ECS Southeast, LLP

Bridge Foundation Design Recommendations

Bridge No. 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek

WBS No.: 17BP.11.R.161
TIP No.: N/A
West Jefferson, Ashe County, North Carolina

ECS Project No. 09:29362

April 27, 2022

April 27, 2022

Mr. Hardy Willis, P.E.
Vaughn & Melton Consulting Engineers
1318-F Patton Avenue
Asheville, North Carolina 28806

ECS Project No.:09:29362

Reference: Bridge Foundation Design Recommendations
Bridge No. 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek
WBS Number: 17BP.11.R.161
TIP Number: N/A
County: Ashe

Dear Mr. Willis:

ECS Southeast, LLP (ECS) is pleased to submit the Bridge Foundation Design Recommendations Report associated with design and construction of Bridge No. 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek in West Jefferson, Ashe County, North Carolina. This work was performed in general accordance with ECS Proposal No. 09-28001PR, dated March 11, 2021.

Our design is based on NCDOT Standard Load Tables and project information provided to us by Vaughn & Melton. This report contains the foundation recommendations, the Structure Subsurface Investigation, and supporting calculations.

ECS Southeast, LLP appreciates the opportunity to assist you during this phase of the project. If you have questions concerning this report, please contact our office at 704-525-5152.

Respectfully,

ECS SOUTHEAST, LLP

NORTH CAROLINA PROFESSIONAL SEAL 026917 ENGINEER MICHAEL J. WALKO 4/27/2022

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FOUNDATION RECOMMENDATIONS

Prepared for NCDOT by: ECS Southeast, LLP

WBS NO. 17BP.11.R.161

T.I.P. NO. N/A

COUNTY Ashe

STATION 13+93.07 -L-

DESCRIPTION Bridge No. 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek

	INITIALS	DATE
DESIGN	MJW	03/28/22
CHECK	KND	03/29/22
SUBMITTED	MJW	04/27/22

SEAL

	STATION	FOUNDATION TYPE	FACTORED LOAD	MISCELLANEOUS DETAILS
END BENT NO. 1	13+66.66 -L-	Cap on HP 12X53 Steel Piles	70 Tons/Pile	Average Bottom of Cap Elevation = 3,015.2 +/- Average Pile Length = 15 ft (LT), 20 ft (RT) 7 Vertical Piles @ 7'-0" Spacing
END BENT NO. 2	14+19.48 -L-	Cap on HP 12X53 Steel Piles	70 Tons/Pile	Average Bottom of Cap Elevation = 3,015.0 ft +/- Average Pile Length = 15 ft (LT), 10 ft (RT) 7 Vertical Piles @ 7'-0" Spacing 1 Wing Wall Pile = 15 ft

(SEE NOTES ON PLANS AND COMMENTS ON FOLLOWING PAGES)

WBS No: 17BP.11.R.161 **County:** Ashe

FOUNDATION RECOMMENDATION NOTES ON PLANS

1) FOR PILES, SEE PILES PROVISION AND SECTION 450 OF THE STANDARD SPECIFICATIONS.

2) FILL THE BOTTOM 3 FT OF HOLES FOR PILE EXCAVATION AT END BENT NO. 1, END BENT NO. 2, AND THE WING WALL PILE WITH CONCRETE AND THE REST OF HOLES WITH CLASS II OR III SELECT MATERIAL THAT MEETS SECTION 1016 OF THE STANDARD SPECIFICATIONS.

FOUNDATION RECOMMENDATION SPECIAL NOTES ON PLANS

1) DRILLED-IN PILES ARE REQUIRED FOR END BENT NO. 1. EXCAVATE HOLES TO A TIP ELEVATION NO HIGHER THAN 3,005 FT (LT) AND 3,001 FT (RT) WITH THE REQUIRED TIP RESISTANCE AND A PENETRATION OF AT LEAST 5 FT INTO WEATHERED ROCK / ROCK. FOR PILE EXCAVATION, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

2) DRILLED-IN PILES ARE REQUIRED FOR END BENT NO. 2. EXCAVATE HOLES TO A TIP ELEVATION NO HIGHER THAN 3,002 FT (LT) AND 3,008 FT (RT) WITH THE REQUIRED TIP RESISTANCE AND A PENETRATION OF AT LEAST 5 FT INTO WEATHERED ROCK / ROCK. FOR PILE EXCAVATION, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

3) A DRILLED-IN PILE IS REQUIRED FOR THE WING WALL AT END BENT NO. 2. EXCAVATE HOLE TO A TIP ELEVATION NO HIGHER THAN 3,002 FT AND A PENETRATION OF AT LEAST 5 FT INTO WEATHERED ROCK / ROCK. FOR PILE EXCAVATION, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

4) PZ 27 SHEETING IS TO BE DRIVEN IN FRONT (STREAM SIDE) OF THE HP 12X53 PILES AT END BENT NO. 1 TO BE USED FOR A VERTICAL FACE.

5) SHEET PILES SHALL BE DRIVEN TO REFUSAL. REFUSAL IS ESTIMATED TO BE AT ELEVATION 3,010 FT (LT) AND 3,006 FT (RT) FOR END BENT NO. 1.

6) PZ 27 SHEETING IS TO BE DRIVEN IN FRONT (STREAM SIDE) OF THE HP 12X53 PILES AT END BENT NO. 2 TO BE USED FOR A VERTICAL FACE.

7) SHEET PILES SHALL BE DRIVEN TO REFUSAL. REFUSAL IS ESTIMATED TO BE AT ELEVATION 3,007 FT (LT) AND 3,013 FT (RT) FOR END BENT NO. 2.

WBS No: 17BP.11.R.161 **County:** Ashe

FOUNDATION RECOMMENDATION COMMENTS

1) PZ-27 SHEETING WILL BE USED TO CREATE A VERTICAL FACE AT END BENT NO. 1 AND END BENT NO. 2.

2) CLASS II RIP RAP WILL ALSO BE USED FOR SCOUR PROTECTION AT END BENT NO. 1 AND END BENT NO. 2.

3) NO WAITING PERIOD IS REQUIRED AT EITHER END BENT PRIOR TO CONSTRUCTION.

4) AVERAGE PILE LENGTHS ARE BASED ON PLUMB PILES FROM THE BOTTOM OF CAP ELEVATION TO THE ANTICIPATED TIP ELEVATION, ROUNDED UP TO THE NEAREST 5 FEET.

5) PDA WILL NOT BE USED TO MONITOR DRIVING STRESSES AT END BENT NO. 1 AND END BENT NO. 2.

6) PROJECT SLOPES SHOULD BE DESIGNED AT A MAXIMUM INCLINATION OF 2H:1V.

7) BASED ON THE BORING LOGS, A GEOTECHNICALLY ADJUSTED SCOUR ELEVATION (GASE) OF 3,007 FT AT END BENT NO. 1 AND 3,009 FT AT END BENT NO. 2 IS RECOMMENDED FOR USE IN PREPARING THE BRIDGE SURVEY & HYDRAULIC DESIGN (BSR) REPORT.

SUMMARY OF PILE INFORMATION/INSTALLATION

(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No, Pile(s) #-# (e.g., "Bent 1, Piles 1-5")	Factored Resistance per Pile TONS	Pile Cut-Off (Top of Pile) Elevation FT	Estimated Pile Lenth per Pile FT	Scour Critical Elevation FT	Driven Piles			Predrilling for Piles*			Drilled-In Piles		
					Min Pile Tip (Tip No Higher Than) Elev FT	Required Driving Resistance (RDR)** per Pile TONS	Total Pile Redrives Quantity EACH	Predrilling Length per Pile Lin FT	Predrilling Elevation (Elev Not To Predrill Below) FT	Maximum Predrilling Dia INCHES	Pile Excavation (Bottom of Hole) Elev FT	Pile Exc Not In Soil per Pile Lin FT	Pile Exc In Soil per Pile Lin FT
End Bent No. 1, Piles 1-4	70	See Substructure Plans	15								3005.0	4.8	5.4
End Bent No. 1, Piles 5-7	70		20								3001.0	5.3	8.9
End Bent No. 2, Piles 1-3	70		15								3002.0	4.8	8.2
End Bent No. 2, Piles 4-7	70		10								3008.0	4.7	2.3
End Bent No. 2, Wing Pile	N/A		15								3002.0	5.9	6.3

**Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.

$$^{**}RDR = \frac{Factored\ Resistance + Factored\ Downdrag\ Load + Factored\ Dead\ Load}{Dynamic\ Resistance\ Factor} + Nominal\ Downdrag\ Resistance + \frac{Nominal\ Scour\ Resistance}{Scour\ Resistance\ Factor}$$

PILE DESIGN INFORMATION

(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No, Pile(s) #-# (e.g., "Bent 1, Piles 1-5")	Factored Axial Load per Pile TONS	Factored Downdrag Load per Pile TONS	Factored Dead Load* per Pile TONS	Dynamic Resistance Factor	Nominal Downdrag Resistance per Pile TONS	Nominal Scour Resistance per Pile TONS	Scour Resistance Factor (Default = 1.00)
End Bent No. 1, Pile 1-7	70						
End Bent No. 2, Piles 1-7	70						

*Factored Dead Load is factored weight of pile above the ground line.

*Factored Dead Load is factored weight of pile above the ground line.

PROJECT NO. 17BP.11.R.161

ASHE COUNTY

STATION: 13+93.07 -L-

NOTES:

1. The Pile Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Michael J. Walko, #026917) on 4-27-2022.
2. Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
3. The Engineer will determine the need for PDA Testing and Pipe Pile Plates when PDAs or plates may be required.

NORTH CAROLINA PROFESSIONAL SEAL 20777 ENGINEER HARDY L. WILLIS

SIGNATURE DATE

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PILE FOUNDATION TABLES

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS

NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO.

TOTAL SHEETS

REPLACE BRIDGE No. 015 ON SR 1147 (NETTLE KNOB ROAD) OVER SOUTH BEAVER CREEK

SUPPORTING DOCUMENTATION

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	17BP.11.R.161	1	21

REFERENCE: 17BP.11.R.161

PROJECT: N/A

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *ASHE*

PROJECT DESCRIPTION *REPLACE BRIDGE NO. 15 ON ST 1147 (NETTLE KNOB ROAD) OVER SOUTH BEAVER CREEK*

CONTENTS

PERSONNEL

A. BLACKMORE

GEOLOGIC EXPLORATION

INVESTIGATED BY *ECS SOUTHEAST, LLP*

DRAWN BY *K. DE MONTBRUN, P.E.*

CHECKED BY *M. WALKO, P.E.*

SUBMITTED BY *ECS SOUTHEAST, LLP*

DATE *MARCH 2022*

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

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2. 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.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045542 KELLY N. DE MONTBRUN

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kelly de Montbrun 3/21/2022
7BDD9975E22A480... SIGNATURE DATE

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PROJECT REFERENCE NO.	SHEET NO.
17BP.11.R.161	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

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

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,
VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

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
MATERIAL PASSING #40 LL PI	6 MX		NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
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 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 RESISTANCE (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 0.5 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) PL — PLASTIC LIMIT	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
OM — OPTIMUM MOISTURE SL — SHRINKAGE LIMIT	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	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.
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

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 WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LL < 31
MODERATELY COMPRESSIBLE	LL = 31 - 50
HIGHLY COMPRESSIBLE	LL > 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	> 10%	> 20%	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 WITH CORE
- SPT N-VALUE

RECOMMENDATION SYMBOLS

- UNDERCUT
- SHALLOW UNDERCUT
- UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
- UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK
- UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

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
ω - 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:
- [ ] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] 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 _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [X] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -N Q2

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

PROJECT REFERENCE NO.	SHEET NO.
17BP.11.R.161	2A

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

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

ROCK DESCRIPTION

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

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, WOULD YIELD SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, WOULD YIELD 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 FOOT
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 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, SUCH 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: FEET

NOTES:

BORINGS LOCATED USING TRIMBLE GEO 7X HANDHELD UNIT.

FIAD = FILLED IN AFTER DRILLING

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
17BP.11.R.161	2B

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)

From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.

STRUCTURE

SURFACE CONDITIONS

VERY GOOD Very rough, fresh unweathered surfaces

GOOD Rough, slightly weathered, iron stained surfaces

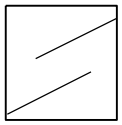
FAIR Smooth, moderately weathered and altered surfaces

POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments

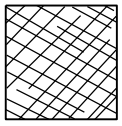
VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings

DECREASING SURFACE QUALITY ⇨

DECREASING INTERLOCKING OF ROCK PIECES ⇩



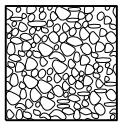
INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities



BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets

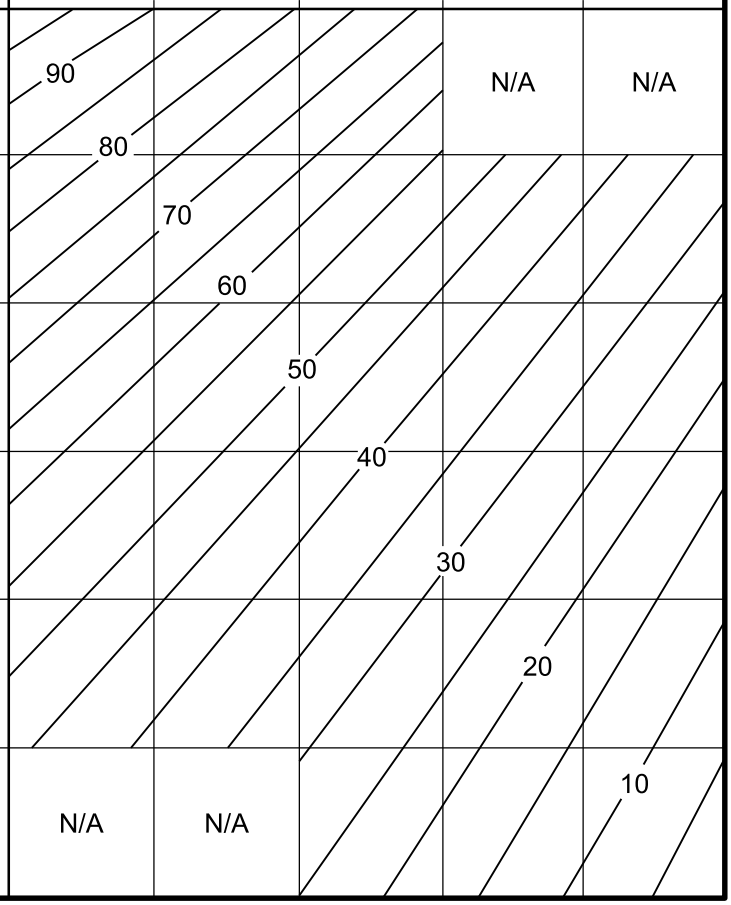
VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets

BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity



DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces

LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes



PROJECT REFERENCE NO.	SHEET NO.
17BP.11.R.161	2C

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

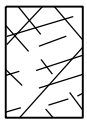
GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos. P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

COMPOSITION AND STRUCTURE

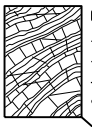
SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces	GOOD - Rough, slightly weathered surfaces	FAIR - Smooth, moderately weathered and altered surfaces	POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings



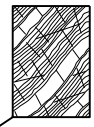
A. *Thick bedded, very blocky sandstone The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.*

B. *Sandstone with thin interlayers of siltstone*



C. *Sandstone and siltstone in similar amounts*

D. *Siltstone or silty shale with sandstone layers*



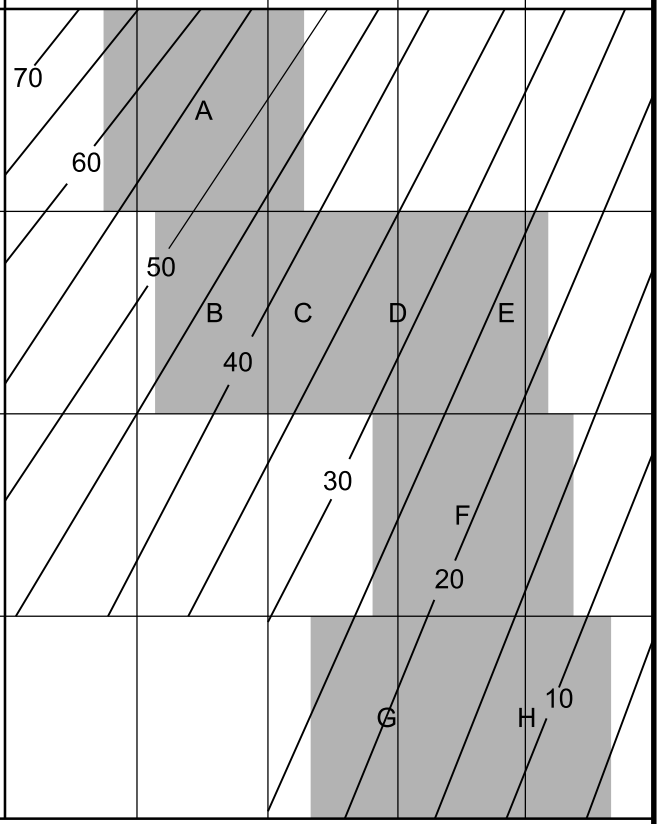
E. *Weak siltstone or clayey shale with sandstone layers*

C, D, E, and **G** - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H.**

F. *Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure*

G. *Undisturbed silty or clayey shale with or without a few very thin sandstone layers*

H. ***Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.***



Means deformation after tectonic disturbance

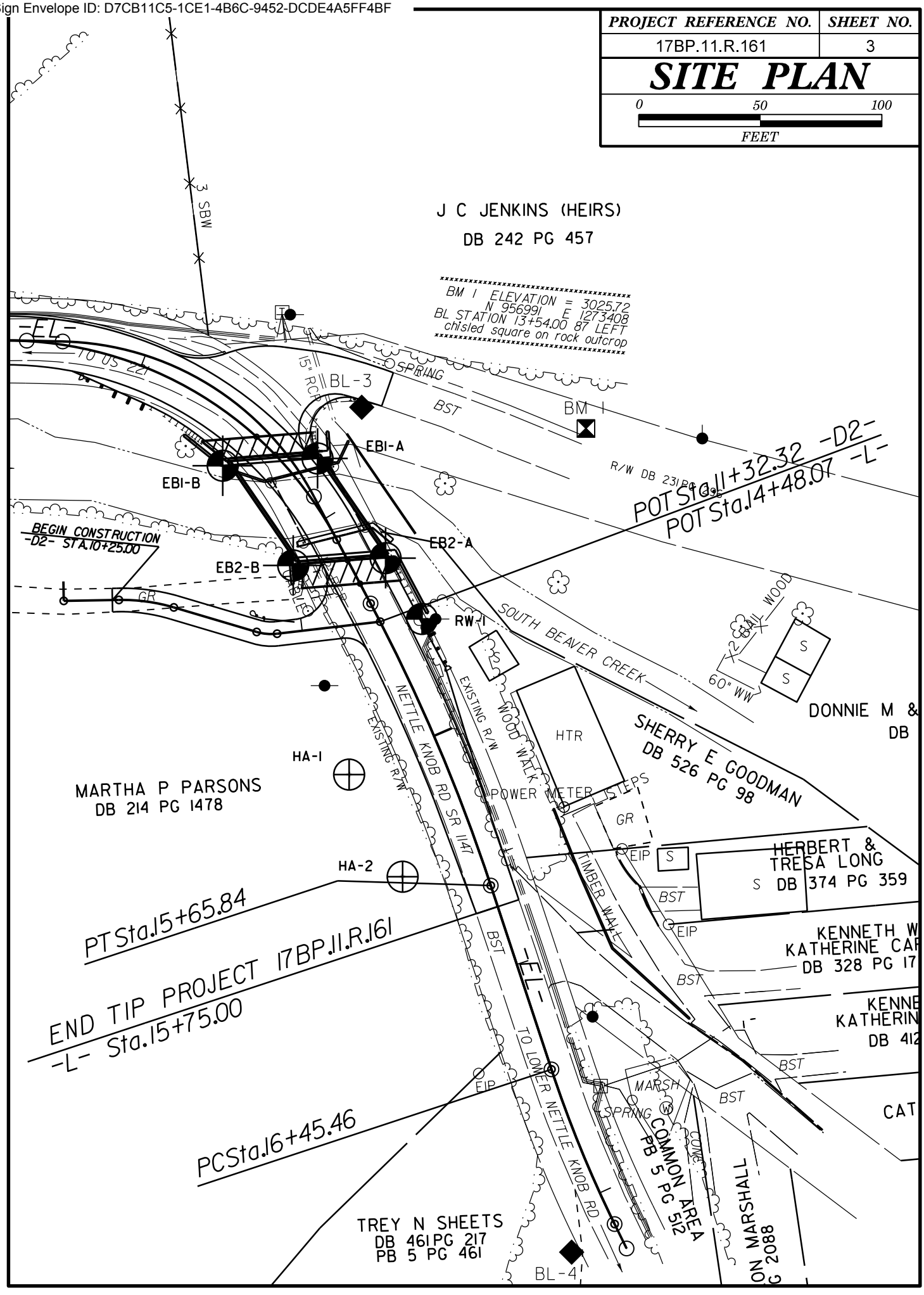
DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
17BP.11.R.161	3

SITE PLAN

0 50 100

FEET



GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+79	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,018.3 ft	**TOTAL DEPTH** 19.2 ft	**NORTHING** 956,979	**EASTING** 1,273,298	**24 HR.** 4.3
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring		**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**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)
3020											
	3,018.3	0.0	5	6	5	11		M		3,018.3 GROUND SURFACE	0.0
3015	3,014.8	3.5	10	1	1	2		M		**ROADWAY EMBANKMENT** Soft to Stiff, Brown, Fine to Coarse Sandy SILT (A-4), with trace rock fragments	
	3,012.3	6.0	1	1	1	2		W		3,012.8	5.5
3010	3,009.8	8.5								**ALLUVIAL** Soft, Brown-Black, Fine to Coarse Sandy SILT (A-4), with trace mica	
	3,009.1	9.2	100/0.4			100/0.4				3,009.8	8.5
3005			60/0.0			60/0.0				3,009.1 **WEATHERED ROCK** Brown (BIOTITE GNEISS)	9.2
										CRYSTALLINE ROCK Gray (BIOTITE GNEISS)	
3000										2,999.1	19.2
										Boring Terminated at Elevation 2,999.1 ft In Crystalline Rock (BIOTITE GNEISS)	

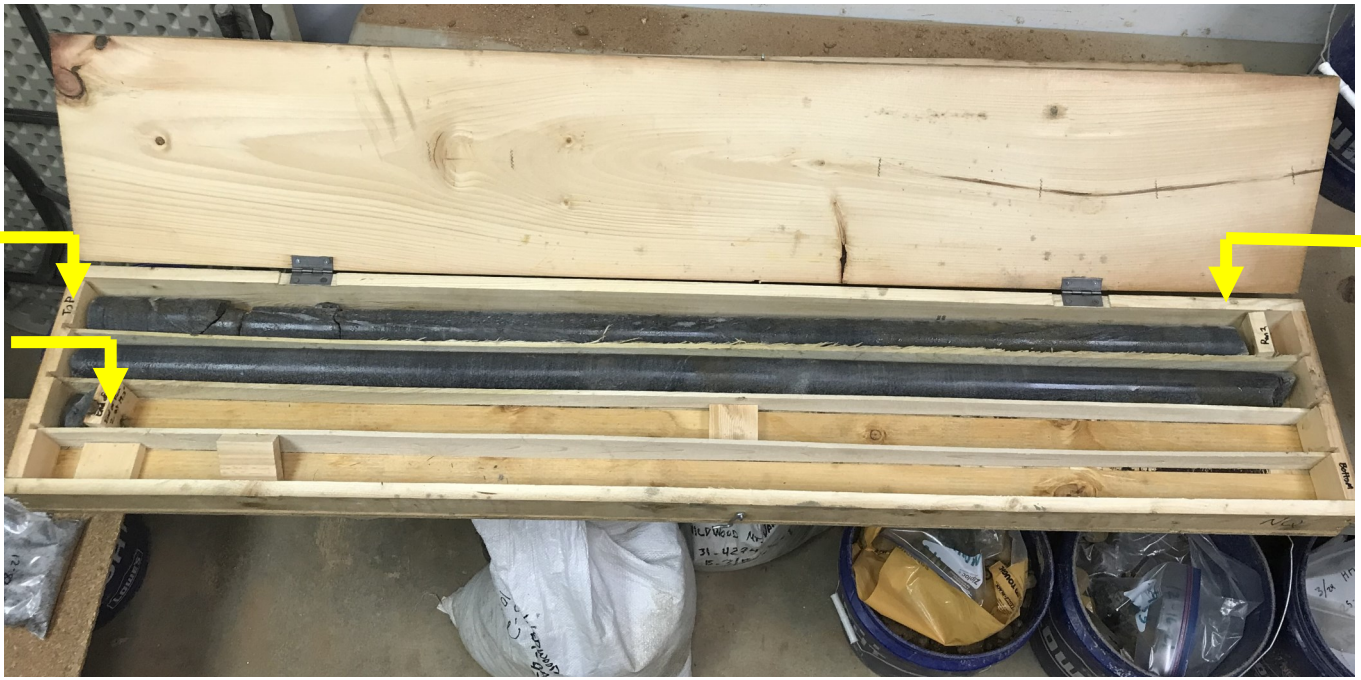
GEOTECHNICAL BORING REPORT
CORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+79	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,018.3 ft	**TOTAL DEPTH** 19.2 ft	**NORTHING** 956,979	**EASTING** 1,273,298	**24 HR.** 4.3
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 10.0 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
3009.1											Begin Coring @ 9.2 ft
	3,009.1	9.2	5.0	*N=60/0.0* 1:03/1.0 1:26/1.0 1:27/1.0 1:32/1.0 1:28/1.0	(4.8) 96%	(4.8) 96%		(9.8) 98%	(9.8) 98%		3,009.1 **CRYSTALLINE ROCK** 9.2 Fresh, Hard, Gray BIOTITE GNEISS with Very Wide Fracture Spacing REC = 98%, RQD = 98%, GSI = 80-85
3005	3,004.1	14.2	5.0	1:24/1.0 1:13/1.0 1:32/1.0 1:12/1.0 1:26/1.0	(5.0) 100%	(5.0) 100%					
3000	2,999.1	19.2									2,999.1 19.2 Boring Terminated at Elevation 2,999.1 ft In Crystalline Rock (BIOTITE GNEISS)

Ashe County Bridge 15

Rock Core Photographs: Boring - EB1-A



GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+53	**OFFSET** 18 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,014.8 ft	**TOTAL DEPTH** 20.5 ft	**NORTHING** 956,976	**EASTING** 1,273,259	**24 HR.** 4.8
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**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)
3015												
	3,014.8	0.0	3	5	12	17		M		GROUND SURFACE	3,014.8	0.0
										ROADWAY EMBANKMENT Medium Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4)		
	3,011.3	3.5	2	1	2	3		W			3,010.8	4.0
3010										**ALLUVIAL** Soft, Gray, Fine to Coarse Sandy SILT (A-4)		
	3,008.8	6.0	2	10	16	26		W			3,007.8	7.0
	3,006.3	8.5								Medium Dense, Brown-Tan, Silty Fine to Coarse SAND (A-2-4), with little cobbles	3,006.3	8.5
3005			73	27/0.2		100/0.7				**WEATHERED ROCK** Brown (BIOTITE GNEISS)		
	3,003.3	11.5	60/0.0			60/0.0					3,003.3	11.5
3000										**CRYSTALLINE ROCK** Gray (BIOTITE GNEISS)		
2995												
											2,994.3	20.5
										Boring Terminated at Elevation 2,994.3 ft In Crystalline Rock (BIOTITE GNEISS)		

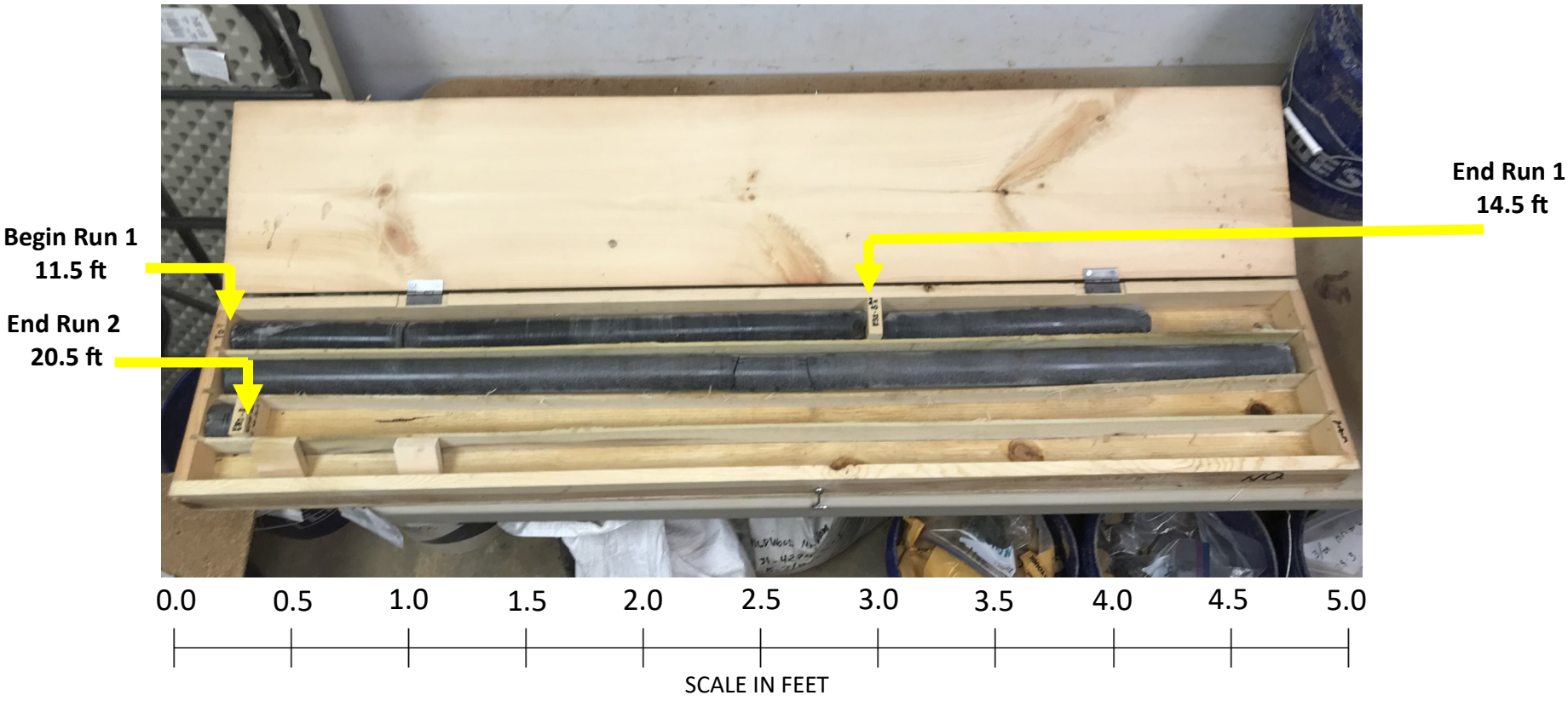
GEOTECHNICAL BORING REPORT
CORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+53	**OFFSET** 18 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,014.8 ft	**TOTAL DEPTH** 20.5 ft	**NORTHING** 956,976	**EASTING** 1,273,259	**24 HR.** 4.8
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 9.0 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
3003.3											Begin Coring @ 11.5 ft
	3,003.3	11.5	3.0	*N=60/0.0* 2:35/1.0 4:04/1.0 1:59/1.0	(3.0) 100%	(3.0) 100%		(9.0) 100%	(9.0) 100%		3,003.3 **CRYSTALLINE ROCK** 11.5 Fresh, Hard, Gray BIOTITE GNEISS with Wide Fracture Spacing REC = 100%, RQD = 100%, GSI = 80-85
3000	3,000.3	14.5	6.0	3:10/1.0 3:17/1.0 3:58/1.0 4:15/1.0 3:30/1.0 4:48/1.0	(6.0) 100%	(6.0) 100%					
2995	2,994.3	20.5									2,994.3 20.5 Boring Terminated at Elevation 2,994.3 ft In Crystalline Rock (BIOTITE GNEISS)

Ashe County Bridge 15

Rock Core Photographs: Boring - EB1-B



GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 14+26	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,017.1 ft	**TOTAL DEPTH** 21.0 ft	**NORTHING** 956,938	**EASTING** 1,273,326	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**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)
3020											
	3,017.1	0.0								3,017.1 GROUND SURFACE	0.0
3015			3	4	5	9		M		**ROADWAY EMBANKMENT** Soft to Stiff, Brown, Fine to Coarse Sandy SILT (A-4), with trace rock fragments	
	3,013.6	3.5	6	2	1	3		M			
	3,011.1	6.0									
3010			1	1	1	2		M		3,009.1	8.0
	3,008.6	8.5	15	85/0.4				Sat.		**ALLUVIAL** Very Dense, Brown-Tan, Silty Fine to Coarse SAND (A-2-4)	
	3,006.8	10.3	60/0.0			100/0.9 60/0.0				3,006.8	10.3
3005										3,006.1	11.0
										CRYSTALLINE ROCK Gray (BIOTITE GNEISS)	
										CRYSTALLINE ROCK Gray (BIOTITE GNEISS)	
3000											
										2,996.1	21.0

Boring Terminated at Elevation 2,996.1 ft In Crystalline Rock (BIOTITE GNEISS)

1) High N-values in the alluvial layer due to cobbles encountered during drilling

2) A tri-cone bit was used to seat the casing after SPT refusal was encountered. Rock coring began at 11.0 feet.

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 14+26	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,017.1 ft	**TOTAL DEPTH** 21.0 ft	**NORTHING** 956,938	**EASTING** 1,273,326	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 10.0 ft			

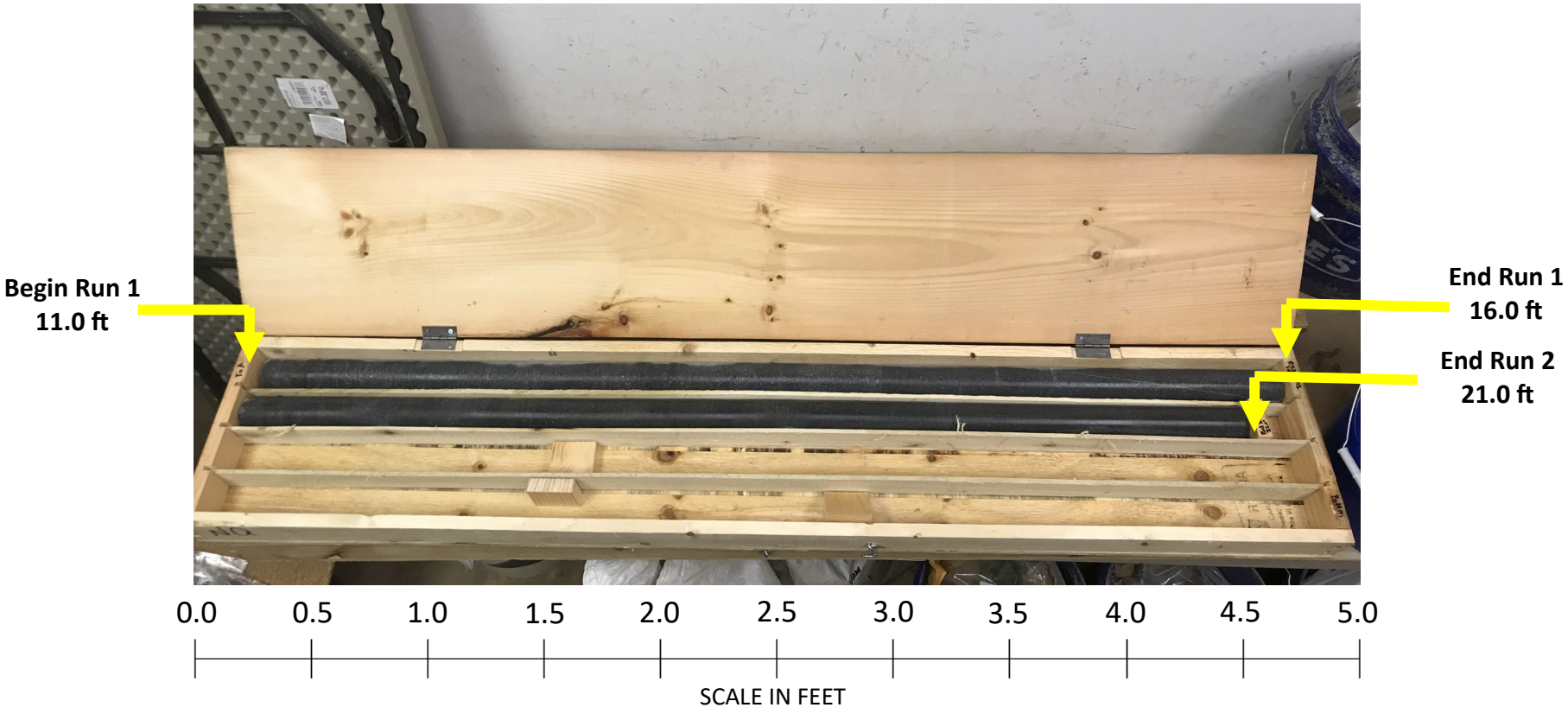
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
3006.1											Begin Coring @ 11.0 ft
3005	3,006.1	11.0	5.0	1:47/1.0 2:26/1.0 2:13/1.0 1:20/1.0 2:15/1.0	(5.0) 100%	(5.0) 100%		(9.9) 99%	(9.9) 99%		**CRYSTALLINE ROCK** Fresh, Hard, Gray BIOITIE GNEISS with Very Wide Fracture Spacing REC = 99%, RQD = 99%, GSI = 80-85
	3,001.1	16.0									
3000			5.0	2:28/1.0 2:56/1.0 2:30/1.0 2:50/1.0 2:53/1.0	(4.9) 98%	(4.9) 98%					
	2,996.1	21.0									Boring Terminated at Elevation 2,996.1 ft In Crystalline Rock (BIOTITE GNEISS) 1) High N-values in the alluvial layer due to cobbles encountered during drilling 2) A tri-cone bit was used to seat the casing after SPT refusal was encountered. Rock coring began at 11.0 feet.

ELEV. (ft) 3,006.1 — DEPTH (ft) 11.0

ELEV. (ft) 2,996.1 — DEPTH (ft) 21.0

Ashe County Bridge 15

Rock Core Photographs: Boring - EB2-A



GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 14+11	**OFFSET** 21 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,017.7 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 956,935	**EASTING** 1,273,288	**24 HR.** 3.4
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring		**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**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
3020										ELEV. (ft) / DEPTH (ft)
	3,017.7	0.0								3,017.7 GROUND SURFACE 0.0
3015			5	5	5	10		M		**ROADWAY EMBANKMENT** Loose, Brown, Silty Fine to Coarse SAND (A-2-4)
	3,014.2	3.5								
	3,012.7	5.0	3	4	2	6 60/0.0		M		3,012.7 5.0
			60/0.0							3,011.7 **CRYSTALLINE ROCK** 6.0 Gray-White (BIOTITE GNEISS)
3010										**CRYSTALLINE ROCK** Gray-White (BIOTITE GNEISS)
3005										3,001.7 16.0

Boring Terminated at Elevation 3,001.7 ft In Crystalline Rock (BIOTITE GNEISS)

1) A tri-cone bit was used to seat the casing after SPT refusal was encountered. Rock coring began at 6.0 feet.

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 14+11	**OFFSET** 21 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,017.7 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 956,935	**EASTING** 1,273,288	**24 HR.** 3.4
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring		**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 10.0 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
3011.7											Begin Coring @ 6.0 ft
3010	3,011.7	6.0	5.0	5:11/1.0 6:47/1.0 6:08/1.0 7:40/1.0 6:38/1.0	(5.0) 100%	(5.0) 100%		(10.0) 100%	(10.0) 100%		ELEV. 3,011.7 DEPTH 6.0 **CRYSTALLINE ROCK** Fresh, Hard, Gray-White BIOTITE GNEISS with Very Wide Fracture Spacing REC = 100%, RQD = 100%, GSI = 80-85
	3,006.7	11.0									
3005			5.0	6:28/1.0 6:18/1.0 9:58/1.0 2:15/1.0 1:57/1.0	(5.0) 100%	(5.0) 100%					
	3,001.7	16.0									ELEV. 3,001.7 DEPTH 16.0 Boring Terminated at Elevation 3,001.7 ft In Crystalline Rock (BIOTITE GNEISS) 1) A tri-cone bit was used to seat the casing after SPT refusal was encountered. Rock coring began at 6.0 feet.

Ashe County Bridge 15

Rock Core Photographs: Boring - EB2-B

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. RW-1	**STATION** 14+55	**OFFSET** 16 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,018.6 ft	**TOTAL DEPTH** 10.0 ft	**NORTHING** 956,913	**EASTING** 1,273,341	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**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
3020										ELEV. (ft) / DEPTH (ft)
	3,018.6	0.0								3,018.6 GROUND SURFACE 0.0
			5	4	5	9		M		**ROADWAY EMBANKMENT** Soft to Stiff, Brown-Black, Fine to Coarse Sandy SILT (A-4), with trace rock fragments
3015	3,015.1	3.5								
			4	4	1	5		M		
	3,012.6	6.0								
			2	1	1	2		W		
3010	3,010.1	8.5								3,010.6 8.0
			1	1	99/0.4			Sat.		3,009.1 **ALLUVIAL** 9.5
	3,008.6	10.0	60/0.0			100/0.9 60/0.0				3,008.6 Soft, Gray-Black, Fine to Coarse Sandy SILT (A-4) 10.0
										WEATHERED ROCK Gray (BIOTITE GNEISS)
										Boring Terminated with Standard Penetration Test Refusal at Elevation 3,008.6 ft On Crystalline Rock (BIOTITE GNEISS)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. HA-1	**STATION** 15+01	**OFFSET** 39 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,031.1 ft	**TOTAL DEPTH** 4.0 ft	**NORTHING** 956,849	**EASTING** 1,273,311	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE N/A		**DRILL METHOD** Hand Auger		**HAMMER TYPE** N/A
DRILLER N/A	**START DATE** 12/29/21	**COMP. DATE** 12/29/21	**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)
3035											
										3,031.1 GROUND SURFACE	0.0
3030								M		**RESIDUAL** Soft, Moist, Brown Fine to Coarse Sandy SILT (A-4)	
								M		3,028.1	3.0
										3,027.1 Very Stiff, Moist, Brown Fine to Coarse Sandy SILT (A-4)	4.0

Boring Terminated by Auger Refusal at Elevation 3,027.1 ft In Residual Sandy SILT (A-4)

1) Surficial Organic Laden Soil from 0.0 - 0.5 feet.

2) Hand auger boring offset several times with similar refusal depths.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. HA-2	**STATION** 15+50	**OFFSET** 33 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 3,033.5 ft	**TOTAL DEPTH** 2.5 ft	**NORTHING** 956,807	**EASTING** 1,273,333	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE N/A		**DRILL METHOD** Hand Auger		**HAMMER TYPE** N/A
DRILLER N/A	**START DATE** 12/29/21	**COMP. DATE** 12/29/21	**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)
3035										3,033.5 GROUND SURFACE	0.0
								M		**RESIDUAL**	
										3,031.5 Very Soft, Moist, Brown Fine to Coarse Sandy SILT (A-4)	2.0
										3,031.0 Very Stiff, Moist, Brown Fine to Coarse Sandy SILT (A-4)	2.5

Boring Terminated by Auger Refusal at Elevation 3,031.0 ft In Residual Sandy SILT (A-4)

1) Surficial Organic Laden Soil from 0.0 - 0.4 feet.

2) Hand auger boring offset several times with similar refusal depths.

End Bent Geometry and Loads

Ashe 15
1@50

Bridge Width	CS Unit Length	Factored Pile Reaction (kips)	Factored Pile Reaction (tons)
27'	25'-0"	106	53
	30'-0"	118	59
	35'-0"	126	63
	40'-0"	132	66
	45'-0"	140	70
	50'-0"	154	77
	55'-0"	162	81
	60'-0"	170	85
	65'-0"	178	89
	70'-0"	184	92
30'	25'-0"	110	55
	30'-0"	122	61
	35'-0"	132	66
	40'-0"	140	70
	45'-0"	148	74
	50'-0"	162	81
	55'-0"	170	85
	60'-0"	180	90
	65'-0"	188	94
	70'-0"	194	97
33'	25'-0"	92	46
	30'-0"	102	51
	35'-0"	110	55
	40'-0"	118	59
	45'-0"	122	61
	50'-0"	134	67
	55'-0"	142	71
	60'-0"	148	74
	65'-0"	156	78
	70'-0"	162	81
36'	25'-0"	96	48
	30'-0"	108	54
	35'-0"	116	58
	40'-0"	122	61
	45'-0"	130	65
	50'-0"	142	71
	55'-0"	148	74
	60'-0"	156	78
	65'-0"	164	82
	70'-0"	170	85
39'	25'-0"	100	50
	30'-0"	112	56
	35'-0"	120	60
	40'-0"	126	63
	45'-0"	136	68
	50'-0"	146	73
	55'-0"	154	77
	60'-0"	162	81
	65'-0"	170	85
	70'-0"	176	88

Factored Load = 70 tons/pile

Bridge Width	Skew	Cap Length	No. of Vertical Piles	Pile Spacing
27'	60/120	38'-2"	5	8'-6"
	75/105	34'-3"	5	7'-6"
	90	33'-0"	5	7'-6"
30'	60/120	41'-8"	5	9'-6"
	75/105	37'-4"	5	8'-3"
	90	36'-0"	5	8'-3"
33'	60/120	45'-2"	7	7'-0"
	75/105	40'-6"	7	6'-0"
	90	39'-0"	7	6'-0"
36'	60/120	48'-7"	7	7'-6"
	75/105	43'-7"	7	6'-6"
	90	42'-0"	7	6'-6"
39'	60/120	52'-0"	7	8'-0"
	75/105	46'-8"	7	7'-0"
	90	45'-0"	7	7'-0"

7 Vertical Piles @ 7'-0" Spacing

Michael J Walko, P.E.

From: Garrett W. Powell <gwpowell@VaughnMelton.com>
Sent: Tuesday, March 22, 2022 4:07 PM
To: Michael J Walko, P.E.; Hardy L. Willis
Cc: Ryan T. Shipman
Subject: [EXTERNAL] RE: Ashe 15 Foundation Recommendations

Here are the revised cap elevations and revised top of pile cutoff elevations.

Bottom of Cap Elevations

	End Bent 1	End Bent 2
Left	3016.0	3015.7
Right	3014.4	3014.2

AVE 3015.2' 3015.0'

Top of pile cutoff elevations:

End Bent 1

Pile	Elevation
1	3016.87
2	3016.65
3	3016.44
4	3016.22
5	3016.00
6	3015.78
7	3015.56

End Bent 2

Pile	Elevation
1	3016.63
2	3016.42
3	3016.20
4	3015.98
5	3015.76
6	3015.54
7	3015.33

EB2 left wing brace pile 3016.73 with 2' Embed, Bottom of WingWall = 3014.7'

GRADE DATA -L-

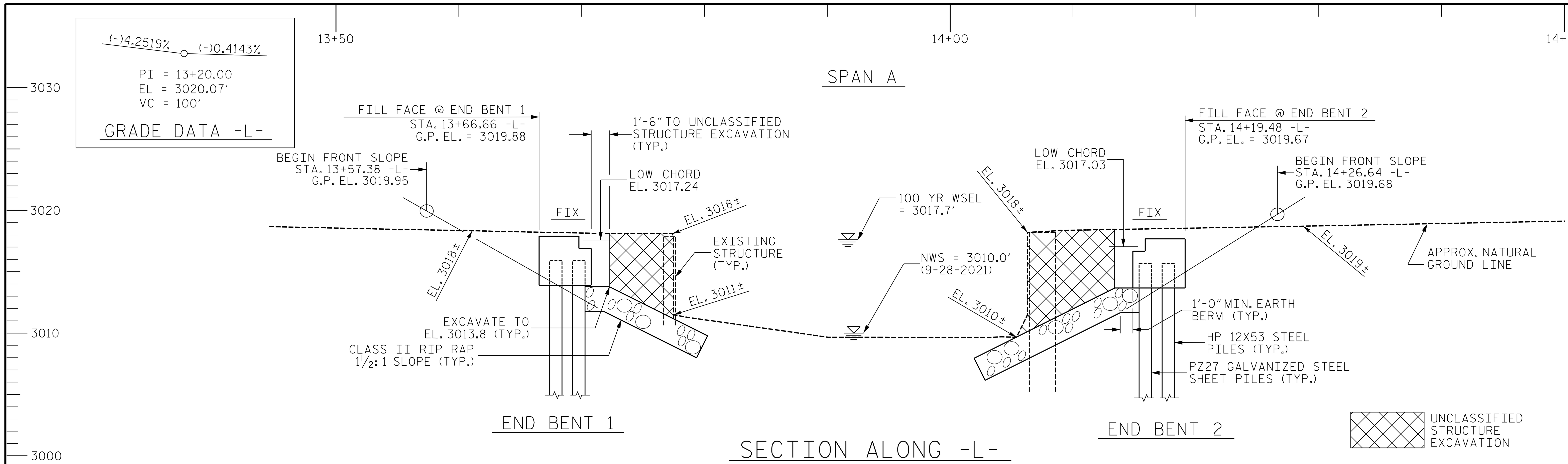
(-)4.2519% (-)0.4143%

PI = 13+20.00
EL = 3020.07'
VC = 100'

GRADE DATA -L-

(-)0.4143% (+)3.2261%

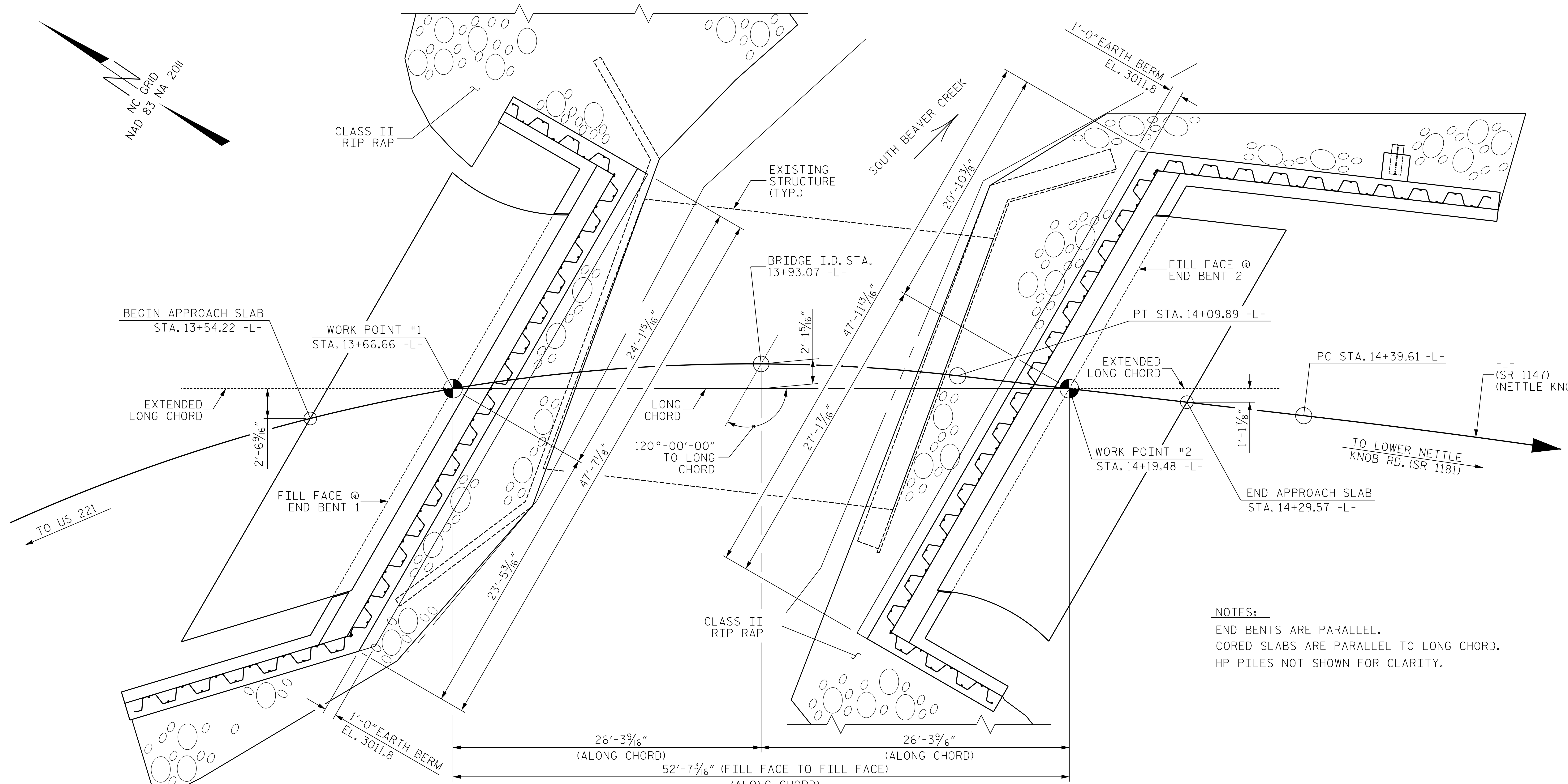
PI = 14+60.00
EL = 3019.49'
VC = 100'



SECTION ALONG -L-

PI STA. 13+35.51	PI STA. 15+02.88
△ = 62°-18'-44.2" (RT)	△ = 9°-38'-34.9" (RT)
D = 37°-12'-18.2"	D = 7°-38'-22.0"
L = 167.48'	L = 126.23'
T = 93.10'	T = 63.26'
R = 154.00'	R = 750.00'

HORIZ. CURVE DATA -L-



PLAN

NOTES:

END BENTS ARE PARALLEL.
CORED SLABS ARE PARALLEL TO LONG CHORD.
HP PILES NOT SHOWN FOR CLARITY.

NORTH CAROLINA PROFESSIONAL SEAL 042890 ENGINEER PATRICK R. GALLAGHER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

V&M Vaughn & Melton Consulting Engineers
Asheville, North Carolina 828-253-2796
Raleigh, NC 919-977-9455 | Charlotte, NC 704-357-0488
Boone, NC 828-355-9933 | Tri-Cities, TN 423-467-8401 | Knoxville, TN 865-546-5800 | Spartanburg, SC 864-574-4775 | Charleston, SC 843-974-5650 | Middlesboro, KY 606-248-6600 | Atlanta, GA 770-627-3590

PROJECT NO. 17BP.11.R.161
ASHE COUNTY
STATION: 13+93.07 -L-

SHEET 1 OF 2 REPLACES BRIDGE NO. 40015

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

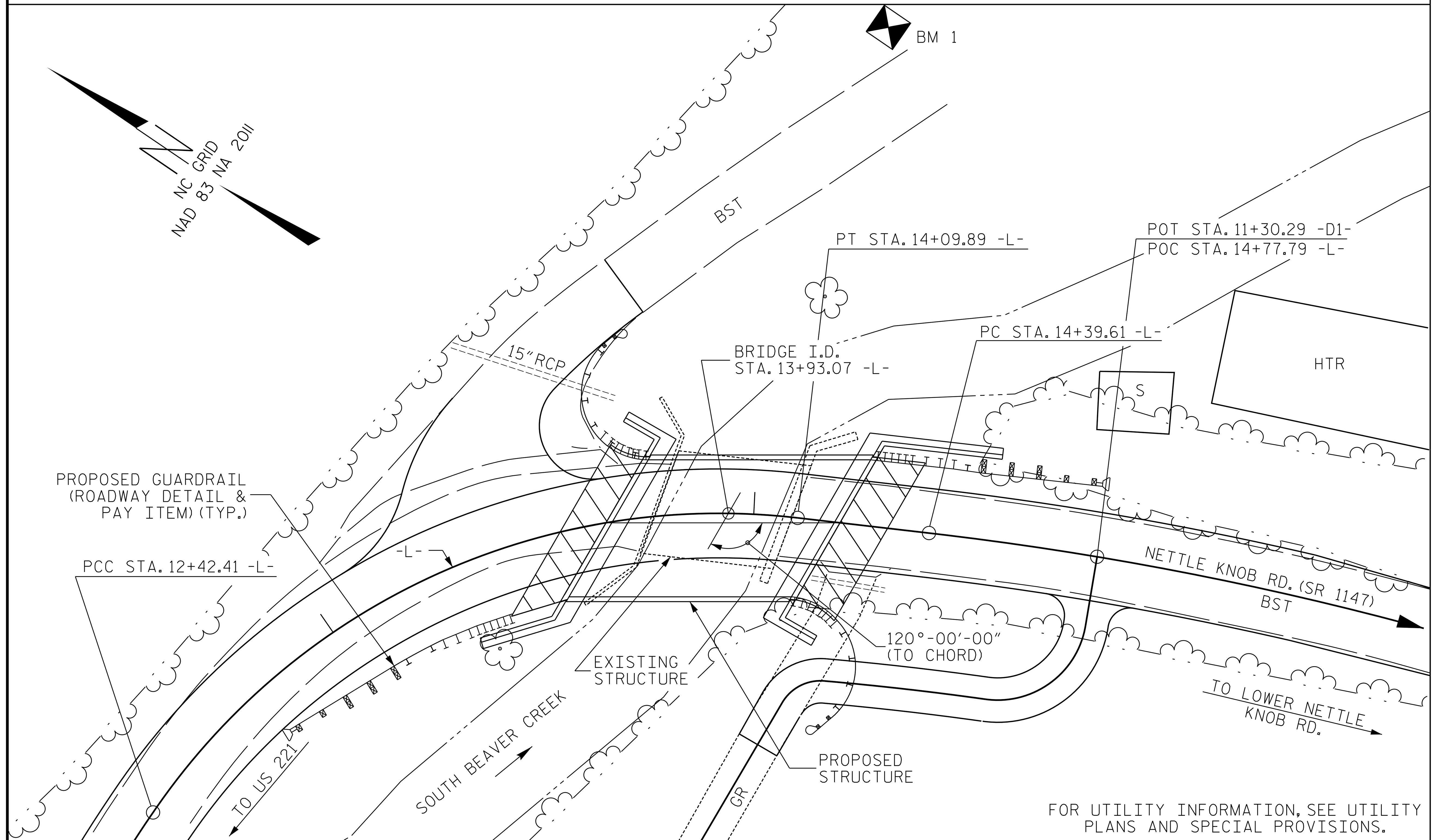
PRELIMINARY GENERAL DRAWING

BRIDGE ON SR 1147 (NETTLE KNOB RD.) OVER SOUTH BEAVER CREEK BETWEEN US 221 AND LOWER NETTLE KNOB RD.

DWN. BY: WDC	DATE: 01-2022	REVISIONS					SHEET NO. S-1
CHKD. BY: PRG	DATE: 01/2022	NO.	BY:	DATE:	NO.	BY: DATE:	TOTAL SHEETS 2
DES. EGR. OF RECORD: GWP	DATE: 01/2022	1			3		
		2			4		

DocuSign Envelope ID: D7CB11C5-1CE1-4B6C-9452-DCDE4A5FF4BF

BM 1: CHISLED SQUARE ON ROCK OUTCROP, 112′ LEFT OF -L- STA. 14+17.51 -L-, N 956991, E 1273408 ELEV. 3025.72



LOCATION SKETCH

GENERAL NOTES

ASSUMED LIVE LOAD = HL-93 OR ALTERNATE LOADING.

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

THIS BRIDGE IS LOCATED IN SEISMIC ZONE 1.

HYDRAULIC DATA

DESIGN DISCHARGE	=	870 CFS
DESIGN FREQUENCY	=	25 YRS
DESIGN HW ELEVATION	=	3016.5 FT
BASE DISCHARGE	=	1300 CFS
BASE FREQUENCY	=	100 YRS
BASE HW ELEVATION	=	3017.7 FT

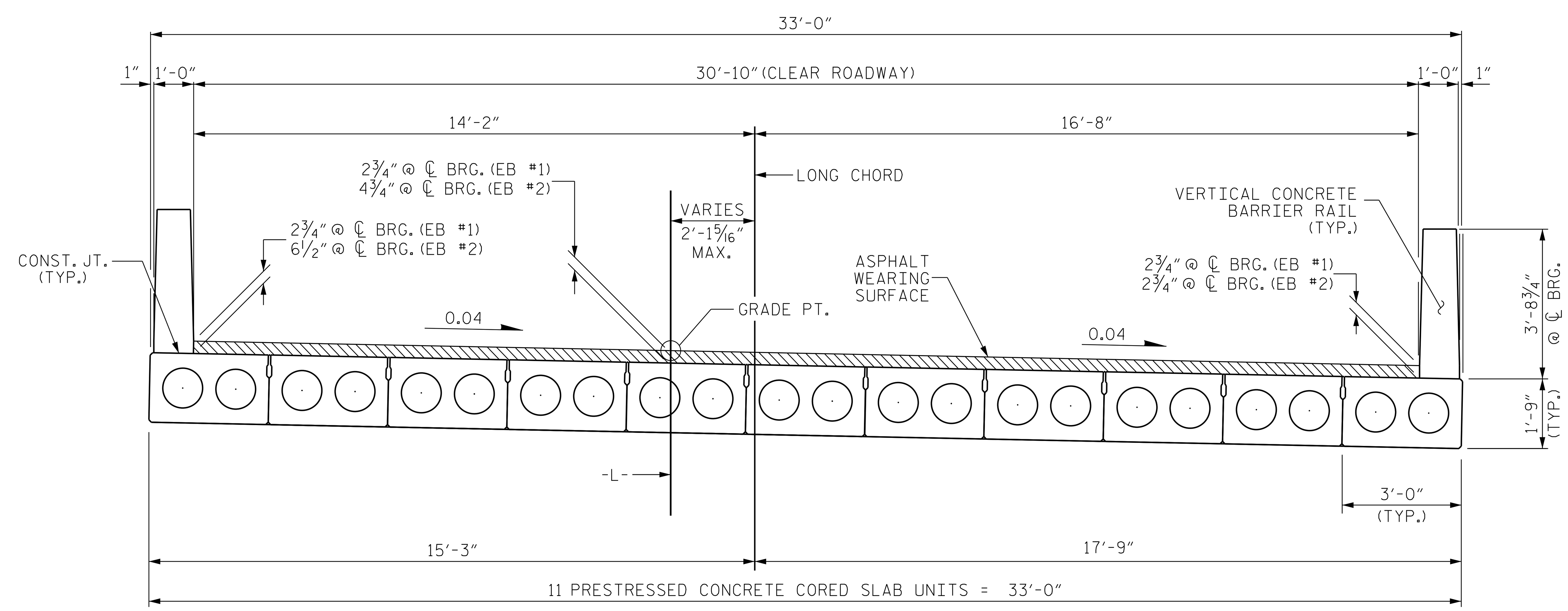
OVERTOPPING FLOOD DATA

OVERTOPPING DISCHARGE	=	2307 CFS
OVERTOPPING FREQUENCY	=	500 YRS+
OVERTOPPING ELEVATION	=	3020.4 FT
DRAINAGE AREA	=	2.96 SQ. MI.

NORTH CAROLINA PROFESSIONAL SEAL 042890 ENGINEER PATRICK R. GALLAGHER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

Vaughn & Melton Consulting Engineers
Asheville, North Carolina 828-253-2796
Boone, NC 828-355-9933; Tri-Cities, TN 423-467-8401; Knoxville, TN 865-546-5800; Spartanburg, SC 864-574-4775; Charleston, SC 843-974-5650; Middlesboro, KY 606-248-6600; Atlanta, GA 770-627-3590; Raleigh, NC 919-977-9455; Charlotte, NC 704-357-0488



TYPICAL SECTION

PROJECT NO. 17BP.11.R.161

ASHE COUNTY

STATION: 13+93.07 -L-

SHEET 2 OF 2

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PRELIMINARY GENERAL DRAWING

BRIDGE ON SR 1147 (NETTLE KNOB RD.) OVER SOUTH BEAVER CREEK BETWEEN US 221 AND LOWER NETTLE KNOB RD.

DWN. BY: WDC	DATE: 01-2022
CHKD. BY: PRG	DATE: 01/2022
DES. EGR. OF RECORD: GWP	DATE: 01/2022

REVISIONS

NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-2

TOTAL SHEETS 2

wdstructprep
DGN: V:\NC\Structures\032140-05 Ashe 15\Structures\Bridge 015\Plans\PGD401_002_ASHE 15_PGD02_S02.dgn
TIME: 09:23 AM on Monday, February 28, 2022

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+79	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,018.3 ft	**TOTAL DEPTH** 19.2 ft	**NORTHING** 956,979	**EASTING** 1,273,298	**24 HR.** 4.3
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**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))
3020						Boc = 3015.2				
	3,018.3	0.0	5	6	5	11		M		3,018.3 GROUND SURFACE 0.0
3015	3,014.8	3.5	10	1	1	Boc	0			**ROADWAY EMBANKMENT** Soft to Stiff, Brown, Fine to Coarse Sandy SILT (A-4), with trace rock fragments
	3,012.3	6.0				2		M		3,012.8 5.5
3010	3,009.8	8.5	1	1	1	2	5.4	W		**ALLUVIAL** Soft, Brown-Black, Fine to Coarse Sandy SILT (A-4), with trace mica 3,009.8 8.5
	3,009.1	9.2	100/0.4			100/0.4				3,009.1 9.2 **WEATHERED ROCK** Brown (BIOTITE GNEISS)
			60/0.0			60/0.0	6.1			**CRYSTALLINE ROCK** Gray (BIOTITE GNEISS)
3005										
3000										2,999.1 19.2 Boring Terminated at Elevation 2,999.1 ft In Crystalline Rock (BIOTITE GNEISS)

EB-1 (LT)

DRILL IN piles A minimum of 5' into WR/Rock And to An elevation below Fixity

L = Boc - Tip EL + 1.0 Embed
= 3015.2 - 3005.0 + 1.0
= 11.2'

Ave Pile Length = 15'

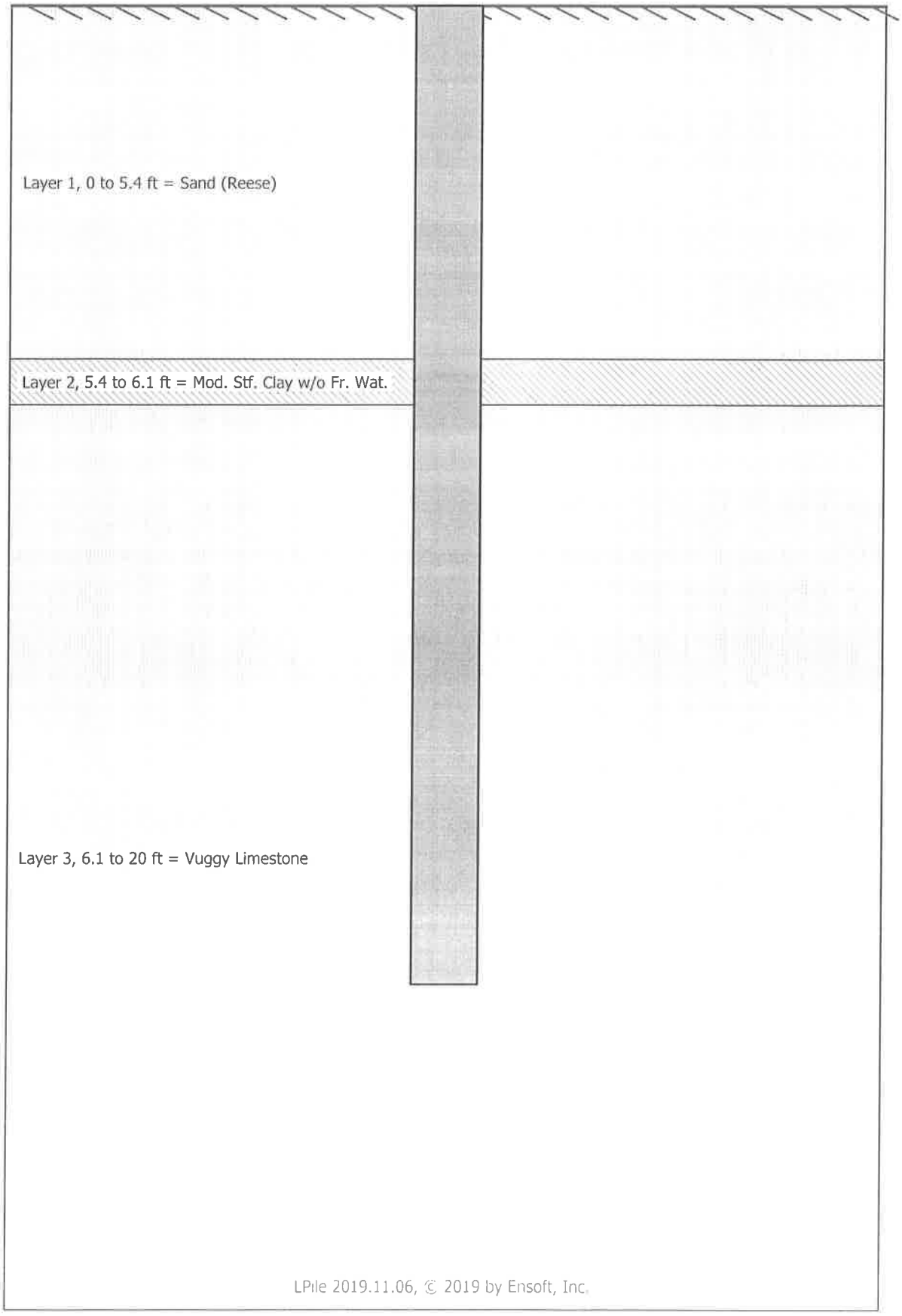
USE 3005 Ft For Tip Elev.

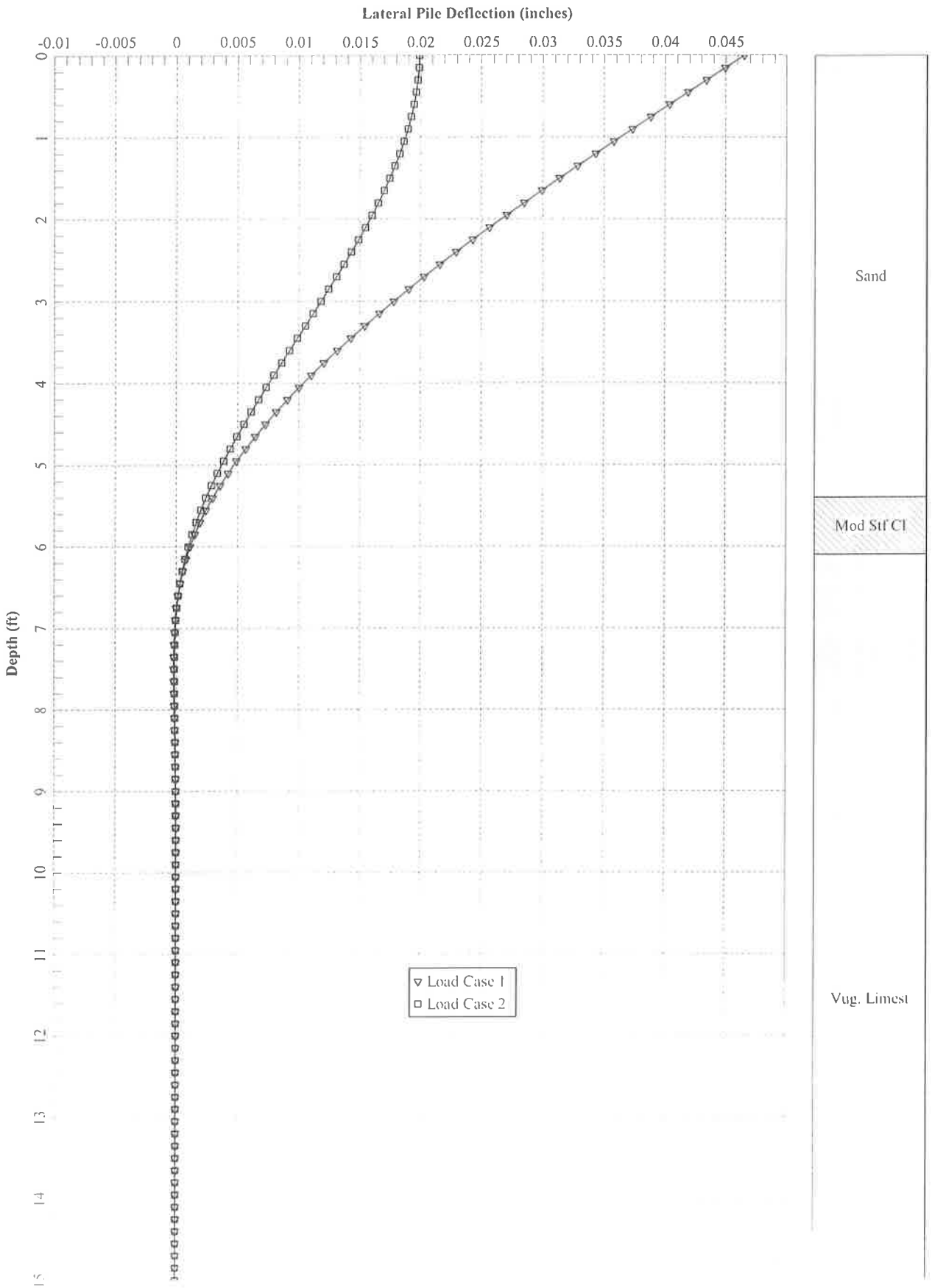
EST QTY

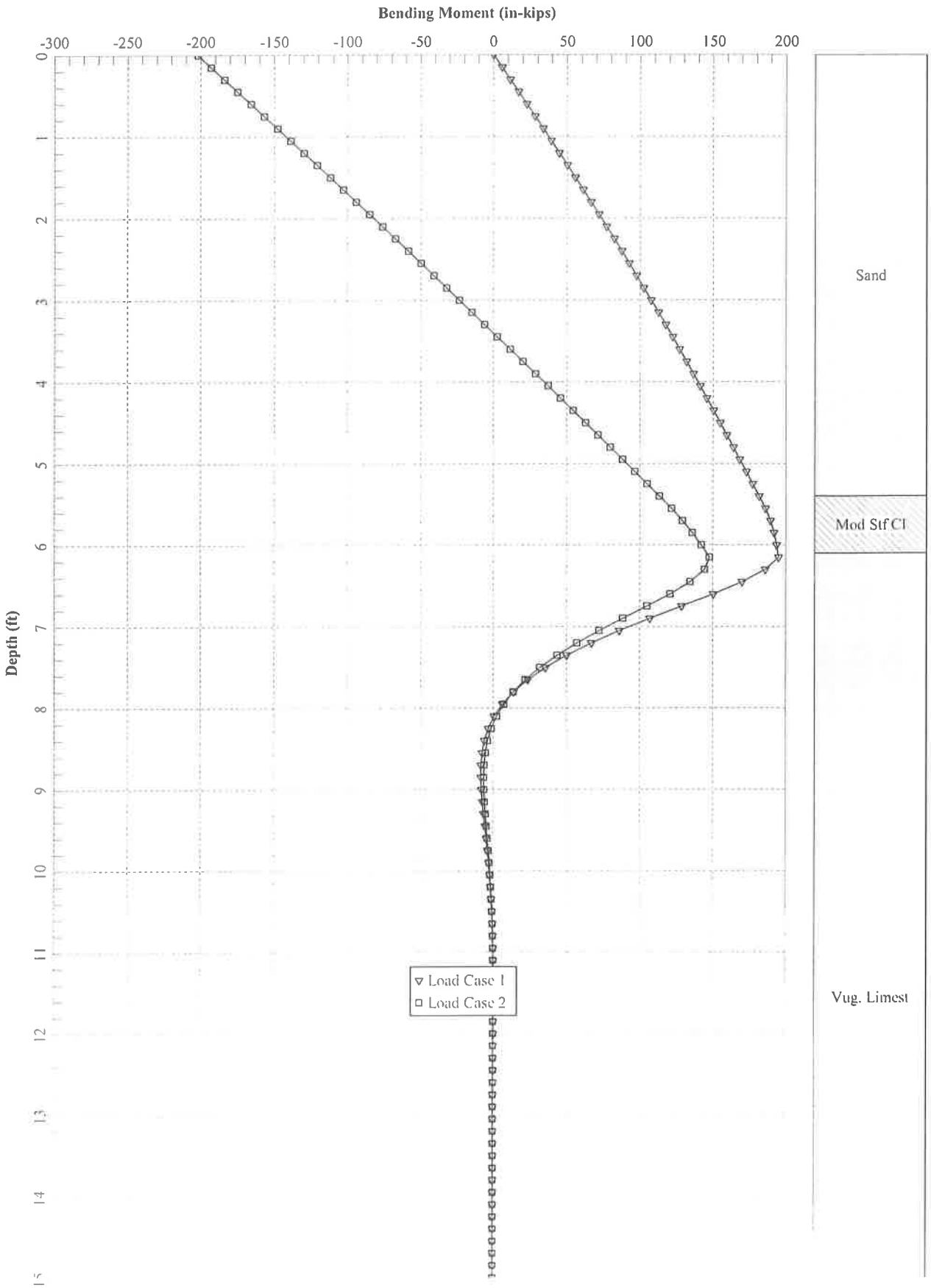
IN Soil = 3015.2 - 3009.8 = 5.4'

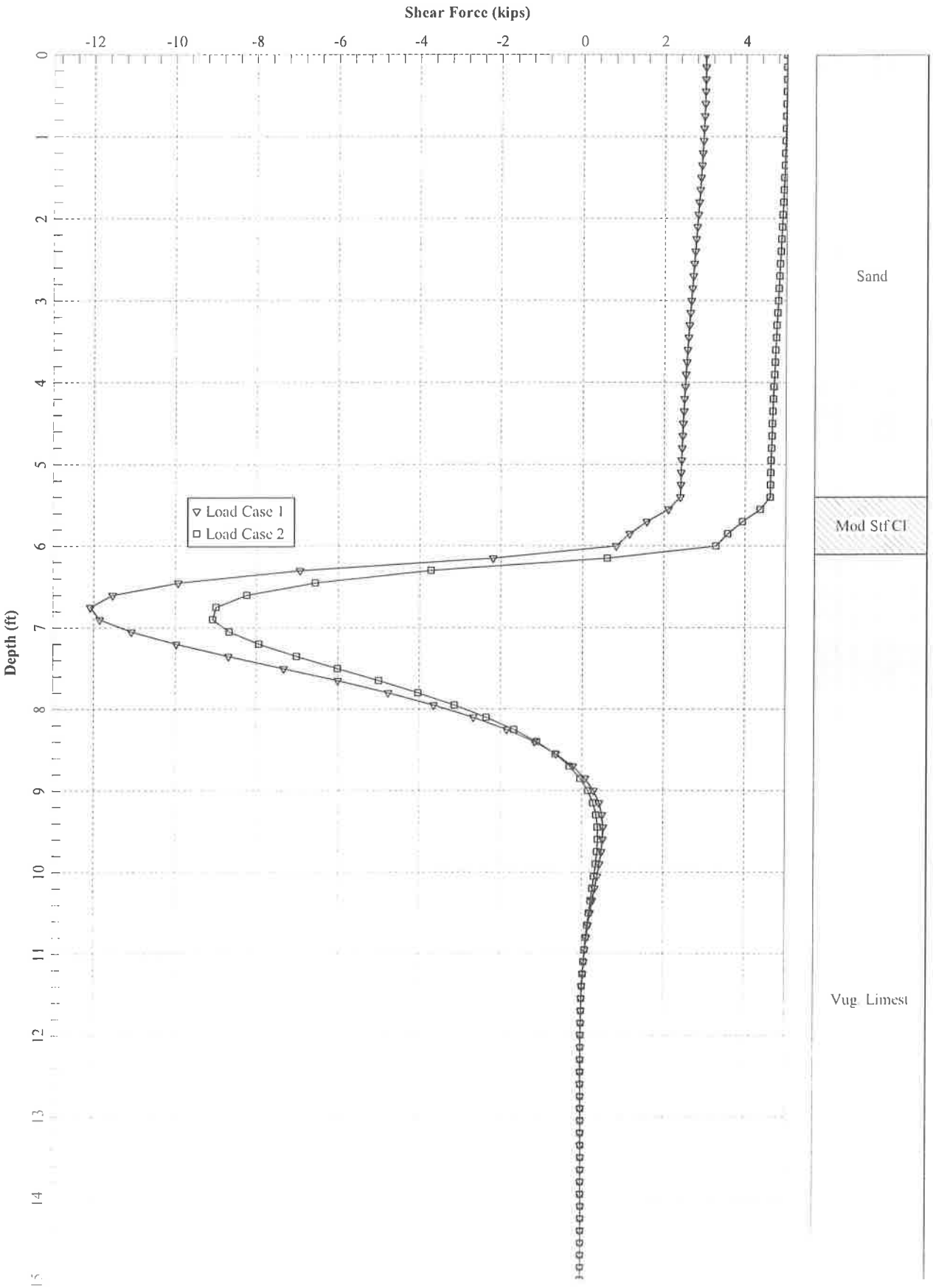
Not IN Soil = 3009.8 - 3005 = 4.8'

EB 1-A









LPile for Windows, Version 2019-11.006

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is being used by:

ECS Southeast
Charlotte, NC

Serial Number of Security Device: 562473626

This copy of LPile is licensed for exclusive use by:

ECS Carolinas, LLP, Charlotte, N

Use of this program by any entity other than ECS Carolinas, LLP, Charlotte, N
is a violation of the software license agreement.

Files Used for Analysis

Path to file locations:
\Users\mwalko\Downloads\

Name of input data file:
EB1-A_REV.lp11d

Name of output report file:
EB1-A_REV.lp11o

Name of plot output file:
EB1-A_REV.lp11p

Name of runtime message file:
EB1-A_REV.lp11r

Date and Time of Analysis

Date: March 28, 2022 Time: 14 37:16

Problem Title

Project Name: Ashe Bridge 15

Job Number 09-29362

Client: Vaughn & Melton

Engineer: ECS Southeast

Description: End Bent 1

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points

p-y curves are computed using pile diameter values interpolated with depth over

the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0450
2	15.000	12.0450

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
Cross-sectional Shape = Strong H-Pile
Length of section = 15.000000 ft
Flange Width = 12.045000 in
Section Depth = 11.780000 in
Flange Thickness = 0.435000 in
Web Thickness = 0.435000 in
Section Area = 15.500000 sq. in
Moment of Inertia = 393.000000 in^4
Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 5.400000 ft
Effective unit weight at top of layer = 42.600000 pcf
Effective unit weight at bottom of layer = 42.600000 pcf
Friction angle at top of layer = 28.000000 deg.
Friction angle at bottom of layer = 28.000000 deg.
Subgrade k at top of layer = 20.000000 pci
Subgrade k at bottom of layer = 20.000000 pci

Layer 2 is stiff clay with user-defined k-value

Distance from top of pile to top of layer = 5.400000 ft

Distance from top of pile to bottom of layer = 6.100000 ft
Effective unit weight at top of layer = 100.000000 pcf
Effective unit weight at bottom of layer = 100.000000 pcf
Undrained cohesion at top of layer = 8000. psf
Undrained cohesion at bottom of layer = 8000. psf
Epsilon-50 at top of layer = 0.004000
Epsilon-50 at bottom of layer = 0.004000
Subgrade k at top of layer = 2000. pci
Subgrade k at bottom of layer = 2000. pci

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 6.100000 ft
Distance from top of pile to bottom of layer = 20.000000 ft
Effective unit weight at top of layer = 160.000000 pcf
Effective unit weight at bottom of layer = 160.000000 pcf
Uniaxial compressive strength at top of layer = 4000. psi
Uniaxial compressive strength at bottom of layer = 4000. psi

(Depth of the lowest soil layer extends 5.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Uniaxial qu or psi	E50 or krm	kpy pci
1	Sand	0.00	42.6000	--	28.0000	--	--	20.0000
	(Reese, et al.)	5.4000	42.6000	--	28.0000	--	--	20.0000
2	Stiff Clay w/o	5.4000	100.0000	8000.	--	--	0.00400	2000.
	Free Water, using k	6.1000	100.0000	8000.	--	--	0.00400	2000.
3	Strong Rock	6.1000	160.0000	--	--	4000.	--	--
	(Vuggy Limestone)	20.0000	160.0000	--	--	4000.	--	--

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses

---

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V =	3000. lbs	M =	0.0000 in-lbs	150000.	No	Yes
2	2	V =	5000. lbs	S =	0.0000 in/in	150000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or Rock Layer	Layer is Below lbs	F0 Integral for Layer lbs	F1 Integral for Layer
1	0.00	0.00	N.A.	No	0.00	5132.	
2	5.4000	0.2093	No	No	5132.	20777.	
3	6.1000	6.1000	No	Yes	N.A.	N.A.	

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 3000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 150000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.04651	7.81E-07	3000.	-8.56E-04	9677.	1.14E+10	0.00	0.00	0.00
0.1500	0.04497	5631.	2999.	-8.56E-04	9764.	1.14E+10	-1.6189	64.8000	0.00
0.3000	0.04343	11257.	2994.	-8.54E-04	9850.	1.14E+10	-3.1269	129.6000	0.00
0.4500	0.04189	16872.	2987.	-8.52E-04	9936.	1.14E+10	-4.5245	194.4000	0.00
0.6000	0.04036	22471.	2978.	-8.49E-04	10022.	1.14E+10	-5.8122	259.2000	0.00
0.7500	0.03884	28051.	2967.	-8.45E-04	10107.	1.14E+10	-6.9908	324.0000	0.00
0.9000	0.03732	33607.	2953.	-8.40E-04	10192.	1.14E+10	-8.0613	388.8000	0.00
1.0500	0.03581	39136.	2938.	-8.34E-04	10277.	1.14E+10	-9.0250	453.6000	0.00
1.2000	0.03432	44633.	2921.	-8.28E-04	10361.	1.14E+10	-9.8834	518.4000	0.00
1.3500	0.03283	50097.	2902.	-8.20E-04	10445.	1.14E+10	-10.6382	583.2000	0.00
1.5000	0.03136	55524.	2882.	-8.12E-04	10528.	1.14E+10	-11.2913	648.0000	0.00
1.6500	0.02991	60912.	2862.	-8.03E-04	10611.	1.14E+10	-11.8449	712.8000	0.00
1.8000	0.02848	66259.	2840.	-7.93E-04	10693.	1.14E+10	-12.3013	777.6000	0.00
1.9500	0.02706	71563.	2817.	-7.82E-04	10774.	1.14E+10	-12.6632	842.4000	0.00
2.1000	0.02566	76824.	2794.	-7.70E-04	10855.	1.14E+10	-12.9332	907.2000	0.00
2.2500	0.02429	82039.	2771.	-7.57E-04	10935.	1.14E+10	-13.1145	972.0000	0.00
2.4000	0.02293	87208.	2747.	-7.44E-04	11014.	1.14E+10	-13.2102	1037.	0.00
2.5500	0.02161	92331.	2723.	-7.30E-04	11092.	1.14E+10	-13.2237	1102.	0.00
2.7000	0.02031	97407.	2700.	-7.15E-04	11170.	1.14E+10	-13.1587	1166.	0.00
2.8500	0.01903	102436.	2676.	-6.99E-04	11247.	1.14E+10	-13.0190	1231.	0.00
3.0000	0.01779	107418.	2653.	-6.83E-04	11324.	1.14E+10	-12.8086	1296.	0.00
3.1500	0.01658	112355.	2630.	-6.65E-04	11399.	1.14E+10	-12.5317	1361.	0.00
3.3000	0.01539	117246.	2608.	-6.47E-04	11474.	1.14E+10	-12.1928	1426.	0.00
3.4500	0.01425	122092.	2586.	-6.28E-04	11548.	1.14E+10	-11.7964	1490.	0.00
3.6000	0.01313	126895.	2565.	-6.09E-04	11622.	1.14E+10	-11.3473	1555.	0.00
3.7500	0.01206	131656.	2545.	-5.88E-04	11695.	1.14E+10	-10.8506	1620.	0.00
3.9000	0.01102	136376.	2526.	-5.67E-04	11767.	1.14E+10	-10.3113	1685.	0.00
4.0500	0.01002	141057.	2508.	-5.45E-04	11839.	1.14E+10	-9.7348	1750.	0.00
4.2000	0.00905	145701.	2491.	-5.22E-04	11910.	1.14E+10	-9.1266	1814.	0.00
4.3500	0.00813	150308.	2476.	-4.99E-04	11981.	1.14E+10	-8.4925	1879.	0.00
4.5000	0.00726	154882.	2461.	-4.75E-04	12051.	1.14E+10	-7.8384	1944.	0.00
4.6500	0.00642	159424.	2447.	-4.50E-04	12120.	1.14E+10	-7.1702	2009.	0.00
4.8000	0.00564	163935.	2435.	-4.25E-04	12190.	1.14E+10	-6.4943	2074.	0.00
4.9500	0.00490	168419.	2424.	-3.98E-04	12258.	1.14E+10	-5.8171	2138.	0.00
5.1000	0.00420	172876.	2414.	-3.71E-04	12327.	1.14E+10	-5.1451	2203.	0.00
5.2500	0.00356	177310.	2405.	-3.44E-04	12395.	1.14E+10	-4.4851	2268.	0.00
5.4000	0.00297	181721.	2398.	-3.15E-04	12462.	1.14E+10	-3.8442	2333.	0.00
5.5500	0.00242	186113.	2104.	-2.86E-04	12529.	1.14E+10	-322.9261	239760.	0.00
5.7000	0.00194	189450.	1575.	-2.57E-04	12581.	1.14E+10	-264.7729	246240.	0.00
5.8500	0.00150	191921.	1147.	-2.27E-04	12618.	1.14E+10	-210.6613	252720.	0.00
6.0000	0.00112	193701.	812.2344	-1.96E-04	12646.	1.14E+10	-161.2741	259200.	0.00
6.1500	7.95E-04	194951.	-2193.	-1.65E-04	12665.	1.14E+10	-3178.	7200000.	0.00
6.3000	5.25E-04	185895.	-6942.	-1.35E-04	12526.	1.14E+10	-2098.	7200000.	0.00
6.4500	3.07E-04	170032.	-9937.	-1.07E-04	12283.	1.14E+10	-1230.	7200000.	0.00
6.6000	1.39E-04	150179.	-11543.	-8.19E-05	11979.	1.14E+10	-554.4449	7200000.	0.00
6.7500	1.25E-05	128522.	-12087.	-5.99E-05	11647.	1.14E+10	-50.0006	7200000.	0.00
6.9000	-7.71E-05	106698.	-11854.	-4.13E-05	11313.	1.14E+10	308.2958	7200000.	0.00
7.0500	-1.36E-04	85869.	-11086.	-2.61E-05	10993.	1.14E+10	545.2611	7200000.	0.00
7.2000	-1.71E-04	66802.	-9979.	-1.41E-05	10701.	1.14E+10	684.5815	7200000.	0.00

1ST Neg

MAX NEG

7.3500	-1.87E-04	49951.	-8690.	-4.86E-06	10443.	1.14E+10	747.9385	7200000.	0.00
7.5000	-1.89E-04	35520.	-7338.	1.89E-06	10222.	1.14E+10	754.4946	7200000.	0.00
7.6500	-1.80E-04	23533.	-6010.	6.56E-06	10038.	1.14E+10	720.6589	7200000.	0.00
7.8000	-1.65E-04	13880.	-4768.	9.51E-06	9890.	1.14E+10	660.0626	7200000.	0.00
7.9500	-1.46E-04	6365.	-3648.	1.11E-05	9775.	1.14E+10	583.6828	7200000.	0.00
8.1000	-1.25E-04	740.3554	-2673.	1.17E-05	9689.	1.14E+10	500.0653	7200000.	0.00
8.2500	-1.04E-04	-3264.	-1849.	1.15E-05	9727.	1.14E+10	415.6060	7200000.	0.00
8.4000	-8.37E-05	-5921.	-1173.	1.07E-05	9768.	1.14E+10	334.8582	7200000.	0.00
8.5500	-6.52E-05	-7494.	-637.2032	9.69E-06	9792.	1.14E+10	260.8437	7200000.	0.00
8.7000	-4.88E-05	-8221.	-226.6283	8.45E-06	9803.	1.14E+10	195.3506	7200000.	0.00
8.8500	-3.48E-05	-8314.	74.4721	7.14E-06	9805.	1.14E+10	139.2054	7200000.	0.00
9.0000	-2.31E-05	-7956.	283.0200	5.86E-06	9799.	1.14E+10	92.5145	7200000.	0.00
9.1500	-1.37E-05	-7298.	415.6669	4.65E-06	9789.	1.14E+10	54.8710	7200000.	0.00
9.3000	-6.38E-06	-6462.	488.0248	3.57E-06	9776.	1.14E+10	25.5267	7200000.	0.00
9.4500	-8.83E-07	-5543.	514.1768	2.62E-06	9762.	1.14E+10	3.5311	7200000.	0.00
9.6000	3.04E-06	-4613.	506.4100	1.82E-06	9748.	1.14E+10	-12.1609	7200000.	0.00
9.7500	5.65E-06	-3721.	475.1186	1.16E-06	9734.	1.14E+10	-22.6075	7200000.	0.00
9.9000	7.21E-06	-2903.	428.8317	6.34E-07	9722.	1.14E+10	-28.8224	7200000.	0.00
10.0500	7.93E-06	-2178.	374.3288	2.33E-07	9711.	1.14E+10	-31.7363	7200000.	0.00
10.2000	8.04E-06	-1555.	316.8099	-6.21E-08	9701.	1.14E+10	-32.1736	7200000.	0.00
10.3500	7.71E-06	-1037.	260.0957	-2.67E-07	9693.	1.14E+10	-30.8422	7200000.	0.00
10.5000	7.08E-06	-619.0090	206.8398	-3.98E-07	9687.	1.14E+10	-28.3311	7200000.	0.00
10.6500	6.28E-06	-292.4733	158.7372	-4.70E-07	9682.	1.14E+10	-25.1162	7200000.	0.00
10.8000	5.39E-06	-47.3015	116.7209	-4.96E-07	9678.	1.14E+10	-21.5686	7200000.	0.00
10.9500	4.49E-06	127.9900	81.1385	-4.90E-07	9679.	1.14E+10	-17.9673	7200000.	0.00
11.1000	3.63E-06	245.0619	51.9076	-4.61E-07	9681.	1.14E+10	-14.5115	7200000.	0.00
11.2500	2.83E-06	315.1060	28.6462	-4.16E-07	9682.	1.14E+10	-11.3344	7200000.	0.00
11.4000	2.13E-06	348.4131	10.7812	-3.64E-07	9683.	1.14E+10	-8.5156	7200000.	0.00
11.5500	1.52E-06	354.1147	-2.3667	-3.09E-07	9683.	1.14E+10	-6.0930	7200000.	0.00
11.7000	1.02E-06	340.0597	-11.5162	-2.54E-07	9683.	1.14E+10	-4.0731	7200000.	0.00
11.8500	6.10E-07	312.7932	-17.3780	-2.02E-07	9682.	1.14E+10	-2.4399	7200000.	0.00
12.0000	2.91E-07	277.6081	-20.6201	-1.56E-07	9682.	1.14E+10	-1.1624	7200000.	0.00
12.1500	5.01E-08	238.6450	-21.8467	-1.15E-07	9681.	1.14E+10	-0.2005	7200000.	0.00
12.3000	-1.22E-07	199.0219	-21.5863	-8.02E-08	9680.	1.14E+10	0.4899	7200000.	0.00
12.4500	-2.39E-07	160.9778	-20.2866	-5.18E-08	9680.	1.14E+10	0.9541	7200000.	0.00
12.6000	-3.09E-07	126.0180	-18.3163	-2.91E-08	9679.	1.14E+10	1.2352	7200000.	0.00
12.7500	-3.43E-07	95.0549	-15.9689	-1.16E-08	9679.	1.14E+10	1.3730	7200000.	0.00
12.9000	-3.51E-07	68.5362	-13.4708	1.29E-09	9678.	1.14E+10	1.4027	7200000.	0.00
13.0500	-3.39E-07	46.5594	-10.9893	1.04E-08	9678.	1.14E+10	1.3545	7200000.	0.00
13.2000	-3.13E-07	28.9692	-8.6423	1.63E-08	9678.	1.14E+10	1.2533	7200000.	0.00
13.3500	-2.80E-07	15.4384	-6.5070	1.98E-08	9678.	1.14E+10	1.1192	7200000.	0.00
13.5000	-2.42E-07	5.5333	-4.6289	2.15E-08	9678.	1.14E+10	0.9675	7200000.	0.00
13.6500	-2.02E-07	-1.2372	-3.0295	2.18E-08	9677.	1.14E+10	0.8096	7200000.	0.00
13.8000	-1.63E-07	-5.3846	-1.7131	2.13E-08	9678.	1.14E+10	0.6530	7200000.	0.00
13.9500	-1.26E-07	-7.4159	-0.6730	2.03E-08	9678.	1.14E+10	0.5026	7200000.	0.00
14.1000	-9.02E-08	-7.8184	0.1039	1.91E-08	9678.	1.14E+10	0.3606	7200000.	0.00
14.2500	-5.69E-08	-7.0522	0.6332	1.79E-08	9678.	1.14E+10	0.2275	7200000.	0.00
14.4000	-2.56E-08	-5.5486	0.9302	1.69E-08	9678.	1.14E+10	0.1024	7200000.	0.00
14.5500	4.09E-09	-3.7128	1.0076	1.62E-08	9677.	1.14E+10	-0.01634	7200000.	0.00
14.7000	3.27E-08	-1.9298	0.8751	1.58E-08	9677.	1.14E+10	-0.1309	7200000.	0.00
14.8500	6.08E-08	-0.5708	0.5384	1.56E-08	9677.	1.14E+10	-0.2433	7200000.	0.00
15.0000	8.87E-08	0.00	0.00	1.55E-08	9677.	1.14E+10	-0.3550	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.04650942 inches
Computed slope at pile head = -0.00085598 radians
Maximum bending moment = 194951. inch-lbs

Maximum shear force = -12087. lbs
Depth of maximum bending moment = 6.15000000 feet below pile head
Depth of maximum shear force = 6.75000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 4

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 150000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.01989	-201950.	5000.	0.00	12772.	1.14E+10	0.00	0.00	0.00
0.1500	0.01987	-192946.	4999.	-3.12E-05	12634.	1.14E+10	-0.7152	64.8000	0.00
0.3000	0.01978	-183936.	4997.	-6.09E-05	12496.	1.14E+10	-1.4243	129.6000	0.00
0.4500	0.01965	-174922.	4994.	-8.93E-05	12358.	1.14E+10	-2.1218	194.4000	0.00
0.6000	0.01946	-165908.	4990.	-1.16E-04	12220.	1.14E+10	-2.8023	259.2000	0.00
0.7500	0.01923	-156896.	4984.	-1.42E-04	12082.	1.14E+10	-3.4610	324.0000	0.00
0.9000	0.01895	-147889.	4977.	-1.66E-04	11944.	1.14E+10	-4.0932	388.8000	0.00
1.0500	0.01863	-138888.	4969.	-1.88E-04	11806.	1.14E+10	-4.6950	453.6000	0.00
1.2000	0.01827	-129897.	4961.	-2.10E-04	11668.	1.14E+10	-5.2623	518.4000	0.00
1.3500	0.01788	-120917.	4951.	-2.29E-04	11530.	1.14E+10	-5.7919	583.2000	0.00
1.5000	0.01745	-111951.	4940.	-2.48E-04	11393.	1.14E+10	-6.2806	648.0000	0.00
1.6500	0.01698	-103000.	4928.	-2.65E-04	11256.	1.14E+10	-6.7257	712.8000	0.00
1.8000	0.01649	-94067.	4916.	-2.80E-04	11119.	1.14E+10	-7.1248	777.6000	0.00
1.9500	0.01597	-85153.	4902.	-2.95E-04	10982.	1.14E+10	-7.4762	842.4000	0.00
2.1000	0.01543	-76260.	4889.	-3.07E-04	10846.	1.14E+10	-7.7780	907.2000	0.00
2.2500	0.01487	-67388.	4874.	-3.19E-04	10710.	1.14E+10	-8.0290	972.0000	0.00
2.4000	0.01429	-58540.	4860.	-3.29E-04	10575.	1.14E+10	-8.2284	1037.	0.00
2.5500	0.01369	-49715.	4845.	-3.37E-04	10439.	1.14E+10	-8.3757	1102.	0.00
2.7000	0.01307	-40916.	4830.	-3.44E-04	10304.	1.14E+10	-8.4706	1166.	0.00
2.8500	0.01245	-32143.	4814.	-3.50E-04	10170.	1.14E+10	-8.5134	1231.	0.00
3.0000	0.01181	-23395.	4799.	-3.54E-04	10036.	1.14E+10	-8.5045	1296.	0.00
3.1500	0.01117	-14675.	4784.	-3.57E-04	9902.	1.14E+10	-8.4450	1361.	0.00
3.3000	0.01053	-5981.	4769.	-3.59E-04	9769.	1.14E+10	-8.3359	1426.	0.00
3.4500	0.00988	2687.	4754.	-3.59E-04	9719.	1.14E+10	-8.1790	1490.	0.00
3.6000	0.00923	11327.	4739.	-3.58E-04	9851.	1.14E+10	-7.9761	1555.	0.00
3.7500	0.00859	19942.	4725.	-3.56E-04	9983.	1.14E+10	-7.7296	1620.	0.00
3.9000	0.00795	28530.	4712.	-3.52E-04	10115.	1.14E+10	-7.4421	1685.	0.00
4.0500	0.00732	37093.	4698.	-3.47E-04	10246.	1.14E+10	-7.1166	1750.	0.00
4.2000	0.00670	45632.	4686.	-3.40E-04	10377.	1.14E+10	-6.7564	1814.	0.00
4.3500	0.00610	54146.	4674.	-3.32E-04	10507.	1.14E+10	-6.3652	1879.	0.00
4.5000	0.00551	62638.	4663.	-3.23E-04	10637.	1.14E+10	-5.9470	1944.	0.00
4.6500	0.00493	71108.	4653.	-3.13E-04	10767.	1.14E+10	-5.5062	2009.	0.00
4.8000	0.00438	79557.	4643.	-3.01E-04	10897.	1.14E+10	-5.0474	2074.	0.00
4.9500	0.00385	87986.	4635.	-2.87E-04	11026.	1.14E+10	-4.5757	2138.	0.00
5.1000	0.00335	96396.	4627.	-2.73E-04	11155.	1.14E+10	-4.0965	2203.	0.00
5.2500	0.00287	104790.	4620.	-2.57E-04	11283.	1.14E+10	-3.6154	2268.	0.00

5.4000	0.00242	113167.	4614.	-2.40E-04	11412.	1.14E+10	-3.1386	2333.	0.00
5.5500	0.00201	121529.	4370.	-2.21E-04	11540.	1.14E+10	-267.2411	239760.	0.00
5.7000	0.00163	129020.	3930.	-2.01E-04	11655.	1.14E+10	-222.3576	246240.	0.00
5.8500	0.00128	135785.	3568.	-1.81E-04	11758.	1.14E+10	-179.8813	252720.	0.00
6.0000	9.76E-04	141961.	3279.	-1.59E-04	11853.	1.14E+10	-140.4853	259200.	0.00
6.1500	7.10E-04	147676.	595.7897	-1.36E-04	11940.	1.14E+10	-2841.	7200000.	0.00
6.3000	4.87E-04	144179.	-3715.	-1.13E-04	11887.	1.14E+10	-1948.	7200000.	0.00
6.4500	3.05E-04	134364.	-6565.	-9.07E-05	11736.	1.14E+10	-1219.	7200000.	0.00
6.6000	1.61E-04	120592.	-8241.	-7.05E-05	11525.	1.14E+10	-642.7483	7200000.	0.00
6.7500	5.09E-05	104734.	-9003.	-5.27E-05	11282.	1.14E+10	-203.5248	7200000.	0.00
6.9000	-2.92E-05	88211.	-9081.	-3.75E-05	11029.	1.14E+10	116.6017	7200000.	0.00
7.0500	-8.41E-05	72062.	-8673.	-2.48E-05	10782.	1.14E+10	336.4199	7200000.	0.00
7.2000	-1.19E-04	57001.	-7944.	-1.46E-05	10551.	1.14E+10	474.2932	7200000.	0.00
7.3500	-1.37E-04	43473.	-7024.	-6.71E-06	10344.	1.14E+10	547.3487	7200000.	0.00
7.5000	-1.43E-04	31717.	-6018.	-7.76E-07	10163.	1.14E+10	570.9691	7200000.	0.00
7.6500	-1.40E-04	21810.	-5001.	3.45E-06	10012.	1.14E+10	558.5226	7200000.	0.00
7.8000	-1.30E-04	13711.	-4029.	6.26E-06	9888.	1.14E+10	521.2752	7200000.	0.00
7.9500	-1.17E-04	7301.	-3139.	7.92E-06	9789.	1.14E+10	468.4361	7200000.	0.00
8.1000	-1.02E-04	2408.	-2350.	8.68E-06	9714.	1.14E+10	407.2948	7200000.	0.00
8.2500	-8.59E-05	-1165.	-1675.	8.78E-06	9695.	1.14E+10	343.4150	7200000.	0.00
8.4000	-7.02E-05	-3626.	-1113.	8.40E-06	9733.	1.14E+10	280.8603	7200000.	0.00
8.5500	-5.56E-05	-5176.	-659.9679	7.71E-06	9757.	1.14E+10	222.4285	7200000.	0.00
8.7000	-4.25E-05	-6006.	-306.8875	6.82E-06	9769.	1.14E+10	169.8829	7200000.	0.00
8.8500	-3.10E-05	-6285.	-42.2427	5.85E-06	9774.	1.14E+10	124.1668	7200000.	0.00
9.0000	-2.14E-05	-6161.	146.5451	4.87E-06	9772.	1.14E+10	85.5974	7200000.	0.00
9.1500	-1.35E-05	-5760.	272.2132	3.93E-06	9766.	1.14E+10	54.0339	7200000.	0.00
9.3000	-7.26E-06	-5183.	346.9620	3.06E-06	9757.	1.14E+10	29.0202	7200000.	0.00
9.4500	-2.48E-06	-4512.	381.9906	2.30E-06	9747.	1.14E+10	9.9005	7200000.	0.00
9.6000	1.02E-06	-3809.	387.2219	1.64E-06	9736.	1.14E+10	-4.0879	7200000.	0.00
9.7500	3.44E-06	-3119.	371.1727	1.09E-06	9725.	1.14E+10	-13.7446	7200000.	0.00
9.9000	4.96E-06	-2474.	340.9336	6.53E-07	9715.	1.14E+10	-19.8543	7200000.	0.00
10.0500	5.79E-06	-1892.	302.2289	3.08E-07	9706.	1.14E+10	-23.1510	7200000.	0.00
10.2000	6.07E-06	-1386.	259.5266	4.96E-08	9699.	1.14E+10	-24.2960	7200000.	0.00
10.3500	5.97E-06	-958.0107	216.1817	-1.36E-07	9692.	1.14E+10	-23.8650	7200000.	0.00
10.5000	5.59E-06	-607.4880	174.5929	-2.59E-07	9687.	1.14E+10	-22.3447	7200000.	0.00
10.6500	5.03E-06	-329.3364	136.3624	-3.33E-07	9682.	1.14E+10	-20.1336	7200000.	0.00
10.8000	4.39E-06	-116.4035	102.4490	-3.68E-07	9679.	1.14E+10	-17.5480	7200000.	0.00
10.9500	3.71E-06	39.6788	73.3088	-3.74E-07	9678.	1.14E+10	-14.8300	7200000.	0.00
11.1000	3.04E-06	147.7102	49.0204	-3.60E-07	9680.	1.14E+10	-12.1571	7200000.	0.00
11.2500	2.41E-06	216.3463	29.3919	-3.31E-07	9681.	1.14E+10	-9.6522	7200000.	0.00
11.4000	1.85E-06	253.6998	14.0509	-2.94E-07	9681.	1.14E+10	-7.3934	7200000.	0.00
11.5500	1.36E-06	267.0881	2.5162	-2.53E-07	9682.	1.14E+10	-5.4230	7200000.	0.00
11.7000	9.39E-07	262.8946	-5.7451	-2.11E-07	9681.	1.14E+10	-3.7563	7200000.	0.00
11.8500	5.97E-07	246.5195	-11.2755	-1.70E-07	9681.	1.14E+10	-2.3886	7200000.	0.00
12.0000	3.25E-07	222.3949	-14.5962	-1.33E-07	9681.	1.14E+10	-1.3012	7200000.	0.00
12.1500	1.17E-07	194.0451	-16.1873	-1.01E-07	9680.	1.14E+10	-0.4667	7200000.	0.00
12.3000	-3.68E-08	164.1750	-16.4748	-7.23E-08	9680.	1.14E+10	0.1472	7200000.	0.00
12.4500	-1.44E-07	134.7747	-15.8255	-4.87E-08	9679.	1.14E+10	0.5743	7200000.	0.00
12.6000	-2.12E-07	107.2296	-14.5452	-2.96E-08	9679.	1.14E+10	0.8482	7200000.	0.00
12.7500	-2.50E-07	82.4281	-12.8816	-1.46E-08	9679.	1.14E+10	1.0002	7200000.	0.00
12.9000	-2.65E-07	60.8638	-11.0288	-3.28E-09	9678.	1.14E+10	1.0584	7200000.	0.00
13.0500	-2.62E-07	42.7261	-9.1335	4.90E-09	9678.	1.14E+10	1.0474	7200000.	0.00
13.2000	-2.47E-07	27.9804	-7.3018	1.05E-08	9678.	1.14E+10	0.9879	7200000.	0.00
13.3500	-2.24E-07	16.4341	-5.6058	1.40E-08	9678.	1.14E+10	0.8965	7200000.	0.00
13.5000	-1.97E-07	7.7919	-4.0912	1.59E-08	9678.	1.14E+10	0.7864	7200000.	0.00
13.6500	-1.67E-07	1.6972	-2.7827	1.67E-08	9677.	1.14E+10	0.6675	7200000.	0.00
13.8000	-1.37E-07	-2.2348	-1.6900	1.66E-08	9677.	1.14E+10	0.5466	7200000.	0.00
13.9500	-1.07E-07	-4.3956	-0.8125	1.61E-08	9677.	1.14E+10	0.4283	7200000.	0.00
14.1000	-7.87E-08	-5.1686	-0.1436	1.53E-08	9677.	1.14E+10	0.3150	7200000.	0.00
14.2500	-5.19E-08	-4.9208	0.3267	1.45E-08	9677.	1.14E+10	0.2075	7200000.	0.00
14.4000	-2.64E-08	-4.0003	0.6086	1.38E-08	9677.	1.14E+10	0.1057	7200000.	0.00

1ST Neg

Max Neg

Fixed End.

1ST Neg = 6.9' (EL 3008.3)

Max Neg = 7.5' (EL 3007.7)

Say POF = 3008 Ft

Min Tip for Fixity = 3006 Ft

5' into WR/Rock = 3005 Ft

USE 3005 Ft for tip elev.

14.5500	-2.10E-09	-2.7373	0.7113	1.33E-08	9677.	1.14E+10	0.00839	7200000.	0.00
14.7000	2.15E-08	-1.4470	0.6416	1.30E-08	9677.	1.14E+10	-0.08580	7200000.	0.00
14.8500	4.46E-08	-0.4346	0.4039	1.28E-08	9677.	1.14E+10	-0.1783	7200000.	0.00
15.0000	6.76E-08	0.00	0.00	1.28E-08	9677.	1.14E+10	-0.2704	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.01989398 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -201950. inch-lbs
Maximum shear force = -9081. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 6.90000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 4

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Pile-head Loading lbs	Pile-head Deflection inches	Max Shear Rotation radians	Max Moment in Pile lbs	in Pile in-lbs
1	V, lb	3000.	M, in-lb	0.00	150000.	0.04651	-8.56E-04	-12087.	194951.
2	V, lb	5000.	S, rad	0.00	150000.	0.01989	0.00	-9081.	-201950.

Maximum pile-head deflection = 0.0465094193 inches
Maximum pile-head rotation = -0.0008559795 radians = -0.049044 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+53	**OFFSET** 18 ft RT	**ALIGNMENT** -L- — **0 HR.** N/A
COLLAR ELEV. 3,014.8 ft	**TOTAL DEPTH** 20.5 ft	**NORTHING** 956,976	**EASTING** 1,273,259 — **24 HR.** 4.8
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**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
						Boc = 3015.2	0			
3015	3,014.8	0.0	3	5	12	17		M		3,014.8 GROUND SURFACE 0.0 **ROADWAY EMBANKMENT** Medium Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4)
	3,011.3	3.5	2	1	2	3		W		3,010.8 4.0 **ALLUVIAL** Soft, Gray, Fine to Coarse Sandy SILT (A-4)
3010	3,008.8	6.0	2	10	16	26	7.4	W		3,007.8 7.0 Medium Dense, Brown-Tan, Silty Fine to Coarse SAND (A-2-4), with little cobbles
	3,006.3	8.5	73	27/0.2		100/0.7	8.9			3,006.3 8.5 **WEATHERED ROCK** Brown (BIOTITE GNEISS)
3005	3,003.3	11.5	60/0.0			60/0.0	11.9			3,003.3 11.5 **CRYSTALLINE ROCK** Gray (BIOTITE GNEISS)
3000										
2995										2,994.3 20.5 Boring Terminated at Elevation 2,994.3 ft In Crystalline Rock (BIOTITE GNEISS)

EB-1 (RT)

DRILL IN PILES A MINIMUM OF 5' INTO WR/ROCK AND TO AN ELEVATION BELOW FIXTY

L = Boc - Tip EL + 1.0 Embed

= 3015.2 - 3001 + 1.0 = 15.2'

Say Ave Pile Length = 30'

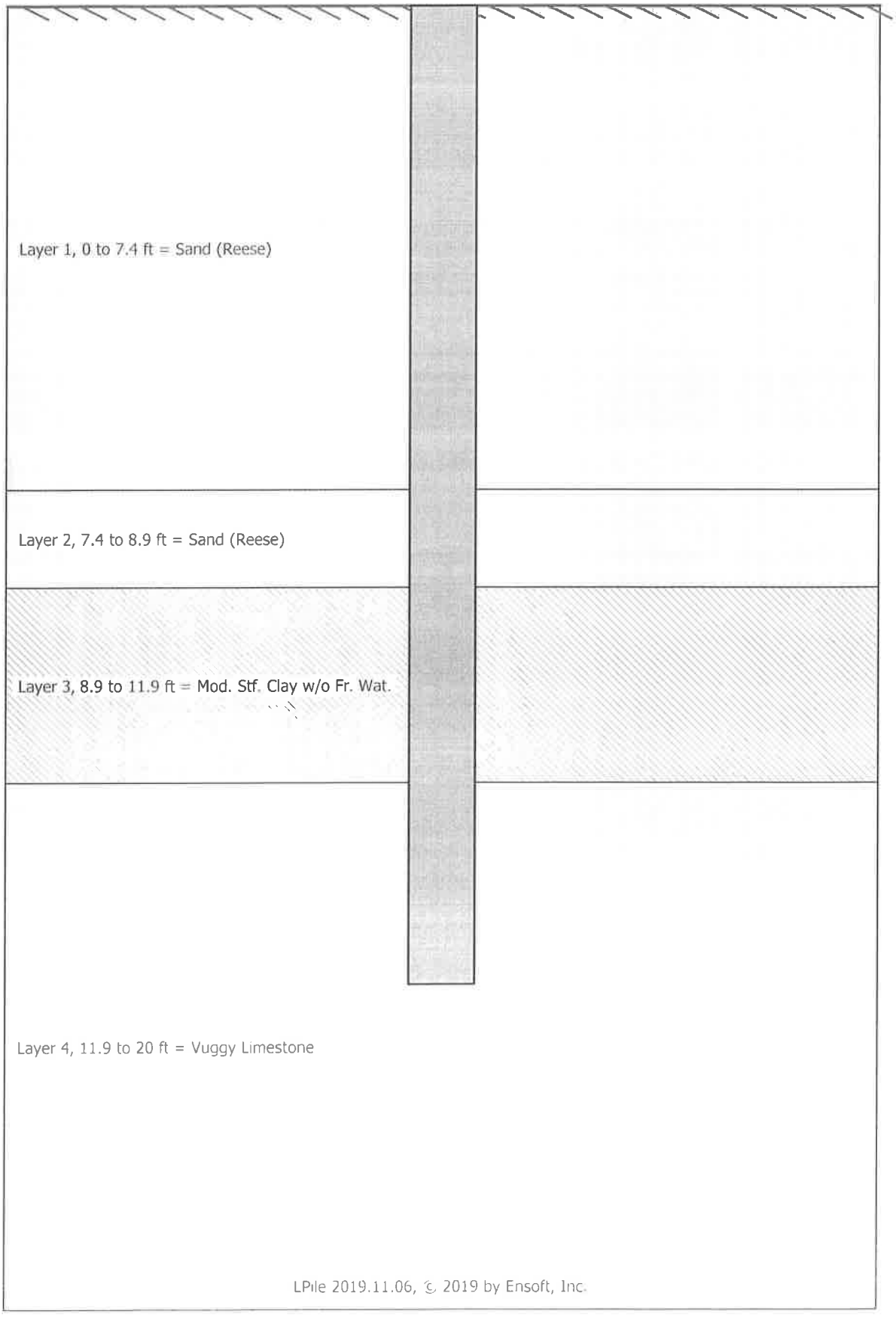
USE 3001 FT for Tip Elev

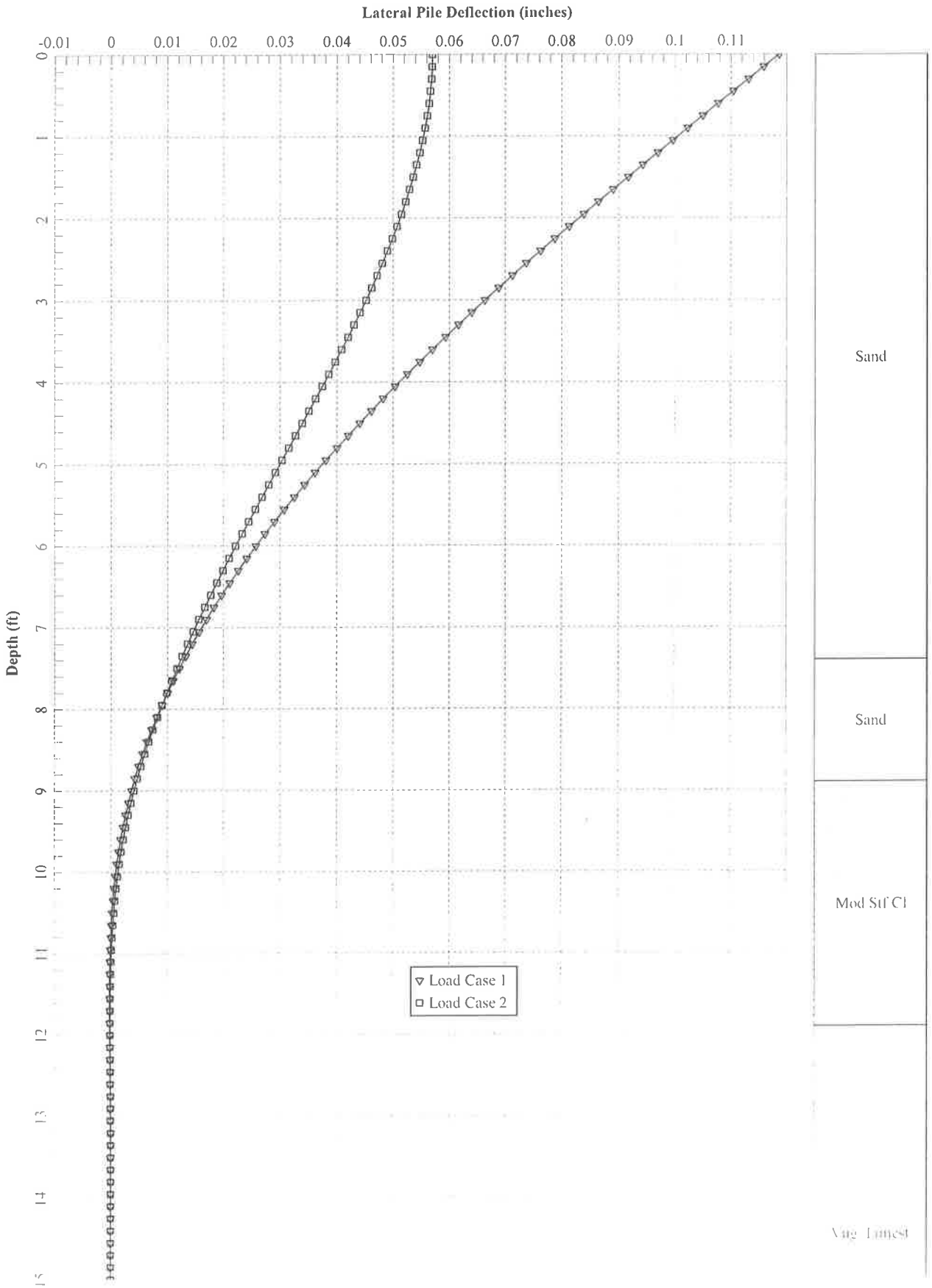
EST QTY

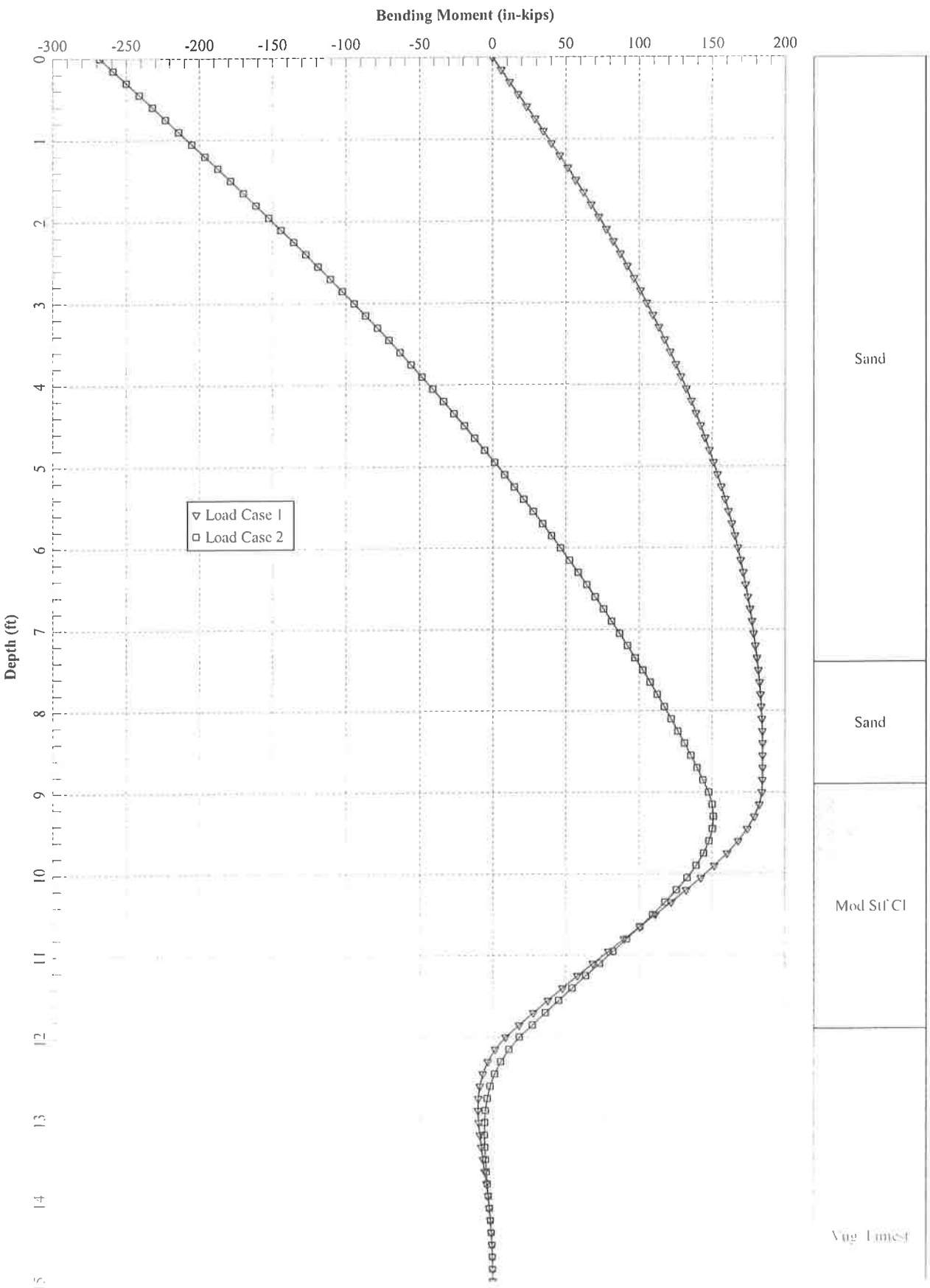
IN SOIL = 3015.2 - 3006.3 = 8.9'

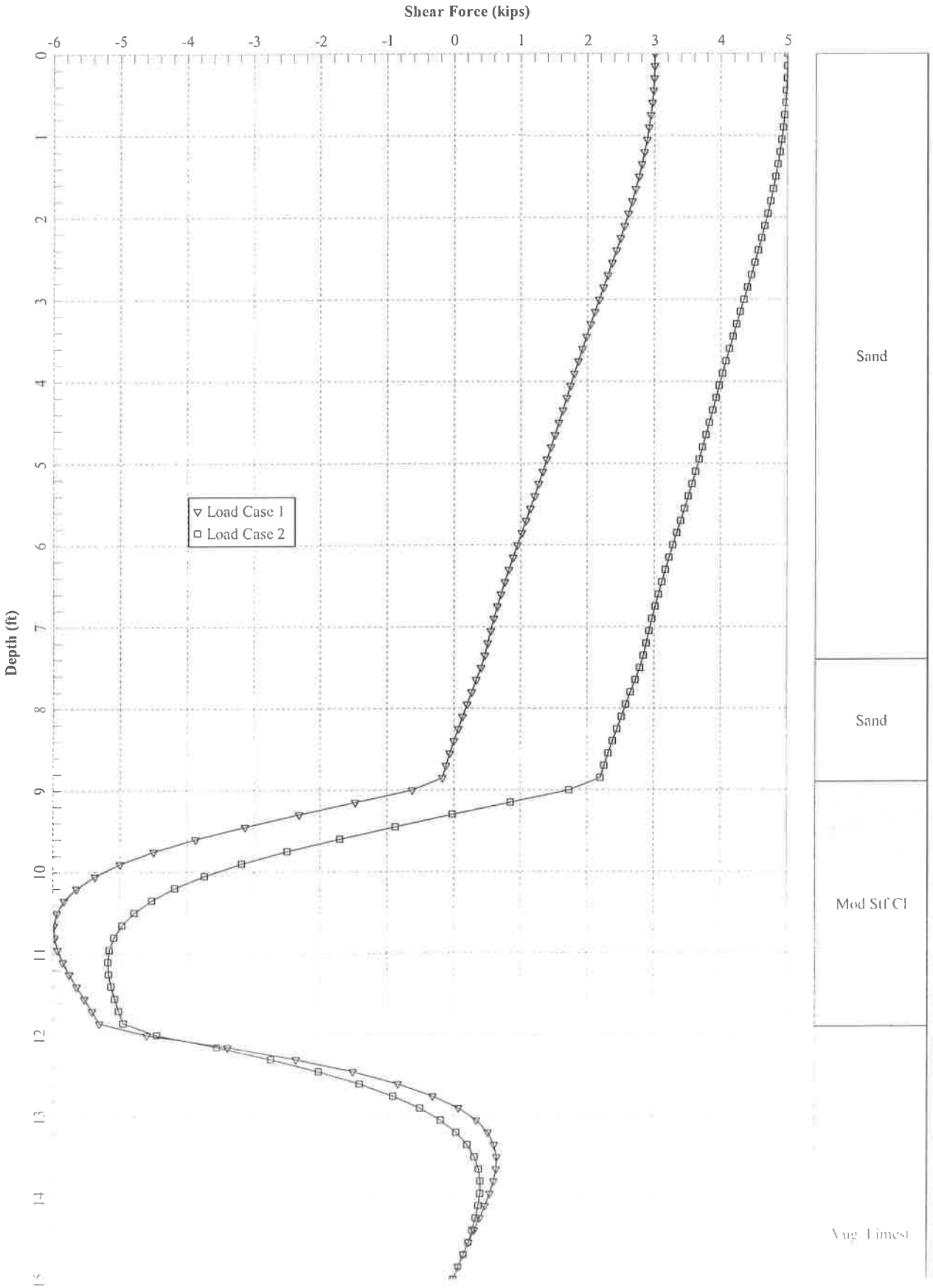
NOT IN SOIL = 3006.3 - 3001 = 5.3'

EB 1-B









LPile for Windows, Version 2019-11.006

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is being used by:

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Files Used for Analysis

Path to file locations:
\Users\mwalko\Downloads\

Name of input data file:
EB1-B_REV.lp11d

Name of output report file:
EB1-B_REV.lp11o

Name of plot output file:
EB1-B_REV.lp11p

Name of runtime message file:
EB1-B_REV.lp11r

Date and Time of Analysis

Date: March 28, 2022 Time: 14 39 20

Problem Title

Project Name Ashe Bridge 15

Job Number 09-29362

Client: Vaughn & Melton

Engineer: ECS Southeast

Description: End Bent 1

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over

the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0450
2	15.000	12.0450

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
Cross-sectional Shape = Strong H-Pile
Length of section = 15.000000 ft
Flange Width = 12.045000 in
Section Depth = 11.780000 in
Flange Thickness = 0.435000 in
Web Thickness = 0.435000 in
Section Area = 15.500000 sq. in
Moment of Inertia = 393.000000 in^4
Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 7.400000 ft
Effective unit weight at top of layer = 42.600000 pcf
Effective unit weight at bottom of layer = 42.600000 pcf
Friction angle at top of layer = 28.000000 deg.
Friction angle at bottom of layer = 28.000000 deg.
Subgrade k at top of layer = 20.000000 pci
Subgrade k at bottom of layer = 20.000000 pci

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 7.400000 ft

Distance from top of pile to bottom of layer = 8.900000 ft
Effective unit weight at top of layer = 57.600000 pcf
Effective unit weight at bottom of layer = 57.600000 pcf
Friction angle at top of layer = 32.000000 deg.
Friction angle at bottom of layer = 32.000000 deg.
Subgrade k at top of layer = 60.000000 pci
Subgrade k at bottom of layer = 60.000000 pci

Layer 3 is stiff clay with user-defined k-value

Distance from top of pile to top of layer = 8.900000 ft
Distance from top of pile to bottom of layer = 11.900000 ft
Effective unit weight at top of layer = 100.000000 pcf
Effective unit weight at bottom of layer = 100.000000 pcf
Undrained cohesion at top of layer = 8000. psf
Undrained cohesion at bottom of layer = 8000. psf
Epsilon-50 at top of layer = 0.004000
Epsilon-50 at bottom of layer = 0.004000
Subgrade k at top of layer = 2000. pci
Subgrade k at bottom of layer = 2000. pci

Layer 4 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 11.900000 ft
Distance from top of pile to bottom of layer = 20.000000 ft
Effective unit weight at top of layer = 160.000000 pcf
Effective unit weight at bottom of layer = 160.000000 pcf
Uniaxial compressive strength at top of layer = 4000. psi
Uniaxial compressive strength at bottom of layer = 4000. psi

(Depth of the lowest soil layer extends 5.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt pcf	Undrained Cohesion psf	Angle of Friction deg	Uniaxial qu psi	E50 or krm	kpy pci
1	Sand	0.00	42.6000	--	28.0000	--	--	20.0000
	(Reese, et al.)	7.4000	42.6000	--	28.0000	--	--	20.0000
2	Sand	7.4000	57.6000	--	32.0000	--	--	60.0000
	(Reese, et al.)	8.9000	57.6000	--	32.0000	--	--	60.0000
3	Stiff Clay w/o Free Water, using k	8.9000	100.0000	8000	--	--	0.00400	2000
		11.9000	100.0000	8000	--	--	0.00400	2000

4	Strong Rock	11.9000	160.0000	--	--	4000.	--	--
	(Vuggy Limestone)	20.0000	160.0000	--	--	4000.	--	--

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V =	3000. lbs	M =	0.0000 in-lbs	150000.	No	Yes
2	2	V =	5000. lbs	S =	0.0000 in/in	150000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

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Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0 00	0 00	N A	No	0 00	11262
2	7 4000	6 5477	Yes	No	11262	8336

3	8.9000	0.7644	No	No	19598.	113906.
4	11.9000	11.9000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 3000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 150000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1186	5.37E-07	3000.	-0.00151	9677.	1.14E+10	0.00	0.00	0.00
0.1500	0.1159	5808.	2998.	-0.00151	9766.	1.14E+10	-2.5050	38.9118	0.00
0.3000	0.1132	11607.	2991.	-0.00151	9855.	1.14E+10	-5.1596	82.0720	0.00
0.4500	0.1104	17389.	2979.	-0.00151	9944.	1.14E+10	-7.8905	128.5939	0.00
0.6000	0.1077	23144.	2962.	-0.00150	10032.	1.14E+10	-10.6763	178.3656	0.00
0.7500	0.1050	28865.	2941.	-0.00150	10120.	1.14E+10	-13.4669	230.7723	0.00
0.9000	0.1023	34540.	2914.	-0.00149	10207.	1.14E+10	-16.1834	284.6178	0.00
1.0500	0.09967	40161.	2882.	-0.00149	10293.	1.14E+10	-18.7943	339.4314	0.00
1.2000	0.09699	45720.	2846.	-0.00148	10378.	1.14E+10	-21.3005	395.2886	0.00
1.3500	0.09434	51208.	2806.	-0.00147	10462.	1.14E+10	-23.6000	450.3036	0.00
1.5000	0.09169	56617.	2762.	-0.00146	10545.	1.14E+10	-25.6425	503.3815	0.00
1.6500	0.08907	61940.	2714.	-0.00145	10627.	1.14E+10	-27.7076	559.9667	0.00
1.8000	0.08646	67171.	2662.	-0.00144	10707.	1.14E+10	-29.5208	614.6220	0.00
1.9500	0.08386	72304.	2608.	-0.00143	10785.	1.14E+10	-31.0314	666.0324	0.00
2.1000	0.08129	77333.	2551.	-0.00142	10863.	1.14E+10	-32.4309	718.0757	0.00
2.2500	0.07875	82254.	2491.	-0.00141	10938.	1.14E+10	-33.6631	769.4800	0.00
2.4000	0.07622	87062.	2430.	-0.00140	11012.	1.14E+10	-34.5714	816.4178	0.00
2.5500	0.07372	91754.	2367.	-0.00138	11084.	1.14E+10	-35.2011	859.4807	0.00
2.7000	0.07125	96329.	2303.	-0.00137	11154.	1.14E+10	-35.6724	901.2321	0.00
2.8500	0.06880	100784.	2239.	-0.00135	11222.	1.14E+10	-35.7758	935.9847	0.00
3.0000	0.06638	105118.	2175.	-0.00134	11288.	1.14E+10	-35.4894	962.3132	0.00
3.1500	0.06399	109333.	2111.	-0.00132	11353.	1.14E+10	-35.6703	1003.	0.00
3.3000	0.06164	113428.	2046.	-0.00130	11416.	1.14E+10	-35.6173	1040	0.00
3.4500	0.05931	117403.	1983.	-0.00128	11477.	1.14E+10	-35.2530	1070	0.00
3.6000	0.05702	121258.	1920.	-0.00126	11536.	1.14E+10	-34.5705	1091	0.00
3.7500	0.05476	124996.	1858.	-0.00124	11593.	1.14E+10	-33.5668	1103.	0.00
3.9000	0.05254	128620.	1799.	-0.00122	11648.	1.14E+10	-32.2444	1105.	0.00
4.0500	0.05036	132134.	1742.	-0.00120	11702.	1.14E+10	-31.1807	1115.	0.00
4.2000	0.04821	135542.	1685.	-0.00118	11755.	1.14E+10	-31.8100	1188.	0.00
4.3500	0.04610	138840.	1628.	-0.00116	11805.	1.14E+10	-32.3387	1263.	0.00
4.5000	0.04403	142028.	1569.	-0.00114	11854.	1.14E+10	-32.7631	1339.	0.00
4.6500	0.04200	145104.	1510.	-0.00112	11901.	1.14E+10	-33.0797	1418.	0.00
4.8000	0.04002	148066.	1450.	-0.00109	11946.	1.14E+10	-33.2860	1497.	0.00
4.9500	0.03807	150915.	1390.	-0.00107	11990.	1.14E+10	-33.3797	1578.	0.00

5.1000	0.03617	153648.	1330.	-0.00104	12032.	1.14E+10	-33.7684	1681.	0.00
5.2500	0.03431	156266.	1268.	-0.00102	12072.	1.14E+10	-34.4278	1806.	0.00
5.4000	0.03249	158765.	1206.	-9.96E-04	12110.	1.14E+10	-35.0208	1940.	0.00
5.5500	0.03073	161145.	1142.	-9.70E-04	12147.	1.14E+10	-35.5439	2082.	0.00
5.7000	0.02900	163402.	1078.	-9.45E-04	12181.	1.14E+10	-35.9941	2234.	0.00
5.8500	0.02732	165535.	1013.	-9.19E-04	12214.	1.14E+10	-36.3684	2396.	0.00
6.0000	0.02569	167544.	947.1028	-8.92E-04	12245.	1.14E+10	-36.6639	2568.	0.00
6.1500	0.02411	169427.	882.0746	-8.66E-04	12274.	1.14E+10	-35.5897	2657.	0.00
6.3000	0.02258	171187.	819.3198	-8.39E-04	12301.	1.14E+10	-34.1379	2722.	0.00
6.4500	0.02109	172829.	759.2099	-8.12E-04	12326.	1.14E+10	-32.6510	2786.	0.00
6.6000	0.01966	174358.	701.8026	-7.84E-04	12349.	1.14E+10	-31.1349	2851.	0.00
6.7500	0.01827	175779.	647.1450	-7.57E-04	12371.	1.14E+10	-29.5957	2916.	0.00
6.9000	0.01693	177097.	595.2733	-7.29E-04	12391.	1.14E+10	-28.0394	2981.	0.00
7.0500	0.01565	178316.	546.2129	-7.01E-04	12410.	1.14E+10	-26.4721	3046.	0.00
7.2000	0.01441	179442.	499.9783	-6.72E-04	12427.	1.14E+10	-24.8997	3110.	0.00
7.3500	0.01322	180479.	456.5731	-6.44E-04	12443.	1.14E+10	-23.3283	3175.	0.00
7.5000	0.01209	181433.	400.5399	-6.15E-04	12458.	1.14E+10	-38.9309	5796.	0.00
7.6500	0.01101	182253.	330.7859	-5.87E-04	12470.	1.14E+10	-38.5735	6307.	0.00
7.8000	0.00998	182941.	261.8051	-5.58E-04	12481.	1.14E+10	-38.0718	6867.	0.00
7.9500	0.00900	183497.	193.8588	-5.29E-04	12489.	1.14E+10	-37.4240	7484.	0.00
8.1000	0.00807	183924.	127.2112	-5.00E-04	12496.	1.14E+10	-36.6289	8165.	0.00
8.2500	0.00720	184225.	62.1278	-4.71E-04	12501.	1.14E+10	-35.6860	8920.	0.00
8.4000	0.00638	184402.	-1.1259	-4.42E-04	12503.	1.14E+10	-34.5958	9761.	0.00
8.5500	0.00561	184459.	-62.2860	-4.13E-04	12504.	1.14E+10	-33.3598	10702.	0.00
8.7000	0.00489	184401.	-119.9013	-3.83E-04	12503.	1.14E+10	-30.6572	11275.	0.00
8.8500	0.00423	184235.	-171.7516	-3.54E-04	12501.	1.14E+10	-26.9543	11470.	0.00
9.0000	0.00362	183974.	-626.7447	-3.25E-04	12497.	1.14E+10	-478.5936	238079.	0.00
9.1500	0.00306	182154.	-1480.	-2.96E-04	12469.	1.14E+10	-469.0296	275988.	0.00
9.3000	0.00255	178807.	-2314.	-2.68E-04	12418.	1.14E+10	-457.8987	323043.	0.00
9.4500	0.00209	173969.	-3127.	-2.40E-04	12343.	1.14E+10	-445.0732	382468.	0.00
9.6000	0.00169	167681.	-3877.	-2.13E-04	12247.	1.14E+10	-388.7569	414720.	0.00
9.7500	0.00133	160127.	-4506.	-1.87E-04	12131.	1.14E+10	-310.6725	421200.	0.00
9.9000	0.00101	151559.	-5003.	-1.63E-04	12000.	1.14E+10	-240.8145	427680.	0.00
10.0500	7.42E-04	142205.	-5381.	-1.39E-04	11857.	1.14E+10	-179.0871	434160.	0.00
10.2000	5.12E-04	132264.	-5655.	-1.18E-04	11704.	1.14E+10	-125.3047	440640.	0.00
10.3500	3.19E-04	121911.	-5839.	-9.76E-05	11546.	1.14E+10	-79.2018	447120.	0.00
10.5000	1.60E-04	111297.	-5946.	-7.92E-05	11383.	1.14E+10	-40.4430	453600.	0.00
10.6500	3.38E-05	100547.	-5991.	-6.25E-05	11218.	1.14E+10	-8.6311	460080.	0.00
10.8000	-6.44E-05	89765.	-5983.	-4.74E-05	11053.	1.14E+10	16.6841	466560.	0.00
10.9500	-1.37E-04	79033.	-5936.	-3.41E-05	10889.	1.14E+10	35.9995	473040.	0.00
11.1000	-1.87E-04	68414.	-5859.	-2.25E-05	10726.	1.14E+10	49.8524	479520.	0.00
11.2500	-2.18E-04	57954.	-5761.	-1.25E-05	10566.	1.14E+10	58.8150	486000.	0.00
11.4000	-2.32E-04	47682.	-5651.	-4.14E-06	10408.	1.14E+10	63.4910	492480.	0.00
11.5500	-2.33E-04	37614.	-5536.	2.60E-06	10254.	1.14E+10	64.5118	498960.	0.00
11.7000	-2.23E-04	27753.	-5421.	7.76E-06	10103.	1.14E+10	62.5349	505440.	0.00
11.8500	-2.05E-04	18093.	-5313.	1.14E-05	9955.	1.14E+10	58.2420	511920.	0.00
12.0000	-1.82E-04	8621.	-4606.	1.35E-05	9810.	1.14E+10	726.9278	7200000	0.00
12.1500	-1.56E-04	1505.	-3389.	1.43E-05	9700.	1.14E+10	624.8952	7200000	0.00
12.3000	-1.30E-04	-3587.	-2358.	1.41E-05	9732.	1.14E+10	521.1516	7200000	0.00
12.4500	-1.05E-04	-6991.	-1509.	1.33E-05	9785.	1.14E+10	421.4874	7200000	0.00
12.6000	-8.24E-05	-9028.	-833.2599	1.20E-05	9816.	1.14E+10	329.7729	7200000	0.00
12.7500	-6.21E-05	-9997.	-312.9719	1.05E-05	9831.	1.14E+10	248.3249	7200000	0.00
12.9000	-4.46E-05	-10161.	70.9411	8.93E-06	9833.	1.14E+10	178.2451	7200000	0.00
13.0500	-2.99E-05	-9747.	339.1094	7.36E-06	9827.	1.14E+10	119.7196	7200000	0.00
13.2000	-1.81E-05	-8944.	511.9067	5.88E-06	9814.	1.14E+10	72.2773	7200000	0.00
13.3500	-8.75E-06	-7907.	608.4613	4.55E-06	9799.	1.14E+10	35.0056	7200000	0.00
13.5000	-1.68E-06	-6756.	646.0191	3.39E-06	9781.	1.14E+10	6.7252	7200000	0.00
13.6500	3.47E-06	-5583.	639.5862	2.42E-06	9763.	1.14E+10	-13.8728	7200000	0.00
13.8000	7.03E-06	-4455.	601.7909	1.63E-06	9746.	1.14E+10	-28.1220	7200000	0.00
13.9500	9.33E-06	-3417.	542.9062	1.01E-06	9730.	1.14E+10	-37.3055	7200000	0.00
14.1000	1.07E-05	-2501.	470.9886	5.38E-07	9716.	1.14E+10	-42.6029	7200000	0.00

1ST Neg

Max Neg

14.2500	1.13E-05	-1722.	392.0953	2.05E-07	9704.	1.14E+10	-45.0564	7200000.	0.00
14.4000	1.14E-05	-1089.	310.5482	-1.73E-08	9694.	1.14E+10	-45.5515	7200000.	0.00
14.5500	1.12E-05	-604.2200	229.2249	-1.51E-07	9687.	1.14E+10	-44.8078	7200000.	0.00
14.7000	1.08E-05	-264.1501	149.8586	-2.20E-07	9681.	1.14E+10	-43.3770	7200000.	0.00
14.8500	1.04E-05	-64.6103	73.3382	-2.46E-07	9678.	1.14E+10	-41.6458	7200000.	0.00
15.0000	9.96E-06	0.00	0.00	-2.51E-07	9677.	1.14E+10	-39.8411	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.11859284 inches
Computed slope at pile head = -0.00150947 radians
Maximum bending moment = 184459. inch-lbs
Maximum shear force = -5991. lbs
Depth of maximum bending moment = 8.55000000 feet below pile head
Depth of maximum shear force = 10.65000000 feet below pile head
Number of iterations = 9
Number of zero deflection points = 2

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 150000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.05698	-268130.	5000.	0.00	13786.	1.14E+10	0.00	0.00	0.00
0.1500	0.05694	-259125.	4998.	-4.16E-05	13648.	1.14E+10	-2.0498	64.8000	0.00
0.3000	0.05683	-250114.	4993.	-8.18E-05	13510.	1.14E+10	-4.0915	129.6000	0.00
0.4500	0.05664	-241107.	4983.	-1.21E-04	13372.	1.14E+10	-6.1175	194.4000	0.00
0.6000	0.05639	-232109.	4971.	-1.58E-04	13234.	1.14E+10	-8.1204	259.2000	0.00
0.7500	0.05607	-223127.	4954.	-1.94E-04	13097.	1.14E+10	-10.0934	324.0000	0.00
0.9000	0.05569	-214169.	4934.	-2.28E-04	12959.	1.14E+10	-12.0298	388.8000	0.00
1.0500	0.05525	-205240.	4911.	-2.62E-04	12823.	1.14E+10	-13.9235	453.6000	0.00
1.2000	0.05475	-196348.	4884.	-2.93E-04	12686.	1.14E+10	-15.7685	518.4000	0.00
1.3500	0.05420	-187499.	4854.	-3.24E-04	12551.	1.14E+10	-17.5595	583.2000	0.00
1.5000	0.05359	-178698.	4821.	-3.53E-04	12416.	1.14E+10	-19.2912	648.0000	0.00
1.6500	0.05293	-169952.	4785.	-3.80E-04	12282.	1.14E+10	-20.9590	712.8000	0.00
1.8000	0.05222	-161267.	4746.	-4.06E-04	12149.	1.14E+10	-22.5583	777.6000	0.00
1.9500	0.05146	-152649.	4704.	-4.31E-04	12017.	1.14E+10	-24.0852	842.4000	0.00
2.1000	0.05067	-144101.	4659.	-4.54E-04	11886.	1.14E+10	-25.5360	907.2000	0.00
2.2500	0.04983	-135631.	4612.	-4.77E-04	11756.	1.14E+10	-26.9072	972.0000	0.00
2.4000	0.04895	-127241.	4562.	-4.97E-04	11627.	1.14E+10	-28.1958	1037.	0.00
2.5500	0.04804	-118938.	4510.	-5.17E-04	11500.	1.14E+10	-29.3991	1102.	0.00
2.7000	0.04709	-110725.	4457.	-5.35E-04	11374.	1.14E+10	-30.5148	1166.	0.00
2.8500	0.04611	-102606.	4401.	-5.52E-04	11250.	1.14E+10	-30.7785	1201.	0.00
3.0000	0.04510	-94582.	4346.	-5.67E-04	11127.	1.14E+10	-30.4895	1217.	0.00

3.1500	0.04407	-86653.	4291.	-5.82E-04	11005.	1.14E+10	-30.5905	1249.	0.00
3.3000	0.04301	-78819.	4236.	-5.95E-04	10885.	1.14E+10	-30.4862	1276.	0.00
3.4500	0.04193	-71081.	4182.	-6.07E-04	10767.	1.14E+10	-30.1114	1293.	0.00
3.6000	0.04083	-63438.	4128.	-6.17E-04	10650.	1.14E+10	-29.4612	1299.	0.00
3.7500	0.03971	-55887.	4076.	-6.27E-04	10534.	1.14E+10	-28.5349	1294.	0.00
3.9000	0.03857	-48426.	4026.	-6.35E-04	10420.	1.14E+10	-27.3365	1276.	0.00
4.0500	0.03742	-41052.	3977.	-6.42E-04	10307.	1.14E+10	-26.4041	1270.	0.00
4.2000	0.03626	-33761.	3929.	-6.48E-04	10195.	1.14E+10	-27.0649	1344.	0.00
4.3500	0.03509	-26557.	3880.	-6.53E-04	10084.	1.14E+10	-27.6469	1418.	0.00
4.5000	0.03391	-19441.	3830.	-6.56E-04	9975.	1.14E+10	-28.1458	1494.	0.00
4.6500	0.03273	-12416.	3779.	-6.59E-04	9868.	1.14E+10	-28.5578	1571.	0.00
4.8000	0.03154	-5483.	3727.	-6.60E-04	9761.	1.14E+10	-28.8794	1648.	0.00
4.9500	0.03035	1358.	3675.	-6.60E-04	9698.	1.14E+10	-29.1077	1726.	0.00
5.1000	0.02916	8103.	3622.	-6.60E-04	9802.	1.14E+10	-29.6260	1829.	0.00
5.2500	0.02798	14753.	3568.	-6.58E-04	9903.	1.14E+10	-30.4117	1957.	0.00
5.4000	0.02679	21303.	3512.	-6.55E-04	10004.	1.14E+10	-31.1462	2092.	0.00
5.5500	0.02562	27751.	3456.	-6.51E-04	10103.	1.14E+10	-31.8257	2236.	0.00
5.7000	0.02445	34095.	3398.	-6.46E-04	10200.	1.14E+10	-32.4463	2389.	0.00
5.8500	0.02329	40333.	3339.	-6.40E-04	10295.	1.14E+10	-32.7017	2527.	0.00
6.0000	0.02214	46463.	3281.	-6.34E-04	10389.	1.14E+10	-31.8885	2592.	0.00
6.1500	0.02101	52487.	3225.	-6.26E-04	10482.	1.14E+10	-31.0123	2657.	0.00
6.3000	0.01989	58409.	3170.	-6.17E-04	10573.	1.14E+10	-30.0770	2722.	0.00
6.4500	0.01879	64231.	3116.	-6.07E-04	10662.	1.14E+10	-29.0868	2786.	0.00
6.6000	0.01771	69956.	3065.	-5.97E-04	10749.	1.14E+10	-28.0463	2851.	0.00
6.7500	0.01664	75587.	3015.	-5.85E-04	10836.	1.14E+10	-26.9598	2916.	0.00
6.9000	0.01560	81127.	2968.	-5.73E-04	10921.	1.14E+10	-25.8324	2981.	0.00
7.0500	0.01458	86581.	2922.	-5.60E-04	11004.	1.14E+10	-24.6689	3046.	0.00
7.2000	0.01358	91950.	2879.	-5.45E-04	11087.	1.14E+10	-23.4745	3110.	0.00
7.3500	0.01262	97240.	2838.	-5.31E-04	11168.	1.14E+10	-22.2546	3175.	0.00
7.5000	0.01167	102453.	2784.	-5.15E-04	11247.	1.14E+10	-38.1122	5876.	0.00
7.6500	0.01076	107539.	2715.	-4.98E-04	11325.	1.14E+10	-38.0485	6363.	0.00
7.8000	0.00988	112497.	2647.	-4.81E-04	11401.	1.14E+10	-37.8472	6894.	0.00
7.9500	0.00903	117327.	2579.	-4.63E-04	11475.	1.14E+10	-37.5049	7474.	0.00
8.1000	0.00822	122031.	2512.	-4.44E-04	11547.	1.14E+10	-37.0188	8110.	0.00
8.2500	0.00743	126610.	2446.	-4.24E-04	11618.	1.14E+10	-36.3871	8810.	0.00
8.4000	0.00669	131065.	2381.	-4.04E-04	11686.	1.14E+10	-35.6086	9582.	0.00
8.5500	0.00598	135399.	2318.	-3.83E-04	11752.	1.14E+10	-34.6833	10439.	0.00
8.7000	0.00531	139616.	2257.	-3.61E-04	11817.	1.14E+10	-33.2685	11275.	0.00
8.8500	0.00468	143718.	2200.	-3.39E-04	11880.	1.14E+10	-29.8278	11470.	0.00
9.0000	0.00409	147718.	1729.	-3.16E-04	11941.	1.14E+10	-493.6215	217139.	0.00
9.1500	0.00354	150112.	846.4188	-2.92E-04	11978.	1.14E+10	-486.7244	247152.	0.00
9.3000	0.00304	150923.	-22.2930	-2.68E-04	11990.	1.14E+10	-478.5110	283297.	0.00
9.4500	0.00258	150177.	-874.9847	-2.45E-04	11979.	1.14E+10	-468.9241	327311.	0.00
9.6000	0.00216	147905.	-1709.	-2.21E-04	11944.	1.14E+10	-457.8940	381593.	0.00
9.7500	0.00178	144143.	-2497.	-1.98E-04	11886.	1.14E+10	-417.2457	421200.	0.00
9.9000	0.00145	139024.	-3182.	-1.76E-04	11808.	1.14E+10	-343.8694	427680.	0.00
10.0500	0.00115	132784.	-3741.	-1.54E-04	11712.	1.14E+10	-277.6077	434160.	0.00
10.2000	8.92E-04	125639.	-4188.	-1.34E-04	11603.	1.14E+10	-218.4534	440640.	0.00
10.3500	6.70E-04	117781.	-4534.	-1.15E-04	11482.	1.14E+10	-166.3096	447120.	0.00
10.5000	4.80E-04	109379.	-4792.	-9.66E-05	11354.	1.14E+10	-120.9990	453600.	0.00
10.6500	3.22E-04	100580.	-4975.	-8.00E-05	11219.	1.14E+10	-82.2729	460080.	0.00
10.8000	1.92E-04	91511.	-5094.	-6.48E-05	11080.	1.14E+10	-49.8186	466560.	0.00
10.9500	8.85E-05	82276.	-5160.	-5.11E-05	10938.	1.14E+10	-23.2674	473040.	0.00
11.1000	8.26E-06	72963.	-5183.	-3.88E-05	10796.	1.14E+10	-2.2010	479520.	0.00
11.2500	-5.13E-05	63639.	-5172.	-2.80E-05	10653.	1.14E+10	13.8431	486000.	0.00
11.4000	-9.27E-05	54357.	-5137.	-1.87E-05	10510.	1.14E+10	25.3660	492480.	0.00
11.5500	-1.19E-04	45155.	-5085.	-1.09E-05	10369.	1.14E+10	32.9037	498960.	0.00
11.7000	-1.32E-04	36058.	-5022.	-4.46E-06	10230.	1.14E+10	37.0239	505440.	0.00
11.8500	-1.35E-04	27079.	-4954.	5.27E-07	10092.	1.14E+10	38.3236	511920.	0.00
12.0000	-1.30E-04	18223.	-4452.	4.10E-06	9957.	1.14E+10	519.8194	7200000.	0.00
12.1500	-1.20E-04	11051.	-3552.	6.42E-06	9847.	1.14E+10	479.9072	7200000.	0.00

1st Neg

Max Neg

Fixed End

1ST Neg = 11.3' (EL 3003.9)

Max Neg = 11.9' (EL 3003.3)

Say POF = 3003 Ft

Min Tip for Fixity = 3001 Ft

5' into WR/Rock = 3001 Ft

USE 3001 Ft AS Tip Elevation

12.3000	-1.07E-04	5433.	-2735.	7.72E-06	9761.	1.14E+10	427.4287	7200000.	0.00
12.4500	-9.22E-05	1200.	-2019.	8.24E-06	9696.	1.14E+10	368.7722	7200000.	0.00
12.6000	-7.72E-05	-1839.	-1409.	8.19E-06	9706.	1.14E+10	308.7515	7200000.	0.00
12.7500	-6.27E-05	-3877.	-905.3157	7.74E-06	9737.	1.14E+10	250.8219	7200000.	0.00
12.9000	-4.93E-05	-5102.	-502.0052	7.03E-06	9756.	1.14E+10	197.3009	7200000.	0.00
13.0500	-3.74E-05	-5688.	-189.8109	6.18E-06	9765.	1.14E+10	149.5817	7200000.	0.00
13.2000	-2.71E-05	-5789.	42.3102	5.27E-06	9766.	1.14E+10	108.3306	7200000.	0.00
13.3500	-1.84E-05	-5538.	206.1037	4.38E-06	9762.	1.14E+10	73.6622	7200000.	0.00
13.5000	-1.13E-05	-5049.	313.1623	3.54E-06	9755.	1.14E+10	45.2918	7200000.	0.00
13.6500	-5.67E-06	-4413.	374.3217	2.79E-06	9745.	1.14E+10	22.6631	7200000.	0.00
13.8000	-1.26E-06	-3703.	399.2658	2.15E-06	9734.	1.14E+10	5.0526	7200000.	0.00
13.9500	2.09E-06	-2977.	396.3010	1.63E-06	9723.	1.14E+10	-8.3469	7200000.	0.00
14.1000	4.59E-06	-2277.	372.2636	1.21E-06	9712.	1.14E+10	-18.3613	7200000.	0.00
14.2500	6.45E-06	-1637.	332.5311	9.02E-07	9703.	1.14E+10	-25.7860	7200000.	0.00
14.4000	7.84E-06	-1081.	281.1097	6.87E-07	9694.	1.14E+10	-31.3489	7200000.	0.00
14.5500	8.92E-06	-625.6910	220.7811	5.53E-07	9687.	1.14E+10	-35.6828	7200000.	0.00
14.7000	9.83E-06	-286.2269	153.2919	4.81E-07	9682.	1.14E+10	-39.3052	7200000.	0.00
14.8500	1.07E-05	-74.0995	79.5753	4.52E-07	9679.	1.14E+10	-42.6022	7200000.	0.00
15.0000	1.15E-05	0.00	0.00	4.46E-07	9677.	1.14E+10	-45.8148	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.05697601 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -268130. inch-lbs
Maximum shear force = -5183. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 11.10000000 feet below pile head
Number of iterations = 7
Number of zero deflection points = 2

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	3000.	M, in-lb	0.00	150000.	0.1186	-0.00151	-5991.	184459.
2	V, lb	5000.	S, rad	0.00	150000.	0.05698	0.00	-5183.	-268130.

Maximum pile-head deflection = 0.1185928444 inches
Maximum pile-head rotation = -0.0015094699 radians = -0.086486 deg.

The analysis ended normally

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore	
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 14+26	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 3,017.1 ft	**TOTAL DEPTH** 21.0 ft	**NORTHING** 956,938	**EASTING** 1,273,326	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring		**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**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
3020						BOC = 3015.0				
	3,017.1	0.0	3	4	5	9	0	M		3,017.1 GROUND SURFACE 0.0
3015										ROADWAY EMBANKMENT Soft to Stiff, Brown, Fine to Coarse Sandy SILT (A-4), with trace rock fragments
	3,013.6	3.5	6	2	1	3		M		
	3,011.1	6.0								
3010			1	1	1	2		M		3,009.1 8.0
	3,008.6	8.5	15	85/0.4				Sat.		ALLUVIAL
	3,006.8	10.3	60/0.0			100/0.9 60/0.0	8.2			3,006.8 Very Dense, Brown-Tan, Silty Fine to Coarse SAND (A-2-4) 10.3
3005										3,006.1 11.0 CRYSTALLINE ROCK Gray (BIOTITE GNEISS)
3000										CRYSTALLINE ROCK Gray (BIOTITE GNEISS)
										2,996.1 21.0

Boring Terminated at Elevation 2,996.1 ft In Crystalline Rock (BIOTITE GNEISS)

1) High N-values in the alluvial layer due to cobbles encountered during drilling

2) A tri-cone bit was used to seat the casing after SPT refusal was encountered. Rock coring began at 11.0 feet.

EB-2 (LT)

Drill in Piles A minimum of 5' into WR/Rock And to An elevation below Fixity

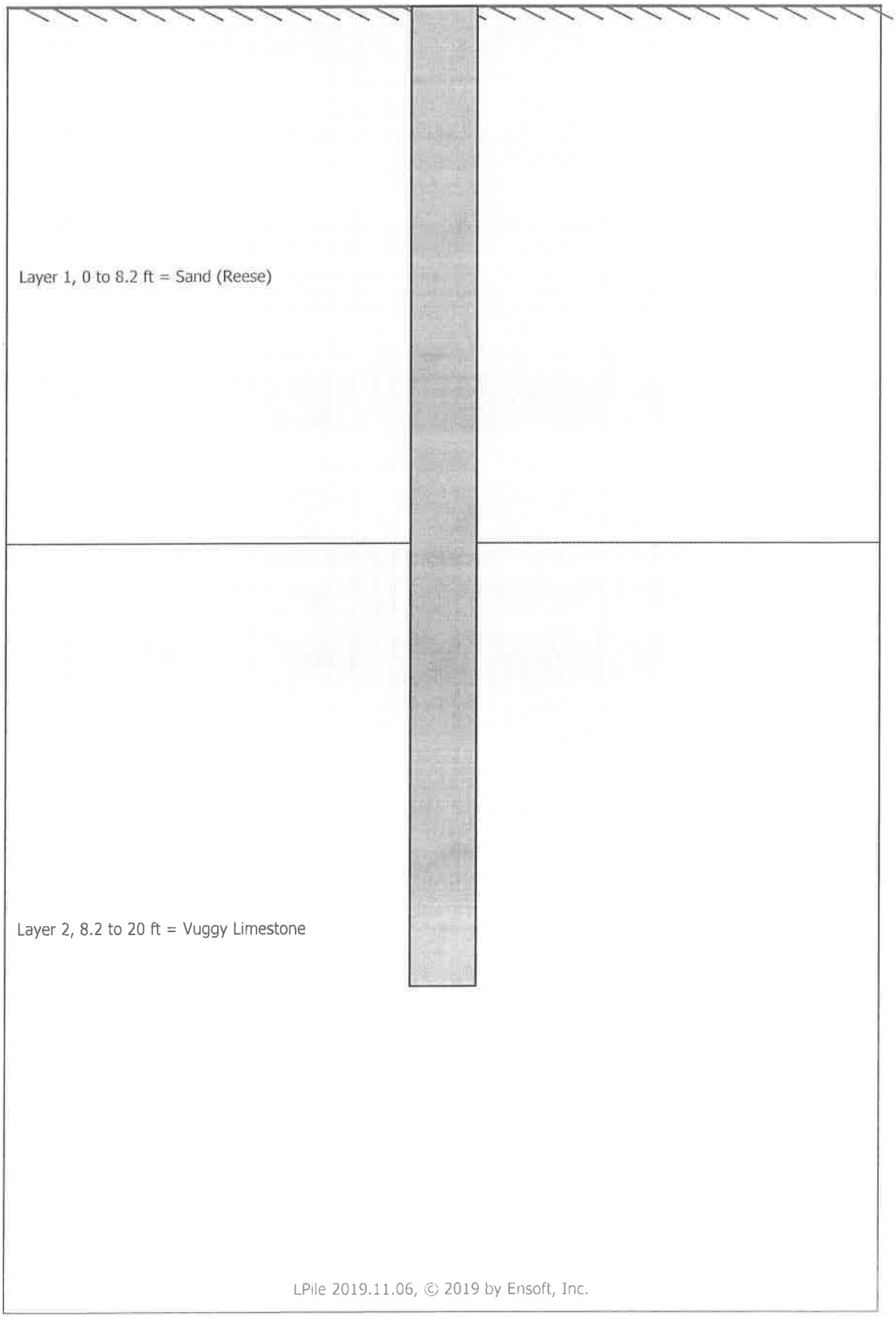
L = BOC - Tip EL + 1.0 Embed
= 3015.0 - 3002 + 1.0 = 14.0'
Ave Pile Length = 15'

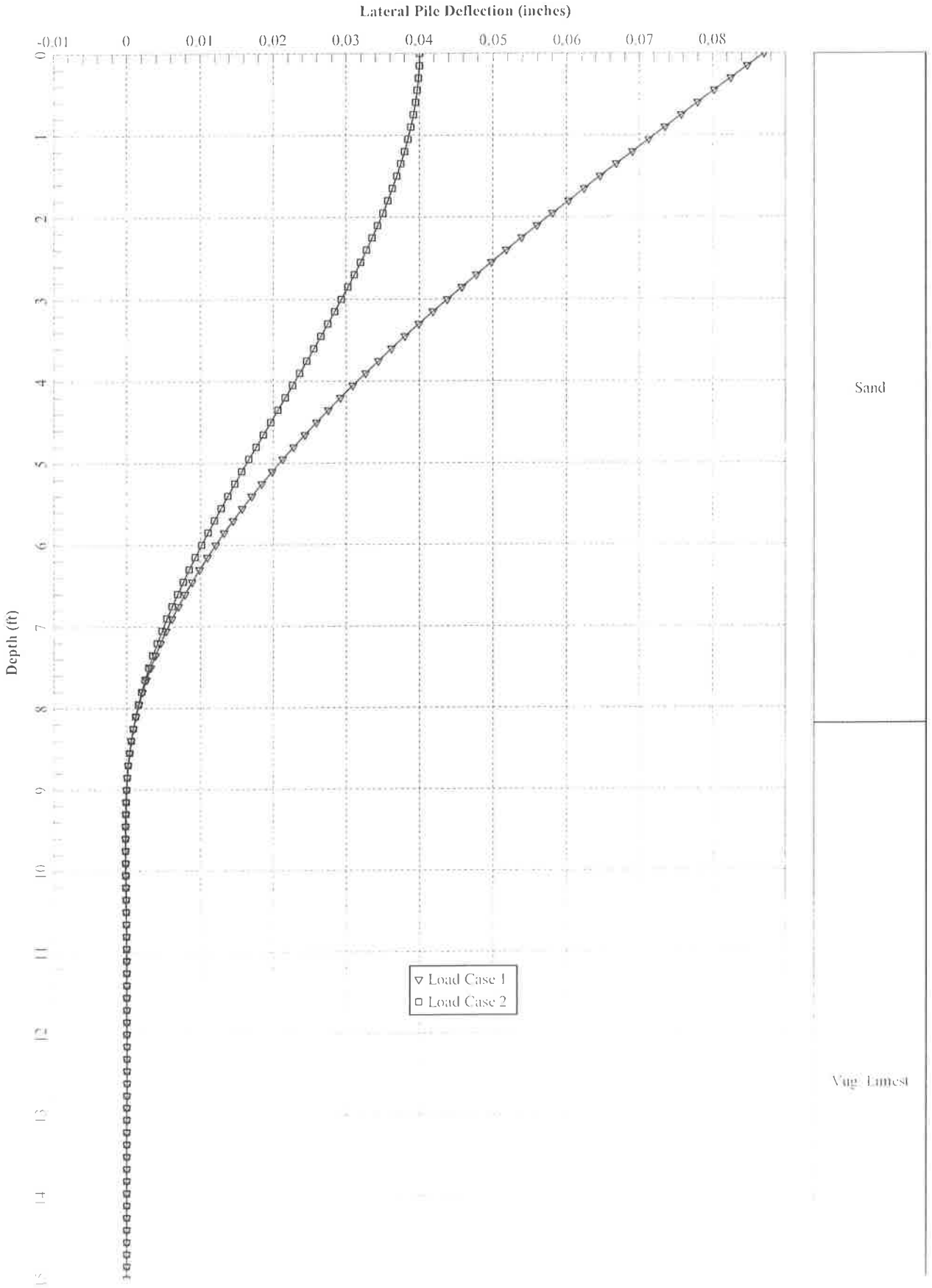
USE 3002 Ft For Tip Elev

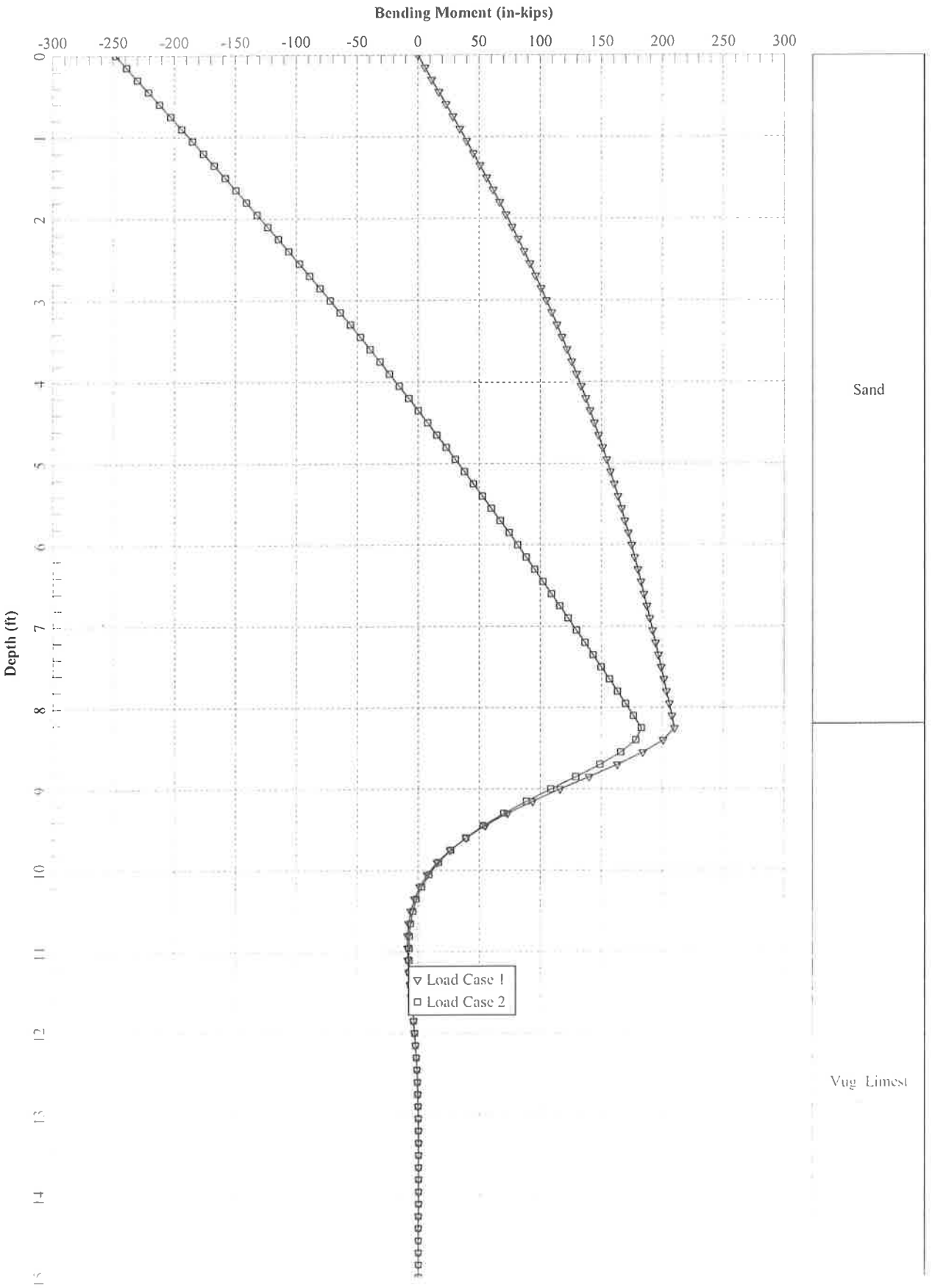
Est Qty

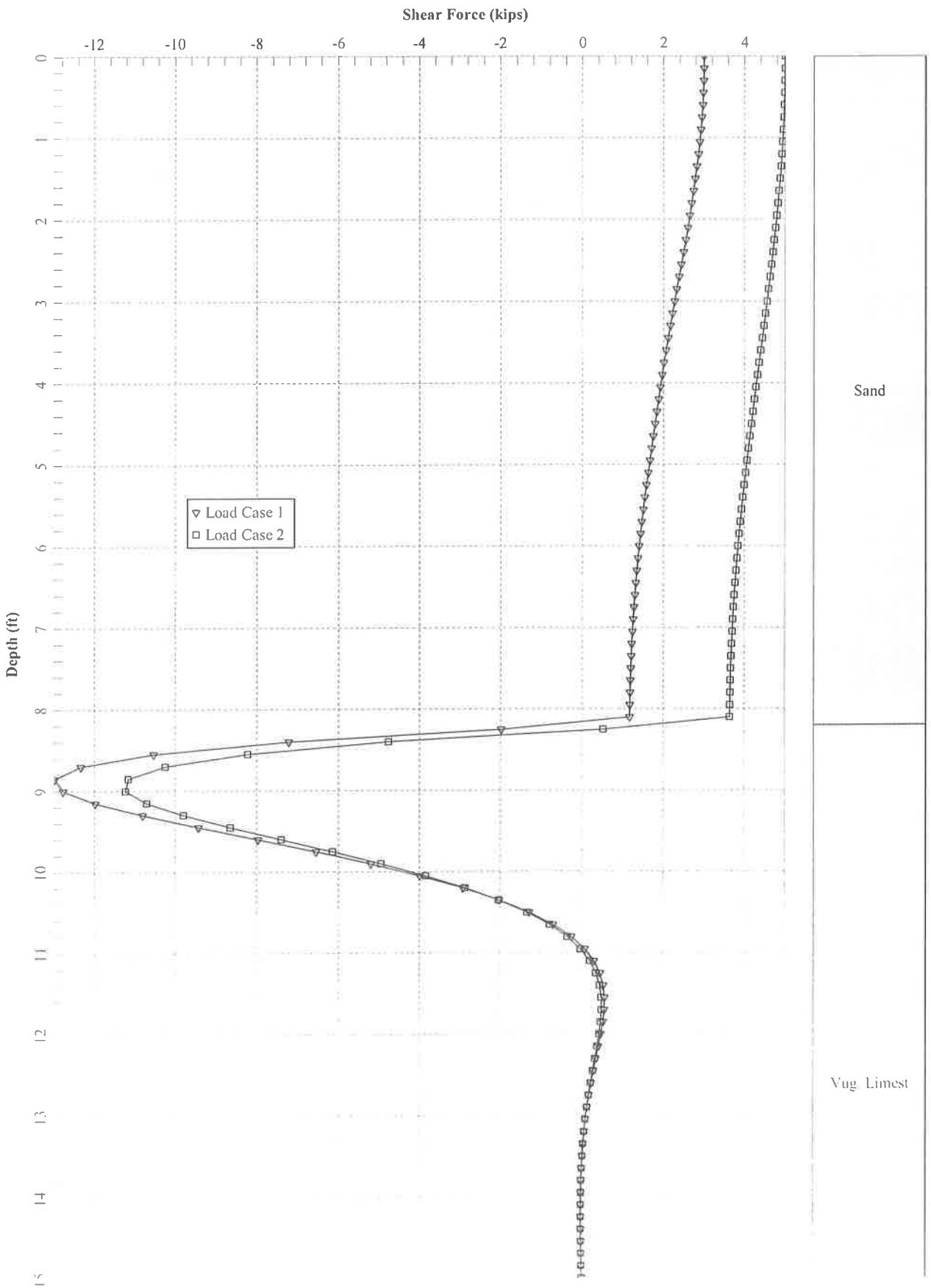
In Soil = 3015.0 - 3006.8 = 8.2'
Not In Soil = 3006.8 - 3002 = 4.8'

EB 2-A









LPile for Windows, Version 2019-11.006

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\Users\mwalko\Downloads\

Name of input data file:
EB2-A_REV.lp11d

Name of output report file:
EB2-A_REV.lp11o

Name of plot output file:
EB2-A_REV.lp11p

Name of runtime message file:
EB2-A_REV.lp11r

Date and Time of Analysis

Date: March 28, 2022 Time: 14:41:05

Problem Title

Project Name: Ashe Bridge 15

Job Number: 09-29362

Client: Vaughn & Melton

Engineer: ECS Southeast

Description: End Bent 2

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points

p-y curves are computed using pile diameter values interpolated with depth over

the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0450
2	15.000	12.0450

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
Cross-sectional Shape = Strong H-Pile
Length of section = 15.000000 ft
Flange Width = 12.045000 in
Section Depth = 11.780000 in
Flange Thickness = 0.435000 in
Web Thickness = 0.435000 in
Section Area = 15.500000 sq. in
Moment of Inertia = 393.000000 in^4
Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 8.200000 ft
Effective unit weight at top of layer = 42.600000 pcf
Effective unit weight at bottom of layer = 42.600000 pcf
Friction angle at top of layer = 28.000000 deg.
Friction angle at bottom of layer = 28.000000 deg.
Subgrade k at top of layer = 20.000000 pci
Subgrade k at bottom of layer = 20.000000 pci

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 8.200000 ft

Distance from top of pile to bottom of layer = 20.000000 ft
Effective unit weight at top of layer = 160.000000 pcf
Effective unit weight at bottom of layer = 160.000000 pcf
Uniaxial compressive strength at top of layer = 4000. psi
Uniaxial compressive strength at bottom of layer = 4000. psi

(Depth of the lowest soil layer extends 5.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	Uniaxial qu psi	kpy pci
1	Sand	0.00	42.6000	28.0000	--	20.0000
	(Reese, et al.)	8.2000	42.6000	28.0000	--	20.0000
2	Strong Rock	8.2000	160.0000	--	4000.	--
	(Vuggy Limestone)	20.0000	160.0000	--	4000.	--

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V =	3000. lbs	M =	0.0000 in-lbs	150000.	No	Yes
2	2	V =	5000. lbs	S =	0.0000 in/in	150000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with

specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

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Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	14731.
2	8.2000	8.2000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 3000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 150000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr Es*H lb/inch	Distrib Lat Load lb/inch
0.00	0.08703	-2.44E-07	3000.	-0.00126	9677.	1.14E+10	0.00	0.00	0.00
0.1500	0.08477	5740.	2998.	-0.00126	9765.	1.14E+10	-2.3058	48.9632	0.00
0.3000	0.08250	11473.	2992.	-0.00126	9853.	1.14E+10	-4.7336	103.2797	0.00
0.4500	0.08024	17190.	2981.	-0.00126	9941.	1.14E+10	-7.2126	161.8066	0.00
0.6000	0.07798	22882.	2966.	-0.00125	10028.	1.14E+10	-9.7326	224.6633	0.00

0.7500	0.07572	28542.	2946.	-0.00125	10115.	1.14E+10	-12.2492	291.1676	0.00
0.9000	0.07348	34162.	2922.	-0.00124	10201.	1.14E+10	-14.6844	359.7121	0.00
1.0500	0.07125	39732.	2893.	-0.00124	10286.	1.14E+10	-17.0101	429.7518	0.00
1.2000	0.06902	45245.	2860.	-0.00123	10371.	1.14E+10	-19.2303	501.4933	0.00
1.3500	0.06681	50694.	2824.	-0.00122	10454.	1.14E+10	-21.2482	572.4475	0.00
1.5000	0.06462	56072.	2784.	-0.00122	10537.	1.14E+10	-23.0178	641.1940	0.00
1.6500	0.06244	61374.	2741.	-0.00121	10618.	1.14E+10	-24.7251	712.8000	0.00
1.8000	0.06027	66592.	2695.	-0.00120	10698.	1.14E+10	-26.0386	777.6000	0.00
1.9500	0.05813	71723.	2648.	-0.00119	10777.	1.14E+10	-27.2053	842.4000	0.00
2.1000	0.05601	76763.	2598.	-0.00117	10854.	1.14E+10	-28.2279	907.2000	0.00
2.2500	0.05391	81709.	2546.	-0.00116	10930.	1.14E+10	-29.1095	972.0000	0.00
2.4000	0.05183	86556.	2493.	-0.00115	11004.	1.14E+10	-29.8531	1037.	0.00
2.5500	0.04977	91303.	2439.	-0.00113	11077.	1.14E+10	-30.4622	1102.	0.00
2.7000	0.04775	95948.	2384.	-0.00112	11148.	1.14E+10	-30.8722	1164.	0.00
2.8500	0.04575	100488.	2328.	-0.00110	11217.	1.14E+10	-30.6851	1207.	0.00
3.0000	0.04378	104925.	2273.	-0.00109	11285.	1.14E+10	-30.1317	1239.	0.00
3.1500	0.04183	109259.	2219.	-0.00107	11352.	1.14E+10	-29.9399	1288.	0.00
3.3000	0.03992	113492.	2166.	-0.00105	11417.	1.14E+10	-29.5184	1331.	0.00
3.4500	0.03804	117625.	2113.	-0.00103	11480.	1.14E+10	-28.8081	1363.	0.00
3.6000	0.03620	121659.	2062.	-0.00102	11542.	1.14E+10	-27.8108	1383.	0.00
3.7500	0.03439	125598.	2013.	-9.96E-04	11602.	1.14E+10	-26.5341	1389.	0.00
3.9000	0.03261	129445.	1967.	-9.76E-04	11661.	1.14E+10	-24.9917	1379.	0.00
4.0500	0.03088	133206.	1923.	-9.55E-04	11719.	1.14E+10	-23.7071	1382.	0.00
4.2000	0.02918	136885.	1880.	-9.34E-04	11775.	1.14E+10	-23.9241	1476.	0.00
4.3500	0.02751	140480.	1837.	-9.12E-04	11830.	1.14E+10	-24.0414	1573.	0.00
4.5000	0.02589	143991.	1794.	-8.89E-04	11884.	1.14E+10	-24.0570	1672.	0.00
4.6500	0.02431	147418.	1751.	-8.66E-04	11937.	1.14E+10	-23.9695	1775.	0.00
4.8000	0.02277	150761.	1708.	-8.43E-04	11988.	1.14E+10	-23.7783	1879.	0.00
4.9500	0.02128	154021.	1665.	-8.19E-04	12038.	1.14E+10	-23.4837	1987.	0.00
5.1000	0.01983	157198.	1623.	-7.94E-04	12086.	1.14E+10	-23.4297	2127.	0.00
5.2500	0.01842	160293.	1581.	-7.69E-04	12134.	1.14E+10	-23.2087	2268.	0.00
5.4000	0.01706	163305.	1540.	-7.44E-04	12180.	1.14E+10	-22.1072	2333.	0.00
5.5500	0.01574	166239.	1501.	-7.17E-04	12225.	1.14E+10	-20.9696	2398.	0.00
5.7000	0.01448	169098.	1465.	-6.91E-04	12269.	1.14E+10	-19.8019	2462.	0.00
5.8500	0.01326	171885.	1430.	-6.64E-04	12311.	1.14E+10	-18.6104	2527.	0.00
6.0000	0.01208	174605.	1398.	-6.37E-04	12353.	1.14E+10	-17.4014	2592.	0.00
6.1500	0.01096	177261.	1368.	-6.09E-04	12394.	1.14E+10	-16.1814	2657.	0.00
6.3000	0.00989	179857.	1340.	-5.81E-04	12434.	1.14E+10	-14.9569	2722.	0.00
6.4500	0.00887	182397.	1314.	-5.52E-04	12473.	1.14E+10	-13.7344	2786.	0.00
6.6000	0.00790	184884.	1290.	-5.23E-04	12511.	1.14E+10	-12.5206	2851.	0.00
6.7500	0.00699	187323.	1269.	-4.94E-04	12548.	1.14E+10	-11.3223	2916.	0.00
6.9000	0.00613	189718.	1249.	-4.64E-04	12585.	1.14E+10	-10.1463	2981.	0.00
7.0500	0.00532	192071.	1232.	-4.34E-04	12621.	1.14E+10	-8.9994	3046.	0.00
7.2000	0.00457	194388.	1217.	-4.03E-04	12656.	1.14E+10	-7.8887	3110.	0.00
7.3500	0.00387	196670.	1204.	-3.72E-04	12691.	1.14E+10	-6.8212	3175.	0.00
7.5000	0.00322	198922.	1192.	-3.41E-04	12726.	1.14E+10	-5.8041	3240.	0.00
7.6500	0.00264	201146.	1183.	-3.10E-04	12760.	1.14E+10	-4.8446	3305.	0.00
7.8000	0.00211	203347.	1175.	-2.78E-04	12794.	1.14E+10	-3.9499	3370.	0.00
7.9500	0.00164	205525.	1168.	-2.45E-04	12827.	1.14E+10	-3.1275	3434.	0.00
8.1000	0.00123	207685.	1163.	-2.13E-04	12860.	1.14E+10	-2.3848	3499.	0.00
8.2500	8.73E-04	209829.	-1983.	-1.80E-04	12893.	1.14E+10	-3493.	7200000.	0.00
8.4000	5.80E-04	200644.	-7213.	-1.47E-04	12752.	1.14E+10	-2318.	7200000.	0.00
8.5500	3.43E-04	183940.	-10534.	-1.17E-04	12496.	1.14E+10	-1372.	7200000.	0.00
8.7000	1.59E-04	162783.	-12340.	-8.96E-05	12172.	1.14E+10	-634.0525	7200000.	0.00
8.8500	2.04E-05	139566.	-12984.	-6.57E-05	11816.	1.14E+10	-81.5493	7200000.	0.00
9.0000	-7.81E-05	116078.	-12776.	-4.55E-05	11456.	1.14E+10	312.2481	7200000.	0.00
9.1500	-1.44E-04	93596.	-11978.	-2.90E-05	11112.	1.14E+10	574.0488	7200000.	0.00
9.3000	-1.82E-04	72971.	-10805.	-1.58E-05	10796.	1.14E+10	729.4171	7200000.	0.00
9.4500	-2.00E-04	54706.	-9427.	-5.73E-06	10516.	1.14E+10	801.8069	7200000.	0.00
9.6000	-2.03E-04	39036.	-7975.	1.67E-06	10276.	1.14E+10	811.9883	7200000.	0.00
9.7500	-1.94E-04	25996.	-6544.	6.80E-06	10076.	1.14E+10	777.7796	7200000.	0.00

1ST Neg

MAX Neg

9.9000	-1.79E-04	15475.	-5201.	1.01E-05	9915.	1.14E+10	714.0098	7200000.	0.00
10.0500	-1.58E-04	7266.	-3989.	1.19E-05	9789.	1.14E+10	632.6431	7200000.	0.00
10.2000	-1.36E-04	1106.	-2931.	1.25E-05	9694.	1.14E+10	543.0143	7200000.	0.00
10.3500	-1.13E-04	-3294.	-2036.	1.24E-05	9728.	1.14E+10	452.1272	7200000.	0.00
10.5000	-9.12E-05	-6228.	-1300.	1.16E-05	9773.	1.14E+10	364.9852	7200000.	0.00
10.6500	-7.12E-05	-7981.	-715.3116	1.05E-05	9800.	1.14E+10	284.9259	7200000.	0.00
10.8000	-5.35E-05	-8809.	-266.3307	9.16E-06	9812.	1.14E+10	213.9417	7200000.	0.00
10.9500	-3.82E-05	-8944.	63.8942	7.76E-06	9814.	1.14E+10	152.9749	7200000.	0.00
11.1000	-2.55E-05	-8583.	293.5327	6.38E-06	9809.	1.14E+10	102.1790	7200000.	0.00
11.2500	-1.53E-05	-7891.	440.5231	5.08E-06	9798.	1.14E+10	61.1437	7200000.	0.00
11.4000	-7.27E-06	-7000.	521.7259	3.90E-06	9785.	1.14E+10	29.0817	7200000.	0.00
11.5500	-1.24E-06	-6015.	552.3813	2.87E-06	9770.	1.14E+10	4.9799	7200000.	0.00
11.7000	3.07E-06	-5013.	545.8095	2.00E-06	9754.	1.14E+10	-12.2820	7200000.	0.00
11.8500	5.96E-06	-4051.	513.2970	1.29E-06	9740.	1.14E+10	-23.8431	7200000.	0.00
12.0000	7.70E-06	-3166.	464.1206	7.16E-07	9726.	1.14E+10	-30.7974	7200000.	0.00
12.1500	8.54E-06	-2381.	405.6665	2.78E-07	9714.	1.14E+10	-34.1515	7200000.	0.00
12.3000	8.70E-06	-1706.	343.6115	-4.49E-08	9704.	1.14E+10	-34.7985	7200000.	0.00
12.4500	8.38E-06	-1144.	282.1378	-2.70E-07	9695.	1.14E+10	-33.5056	7200000.	0.00
12.6000	7.73E-06	-689.9908	224.1617	-4.15E-07	9688.	1.14E+10	-30.9123	7200000.	0.00
12.7500	6.88E-06	-336.4511	171.5597	-4.96E-07	9683.	1.14E+10	-27.5343	7200000.	0.00
12.9000	5.94E-06	-72.1082	125.3824	-5.28E-07	9679.	1.14E+10	-23.7738	7200000.	0.00
13.0500	4.98E-06	115.2107	86.0479	-5.25E-07	9679.	1.14E+10	-19.9312	7200000.	0.00
13.2000	4.05E-06	237.9475	53.5121	-4.97E-07	9681.	1.14E+10	-16.2197	7200000.	0.00
13.3500	3.19E-06	308.1224	27.4135	-4.54E-07	9682.	1.14E+10	-12.7787	7200000.	0.00
13.5000	2.42E-06	336.8810	7.1933	-4.03E-07	9683.	1.14E+10	-9.6882	7200000.	0.00
13.6500	1.75E-06	334.2357	-7.8086	-3.50E-07	9683.	1.14E+10	-6.9807	7200000.	0.00
13.8000	1.16E-06	308.9588	-18.2791	-2.99E-07	9682.	1.14E+10	-4.6532	7200000.	0.00
13.9500	6.69E-07	268.5923	-24.8764	-2.53E-07	9682.	1.14E+10	-2.6771	7200000.	0.00
14.1000	2.52E-07	219.5404	-28.1917	-2.15E-07	9681.	1.14E+10	-1.0065	7200000.	0.00
14.2500	-1.04E-07	167.2182	-28.7244	-1.84E-07	9680.	1.14E+10	0.4146	7200000.	0.00
14.4000	-4.11E-07	116.2321	-26.8704	-1.62E-07	9679.	1.14E+10	1.6454	7200000.	0.00
14.5500	-6.86E-07	70.5721	-22.9198	-1.47E-07	9679.	1.14E+10	2.7441	7200000.	0.00
14.7000	-9.41E-07	33.8000	-17.0638	-1.39E-07	9678.	1.14E+10	3.7626	7200000.	0.00
14.8500	-1.19E-06	9.2172	-9.4092	-1.35E-07	9678.	1.14E+10	4.7426	7200000.	0.00
15.0000	-1.43E-06	0.00	0.00	-1.35E-07	9677.	1.14E+10	5.7121	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.08703500 inches
Computed slope at pile head = -0.00126031 radians
Maximum bending moment = 209829. inch-lbs
Maximum shear force = -12984. lbs
Depth of maximum bending moment = 8.25000000 feet below pile head
Depth of maximum shear force = 8.85000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 3

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
Rotation of pile head = 0.000E+00 radians

Axial load at pile head = 150000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.04004	-248102.	5000.	0.00	13479.	1.14E+10	0.00	0.00	0.00
0.1500	0.04000	-239097.	4999.	-3.85E-05	13341.	1.14E+10	-1.4401	64.8000	0.00
0.3000	0.03990	-230086.	4995.	-7.55E-05	13203.	1.14E+10	-2.8727	129.6000	0.00
0.4500	0.03973	-221075.	4988.	-1.11E-04	13065.	1.14E+10	-4.2908	194.4000	0.00
0.6000	0.03950	-212068.	4979.	-1.45E-04	12927.	1.14E+10	-5.6878	259.2000	0.00
0.7500	0.03921	-203070.	4968.	-1.78E-04	12789.	1.14E+10	-7.0572	324.0000	0.00
0.9000	0.03886	-194087.	4954.	-2.10E-04	12652.	1.14E+10	-8.3931	388.8000	0.00
1.0500	0.03845	-185123.	4938.	-2.39E-04	12514.	1.14E+10	-9.6900	453.6000	0.00
1.2000	0.03800	-176182.	4919.	-2.68E-04	12377.	1.14E+10	-10.9426	518.4000	0.00
1.3500	0.03749	-167269.	4898.	-2.95E-04	12241.	1.14E+10	-12.1460	583.2000	0.00
1.5000	0.03693	-158388.	4875.	-3.21E-04	12105.	1.14E+10	-13.2958	648.0000	0.00
1.6500	0.03633	-149544.	4851.	-3.45E-04	11969.	1.14E+10	-14.3878	712.8000	0.00
1.8000	0.03569	-140740.	4824.	-3.68E-04	11834.	1.14E+10	-15.4182	777.6000	0.00
1.9500	0.03501	-131980.	4795.	-3.90E-04	11700.	1.14E+10	-16.3836	842.4000	0.00
2.1000	0.03429	-123267.	4765.	-4.10E-04	11566.	1.14E+10	-17.2810	907.2000	0.00
2.2500	0.03353	-114605.	4733.	-4.29E-04	11434.	1.14E+10	-18.1077	972.0000	0.00
2.4000	0.03275	-105997.	4700.	-4.46E-04	11302.	1.14E+10	-18.8611	1037.	0.00
2.5500	0.03193	-97445.	4665.	-4.62E-04	11171.	1.14E+10	-19.5395	1102.	0.00
2.7000	0.03108	-88953.	4629.	-4.77E-04	11041.	1.14E+10	-20.1410	1166.	0.00
2.8500	0.03021	-80522.	4593.	-4.90E-04	10911.	1.14E+10	-20.6643	1231.	0.00
3.0000	0.02932	-72154.	4555.	-5.02E-04	10783.	1.14E+10	-21.1085	1296.	0.00
3.1500	0.02840	-63852.	4517.	-5.13E-04	10656.	1.14E+10	-21.4728	1361.	0.00
3.3000	0.02747	-55617.	4478.	-5.22E-04	10530.	1.14E+10	-21.7569	1426.	0.00
3.4500	0.02652	-47450.	4439.	-5.30E-04	10405.	1.14E+10	-21.9608	1490.	0.00
3.6000	0.02556	-39352.	4399.	-5.37E-04	10280.	1.14E+10	-22.0848	1555.	0.00
3.7500	0.02459	-31323.	4359.	-5.43E-04	10157.	1.14E+10	-22.1294	1620.	0.00
3.9000	0.02361	-23366.	4320.	-5.47E-04	10035.	1.14E+10	-21.0284	1603.	0.00
4.0500	0.02262	-15475.	4283.	-5.50E-04	9915.	1.14E+10	-19.9146	1585.	0.00
4.2000	0.02163	-7648.	4247.	-5.52E-04	9795.	1.14E+10	-20.1869	1680.	0.00
4.3500	0.02063	113.6819	4211.	-5.53E-04	9679.	1.14E+10	-20.3767	1778.	0.00
4.5000	0.01964	7809.	4174.	-5.52E-04	9797.	1.14E+10	-20.4813	1878.	0.00
4.6500	0.01864	15438.	4137.	-5.50E-04	9914.	1.14E+10	-20.4984	1979.	0.00
4.8000	0.01765	23000.	4100.	-5.47E-04	10030.	1.14E+10	-20.3381	2074.	0.00
4.9500	0.01667	30495.	4064.	-5.43E-04	10145.	1.14E+10	-19.8073	2138.	0.00
5.1000	0.01570	37925.	4029.	-5.38E-04	10259.	1.14E+10	-19.2165	2203.	0.00
5.2500	0.01474	45291.	3995.	-5.31E-04	10371.	1.14E+10	-18.5692	2268.	0.00
5.4000	0.01379	52594.	3962.	-5.23E-04	10483.	1.14E+10	-17.8693	2333.	0.00
5.5500	0.01285	59838.	3931.	-5.14E-04	10594.	1.14E+10	-17.1209	2398.	0.00
5.7000	0.01194	67023.	3901.	-5.04E-04	10705.	1.14E+10	-16.3285	2462.	0.00
5.8500	0.01104	74153.	3872.	-4.93E-04	10814.	1.14E+10	-15.4969	2527.	0.00
6.0000	0.01016	81229.	3845.	-4.81E-04	10922.	1.14E+10	-14.6309	2592.	0.00
6.1500	0.00931	88255.	3819.	-4.68E-04	11030.	1.14E+10	-13.7358	2657.	0.00
6.3000	0.00848	95232.	3796.	-4.53E-04	11137.	1.14E+10	-12.8171	2722.	0.00
6.4500	0.00767	102163.	3773.	-4.38E-04	11243.	1.14E+10	-11.8807	2786.	0.00
6.6000	0.00690	109052.	3753.	-4.21E-04	11349.	1.14E+10	-10.9325	2851.	0.00
6.7500	0.00616	115901.	3734.	-4.03E-04	11454.	1.14E+10	-9.9788	2916.	0.00
6.9000	0.00545	122712.	3717.	-3.84E-04	11558.	1.14E+10	-9.0264	2981.	0.00
7.0500	0.00478	129489.	3701.	-3.64E-04	11662.	1.14E+10	-8.0818	3046.	0.00
7.2000	0.00414	136234.	3688.	-3.43E-04	11765.	1.14E+10	-7.1524	3110.	0.00
7.3500	0.00354	142951.	3676.	-3.21E-04	11868.	1.14E+10	-6.2454	3175.	0.00
7.5000	0.00298	149641.	3665.	-2.98E-04	11971.	1.14E+10	-5.3684	3240.	0.00
7.6500	0.00247	156307.	3656.	-2.74E-04	12073.	1.14E+10	-4.5293	3305.	0.00
7.8000	0.00200	162951.	3649.	-2.49E-04	12175.	1.14E+10	-3.7364	3370.	0.00

	7.9500	0.00157	169577.	3643.	-2.23E-04	12276.	1.14E+10	-2.9979	3434.	0.00
	8.1000	0.00119	176186.	3638.	-1.95E-04	12377.	1.14E+10	-2.3225	3499.	0.00
	8.2500	8.68E-04	182780.	510.2155	-1.67E-04	12478.	1.14E+10	-3473.	7200000.	0.00
	8.4000	5.94E-04	178113.	-4753.	-1.38E-04	12407.	1.14E+10	-2375.	7200000.	0.00
	8.5500	3.70E-04	165743.	-8223.	-1.11E-04	12217.	1.14E+10	-1480.	7200000.	0.00
1ST Neg	8.7000	1.93E-04	148570.	-10251.	-8.64E-05	11954.	1.14E+10	-773.1133	7200000.	0.00
	8.8500	5.88E-05	128887.	-11158.	-6.45E-05	11653.	1.14E+10	-235.2303	7200000.	0.00
—	9.0000	-3.90E-05	108436.	-11229.	-4.58E-05	11339.	1.14E+10	156.0901	7200000.	0.00
	9.1500	-1.06E-04	88486.	-10707.	-3.02E-05	11033.	1.14E+10	424.1039	7200000.	0.00
	9.3000	-1.48E-04	69906.	-9793.	-1.77E-05	10749.	1.14E+10	591.4971	7200000.	0.00
	9.4500	-1.70E-04	53240.	-8649.	-8.00E-06	10493.	1.14E+10	679.3973	7200000.	0.00
—	9.6000	-1.77E-04	38772.	-7402.	-7.38E-07	10272.	1.14E+10	706.7566	7200000.	0.00
	9.7500	-1.73E-04	26593.	-6145.	4.42E-06	10085.	1.14E+10	690.0263	7200000.	0.00
MaxNeg	9.9000	-1.61E-04	16649.	-4945.	7.84E-06	9933.	1.14E+10	643.0557	7200000.	0.00
	10.0500	-1.44E-04	8787.	-3847.	9.85E-06	9812.	1.14E+10	577.1531	7200000.	0.00
	10.2000	-1.25E-04	2795.	-2876.	1.08E-05	9720.	1.14E+10	501.2584	7200000.	0.00
	10.3500	-1.06E-04	-1573.	-2045.	1.09E-05	9702.	1.14E+10	422.1854	7200000.	0.00
	10.5000	-8.62E-05	-4573.	-1355.	1.04E-05	9748.	1.14E+10	344.9013	7200000.	0.00
	10.6500	-6.82E-05	-6456.	-798.8100	9.50E-06	9776.	1.14E+10	272.8178	7200000.	0.00
	10.8000	-5.20E-05	-7454.	-366.0059	8.40E-06	9792.	1.14E+10	208.0756	7200000.	0.00
	10.9500	-3.80E-05	-7778.	-42.1088	7.20E-06	9797.	1.14E+10	151.8100	7200000.	0.00
	11.1000	-2.61E-05	-7610.	188.4704	5.99E-06	9794.	1.14E+10	104.3891	7200000.	0.00
	11.2500	-1.64E-05	-7103.	341.4799	4.82E-06	9786.	1.14E+10	65.6215	7200000.	0.00
	11.4000	-8.73E-06	-6383.	431.9771	3.76E-06	9775.	1.14E+10	34.9309	7200000.	0.00
	11.5500	-2.87E-06	-5550.	473.7637	2.82E-06	9762.	1.14E+10	11.4986	7200000.	0.00
	11.7000	1.41E-06	-4679.	479.0519	2.01E-06	9749.	1.14E+10	-5.6228	7200000.	0.00
	11.8500	4.36E-06	-3826.	458.3101	1.34E-06	9736.	1.14E+10	-17.4236	7200000.	0.00
	12.0000	6.22E-06	-3030.	420.2427	7.95E-07	9724.	1.14E+10	-24.8735	7200000.	0.00
	12.1500	7.22E-06	-2314.	371.8664	3.73E-07	9713.	1.14E+10	-28.8780	7200000.	0.00
	12.3000	7.56E-06	-1691.	318.6498	5.72E-08	9703.	1.14E+10	-30.2515	7200000.	0.00
	12.4500	7.43E-06	-1167.	264.6919	-1.68E-07	9695.	1.14E+10	-29.7018	7200000.	0.00
	12.6000	6.96E-06	-738.2748	212.9175	-3.19E-07	9689.	1.14E+10	-27.8254	7200000.	0.00
	12.7500	6.28E-06	-399.9986	165.2761	-4.09E-07	9684.	1.14E+10	-25.1094	7200000.	0.00
	12.9000	5.48E-06	-143.0599	122.9329	-4.52E-07	9680.	1.14E+10	-21.9386	7200000.	0.00
	13.0500	4.65E-06	42.8037	86.4434	-4.60E-07	9678.	1.14E+10	-18.6052	7200000.	0.00
	13.2000	3.83E-06	168.3846	55.9104	-4.43E-07	9680.	1.14E+10	-15.3204	7200000.	0.00
	13.3500	3.06E-06	244.3203	31.1177	-4.10E-07	9681.	1.14E+10	-12.2271	7200000.	0.00
	13.5000	2.35E-06	280.6298	11.6429	-3.69E-07	9682.	1.14E+10	-9.4116	7200000.	0.00
	13.6500	1.73E-06	286.4338	-3.0513	-3.24E-07	9682.	1.14E+10	-6.9152	7200000.	0.00
	13.8000	1.19E-06	269.8202	-13.5451	-2.80E-07	9682.	1.14E+10	-4.7446	7200000.	0.00
	13.9500	7.20E-07	237.8227	-20.4079	-2.40E-07	9681.	1.14E+10	-2.8807	7200000.	0.00
	14.1000	3.22E-07	196.4814	-24.1592	-2.06E-07	9680.	1.14E+10	-1.2874	7200000.	0.00
	14.2500	-2.07E-08	150.9607	-25.2434	-1.78E-07	9680.	1.14E+10	0.08261	7200000.	0.00
	14.4000	-3.20E-07	105.7013	-24.0163	-1.58E-07	9679.	1.14E+10	1.2809	7200000.	0.00
	14.5500	-5.90E-07	64.5875	-20.7403	-1.45E-07	9678.	1.14E+10	2.3590	7200000.	0.00
	14.7000	-8.41E-07	31.1142	-15.5899	-1.37E-07	9678.	1.14E+10	3.3637	7200000.	0.00
	14.8500	-1.08E-06	8.5379	-8.6629	-1.34E-07	9678.	1.14E+10	4.3330	7200000.	0.00
	15.0000	-1.32E-06	0.00	0.00	-1.33E-07	9677.	1.14E+10	5.2925	3600000.	0.00

Fixed End

1ST Neg = 9.0' (EL 3006.0)

MaxNeg = 9.6' (EL 3005.4)

Say POF = 3005 Ft

Min Tip For Lateral = 3003 Ft

5' into WR/Rock = 3002 Ft

USE 3002 Ft AS Tip Elevation

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.04003708 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -248102 inch-lbs
Maximum shear force = -11229 lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 9.00000000 feet below pile head
Number of iterations = 6

Number of zero deflection points = 3

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	3000.	M, in-lb	0.00	150000.	0.08703	-0.00126	-12984.	209829.
2	V, lb	5000.	S, rad	0.00	150000.	0.04004	0.00	-11229.	-248102.

Maximum pile-head deflection = 0.0870349991 inches
Maximum pile-head rotation = -0.0012603057 radians = -0.072210 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 14+11	**OFFSET** 21 ft RT	**ALIGNMENT** -L- / **0 HR.** N/A
COLLAR ELEV. 3,017.7 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 956,935	**EASTING** 1,273,288 / **24 HR.** 3.4
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/27/21	**COMP. DATE** 12/27/21	**SURFACE WATER DEPTH** N/A

DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT	SAMP. NO.	MOI	SOIL AND ROCK DESCRIPTION
3,017.7	0.0							3,017.7 GROUND SURFACE 0.0
		5	5	5	10		M	**ROADWAY EMBANKMENT** Loose, Brown, Silty Fine to Coarse SAND (A-2-4)
3,014.2	3.5							
3,012.7	5.0	3	4	2	6		M	3,012.7 5.0
		60/0.0			60/0.0			3,011.7 **CRYSTALLINE ROCK** Gray-White (BIOTITE GNEISS) 6.0
								CRYSTALLINE ROCK Gray-White (BIOTITE GNEISS)
								3,001.7 16.0

Elevation scale: 3020, 3015, 3010, 3005

Boring Terminated at Elevation 3,001.7 ft In Crystalline Rock (BIOTITE GNEISS)

1) A tri-cone bit was used to seal the casing after SPT refusal was encountered. Rock coring began at 6.0 feet.

BOC = 3015.0

0

2.3

EB-2 (RT)

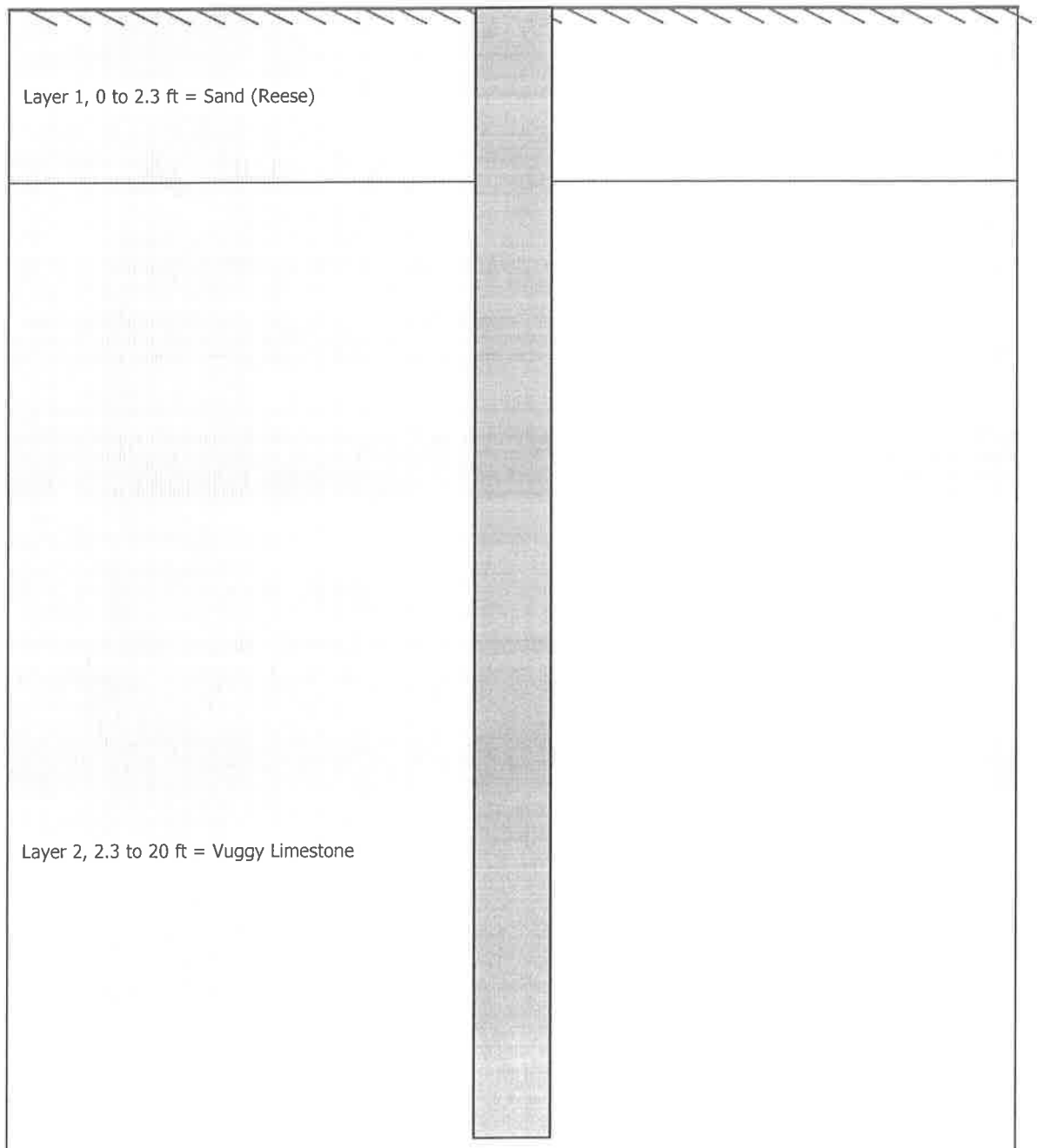
DRill in Piles A minimum of 5' Into WR/Rock And to An elevation below fixity

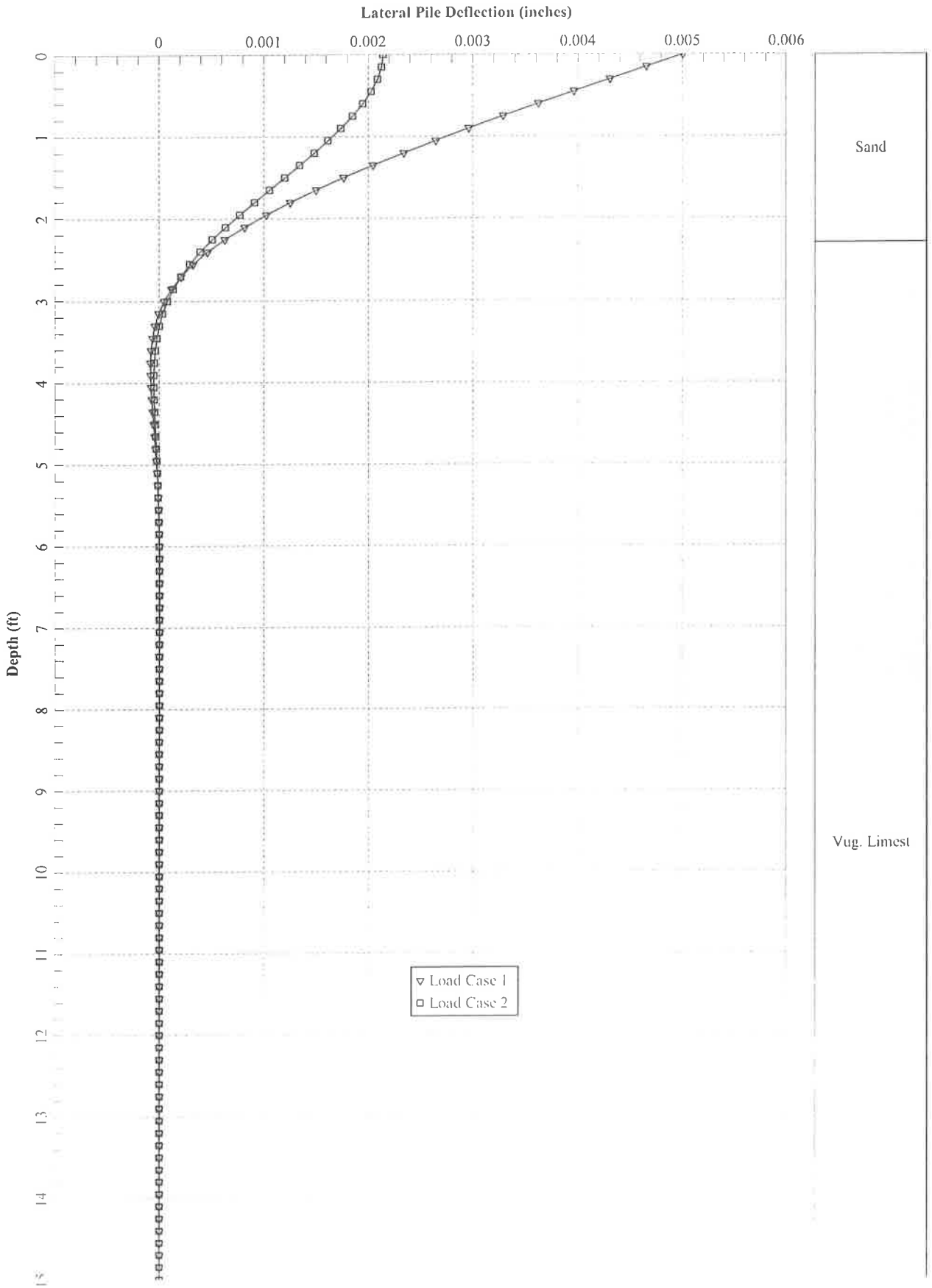
L = BOC - Tip EL + 1.0 Embed
3015.0 - 3008 + 1.0 = 8.0'
Ave Pile Length = 10'

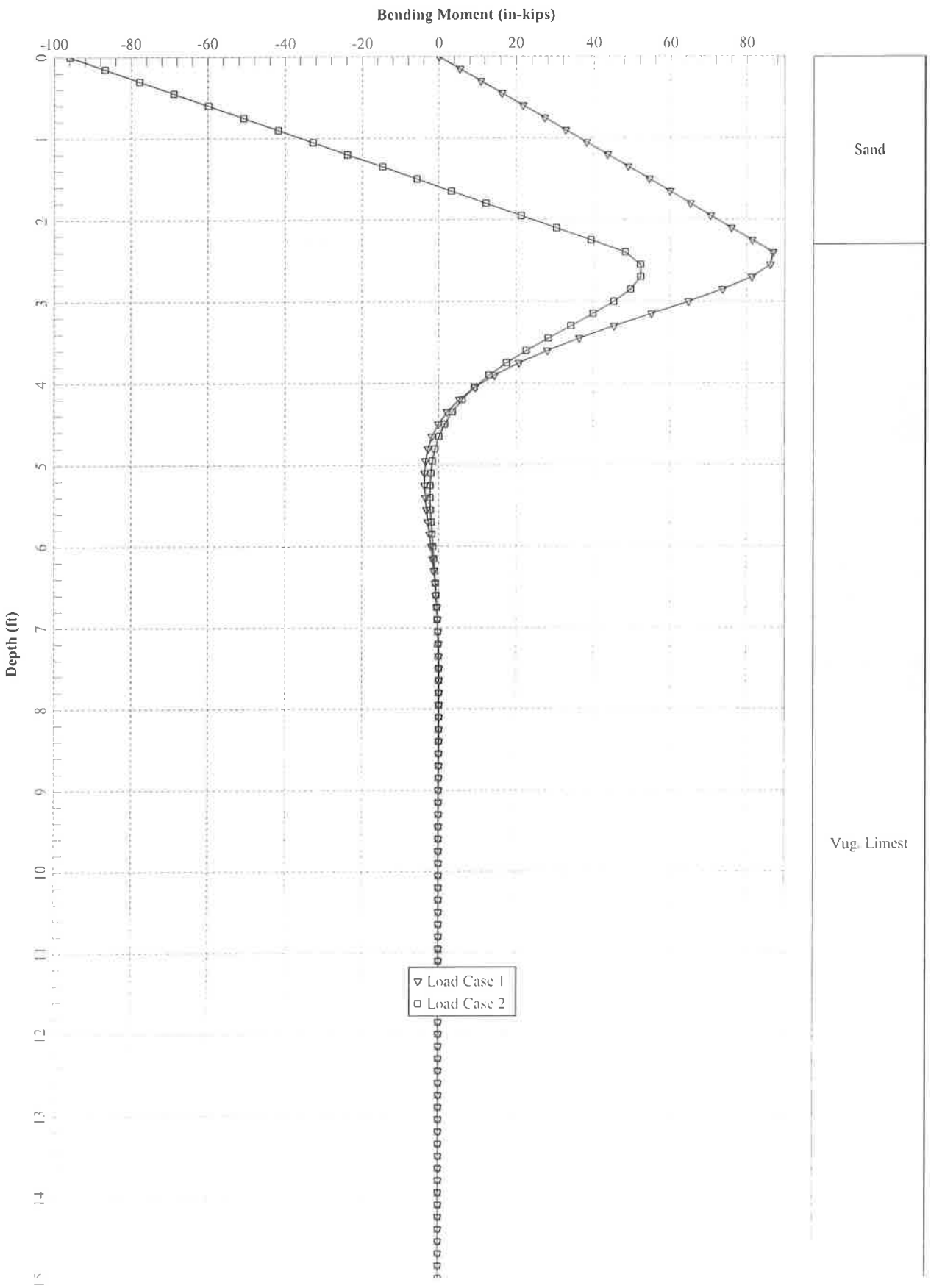
USE 3008 Ft for Tip Elev.

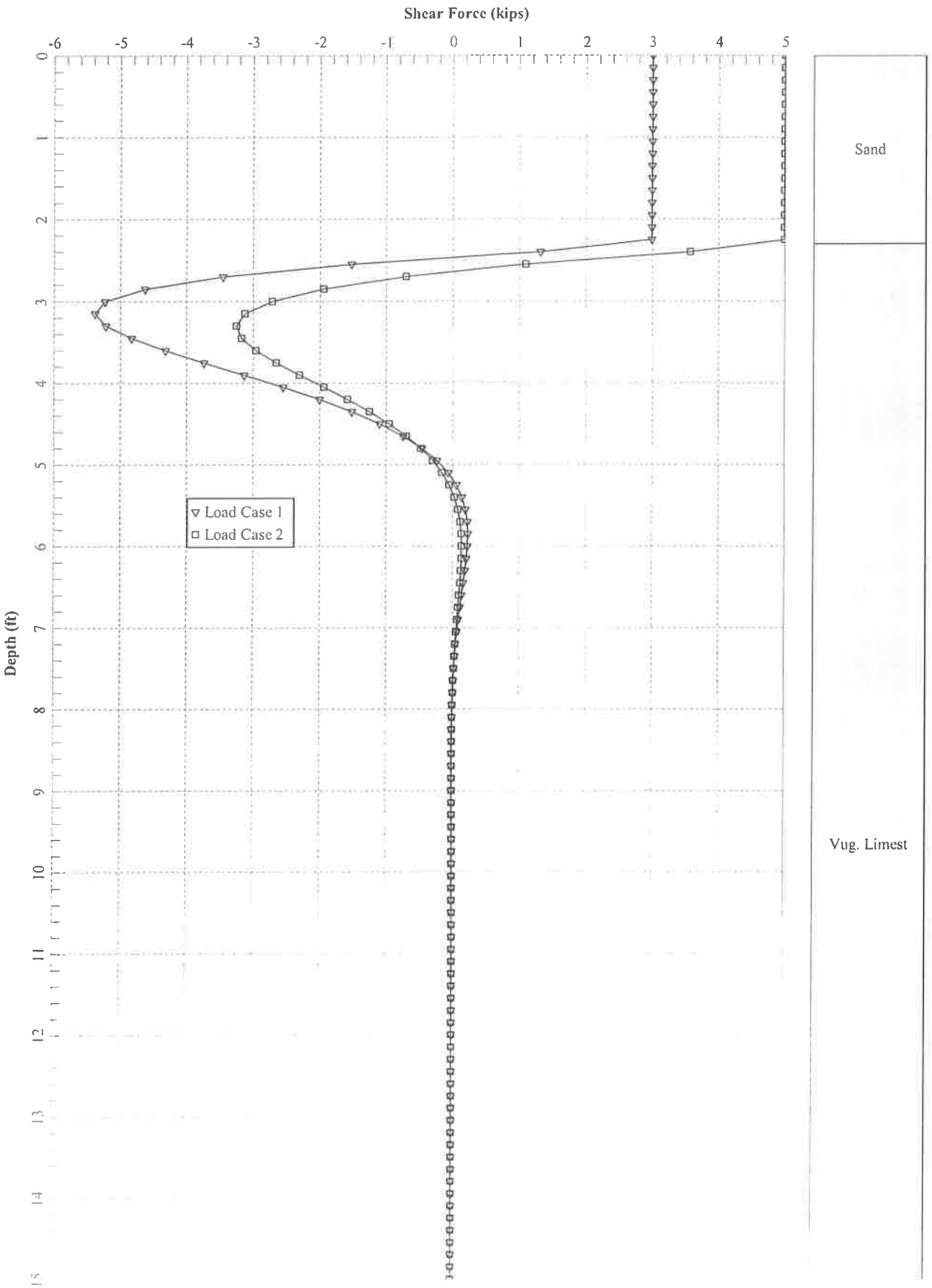
Est Qty
In Soil = 3015.0 - 3012.7 = 2.3'
Not in Soil = 3012.7 - 3008 = 4.7'

EB2-B









LPile for Windows, Version 2019-11.006

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\Users\mwalko\Downloads\

Name of input data file:
EB2-B_REV.lp11d

Name of output report file:
EB2-B_REV.lp11o

Name of plot output file:
EB2-B_REV.lp11p

Name of runtime message file:
EB2-B_REV.lp11r

Date and Time of Analysis

Date: March 28, 2022 Time: 14:42:46

Problem Title

Project Name: Ashe Bridge 15

Job Number 09-29362

Client: Vaughn & Melton

Engineer: ECS Southeast

Description: End Bent 2

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points

p-y curves are computed using pile diameter values interpolated with depth over

the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	12.0450
2	15.000	12.0450

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile

Cross-sectional Shape	= Strong H-Pile
Length of section	= 15.000000 ft
Flange Width	= 12.045000 in
Section Depth	= 11.780000 in
Flange Thickness	= 0.435000 in
Web Thickness	= 0.435000 in
Section Area	= 15.500000 sq. in
Moment of Inertia	= 393.000000 in^4
Elastic Modulus	= 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	= 0.0000 ft
Distance from top of pile to bottom of layer	= 2.300000 ft
Effective unit weight at top of layer	= 42.600000 pcf
Effective unit weight at bottom of layer	= 42.600000 pcf
Friction angle at top of layer	= 28.000000 deg
Friction angle at bottom of layer	= 28.000000 deg
Subgrade k at top of layer	= 20.000000 pci
Subgrade k at bottom of layer	= 20.000000 pci

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 2.300000 ft

Distance from top of pile to bottom of layer = 20.000000 ft
Effective unit weight at top of layer = 160.000000 pcf
Effective unit weight at bottom of layer = 160.000000 pcf
Uniaxial compressive strength at top of layer = 4000. psi
Uniaxial compressive strength at bottom of layer = 4000. psi

(Depth of the lowest soil layer extends 5.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	Uniaxial qu psi	kpy pci
1	Sand	0.00	42.6000	28.0000	--	20.0000
	(Reese, et al.)	2.3000	42.6000	28.0000	--	20.0000
2	Strong Rock	2.3000	160.0000	--	4000.	--
	(Vuggy Limestone)	20.0000	160.0000	--	4000.	--

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 3000. lbs	M = 0.0000 in-lbs	150000.	No	Yes
2	2	V = 5000. lbs	S = 0.0000 in/in	150000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with

specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

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Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	928.7952
2	2.3000	2.3000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 3000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 150000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.00501	-2.14E-08	3000.	-1.94E-04	9677.	1.14E+10	0.00	0.00	0.00
0.1500	0.00466	5452.	3000.	-1.94E-04	9761.	1.14E+10	-0.1677	64.8000	0.00
0.3000	0.00431	10904.	2999.	-1.93E-04	9845.	1.14E+10	-0.3103	129.6000	0.00
0.4500	0.00396	16354.	2999.	-1.90E-04	9928.	1.14E+10	-0.4281	194.4000	0.00
0.6000	0.00362	21802.	2998.	-1.87E-04	10012.	1.14E+10	-0.5218	259.2000	0.00

0.7500	0.00329	27248.	2997.	-1.84E-04	10095.	1.14E+10	-0.5921	324.0000	0.00
0.9000	0.00296	32690.	2996.	-1.79E-04	10178.	1.14E+10	-0.6400	388.8000	0.00
1.0500	0.00265	38129.	2995.	-1.73E-04	10262.	1.14E+10	-0.6667	453.6000	0.00
1.2000	0.00234	43565.	2993.	-1.67E-04	10345.	1.14E+10	-0.6738	518.4000	0.00
1.3500	0.00205	48996.	2992.	-1.59E-04	10428.	1.14E+10	-0.6628	583.2000	0.00
1.5000	0.00177	54423.	2991.	-1.51E-04	10511.	1.14E+10	-0.6356	648.0000	0.00
1.6500	0.00150	59845.	2990.	-1.42E-04	10595.	1.14E+10	-0.5944	712.8000	0.00
1.8000	0.00125	65263.	2989.	-1.32E-04	10678.	1.14E+10	-0.5415	777.6000	0.00
1.9500	0.00102	70677.	2988.	-1.22E-04	10760.	1.14E+10	-0.4795	842.4000	0.00
2.1000	8.16E-04	76086.	2987.	-1.10E-04	10843.	1.14E+10	-0.4111	907.2000	0.00
2.2500	6.28E-04	81490.	2987.	-9.76E-05	10926.	1.14E+10	-0.3393	972.0000	0.00
2.4000	4.64E-04	86890.	1315.	-8.43E-05	11009.	1.14E+10	-1857.	7200000.	0.00
2.5500	3.25E-04	86269.	-1526.	-7.06E-05	10999.	1.14E+10	-1300.	7200000.	0.00
2.7000	2.10E-04	81433.	-3452.	-5.74E-05	10925.	1.14E+10	-840.1640	7200000.	0.00
2.8500	1.18E-04	73872.	-4634.	-4.51E-05	10809.	1.14E+10	-473.3366	7200000.	0.00
3.0000	4.76E-05	64775.	-5232.	-3.42E-05	10670.	1.14E+10	-190.5124	7200000.	0.00
3.1500	-4.66E-06	55057.	-5386.	-2.47E-05	10521.	1.14E+10	18.6538	7200000.	0.00
3.3000	-4.13E-05	45397.	-5221.	-1.68E-05	10373.	1.14E+10	165.2126	7200000.	0.00
3.4500	-6.50E-05	36271.	-4838.	-1.03E-05	10233.	1.14E+10	260.1483	7200000.	0.00
3.6000	-7.85E-05	27986.	-4321.	-5.25E-06	10106.	1.14E+10	313.8389	7200000.	0.00
3.7500	-8.39E-05	20717.	-3737.	-1.40E-06	9995.	1.14E+10	335.7054	7200000.	0.00
3.9000	-8.35E-05	14534.	-3134.	1.38E-06	9900.	1.14E+10	334.0143	7200000.	0.00
4.0500	-7.89E-05	9433.	-2549.	3.28E-06	9822.	1.14E+10	315.7957	7200000.	0.00
4.2000	-7.17E-05	5355.	-2007.	4.44E-06	9759.	1.14E+10	286.8503	7200000.	0.00
4.3500	-6.30E-05	2206.	-1522.	5.04E-06	9711.	1.14E+10	251.8155	7200000.	0.00
4.5000	-5.36E-05	-127.1600	-1103.	5.20E-06	9679.	1.14E+10	214.2721	7200000.	0.00
4.6500	-4.42E-05	-1766.	-750.5651	5.05E-06	9704.	1.14E+10	176.8733	7200000.	0.00
4.8000	-3.54E-05	-2832.	-464.0446	4.69E-06	9721.	1.14E+10	141.4828	7200000.	0.00
4.9500	-2.73E-05	-3439.	-238.3287	4.20E-06	9730.	1.14E+10	109.3126	7200000.	0.00
5.1000	-2.03E-05	-3692.	-66.9994	3.63E-06	9734.	1.14E+10	81.0533	7200000.	0.00
5.2500	-1.42E-05	-3682.	57.2419	3.05E-06	9734.	1.14E+10	56.9925	7200000.	0.00
5.4000	-9.28E-06	-3488.	141.9423	2.48E-06	9731.	1.14E+10	37.1191	7200000.	0.00
5.5500	-5.30E-06	-3173.	194.4400	1.96E-06	9726.	1.14E+10	21.2117	7200000.	0.00
5.7000	-2.23E-06	-2789.	221.5515	1.49E-06	9720.	1.14E+10	8.9122	7200000.	0.00
5.8500	5.40E-08	-2376.	229.3781	1.08E-06	9714.	1.14E+10	-0.2161	7200000.	0.00
6.0000	1.66E-06	-1964.	223.2053	7.37E-07	9708.	1.14E+10	-6.6425	7200000.	0.00
6.1500	2.71E-06	-1573.	207.4746	4.58E-07	9702.	1.14E+10	-10.8360	7200000.	0.00
6.3000	3.31E-06	-1217.	185.8052	2.38E-07	9696.	1.14E+10	-13.2411	7200000.	0.00
6.4500	3.57E-06	-904.0247	161.0522	7.04E-08	9691.	1.14E+10	-14.2622	7200000.	0.00
6.6000	3.56E-06	-637.2353	135.3863	-5.13E-08	9687.	1.14E+10	-14.2554	7200000.	0.00
6.7500	3.38E-06	-416.6061	110.3850	-1.34E-07	9684.	1.14E+10	-13.5239	7200000.	0.00
6.9000	3.08E-06	-239.7767	87.1266	-1.86E-07	9681.	1.14E+10	-12.3187	7200000.	0.00
7.0500	2.71E-06	-102.8496	66.2831	-2.13E-07	9679.	1.14E+10	-10.8408	7200000.	0.00
7.2000	2.31E-06	-1.0424	48.2050	-2.22E-07	9677.	1.14E+10	-9.2460	7200000.	0.00
7.3500	1.91E-06	70.8080	32.9986	-2.16E-07	9679.	1.14E+10	-7.6500	7200000.	0.00
7.5000	1.53E-06	117.8694	20.5927	-2.01E-07	9679.	1.14E+10	-6.1345	7200000.	0.00
7.6500	1.19E-06	145.0502	10.7940	-1.80E-07	9680.	1.14E+10	-4.7530	7200000.	0.00
7.8000	8.84E-07	156.8251	3.3334	-1.57E-07	9680.	1.14E+10	-3.5365	7200000.	0.00
7.9500	6.25E-07	157.1352	-2.0978	-1.32E-07	9680.	1.14E+10	-2.4983	7200000.	0.00
8.1000	4.10E-07	149.3441	-5.8212	-1.08E-07	9680.	1.14E+10	-1.6388	7200000.	0.00
8.2500	2.37E-07	136.2370	-8.1503	-8.50E-08	9680.	1.14E+10	-0.9491	7200000.	0.00
8.4000	1.04E-07	120.0491	-9.3773	-6.48E-08	9679.	1.14E+10	-0.4143	7200000.	0.00
8.5500	4.02E-09	102.5136	-9.7647	-4.72E-08	9679.	1.14E+10	-0.01609	7200000.	0.00
8.7000	-6.64E-08	84.9217	-9.5402	-3.24E-08	9679.	1.14E+10	0.2656	7200000.	0.00
8.8500	-1.13E-07	68.1866	-8.8955	-2.03E-08	9678.	1.14E+10	0.4507	7200000.	0.00
9.0000	-1.40E-07	52.9088	-7.9874	-1.08E-08	9678.	1.14E+10	0.5583	7200000.	0.00
9.1500	-1.51E-07	39.4376	-6.9399	-3.47E-09	9678.	1.14E+10	0.6057	7200000.	0.00
9.3000	-1.52E-07	27.9271	-5.8474	1.85E-09	9678.	1.14E+10	0.6082	7200000.	0.00
9.4500	-1.45E-07	18.3860	-4.7789	5.51E-09	9678.	1.14E+10	0.5790	7200000.	0.00
9.6000	-1.32E-07	10.7202	-3.7817	7.81E-09	9678.	1.14E+10	0.5289	7200000.	0.00
9.7500	-1.17E-07	4.7676	-2.8857	9.03E-09	9677.	1.14E+10	0.4666	7200000.	0.00

9.9000	-9.97E-08	0.3267	-2.1067	9.43E-09	9677.	1.14E+10	0.3989	7200000.	0.00
10.0500	-8.27E-08	-2.8218	-1.4500	9.23E-09	9677.	1.14E+10	0.3308	7200000.	0.00
10.2000	-6.65E-08	-4.8983	-0.9129	8.62E-09	9677.	1.14E+10	0.2659	7200000.	0.00
10.3500	-5.17E-08	-6.1129	-0.4876	7.75E-09	9678.	1.14E+10	0.2066	7200000.	0.00
10.5000	-3.86E-08	-6.6579	-0.1628	6.75E-09	9678.	1.14E+10	0.1543	7200000.	0.00
10.6500	-2.74E-08	-6.7028	0.07453	5.69E-09	9678.	1.14E+10	0.1095	7200000.	0.00
10.8000	-1.81E-08	-6.3927	0.2381	4.66E-09	9678.	1.14E+10	0.07231	7200000.	0.00
10.9500	-1.06E-08	-5.8480	0.3414	3.69E-09	9678.	1.14E+10	0.04241	7200000.	0.00
11.1000	-4.79E-09	-5.1657	0.3968	2.82E-09	9677.	1.14E+10	0.01916	7200000.	0.00
11.2500	-4.47E-10	-4.4211	0.4156	2.06E-09	9677.	1.14E+10	0.00179	7200000.	0.00
11.4000	2.64E-09	-3.6706	0.4077	1.42E-09	9677.	1.14E+10	-0.01056	7200000.	0.00
11.5500	4.68E-09	-2.9540	0.3814	9.02E-10	9677.	1.14E+10	-0.01873	7200000.	0.00
11.7000	5.89E-09	-2.2981	0.3433	4.87E-10	9677.	1.14E+10	-0.02354	7200000.	0.00
11.8500	6.44E-09	-1.7183	0.2990	1.70E-10	9677.	1.14E+10	-0.02574	7200000.	0.00
12.0000	6.50E-09	-1.2219	0.2524	-6.24E-11	9677.	1.14E+10	-0.02599	7200000.	0.00
12.1500	6.21E-09	-0.8096	0.2067	-2.23E-10	9677.	1.14E+10	-0.02485	7200000.	0.00
12.3000	5.70E-09	-0.4778	0.1638	-3.24E-10	9677.	1.14E+10	-0.02278	7200000.	0.00
12.4500	5.04E-09	-0.2197	0.1251	-3.80E-10	9677.	1.14E+10	-0.02017	7200000.	0.00
12.6000	4.33E-09	-0.02706	0.09140	-3.99E-10	9677.	1.14E+10	-0.01732	7200000.	0.00
12.7500	3.61E-09	0.1095	0.06283	-3.92E-10	9677.	1.14E+10	-0.01443	7200000.	0.00
12.9000	2.92E-09	0.1993	0.03934	-3.68E-10	9677.	1.14E+10	-0.01166	7200000.	0.00
13.0500	2.28E-09	0.2513	0.02063	-3.33E-10	9677.	1.14E+10	-0.00913	7200000.	0.00
13.2000	1.72E-09	0.2738	0.00623	-2.91E-10	9677.	1.14E+10	-0.00688	7200000.	0.00
13.3500	1.23E-09	0.2739	-0.00440	-2.48E-10	9677.	1.14E+10	-0.00494	7200000.	0.00
13.5000	8.27E-10	0.2581	-0.01182	-2.06E-10	9677.	1.14E+10	-0.00331	7200000.	0.00
13.6500	4.93E-10	0.2315	-0.01657	-1.67E-10	9677.	1.14E+10	-0.00197	7200000.	0.00
13.8000	2.25E-10	0.1985	-0.01916	-1.33E-10	9677.	1.14E+10	-9.01E-04	7200000.	0.00
13.9500	1.38E-11	0.1626	-0.02002	-1.05E-10	9677.	1.14E+10	-5.51E-05	7200000.	0.00
14.1000	-1.52E-10	0.1265	-0.01953	-8.18E-11	9677.	1.14E+10	6.06E-04	7200000.	0.00
14.2500	-2.81E-10	0.09232	-0.01797	-6.46E-11	9677.	1.14E+10	0.00112	7200000.	0.00
14.4000	-3.84E-10	0.06181	-0.01558	-5.24E-11	9677.	1.14E+10	0.00154	7200000.	0.00
14.5500	-4.69E-10	0.03627	-0.01250	-4.46E-11	9677.	1.14E+10	0.00188	7200000.	0.00
14.7000	-5.45E-10	0.01682	-0.00885	-4.05E-11	9677.	1.14E+10	0.00218	7200000.	0.00
14.8500	-6.15E-10	0.00442	-0.00468	-3.88E-11	9677.	1.14E+10	0.00246	7200000.	0.00
15.0000	-6.84E-10	0.00	0.00	-3.84E-11	9677.	1.14E+10	0.00274	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.00500693 inches
Computed slope at pile head = -0.00019428 radians
Maximum bending moment = 86890. inch-lbs
Maximum shear force = -5386. lbs
Depth of maximum bending moment = 2.40000000 feet below pile head
Depth of maximum shear force = 3.15000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 5

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
Rotation of pile head = 0.000E+00 radians

Axial load at pile head = 150000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.00214	-95818.	5000.	0.00	11146.	1.14E+10	0.00	0.00	0.00
0.1500	0.00213	-86816.	5000.	-1.44E-05	11008.	1.14E+10	-0.07654	64.8000	0.00
0.3000	0.00209	-77810.	5000.	-2.74E-05	10870.	1.14E+10	-0.1503	129.6000	0.00
0.4500	0.00203	-68802.	4999.	-3.90E-05	10732.	1.14E+10	-0.2190	194.4000	0.00
0.6000	0.00195	-59791.	4999.	-4.92E-05	10594.	1.14E+10	-0.2804	259.2000	0.00
0.7500	0.00185	-50779.	4998.	-5.79E-05	10456.	1.14E+10	-0.3331	324.0000	0.00
0.9000	0.00174	-41766.	4998.	-6.52E-05	10317.	1.14E+10	-0.3756	388.8000	0.00
1.0500	0.00162	-32752.	4997.	-7.11E-05	10179.	1.14E+10	-0.4072	453.6000	0.00
1.2000	0.00148	-23738.	4996.	-7.55E-05	10041.	1.14E+10	-0.4272	518.4000	0.00
1.3500	0.00134	-14725.	4996.	-7.86E-05	9903.	1.14E+10	-0.4354	583.2000	0.00
1.5000	0.00120	-5712.	4995.	-8.02E-05	9765.	1.14E+10	-0.4321	648.0000	0.00
1.6500	0.00106	3300.	4994.	-8.04E-05	9728.	1.14E+10	-0.4178	712.8000	0.00
1.8000	9.11E-04	12310.	4993.	-7.91E-05	9866.	1.14E+10	-0.3935	777.6000	0.00
1.9500	7.70E-04	21318.	4993.	-7.65E-05	10004.	1.14E+10	-0.3605	842.4000	0.00
2.1000	6.36E-04	30324.	4992.	-7.24E-05	10142.	1.14E+10	-0.3203	907.2000	0.00
2.2500	5.10E-04	39328.	4991.	-6.69E-05	10280.	1.14E+10	-0.2751	972.0000	0.00
2.4000	3.95E-04	48330.	3570.	-6.00E-05	10418.	1.14E+10	-1579.	7200000.	0.00
2.5500	2.94E-04	52214.	1093.	-5.21E-05	10478.	1.14E+10	-1174.	7200000.	0.00
2.7000	2.07E-04	52292.	-710.0953	-4.38E-05	10479.	1.14E+10	-829.0846	7200000.	0.00
2.8500	1.36E-04	49681.	-1945.	-3.57E-05	10439.	1.14E+10	-543.4531	7200000.	0.00
3.0000	7.86E-05	45308.	-2717.	-2.82E-05	10372.	1.14E+10	-314.3165	7200000.	0.00
3.1500	3.42E-05	39914.	-3123.	-2.15E-05	10289.	1.14E+10	-136.7014	7200000.	0.00
3.3000	1.12E-06	34076.	-3250.	-1.57E-05	10200.	1.14E+10	-4.4743	7200000.	0.00
3.4500	-2.23E-05	28221.	-3174.	-1.08E-05	10110.	1.14E+10	89.0039	7200000.	0.00
3.6000	-3.76E-05	22654.	-2959.	-6.74E-06	10025.	1.14E+10	150.3903	7200000.	0.00
3.7500	-4.65E-05	17573.	-2656.	-3.56E-06	9947.	1.14E+10	186.0158	7200000.	0.00
3.9000	-5.04E-05	13094.	-2307.	-1.14E-06	9878.	1.14E+10	201.6580	7200000.	0.00
4.0500	-5.06E-05	9268.	-1943.	6.27E-07	9819.	1.14E+10	202.4100	7200000.	0.00
4.2000	-4.82E-05	6097.	-1588.	1.84E-06	9771.	1.14E+10	192.6229	7200000.	0.00
4.3500	-4.40E-05	3551.	-1256.	2.60E-06	9732.	1.14E+10	175.9020	7200000.	0.00
4.5000	-3.88E-05	1573.	-958.3384	3.01E-06	9702.	1.14E+10	155.1437	7200000.	0.00
4.6500	-3.31E-05	98.9149	-699.3724	3.14E-06	9679.	1.14E+10	132.5962	7200000.	0.00
4.8000	-2.75E-05	-945.9994	-481.0933	3.07E-06	9692.	1.14E+10	109.9362	7200000.	0.00
4.9500	-2.21E-05	-1635.	-302.6340	2.87E-06	9702.	1.14E+10	88.3519	7200000.	0.00
5.1000	-1.72E-05	-2037.	-161.3534	2.58E-06	9709.	1.14E+10	68.6265	7200000.	0.00
5.2500	-1.28E-05	-2217.	-53.4938	2.24E-06	9711.	1.14E+10	51.2175	7200000.	0.00
5.4000	-9.08E-06	-2231.	25.2984	1.89E-06	9712.	1.14E+10	36.3294	7200000.	0.00
5.5500	-5.99E-06	-2127.	79.5753	1.55E-06	9710.	1.14E+10	23.9782	7200000.	0.00
5.7000	-3.51E-06	-1945.	113.7965	1.23E-06	9707.	1.14E+10	14.0455	7200000.	0.00
5.8500	-1.58E-06	-1718.	132.1297	9.37E-07	9704.	1.14E+10	6.3247	7200000.	0.00
6.0000	-1.39E-07	-1470.	138.3236	6.85E-07	9700.	1.14E+10	0.5574	7200000.	0.00
6.1500	8.85E-07	-1220.	135.6409	4.72E-07	9696.	1.14E+10	-3.5382	7200000.	0.00
6.3000	1.56E-06	-981.9712	126.8349	2.99E-07	9692.	1.14E+10	-6.2462	7200000.	0.00
6.4500	1.96E-06	-763.8470	114.1594	1.61E-07	9689.	1.14E+10	-7.8376	7200000.	0.00
6.6000	2.14E-06	-571.0841	99.4013	5.53E-08	9686.	1.14E+10	-8.5604	7200000.	0.00
6.7500	2.16E-06	-406.0323	83.9266	-2.19E-08	9684.	1.14E+10	-8.6337	7200000.	0.00
6.9000	2.06E-06	-268.9365	68.7354	-7.52E-08	9682.	1.14E+10	-8.2454	7200000.	0.00
7.0500	1.89E-06	-158.5443	54.5185	-1.09E-07	9680.	1.14E+10	-7.5512	7200000.	0.00
7.2000	1.67E-06	-72.6112	41.7133	-1.27E-07	9679.	1.14E+10	-6.6767	7200000.	0.00
7.3500	1.43E-06	-8.3076	30.5565	-1.34E-07	9678.	1.14E+10	-5.7197	7200000.	0.00
7.5000	1.19E-06	37.4645	21.1309	-1.31E-07	9678.	1.14E+10	-4.7532	7200000.	0.00
7.6500	9.57E-07	67.8345	13.4065	-1.23E-07	9678.	1.14E+10	-3.8294	7200000.	0.00
7.8000	7.46E-07	85.7945	7.2758	-1.11E-07	9679.	1.14E+10	-2.9826	7200000.	0.00

1ST Neg

Max Neg

Fixed End

1ST Neg = 3.5' (EL 3011.5)

Max Neg = 4.1' (EL 3010.9)

Say POF = 3011 Ft

Min Tip for lateral = 3009 Ft

5' into WR/ Rock = 3008 Ft

USE 3008 As Tip Elevation

7.9500	5.58E-07	94.0871	2.5813	-9.66E-08	9679.	1.14E+10	-2.2334	7200000.	0.00
8.1000	3.98E-07	95.1393	-0.8609	-8.17E-08	9679.	1.14E+10	-1.5913	7200000.	0.00
8.2500	2.64E-07	91.0318	-3.2446	-6.70E-08	9679.	1.14E+10	-1.0573	7200000.	0.00
8.4000	1.57E-07	83.4948	-4.7603	-5.32E-08	9679.	1.14E+10	-0.6268	7200000.	0.00
8.5500	7.28E-08	73.9235	-5.5865	-4.08E-08	9679.	1.14E+10	-0.2912	7200000.	0.00
8.7000	9.94E-09	63.4055	-5.8844	-2.99E-08	9678.	1.14E+10	-0.03977	7200000.	0.00
8.8500	-3.49E-08	52.7559	-5.7945	-2.07E-08	9678.	1.14E+10	0.1396	7200000.	0.00
9.0000	-6.47E-08	42.5563	-5.4358	-1.32E-08	9678.	1.14E+10	0.2590	7200000.	0.00
9.1500	-8.25E-08	33.1941	-4.9057	-7.24E-09	9678.	1.14E+10	0.3300	7200000.	0.00
9.3000	-9.08E-08	24.8995	-4.2819	-2.65E-09	9678.	1.14E+10	0.3632	7200000.	0.00
9.4500	-9.20E-08	17.7808	-3.6236	7.19E-10	9678.	1.14E+10	0.3682	7200000.	0.00
9.6000	-8.82E-08	11.8542	-2.9747	3.06E-09	9678.	1.14E+10	0.3529	7200000.	0.00
9.7500	-8.10E-08	7.0703	-2.3654	4.55E-09	9678.	1.14E+10	0.3241	7200000.	0.00
9.9000	-7.18E-08	3.3362	-1.8152	5.38E-09	9677.	1.14E+10	0.2873	7200000.	0.00
10.0500	-6.17E-08	0.5328	-1.3346	5.68E-09	9677.	1.14E+10	0.2467	7200000.	0.00
10.2000	-5.14E-08	-1.4714	-0.9276	5.61E-09	9677.	1.14E+10	0.2055	7200000.	0.00
10.3500	-4.15E-08	-2.8098	-0.5934	5.27E-09	9677.	1.14E+10	0.1659	7200000.	0.00
10.5000	-3.24E-08	-3.6103	-0.3274	4.76E-09	9677.	1.14E+10	0.1296	7200000.	0.00
10.6500	-2.43E-08	-3.9908	-0.1231	4.16E-09	9677.	1.14E+10	0.09737	7200000.	0.00
10.8000	-1.74E-08	-4.0556	0.02727	3.53E-09	9677.	1.14E+10	0.06968	7200000.	0.00
10.9500	-1.16E-08	-3.8945	0.1319	2.90E-09	9677.	1.14E+10	0.04659	7200000.	0.00
11.1000	-6.98E-09	-3.5823	0.1990	2.31E-09	9677.	1.14E+10	0.02794	7200000.	0.00
11.2500	-3.34E-09	-3.1794	0.2361	1.77E-09	9677.	1.14E+10	0.01335	7200000.	0.00
11.4000	-5.97E-10	-2.7331	0.2503	1.31E-09	9677.	1.14E+10	0.00239	7200000.	0.00
11.5500	1.37E-09	-2.2790	0.2475	9.12E-10	9677.	1.14E+10	-0.00547	7200000.	0.00
11.7000	2.68E-09	-1.8425	0.2330	5.86E-10	9677.	1.14E+10	-0.01074	7200000.	0.00
11.8500	3.48E-09	-1.4407	0.2108	3.27E-10	9677.	1.14E+10	-0.01391	7200000.	0.00
12.0000	3.86E-09	-1.0839	0.1844	1.27E-10	9677.	1.14E+10	-0.01544	7200000.	0.00
12.1500	3.94E-09	-0.7771	0.1563	-1.95E-11	9677.	1.14E+10	-0.01574	7200000.	0.00
12.3000	3.79E-09	-0.5212	0.1285	-1.22E-10	9677.	1.14E+10	-0.01516	7200000.	0.00
12.4500	3.50E-09	-0.3145	0.1022	-1.88E-10	9677.	1.14E+10	-0.01399	7200000.	0.00
12.6000	3.11E-09	-0.1531	0.07844	-2.25E-10	9677.	1.14E+10	-0.01245	7200000.	0.00
12.7500	2.69E-09	-0.03202	0.05756	-2.40E-10	9677.	1.14E+10	-0.01075	7200000.	0.00
12.9000	2.25E-09	0.05424	0.03978	-2.38E-10	9677.	1.14E+10	-0.00900	7200000.	0.00
13.0500	1.83E-09	0.1113	0.02509	-2.25E-10	9677.	1.14E+10	-0.00732	7200000.	0.00
13.2000	1.44E-09	0.1447	0.01331	-2.05E-10	9677.	1.14E+10	-0.00577	7200000.	0.00
13.3500	1.09E-09	0.1593	0.00418	-1.81E-10	9677.	1.14E+10	-0.00438	7200000.	0.00
13.5000	7.92E-10	0.1598	-0.00261	-1.55E-10	9677.	1.14E+10	-0.00317	7200000.	0.00
13.6500	5.35E-10	0.1500	-0.00738	-1.31E-10	9677.	1.14E+10	-0.00214	7200000.	0.00
13.8000	3.21E-10	0.1333	-0.01046	-1.09E-10	9677.	1.14E+10	-0.00128	7200000.	0.00
13.9500	1.44E-10	0.1124	-0.01214	-8.91E-11	9677.	1.14E+10	-5.77E-04	7200000.	0.00
14.1000	0.00	0.08966	-0.01266	-7.31E-11	9677.	1.14E+10	9.71E-07	7200000.	0.00
14.2500	-1.19E-10	0.06690	-0.01223	-6.08E-11	9677.	1.14E+10	4.77E-04	7200000.	0.00
14.4000	-2.19E-10	0.04568	-0.01101	-5.19E-11	9677.	1.14E+10	8.76E-04	7200000.	0.00
14.5500	-3.06E-10	0.02730	-0.00912	-4.61E-11	9677.	1.14E+10	0.00122	7200000.	0.00
14.7000	-3.85E-10	0.01288	-0.00663	-4.30E-11	9677.	1.14E+10	0.00154	7200000.	0.00
14.8500	-4.61E-10	0.00346	-0.00358	-4.17E-11	9677.	1.14E+10	0.00184	7200000.	0.00
15.0000	-5.35E-10	0.00	0.00	-4.14E-11	9677.	1.14E+10	0.00214	3600000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.00213978 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -95818. inch-lbs
Maximum shear force = 5000. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 0.000000 feet below pile head
Number of iterations = 6

Number of zero deflection points = 5

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Pile-head Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	3000.	M, in-lb	0.00	150000.	0.00501	-1.94E-04	-5386.	86890.
2	V, lb	5000.	S, rad	0.00	150000.	0.00214	0.00	5000.	-95818.

Maximum pile-head deflection = 0.0050069271 inches
Maximum pile-head rotation = -0.0001942779 radians = -0.011131 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 17BP.11.R.161	**TIP** N/A	**COUNTY** ASHE	**GEOLOGIST** A. Blackmore
SITE DESCRIPTION Bridge 015 on SR 1147 (Nettle Knob Road) over South Beaver Creek			**GROUND WTR (ft)**
BORING NO. RW-1	**STATION** 14+55	**OFFSET** 16 ft LT	**ALIGNMENT** -L- / **0 HR.** Dry
COLLAR ELEV. 3,018.6 ft	**TOTAL DEPTH** 10.0 ft	**NORTHING** 956,913	**EASTING** 1,273,341 / **24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE GEO366 Diedrich D-50 68% 07/15/2020		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER J. Messick	**START DATE** 12/28/21	**COMP. DATE** 12/28/21	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT	SAMP. NO.	MOI	SOIL AND ROCK DESCRIPTION
3020									
	3,018.6	0.0	5	4	5	9		M	3,018.6 GROUND SURFACE 0.0 ROADWAY EMBANKMENT Soft to Stiff, Brown-Black, Fine to Coarse Sandy SILT (A-4), with trace rock fragments
3015	3,015.1	3.5	4	4	1	5		M	
	3,012.6	6.0	2	1	1	2		W	
3010	3,010.1	8.5	1	1	99/0.4	100/0.9		Sat.	3,010.6 8.0 ALLUVIAL Soft, Gray-Black, Fine to Coarse Sandy SILT (A-4)
	3,008.6	10.0	60/0.0			60/0.0			3,009.1 9.5 WEATHERED ROCK Gray (BIOTITE GNEISS) 3,008.6 10.0 Boring Terminated with Standard Penetration Test Refusal at Elevation 3,008.6 ft On Crystalline Rock (BIOTITE GNEISS)

Bottom of Wing Wall = 3014.7

Drilled in pile required for Wing Wall Pile

5' into WR/Rock for a tip elevation of 3004 Ft

L = BOW - Tip EL + 2.0 Embed
= 3014.7 - 3004 + 2.0 = 12.7'

Say 15' Pile

Est Qty

In Soil = 3014.7 - 3008.6 = 6.1'

Not In Soil = 3008.6 - 3004 = 4.6'