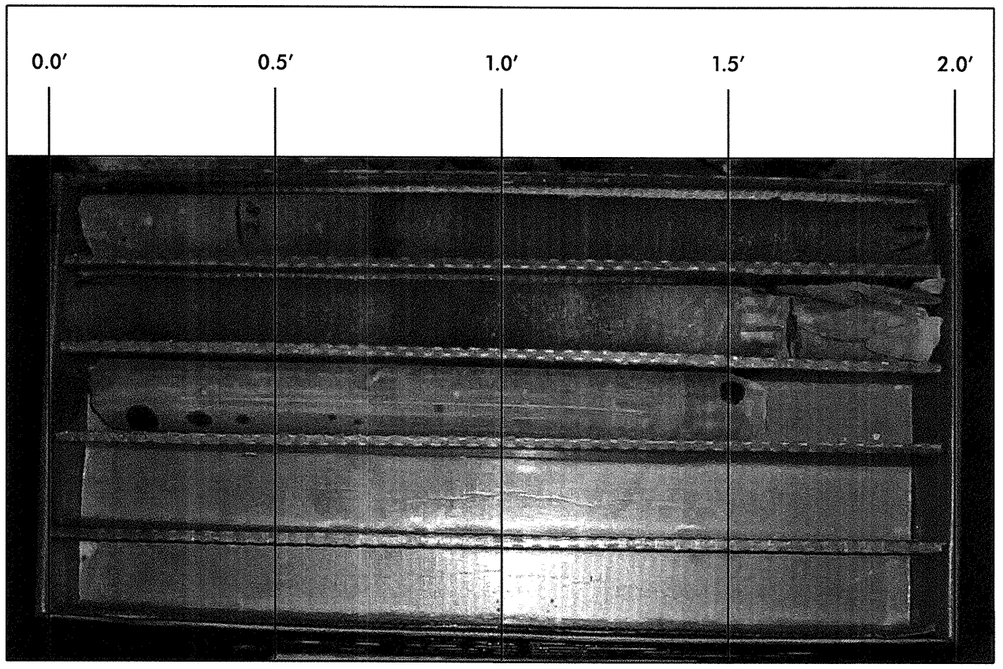
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 3315+84	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 384.5 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,181	**EASTING** 2,043,226	**24 HR.** 2.9
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/29/11	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.5 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
365.99											Begin Coring @ 18.5 ft	
365	366.0	18.5	2.5	2:17/1.0 2:05/1.0 0:43/0.5	(2.5) 100%	(2.2) 88%		(2.5) 100%	2.2		366.0 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE	18.5
	363.5	21.0	5.0	2:09/1.0 2:46/1.0 2:41/1.0 2:42/1.0 1:52/1.0	(5.0) 100%	(5.0) 100%		(5.0) 100%	5		363.5 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD,WIDELY FRACTURED, TRIASSIC SILTSTONE	21.0
360	358.5	26.0	5.0	2:30/1.0 1:14/1.0 1:41/1.0 3:04/1.0 3:55/1.0	(5.0) 100%	(4.7) 94%	RS-3	(3.1) 100%	2.9		358.5 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE	26.0
355	353.5	31.0						(1.9) 100%	1.8		355.4 **NON-CRYSTALLINE ROCK** RED-BROWN, SEV. TO MOD. SEV. WEATHRED, SOFT TO MED. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE	29.1
											353.5 Boring Terminated at Elevation 353.5 ft in NCR: Triassic Siltstone	31.0

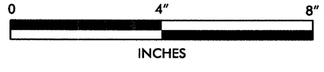
NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–2B, BOX 1 OF 2, 16.5 FEET TO 25.6 FEET.



BORING B–2B, BOX 2 OF 2, 25.6 FEET TO 31.0 FEET.



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ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B3-A	**STATION** 3316+07	**OFFSET** 28 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 383.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,155	**EASTING** 2,043,251	**24 HR.** 3.5
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/28/11	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
385										
										383.0 GROUND SURFACE 0.0
										382.6 TOPSOIL 0.4
	382.0	1.0	3	4	5	9	SS-6	19%		**TRIASSIC RESIDUAL** GRAY AND TAN, STIFF, SANDY CLAY (A-7-6)
380										
	379.5	3.5	13	87/.3		100/.8				379.0 4.0
	377.0	6.0	100/.2			100/.2				**WEATHERED ROCK** GRAY RED-BROWN AND PURPLE, TRASSIC SANDSTONE
375										
	374.5	8.5	100/.3			100/.3				
370										
	369.5	13.5	100/.2			100/.2				
365										
	364.5	18.5	60/.1			60/.1				364.5 18.5
										NON-CRYSTALLINE ROCK RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
360										362.0 21.0
										NON-CRYSTALLINE ROCK RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
										357.0 26.0
355										**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
							RS-4			354.0 29.0
										NON-CRYSTALLINE ROCK RED-BROWN, SEV. WEATHERED, MOD. HARD, CLOSELY FRACTURED, TRIASSIC SILTSTONE
										352.0 31.0
										Boring Terminated at Elevation 352.0 ft in NCR: Triassic Siltstone and Sandstone

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

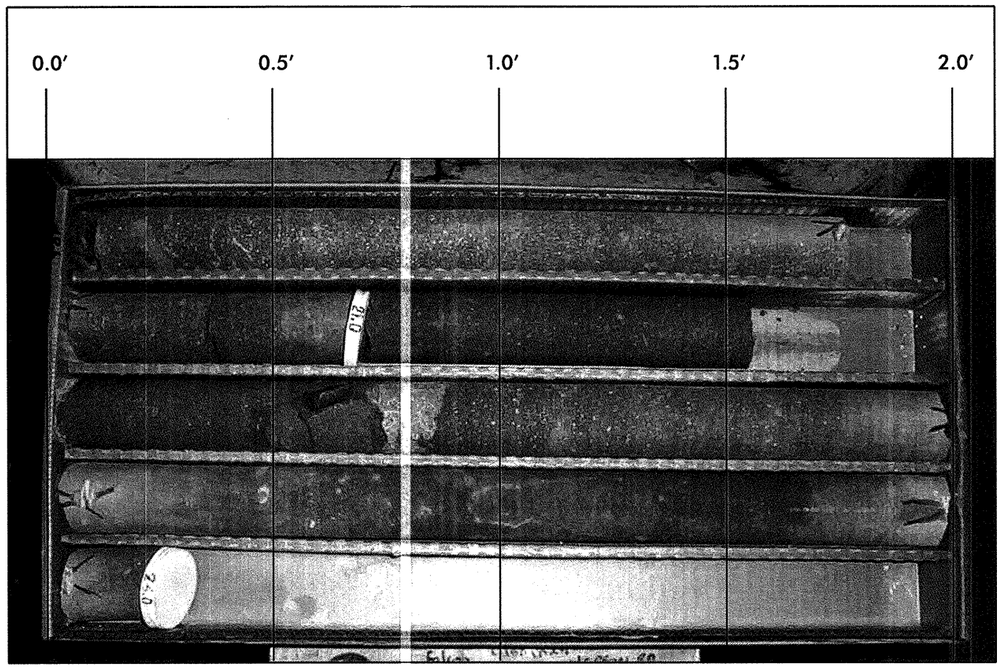
SHEET

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

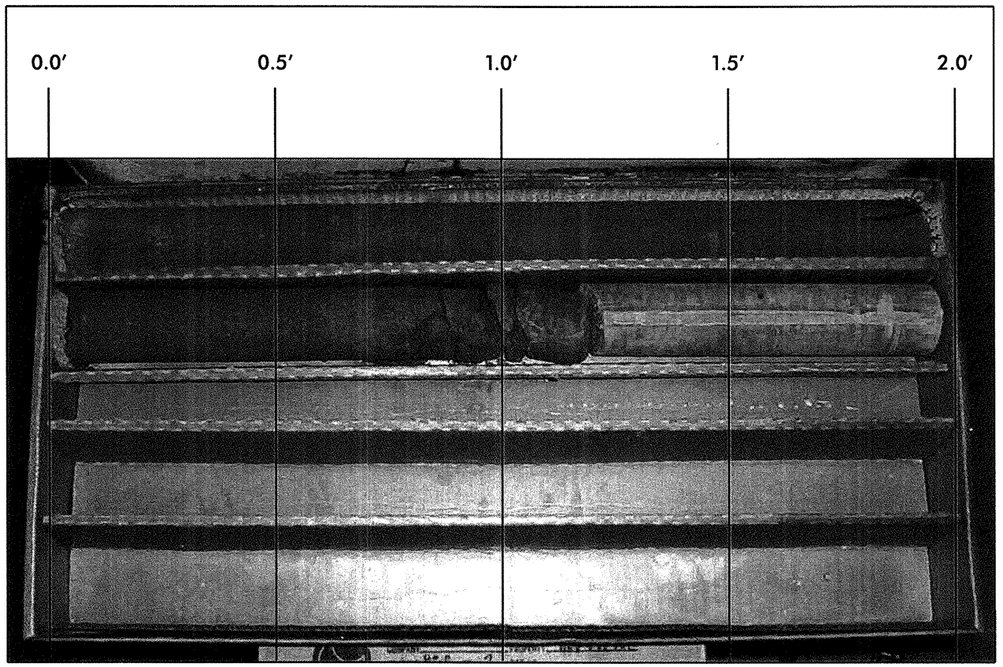
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS	
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS				**GROUND WTR (ft)**
BORING NO. B3-A	**STATION** 3316+07	**OFFSET** 28 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 383.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,155	**EASTING** 2,043,251	**24 HR.** 3.5
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W. DUGGINS	**START DATE** 04/28/11	**COMP. DATE** 04/28/11	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.5 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
											ELEV. (ft) DEPTH (ft)
364.49											Begin Coring @ 18.5 ft
	364.5	18.5	2.5	4:06/1.0	(2.2) 88%	(2.2) 88%			(2.4) 96% 2.4		364.5 **NON-CRYSTALLINE ROCK** 18.5 RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
				2:13/1.0							
	362.0	21.0		0:51/0.5							362.0 21.0
			5.0	3:27/1.0	(5.0) 100%	(4.7) 94%			(5.0) 100% 4.8		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
360				2:00/1.0							
				1:20/1.0							
				1:00/1.0							
				1:40/1.0							
	357.0	26.0									357.0 26.0
			5.0	1:17/1.0	(4.5) 90%	(4.5) 90%			(3.0) 100% 3		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
355				1:18/1.0							
				1:37/1.0			RS-4				
				2:42/1.0							354.0 29.0
				2:30/1.0					(1.0) 50% 1		**NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SANDSTONE
	352.0	31.0									352.0 31.0
											Boring Terminated at Elevation 352.0 ft in NCR: Triassic Siltstone and Sandstone

NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–3A, BOX 1 OF 2, 18.5 FEET TO 26.0 FEET.



BORING B–3A, BOX 2 OF 2, 26 FEET TO 31.0 FEET.

0 4″ 8″

INCHES

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B3-B	**STATION** 3316+11	**OFFSET** N/A	**ALIGNMENT** -L- / **0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,154	**EASTING** 2,043,223 / **24 HR.** 7.4
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/27/11	**COMP. DATE** 04/27/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION (ELEV. (ft) / DEPTH (ft))
385										385.0 GROUND SURFACE 0.0
	384.0	1.0	3	2	4	6		M		384.5 TOPSOIL 0.5 **TRIASSIC RESIDUAL** TAN AND GRAY, MED. STIFF, SILTY CLAY (A-6)
	381.5	3.5	11	25	38	63	SS-7	13%		382.0 3.0 **TRIASSIC RESIDUAL** TAN AND GRAY, V. DENSE, CLAYEY SAND (A-2-6)
380	379.0	6.0	100/.3			100/.3				379.0 6.0 **WEATHERED ROCK** RED-BROWN, TRIASSIC SILTSTONE
	376.5	8.5	100/.3			100/.3				377.5 7.5 **WEATHERED ROCK** GARY AND RED-BROWN, TRIASSIC SANDSTONE
375										
	371.5	13.5	100/.3			100/.3				
370										
	366.5	18.5	60/.1			60/.1				366.5 18.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE, W/ CONGLOMERATE
365										364.0 21.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SILTSTONE, W/ SANDSTONE LAYERS
360										359.0 26.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, V. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE
							RS-5			354.0 31.0 Boring Terminated at Elevation 354.0 ft in NCR: Triassic Siltstone and Sandstone
355										

NCDOT BORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

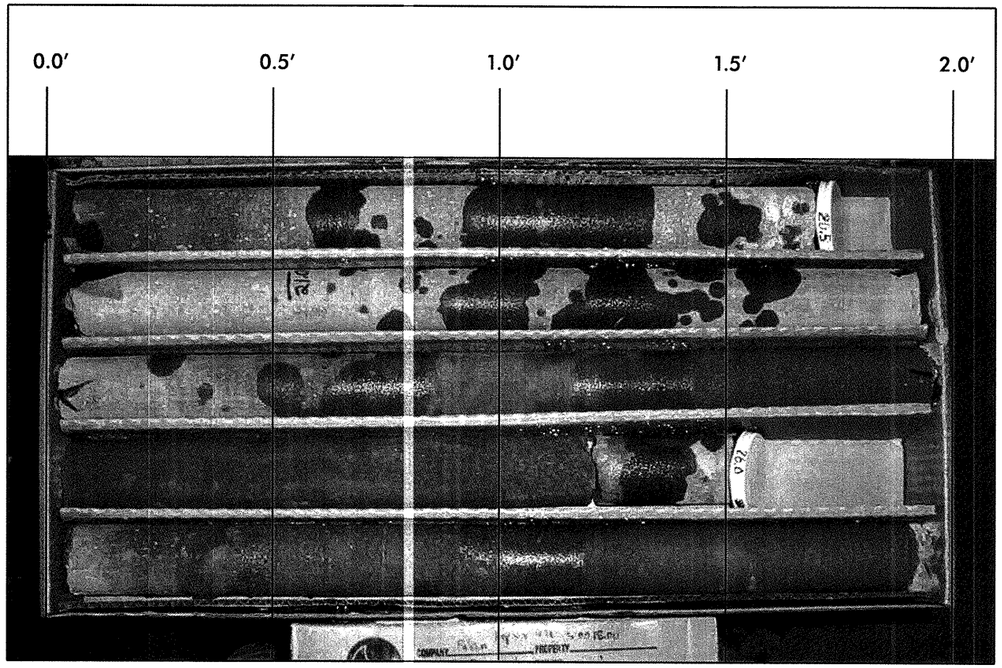
NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET

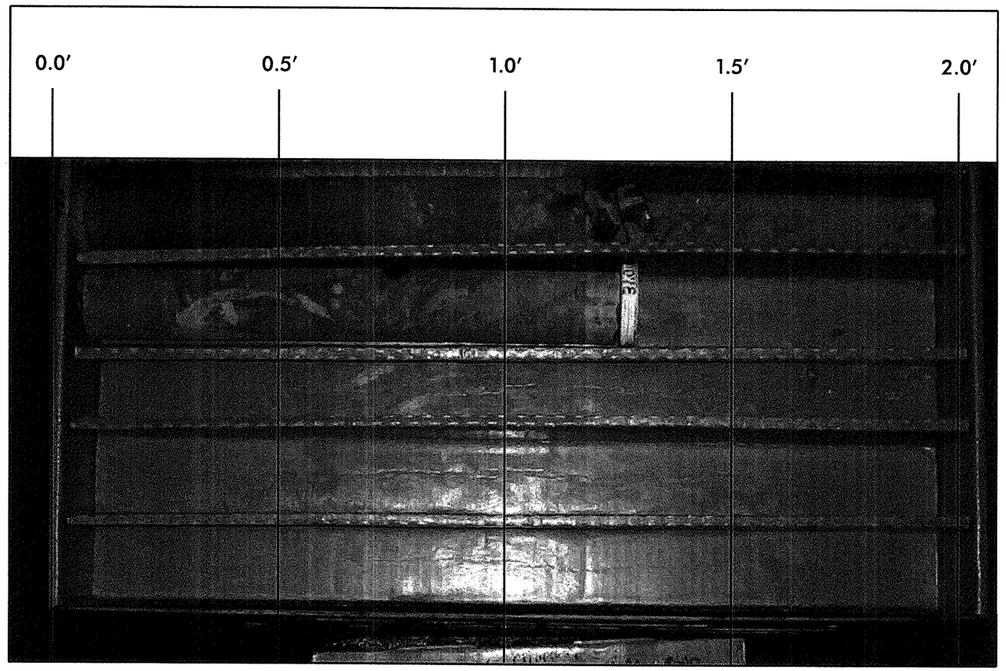
WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. B3-B	**STATION** 3316+11	**OFFSET** N/A	**ALIGNMENT** -L- / **0 HR.** N/A
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 31.0 ft	**NORTHING** 774,154	**EASTING** 2,043,223 / **24 HR.** 7.4
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/27/11	**COMP. DATE** 04/27/11	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 12.5 ft		

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS (ELEV. (ft) / DEPTH (ft))
366.49											Begin Coring @ 18.5 ft
365	366.5	18.5	2.5	2:10/1.0 1:20/1.0 0:37/0.5	(2.4) 96%	(2.4) 96%		(2.2) 88%	(2.2) 88%		366.5 18.5 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE, W/ CONGLOMERATE
	364.0	21.0	5.0	1:33/1.0 1:31/1.0 2:04/1.0 2:07/1.0 1:46/1.0	(5.0) 100%	(4.8) 96%		(5.0) 100%	(4.7) 94%		364.0 21.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, MOD. HARD, MOD. CLOSELY TO WIDELY FRACTURED, TRIASSIC SILTSTONE, W/ SANDSTONE LAYERS
360	359.0	26.0	5.0	1:47/1.0 1:40/1.0 1:25/1.0 3:05/1.0 2:17/1.0	(4.0) 80%	(4.0) 80%	RS-5	(4.5) 90%	(4.5) 90%		359.0 26.0 **NON-CRYSTALLINE ROCK** RED-BROWN, MOD. WEATHERED, V. HARD, MOD. CLOSELY FRACTURED, TRIASSIC SILTSTONE
355	354.0	31.0									354.0 31.0 Boring Terminated at Elevation 354.0 ft in NCR: Triassic Siltstone and Sandstone

NCDOT CORE SINGLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12



BORING B–3B, BOX 1 OF 2, 18.5 FEET TO 28.0 FEET.



BORING B–3B, BOX 2 OF 2, 28.0 FEET TO 31.0 FEET.

0 4″ 8″
INCHES

FALCON ENGINEERING
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607
PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 1

NCDOT GEOTECHNICAL ENGINEERING UNIT
BOREHOLE REPORT

SHEET □□

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 3314+82	**OFFSET** 27 ft LT	**ALIGNMENT** -L- — **0 HR.** 9.5
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 774,277	**EASTING** 2,043,266 — **24 HR.** 3.5
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/26/11	**COMP. DATE** 04/26/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION — ELEV. (ft)	DEPTH (ft)
385										385.0 GROUND SURFACE	0.0
	384.0	1.0								384.9 GRAVEL	0.2
										384.3 TOPSOIL	0.8
			10	10	11	21		D		**TRIASSIC RESIDUAL** LT. GRAY, MED. DENSE, SILTY SAND (A-2-4) W/ GRAVEL	
	381.5	3.5								382.0	3.0
380			3	7	15	22		D		**TRIASSIC RESIDUAL** BLUE-GRAY, MED. DENSE, SILTY SAND (A-2-4), W/ GRAVEL	
	379.0	6.0									
			11	13	14	27		D			
	376.5	8.5								376.5	8.5
375			19	28	23	51				**TRIASSIC RESIDUAL** PURPLE PINK AND GRAY, V. DENSE, SILTY SAND (A-2-4) W/ GRAVEL, TRACE MICA	
	371.5	13.5								371.0	14.0
			32	63	37/.2	100/.7				**WEATHERED ROCK** RED-BROWN, TRIASSIC SILTSTONE, TRACE MICA	
370											
	366.5	18.5	100/.2			100/.2					
365	365.0	20.0	60/0			60/0				365.0	20.0
										Boring Terminated by Auger Refusal at Elevation 365.0 ft	

WBS G10018.00	**TIP** N/A	**COUNTY** DURHAM	**GEOLOGIST** T. EVANS
SITE DESCRIPTION HOPSON ROAD IMPROVEMENTS			**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 3314+83	**OFFSET** N/A	**ALIGNMENT** -L- — **0 HR.** 5.5
COLLAR ELEV. 385.0 ft	**TOTAL DEPTH** 19.0 ft	**NORTHING** 774,281	**EASTING** 2,043,240 — **24 HR.** 2.4
DRILL RIG/HAMMER EFF./DATE SUM0093 DIEDRICH D-50 82% 07/22/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W. DUGGINS	**START DATE** 04/26/11	**COMP. DATE** 04/26/11	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
385										385.0 GROUND SURFACE 0.0
	384.0	1.0								384.6 GRAVEL 0.4
			10	7	7	14				**TRIASSIC RESIDUAL** LT. GRAY TAN AND ORANGE, MED. DENSE, SILTY SAND (A-2-4) W/ LITTLE ORGANICS
	381.5	3.5						M		
380			4	7	10	17				
	379.0	6.0						W		
			5	6	6	12				
	376.5	8.5								377.0 8.0
375			3	2	4	6	SS-17	13%		**TRIASSIC RESIDUAL** LT. GRAY AND TAN, LOOSE, SILTY SAND (A-2-4) W/ LITTLE MICA
	371.5	13.5								373.0 12.0
			26	50/.3		76/.8				**WEATHERED ROCK** RED-BROWN, TRIASSSIC SILTSTONE
370										
	366.5	18.5	60/.2			60/.2				
	366.0	19.0	60/0			60/0				366.0 19.0
										Boring Terminated by Auger Refusal at Elevation 366.0 ft

NCDOT BORE DOUBLE G10018.00HOPSON ROAD IMPROVEMENTS.GPJ NC_DOT.GDT 2/14/12

FALCON | 1210 TRINITY ROAD, SUITE 110, RALEIGH, NC 27607

AASHTO SOIL CLASSIFICATION AND GRADATION SHEET

BRIDGE ON NCRR MAINLINE OVER HOPSON ROAD BETWEEN DAVIS DRIVE (SR 1999) AND S. MIAMI BLVD (NC 54)

TIP NO.: U-4716A

DURHAM COUNTY, NORTH CAROLINA

FALCON ENGINEERING, INC. PROJECT NO: G10018.00

BORING #	SAMPLE #	TOTAL SAMPLE			Atterberg Limit Test Results			Natural Moisture Content	Organic Content
AASHTO Classification		PERCENT PASSING							
STATION # / OFFSET (FEET)	DEPTH (FEET)	#10	#40	#200	LL	PL	PI	%	%
EB1-B	SS-1	95	60	30	27	21	6	22.7	N/A
A-2-4									
	8.5 - 10.0								
B1-A	SS-2	97	70	43	26	19	17	15.8	N/A
A-6									
	3.5 - 5.0								
B1-B	SS-3	99	87	64	60	17	43	24.4	N/A
A-7-6									
	1.0 - 2.5								
B2-A	SS-4	100	91	63	34	16	18	19.0	N/A
A-6									
	3.5 - 5.0								
B2-B	SS-5	100	100	85	33	22	11	12.8	N/A
A-6									
	13.5 - 15								
B3-A	SS-6	100	83	55	50	19	31	19.3	N/A
A-7-6									
	1.0 - 2.5								
B3-B	SS-7	97	60	26	37	22	15	12.8	N/A
A-2-6									
	3.5 - 5.0								
EB2-A	SS-8	100	87	56	30	14	16	16.2	N/A
A-6									
	1.0 - 2.5								

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

SHEET

PROJECT ID NO.: (U-4716A)
F.A. NO.:
COUNTY: DURHAM
BRIDGE ON NCRR MAINLINE OVER HOPSON ROAD BETWEEN DAVIS DRIVE (SR 1999) AND S. MIAMI BLVD (NC 54)

Sample #	Boring #	Depth (ft)	Rock Type	Geologic Map Unit	Run RQD	Length (ft)	Diameter (ft)	Unit Weight (PCF)	Unconfined Compressive Strength (PSI)	Young's Modulus (PSI)	Splitting Tensile Strength (PSI)
RS-1	B1-B	28.0 - 29.0	Triassic Sandstone	-	72%	0.33	0.17	148.2	6,652	1,027,826	-
RS-2	B2-A	26.0 - 26.9	Triassic Sandstone	-	94%	0.34	0.16	143.1	2,971	408,502	-
RS-3	B2-B	26.2 - 27.6	Triassic Sandstone	-	94%	0.35	0.16	146.3	4,810	757,058	-
RS-4	B-3A	28.0 - 28.8	Triassic Sandstone	-	90%	0.34	0.17	151.9	6,807	935,943	-
RS-5	B-3B	28.0 - 29.2	Triassic Siltstone	-	80%	0.35	0.17	145.5	5,966	1,056,493	-

PHOTO 1: LOOKING SOUTHWARD ALONG PROPOSED REALIGNMENT FROM EAST SIDE OF EXISTING TRACKS NEAR THE BEGINNING OF THE PROJECT.

PHOTO 2: TYPICAL WOODED AREA ALONG PROPOSED NEW ALIGNMENT. PHOTO TAKEN NEAR STATION 19+00 ON NORTH SIDE OF HOPSON ROAD.

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

SITE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 1 OF 2

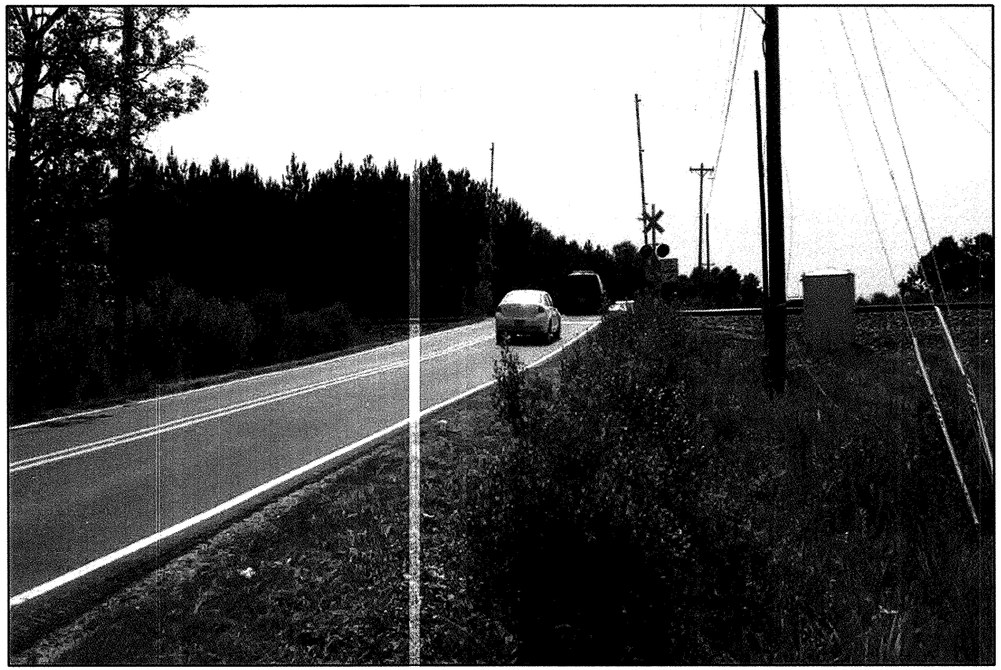


PHOTO 3: LOOKING WEST ALONG HOPSON ROAD AT EXISTING AT–GRADE CROSSING. PHOTO TAKEN FROM NEAR PROPOSED GRADE SEPARATION LOCATION EAST OF EXISTING TRACKS.

PHOTO 4: LOOKING SOUTH FROM NEAR EXISTING AT–GRADE CROSSING TOWARDS PROPOSED RAILROAD ALIGNMENT.

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1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
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SITE PHOTOGRAPHS

PROPOSED RAILROAD ALIGNMENT
AT HOPSON ROAD GRADE SEPARATION
DURHAM COUNTY, NORTH CAROLINA

FEBRUARY 2012	PROJECT NO.: G10018.00	SHEET 2 OF 2

LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-1 (LT)
County	Durham	Boring #	B1-A

Pile Properties

Total Pile Length	480.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	-	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	146	54	417393	2290.0	3800000
3	146	60	636172	2827.0	3800000
4	480.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	22000	4260000	776000
Shear & Moment	2000	-876000	776000
Shear & Moment	9000	1044000	181000
Shear & Moment	69000	-2076000	181000
Shear & Moment	16000	3252000	618000
Shear & Moment	60000	-381600	618000
Shear & Moment	25000	4272000	158000
Shear & Moment	2000	-468000	158000
Shear & Moment	22000	3732000	137000
Shear & Moment	62000	-1860000	137000

Long. - Longitudinal, Trans.-Translational

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	1	146	176
2	4	176	236
3	4	236	428
4	9	428	458
5	9	458	518
6	9	518	578

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

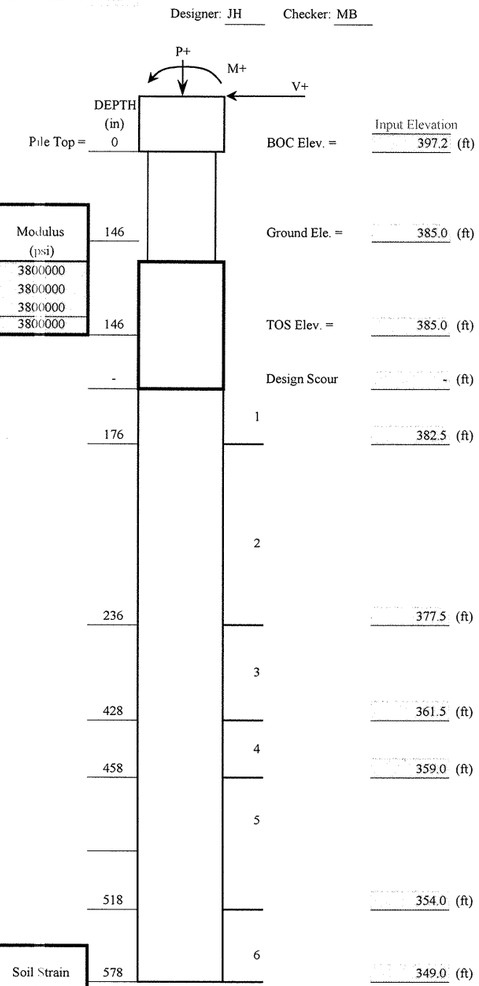
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(1)	0.060	50	-	32	-
2(4)	0.030	-	2.0	-	0.01
3(4)	0.040	150	-	40	-

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	krm (.0005 to .00005)
4	0.045	1000000	6000	100	0.0005
5	0.045	1000000	6000	100	0.0005
6	0.045	1000000	6000	70	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)



DEFLECTION @ PILE TOP = Δ_{TOP}

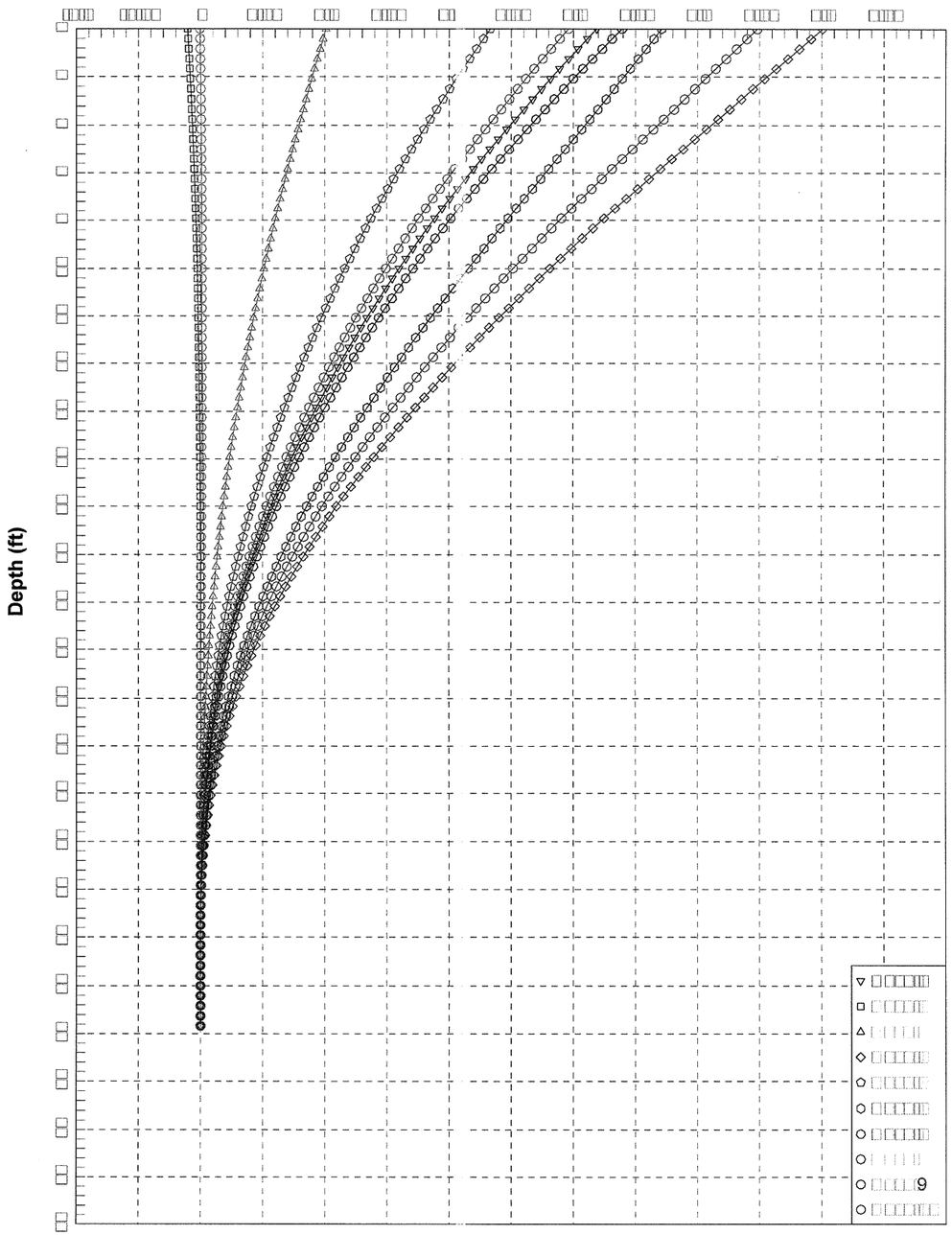
Δ_{TOP}	Max. Neg.	Pile Length
0.50		
(in)	(in)	(in)

COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**360**
TIP NO HIGHER THAN =	**350**

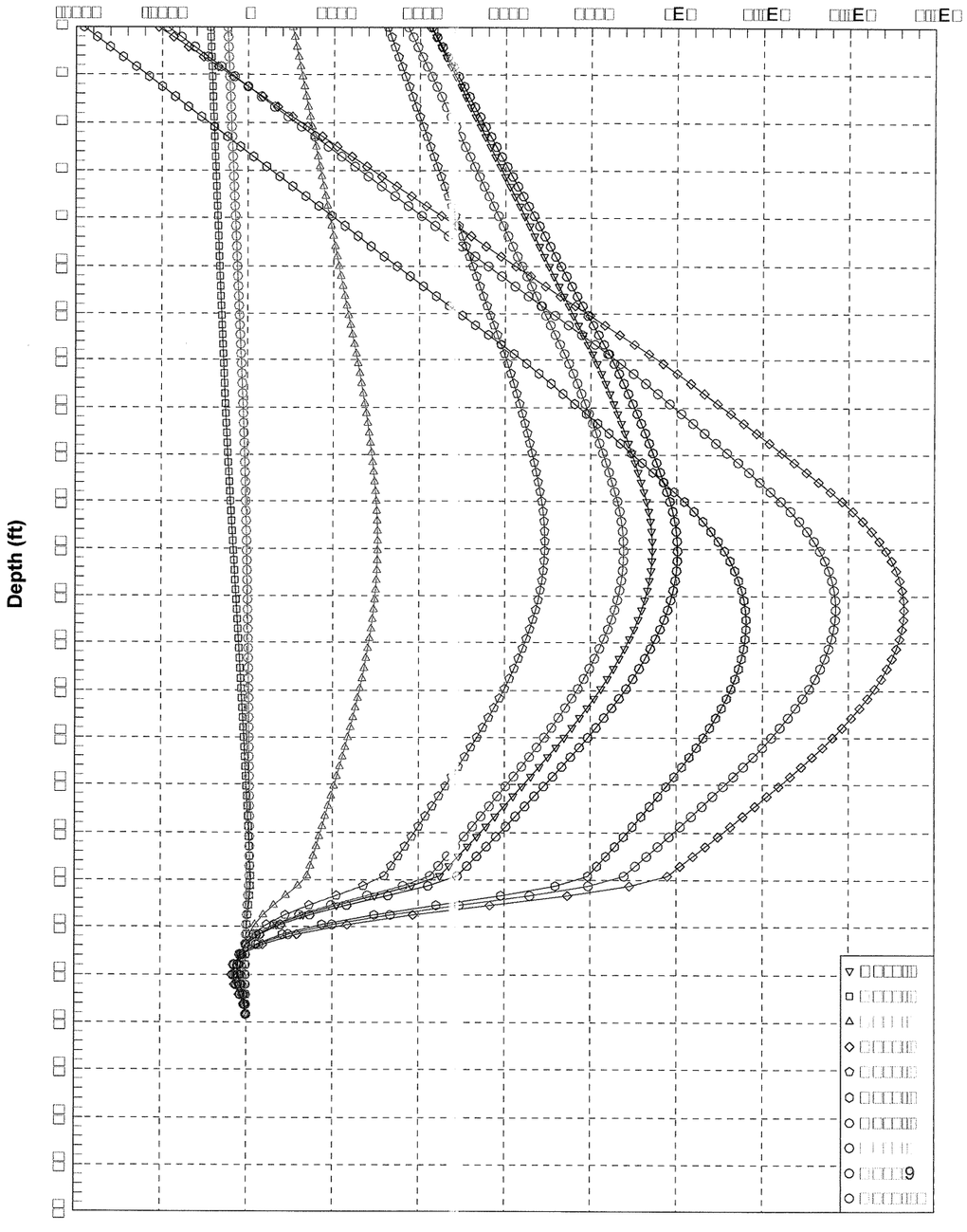
BENT 1 (LT)

Lateral Deflection (in)



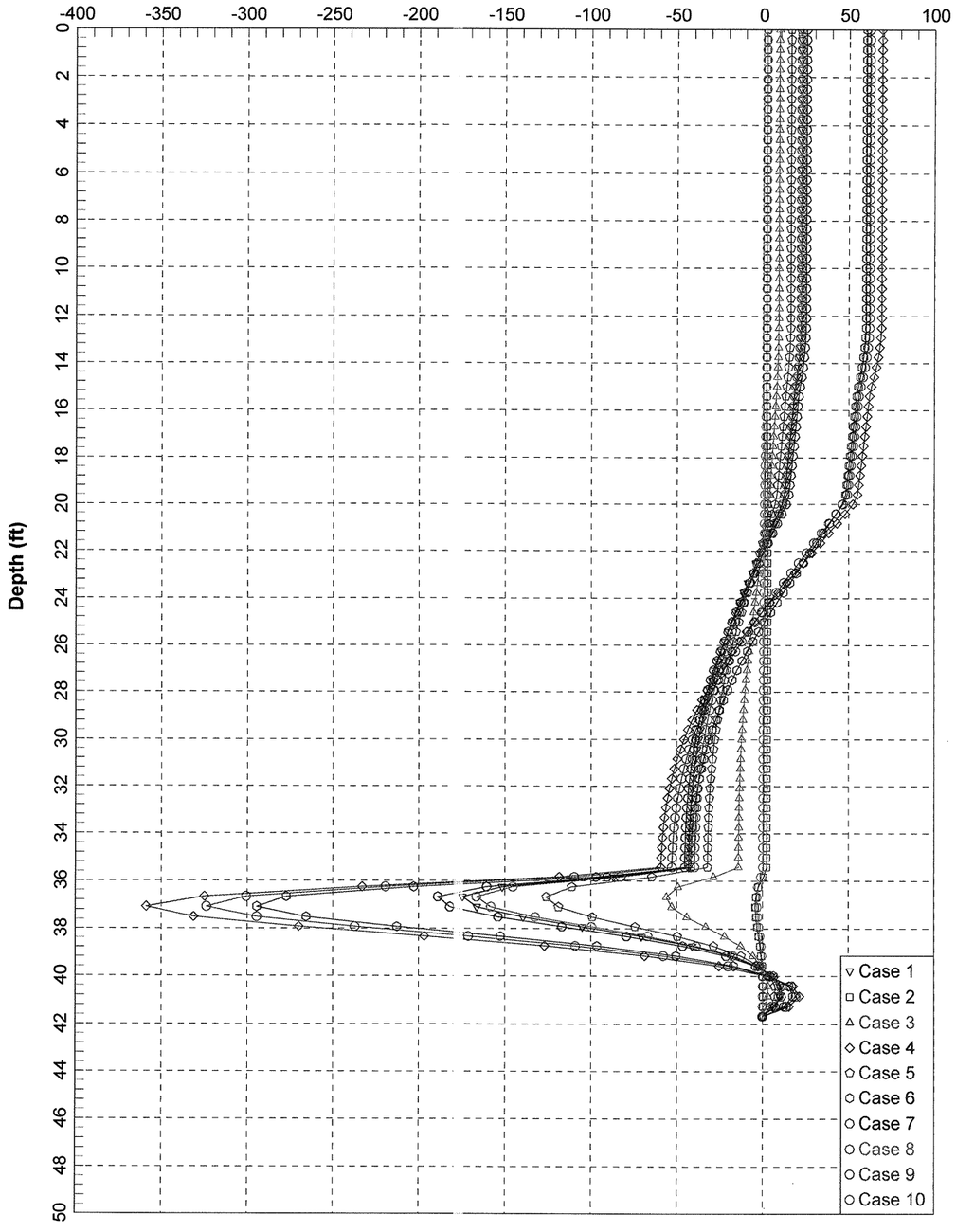
BENT 1 (LT)

Bending Moment (in-kips)



BENT 1 (LT)

Shear Force (kips)



LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-1 (RT)
County	Durham	Boring #	B1-B

Pile Properties

Total Pile Length	480.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	-	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	146	54	417393	2290.0	3800000
3	146	60	636172	2827.0	3800000
4	480.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	46000	9792000	417000
Shear & Moment	3000	-672000	417000
Shear & Moment	38000	7632000	844000
Shear & Moment	3000	-720000	844000
Shear & Moment	29000	5940000	679000
Shear & Moment	92000	-720000	679000
Shear & Moment	36000	7728000	338000
Shear & Moment	79000	-3084000	338000

Long. - Longitudinal, Trans.-Translational

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	1	146	182
2	4	182	320
3	4	320	368
4	9	368	398
5	9	398	458
6	9	458	518

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

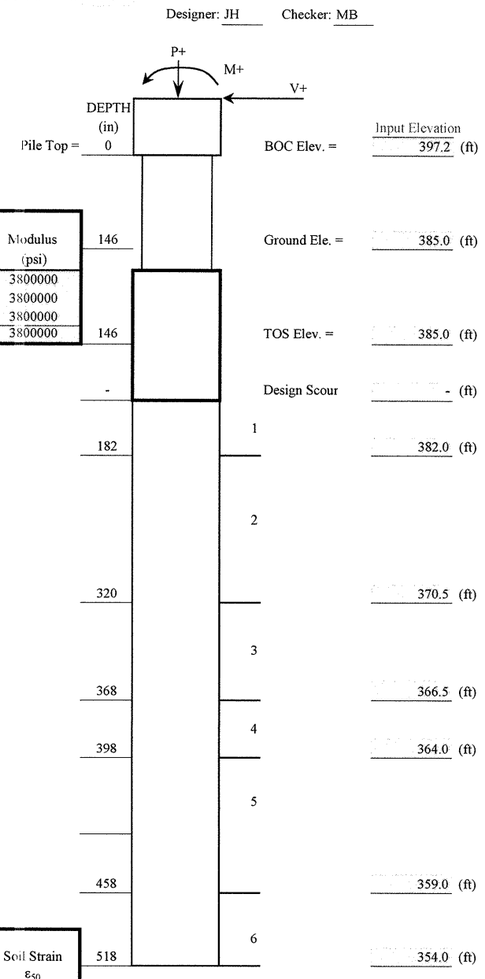
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(1)	0.060	50	2.0	-	0.01
2(4)	0.036	100	-	36	-
3(4)	0.040	150	-	40	-

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	krm (.0005 to .00005)
4	0.045	1000000	6000	92	0.0005
5	0.045	1000000	6000	100	0.0005
6	0.045	1000000	6000	72	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)



Input Elevation

BOC Elev. = 397.2 (ft)

Ground Ele. = 385.0 (ft)

TOS Elev. = 385.0 (ft)

Design Scour - (ft)

382.0 (ft)

370.5 (ft)

366.5 (ft)

364.0 (ft)

359.0 (ft)

354.0 (ft)

DEFLECTION @ PILE TOP = Δ_{TOP}

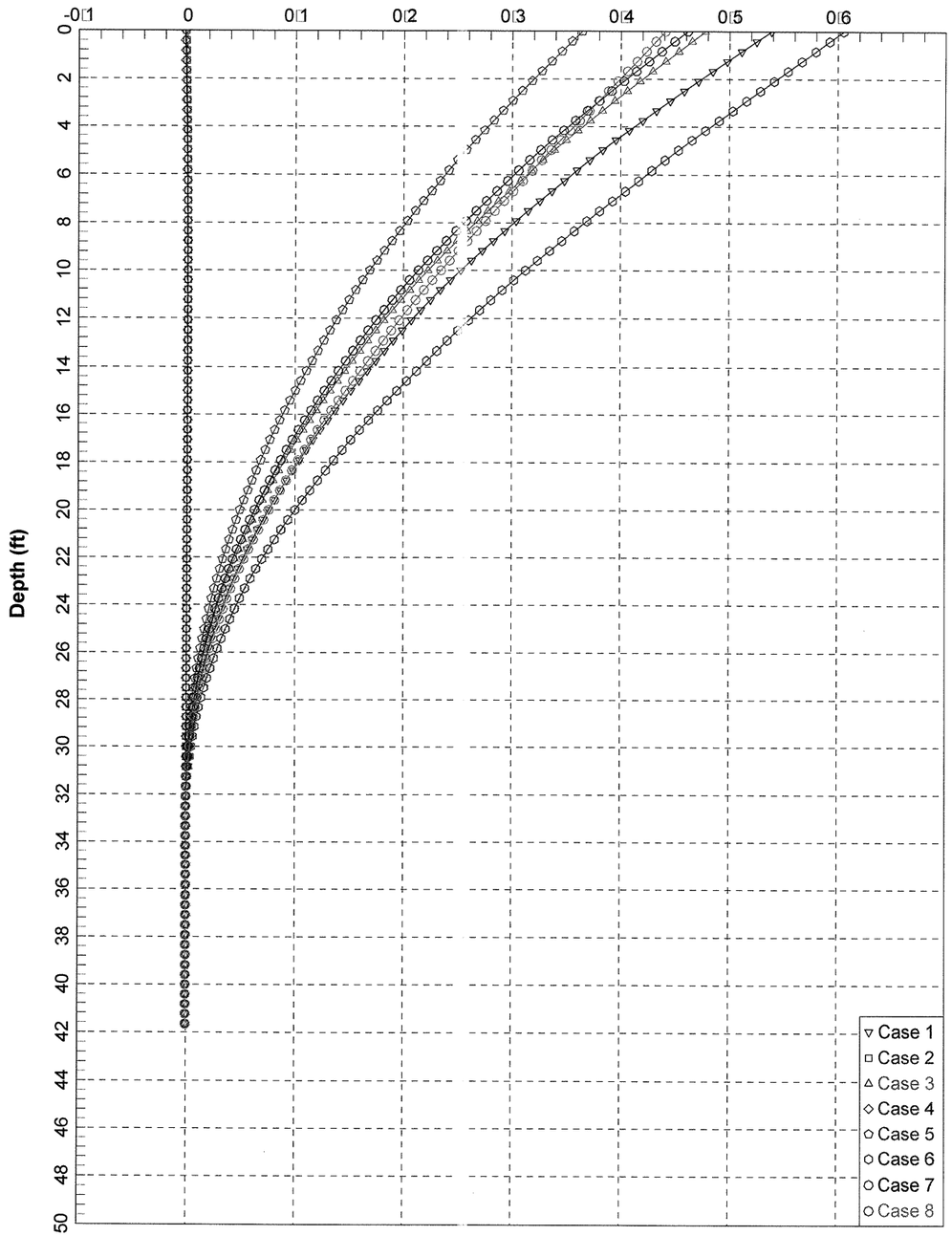
Δ_{TOP}	Max. Neg.	Pile Length
0.61		
(in)	(in)	(in)

COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**364**
TIP NO HIGHER THAN =	**354**

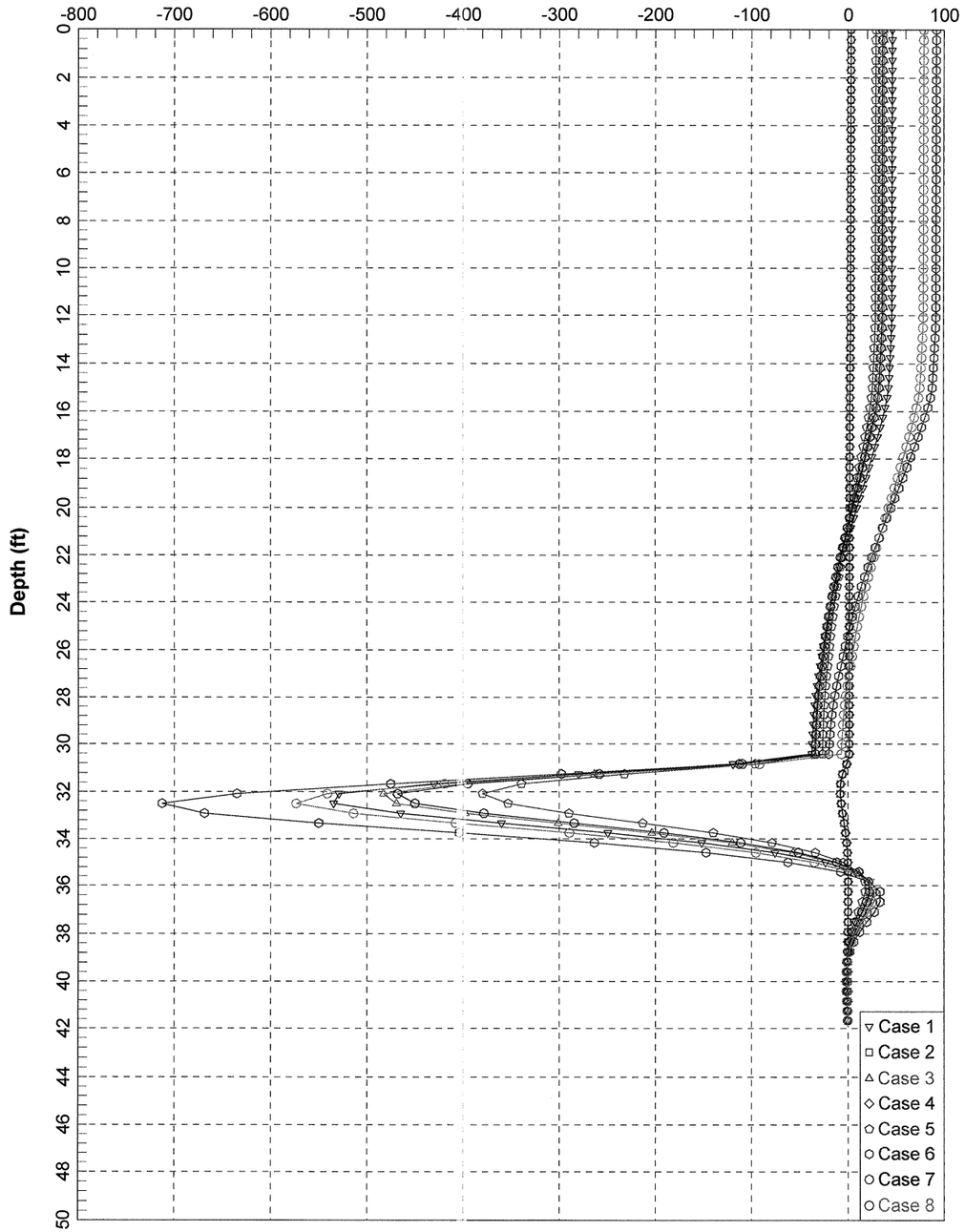
BENT 1 (RT)

Lateral Deflection (in)



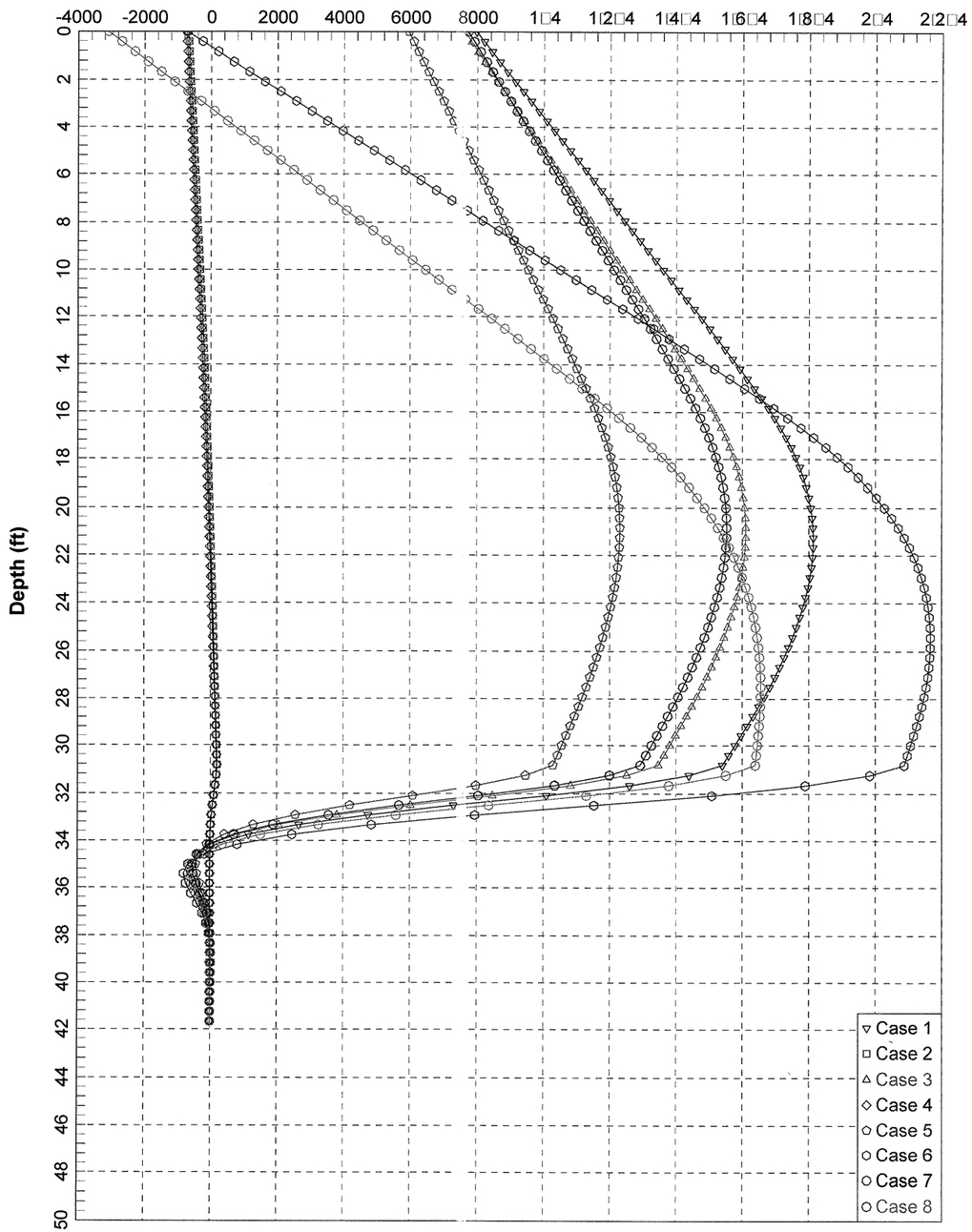
BENT 1 (RT)

Shear Force (kips)



BENT 1 (RT)

Bending Moment (in-kips)



LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-2 (LT)
County	Durham	Boring #	B2-A

Pile Properties

Total Pile Length	240.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	151.2	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	145	54	417393	2290.0	3800000
3	145	60	636172	2827.0	3800000
4	240.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	22000	4260000	776000
Shear & Moment	2000	-876000	776000
Shear & Moment	9000	1044000	181000
Shear & Moment	69000	-2076000	181000
Shear & Moment	16000	3252000	618000
Shear & Moment	60000	-3816000	618000
Shear & Moment	25000	4272000	158000
Shear & Moment	2000	-468000	158000
Shear & Moment	22000	3732000	137000
Shear & Moment	62000	-1860000	137000

Long. - Longitudinal, Trans.-Translational

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	4	151	217
2	4	217	451
3	9	451	481
4	9	481	541

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

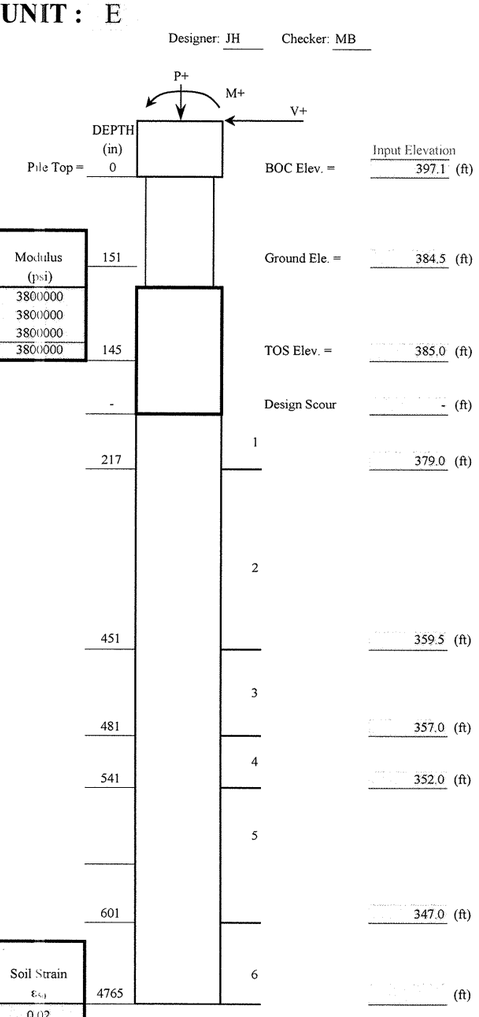
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(1)	0.060	-	2.0	-	0.02
2(4)	0.040	150	-	40	-

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	k rm (.0005 to .00005)
4	0.045	400000	3000	100	0.0005
5	0.045	400000	3000	94	0.0005
6	0.045	1000000	6000	94	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)



DEFLECTION @ PILE TOP = Δ_{TOP}

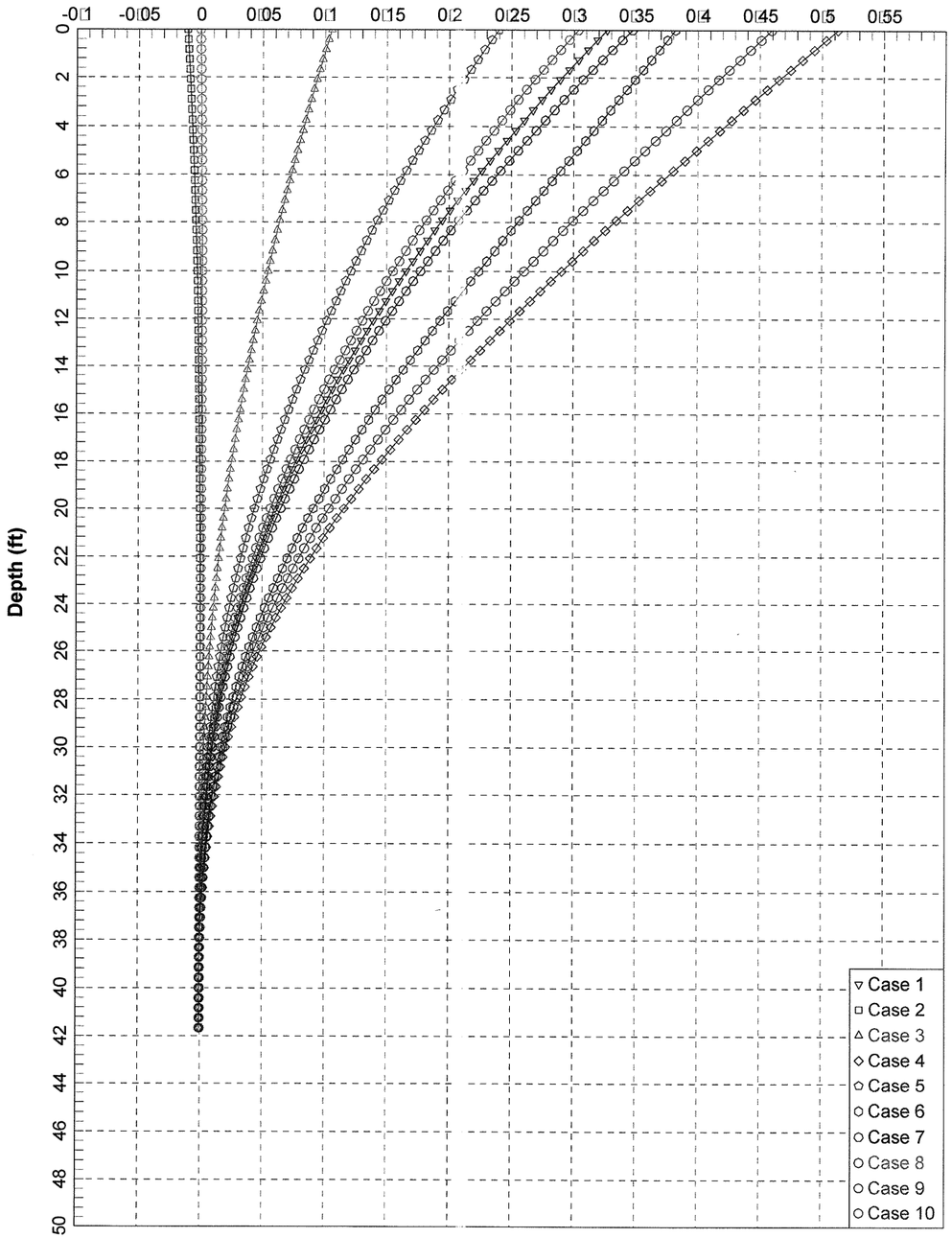
Δ_{TOP}	Max. Neg.	Pile Length
0.51		
(in)	(in)	(in)

COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**358**
TIP NO HIGHER THAN =	**348**

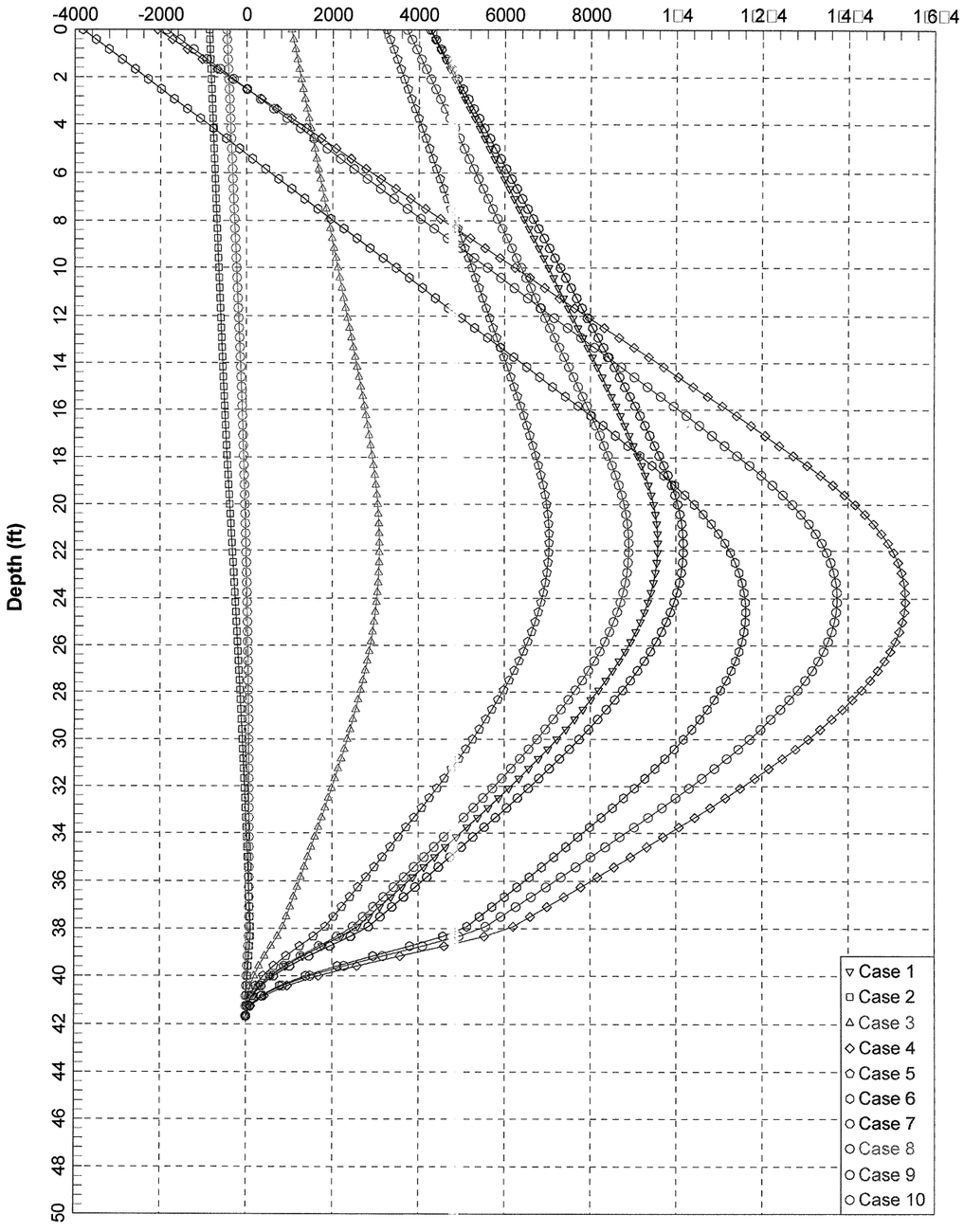
BENT 2 (LT)

Lateral Deflection (in)



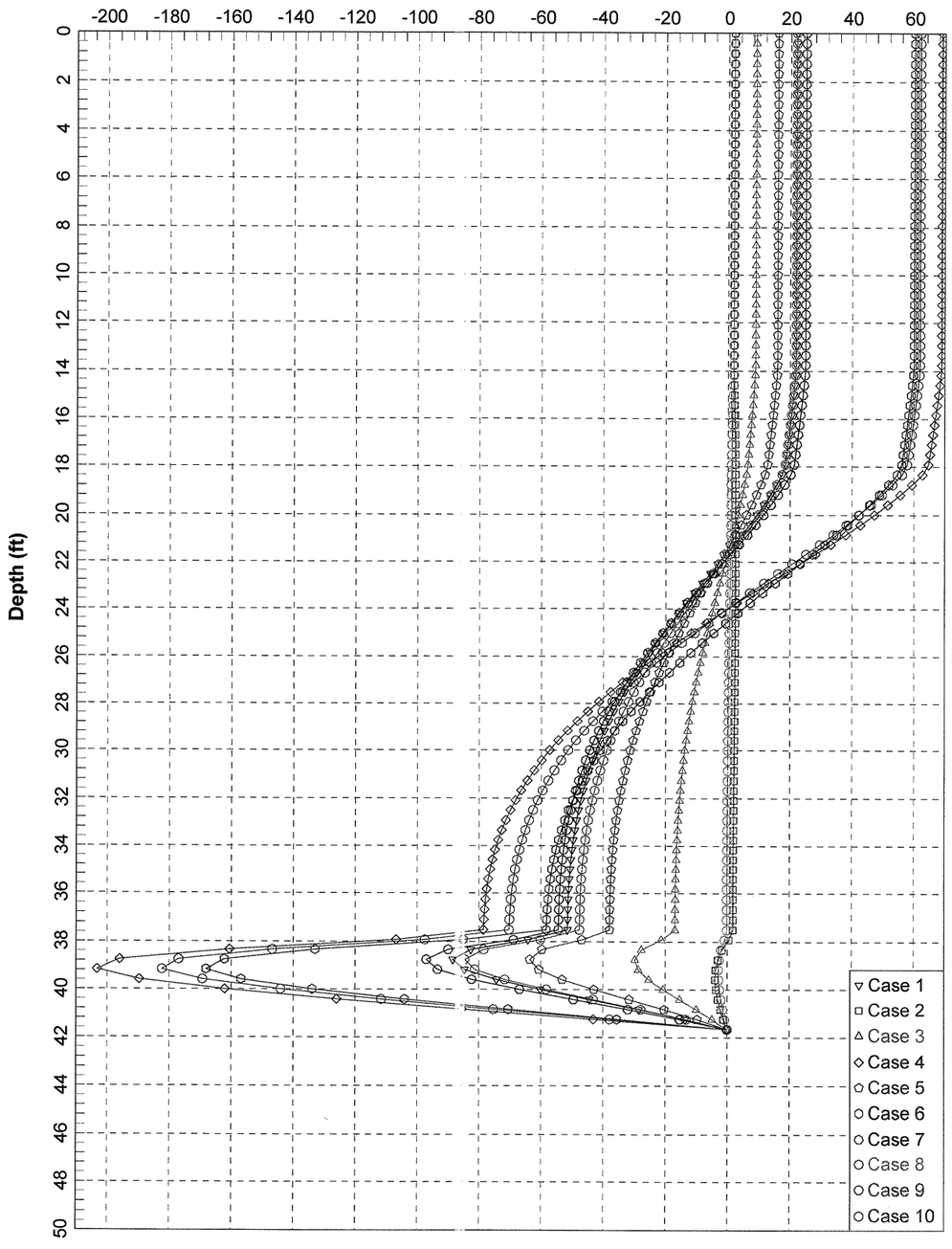
BENT 2 (LT)

Bending Moment (in-kips)



BENT 2 (LT)

Shear Force (kips)



LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-2 (RT)
County	Durham	Boring #	B2-B

Pile Properties

Total Pile Length	240.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	151.2	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	145	54	417393	2290.0	3800000
3	145	60	636172	2827.0	3800000
4	240.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	46000	9792000	417000
Shear & Moment	3000	-672000	417000
Shear & Moment	38000	7632000	844000
Shear & Moment	3000	-720000	844000
Shear & Moment	29000	5940000	679000
Shear & Moment	92000	-720000	679000
Shear & Moment	36000	7728000	338000
Shear & Moment	79000	-3084000	338000

Long. - Longitudinal, Trans.-Translational

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	4	151	205
2	4	205	313
3	4	313	373
4	9	373	403
5	9	403	463
6	9	463	523

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

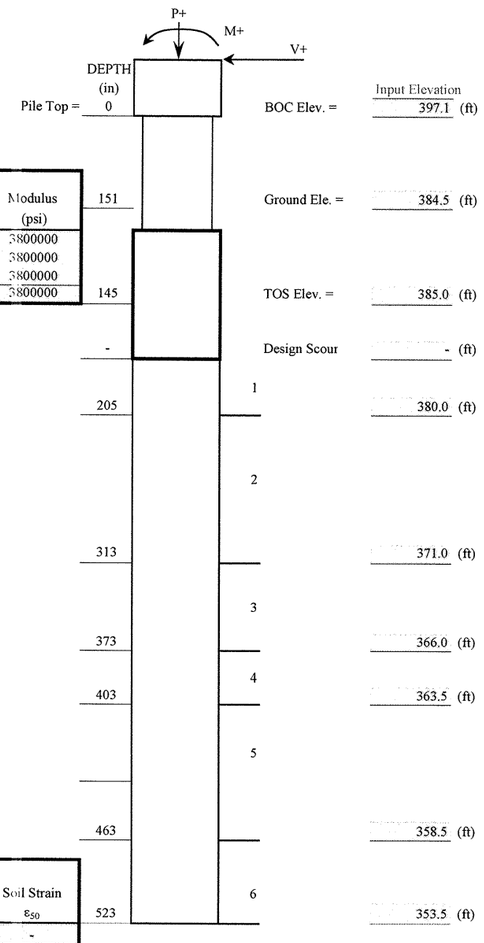
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(4)	0.030	50	-	32	-
2(4)	0.040	150	-	40	-
3(2)	0.036	2000	25.0	-	0.004

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	k rm (.0005 to .0005)
4	0.045	750000	4800	88	0.0005
5	0.045	750000	4800	100	0.0005
6	0.045	750000	4800	94	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)



Input Elevation

BOC Elev. =	397.1	(ft)
Ground Ele. =	384.5	(ft)
TOS Elev. =	385.0	(ft)
Design Scour	-	(ft)
	380.0	(ft)
	371.0	(ft)
	366.0	(ft)
	363.5	(ft)
	358.5	(ft)
	353.5	(ft)

DEFLECTION @ PILE TOP = Δ_{TOP}

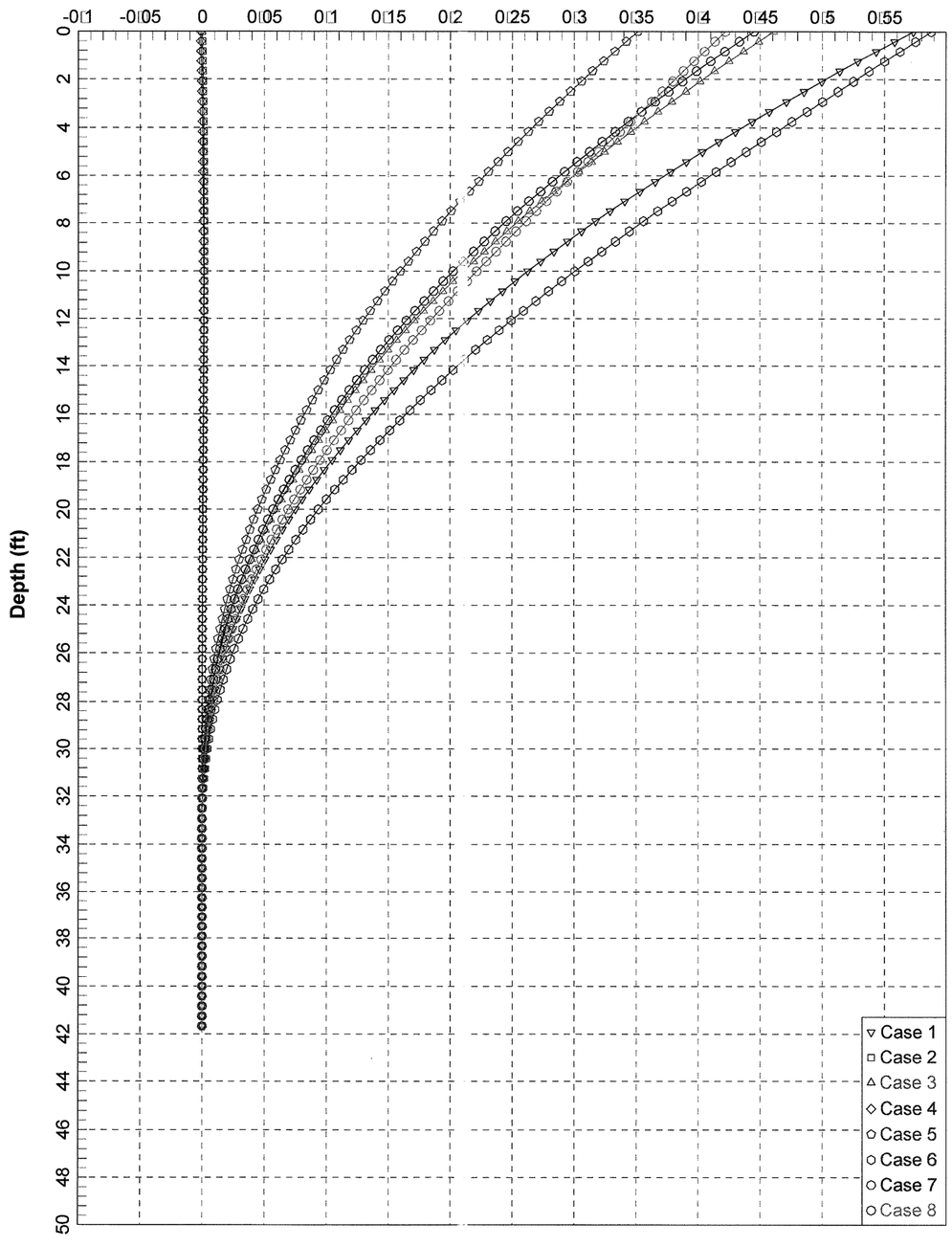
Δ_{TOP}	Max. Neg.	Pile Length
0.59		
(in)	(in)	(in)

COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**364**
TIP NO HIGHER THAN =	**354**

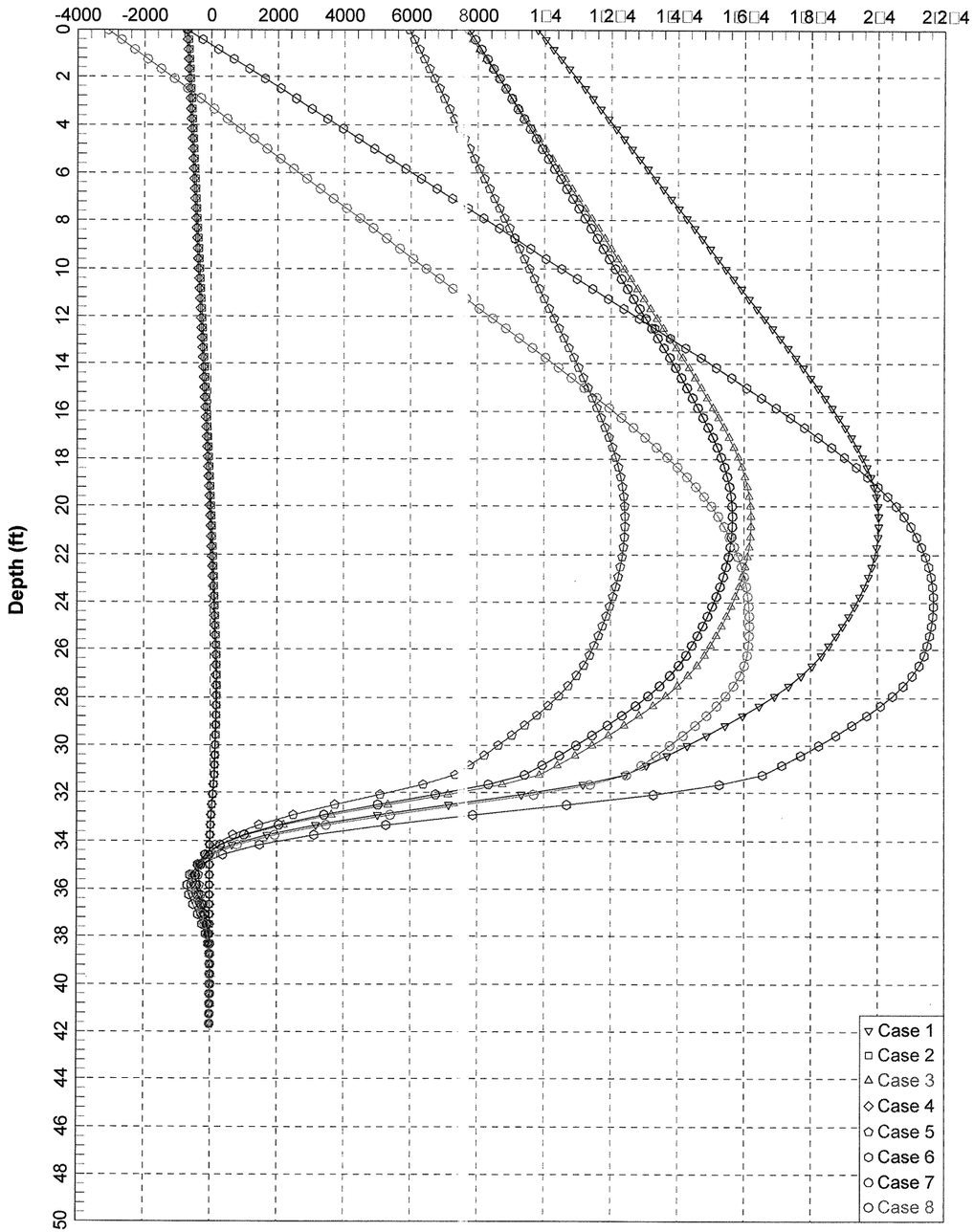
BENT 2 (RT)

Lateral Deflection (in)



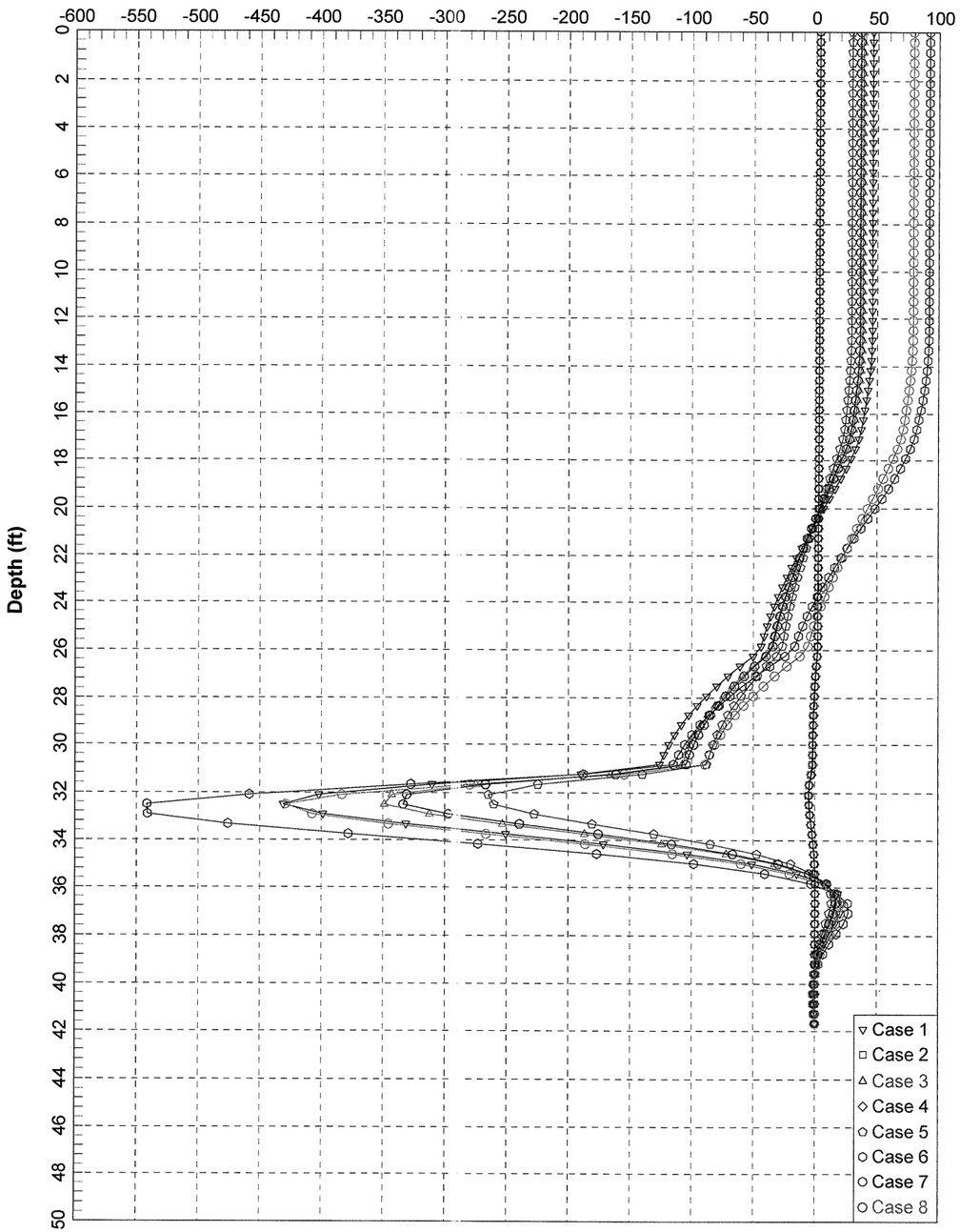
BENT 2 (LT)

Bending Moment (in-kips)



BENT 2 (LT)

Shear Force (kips)



LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-3 (LT)
County	Durham	Boring #	B3-A

Pile Properties

Total Pile Length	240.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	-	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	144	54	417393	2290.0	3800000
3	144	60	636172	2827.0	3800000
4	480.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	22000	4260000	776000
Shear & Moment	2000	-876000	776000
Shear & Moment	9000	1044000	181000
Shear & Moment	69000	-2076000	181000
Shear & Moment	16000	3252000	618000
Shear & Moment	60000	-3816000	618000
Shear & Moment	25000	4272000	158000
Shear & Moment	2000	-468000	158000
Shear & Moment	22000	3732000	137000
Shear & Moment	62000	-1860000	137000

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	4	144	216
2	4	216	390
3	9	390	420
4	9	420	480
5	9	480	540

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

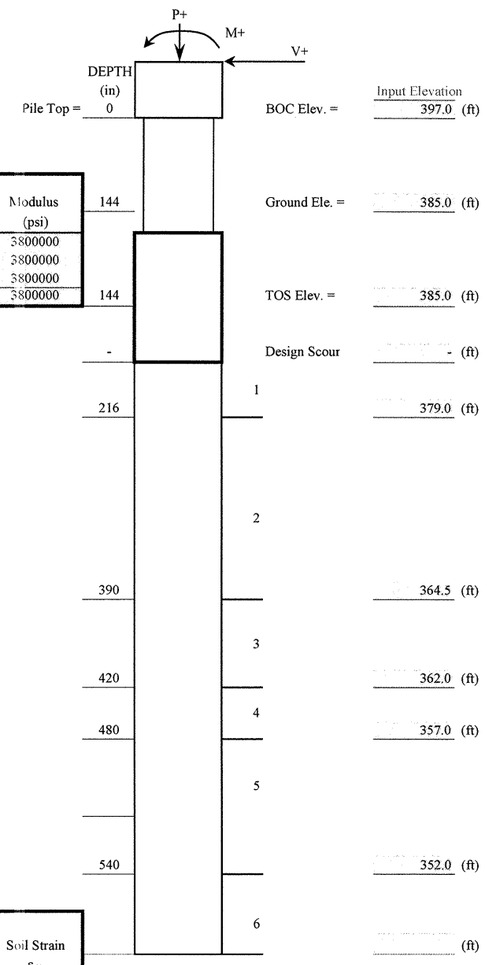
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(2)	0.060	-	5.0	-	0.007
2(4)	0.040	150	-	40	-

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	k rm (.0005 to .0005)
3	0.045	930000	6000	88	0.0005
4	0.045	930000	6000	94	0.0005
5	0.045	930000	6000	90	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)

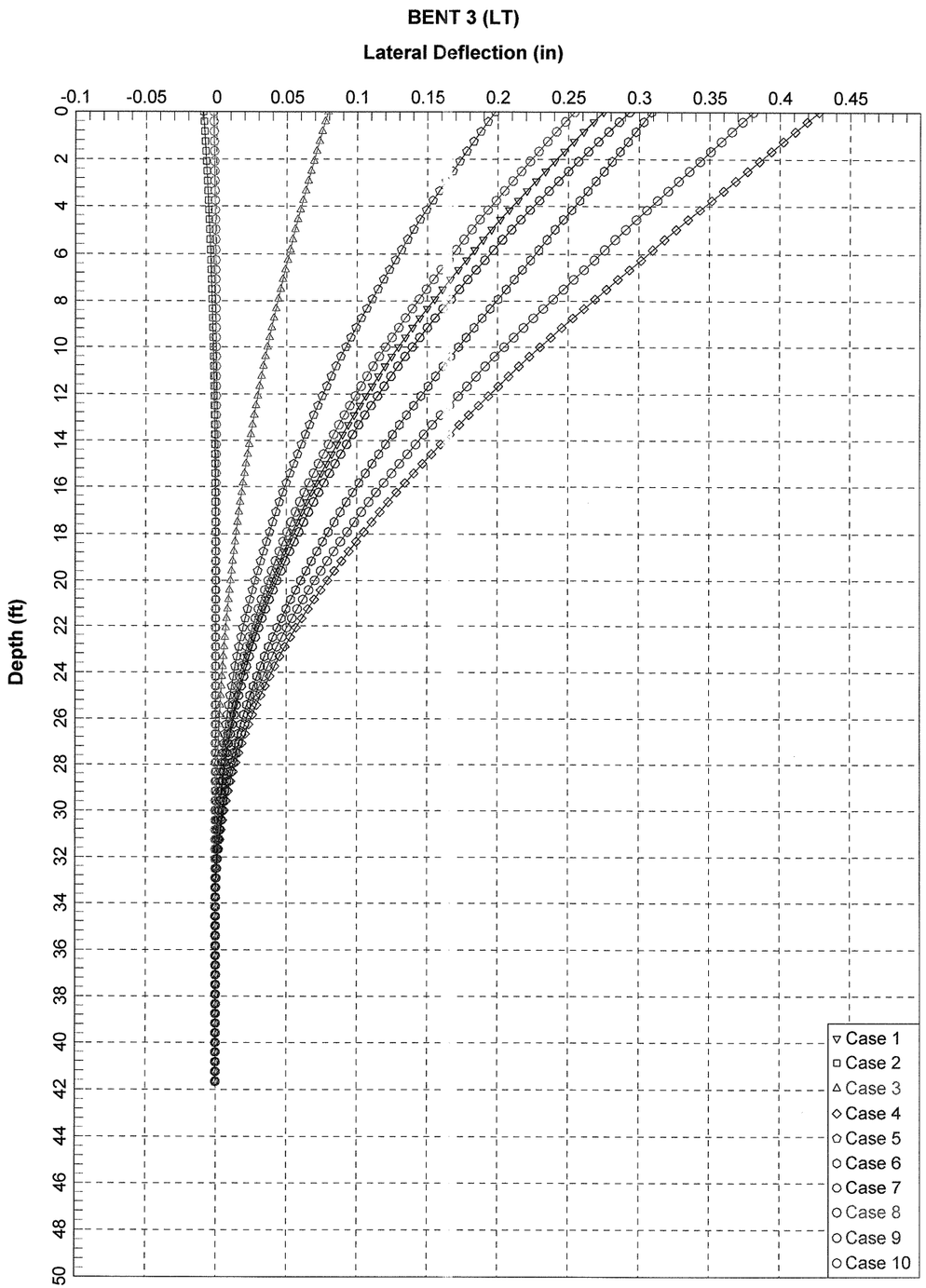


DEFLECTION @ PILE TOP = Δ_{TOP}

Δ_{TOP}	Max. Neg.	Pile Length
0.43		
(in)	(in)	(in)

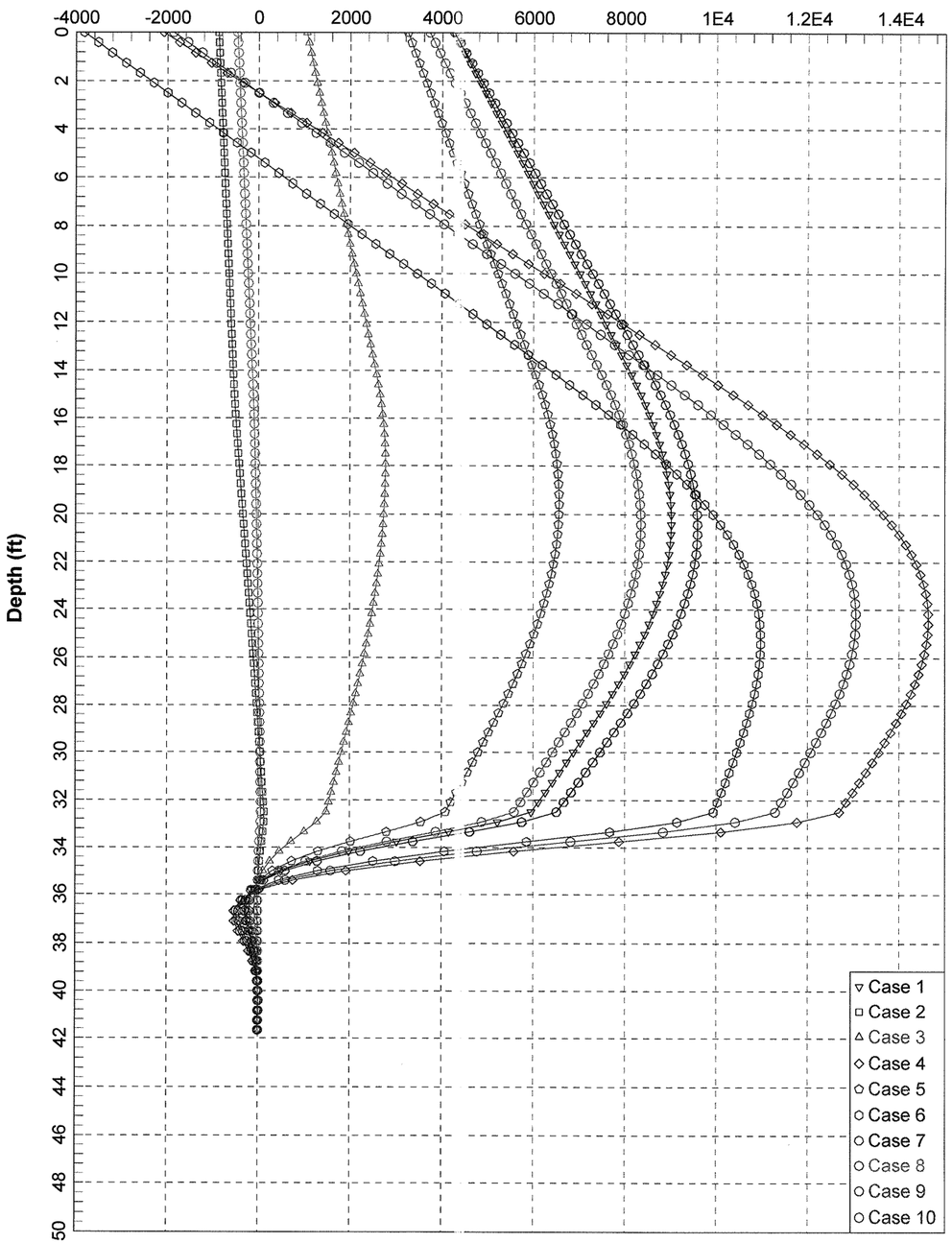
COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**363**
TIP NO HIGHER THAN =	**353**


BENT 3 (LT)
Lateral Deflection (in)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Case 8
Case 9
Case 10

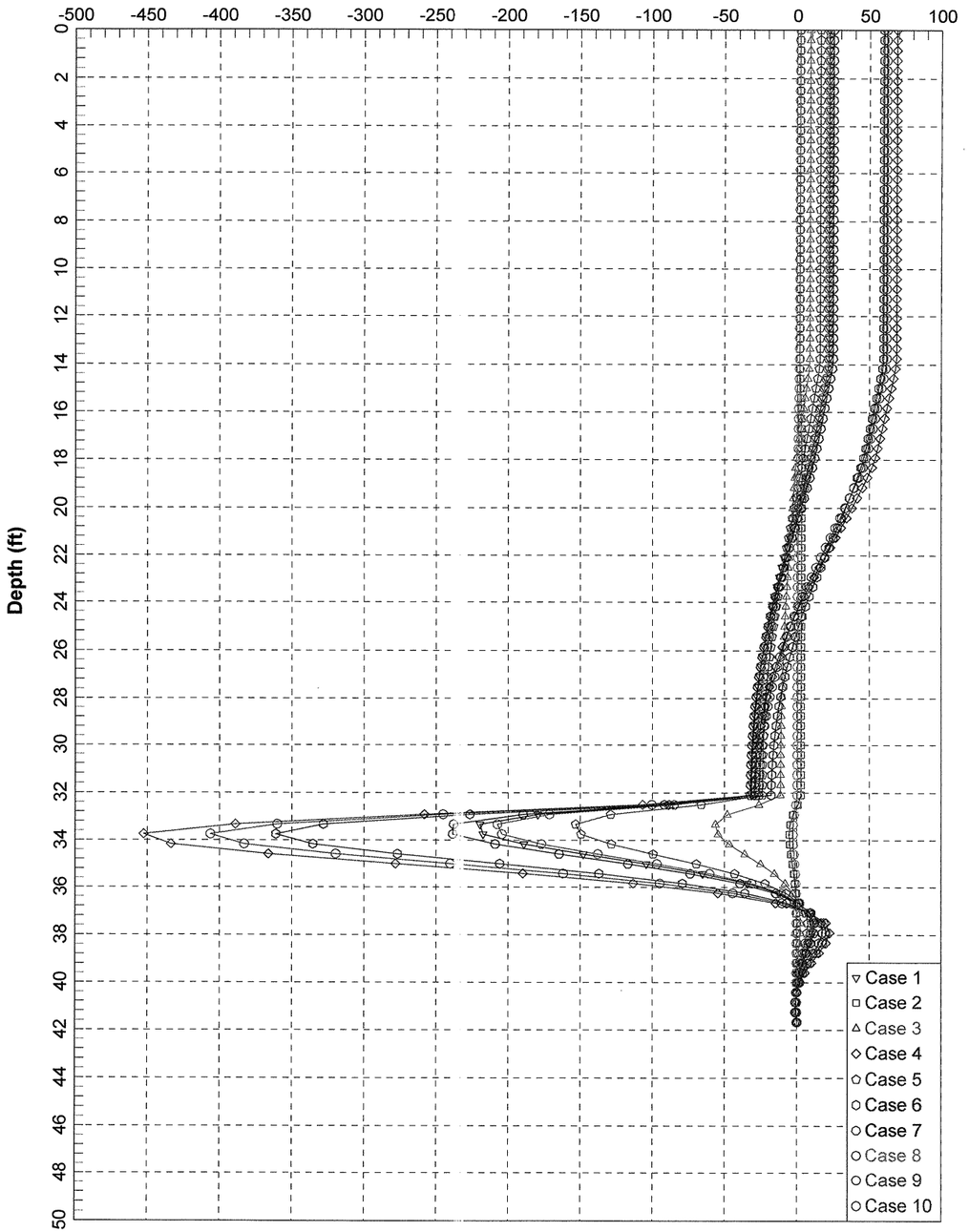
BENT 3 (LT)

Bending Moment (in-kips)



BENT 3 (LT)

Shear Force (kips)



LPILE+ 5.0 INPUT SHEET:

UNIT : E

Designer: JH Checker: MB

Project Title

Proj. #:	Hopson Road Br. Repl.	Bent #	B-3 (RT)
County	Durham	Boring #	B3-B

Pile Properties

Total Pile Length	240.0	(in)
Increments (recommend 50 to 100)	100.0	
Distance from Top of Pile to Ground	-	(in)
Combined Ground Slope & Batter Angles	0	(degrees)

Pile Sections

Section #	Depth (in)	Diameter (in)	Mom. of Inertia (in4)	Area (in2)	Modulus (psi)
1	0	54	417393	2290.0	3800000
2	144	54	417393	2290.0	3800000
3	144	60	636172	2827.0	3800000
4	480.0	60	636172	2827.0	3800000

Pile-Head Boundary Conditions & Loading

Pile-Head B.C.	V (Shear) (lbs)	M (Moment) (lbs-in)	P (Axial) (lbs)
Shear & Moment	46000	9792000	417000
Shear & Moment	3000	-672000	417000
Shear & Moment	38000	7632000	844000
Shear & Moment	3000	-720000	844000
Shear & Moment	29000	5940000	679000
Shear & Moment	92000	-720000	679000
Shear & Moment	36000	7728000	338000
Shear & Moment	79000	-3084000	338000

Soil Layers

Layer #	Internal Soil Type	x-top (in)	x-bottom (in)
1	4	144	180
2	4	180	216
3	4	216	366
4	9	366	396
5	9	396	456
6	9	456	516

#1 = Soft Clay Criteria (Matlock)
#2 = Stiff Clay with Free Water
#3 = Stiff Clay without Free Water
#4 = Sand (Reese, 1974)
#5 = Linear Interp. p-y curves
#6 = Strong Rock (Vuggy Limestone)
#7 = Silt (Cemented c-phi soil)
#8 = API Sand (O'Neill)
#9 = Weak Rock (Reese, 1977)

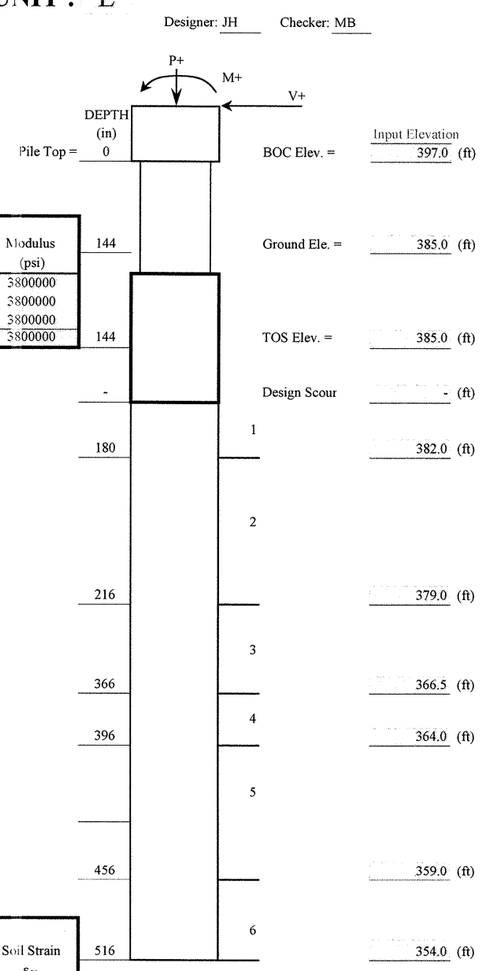
SOIL and ROCK PROPERTIES FOR FEE EVENT

Layer No. (Soil Type)	Eff. Unit Wt. (pci)	p-y Modulus (pci)	Cohesion. (psi)	Friction Angle ϕ (degrees)	Soil Strain ε_{50}
1(1)	0.060	100	3.5	-	0.01
2(4)	0.036	100	-	36	-
3(4)	0.040	150	-	40	-

Weak Rock	Eff. Unit Wt. (pci)	Young's Mod.* (psi)	Uniax. Comp. Str. (psi)	RQD (%)	k rm (.0005 to .0005)
4	0.045	1000000	6000	88	0.0005
5	0.045	1000000	6000	94	0.0005
6	0.045	1000000	6000	90	0.0005

Strong Rock Properties (Vuggy Limestone)	Eff. Unit Wt. (pci)	Uniax. Comp. Str. (psi)

* Young's Modulus of Rock = 200 to 500 X Comp. Strength of Rock (RULE OF THUMB)



Input Elevation

BOC Elev. =	397.0	(ft)
Ground Ele. =	385.0	(ft)
TOS Elev. =	385.0	(ft)
Design Scour	-	(ft)
	382.0	(ft)
	379.0	(ft)
	366.5	(ft)
	364.0	(ft)
	359.0	(ft)
	354.0	(ft)

DEFLECTION @ PILE TOP = Δ_{TOP}

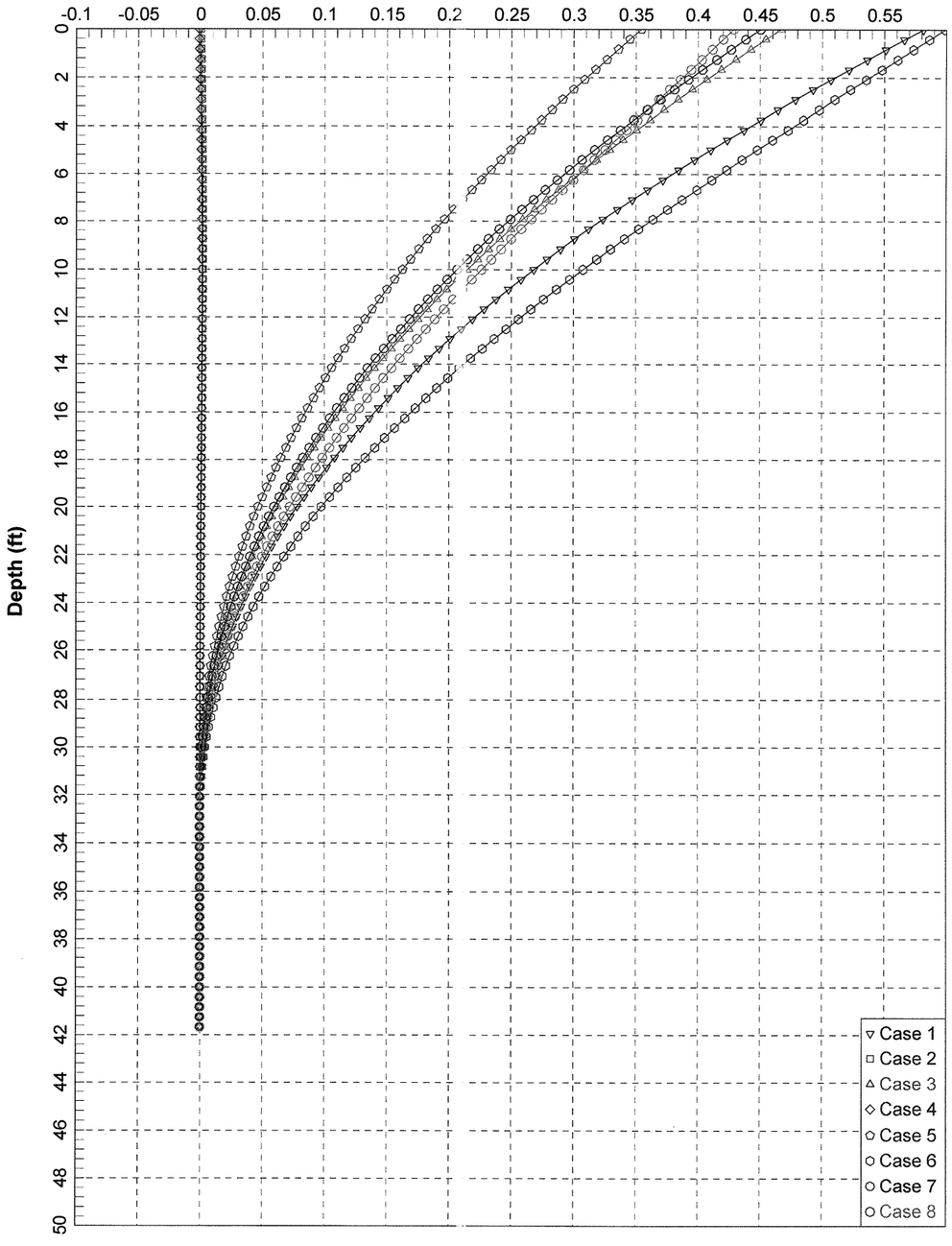
Δ_{TOP}	Max. Neg.	Pile Length
0.60		
(in)	(in)	(in)

COMMENTS:

	(ft)
POINT OF FIXITY EL. =	**364**
TIP NO HIGHER THAN =	**354**

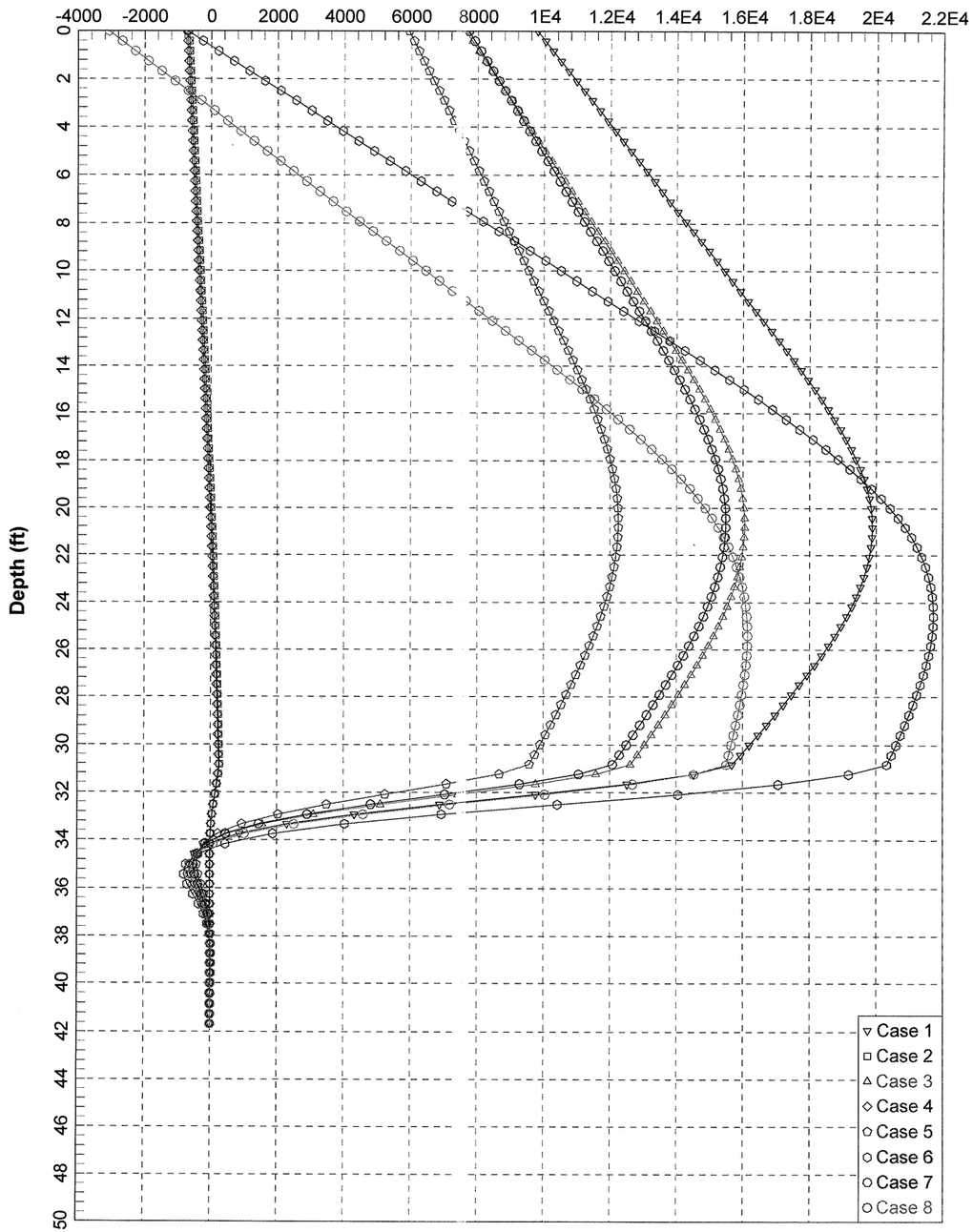
BENT 3 (RT)

Lateral Deflection (in)



BENT 3 (RT)

Bending Moment (in-kips)



BENT 3 (RT)

Shear Force (kips)