ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 110706

FEDERAL AID PROJECT NO. BFP-NHPP-0048(39)

BOAT GUNWALE SLASH STR. & APPRS. (S)

STATE HIGHWAY 17 **SECTION** 1

IN MONROE **COUNTY**

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

ARKANSAS DEPARTMENT OF TRANSPORTATION
ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
MATERIALS DIVISION
11301 West Baseline Road | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2185 | Fax: 501.569.2368

February 4, 2021

TO: Mr. Trinity Smith, Engineer of Roadway Design

SUBJECT: Job No. 110706
Boat Gunwale Slash Str. & Apprs. (S)
Route 17 Section 1
Monroe County

Attached is the requested soil survey, strength data, and resilient modulus test results. The project consists of replacing the bridge crossing Boat Gunwale Slash on Highway 17. Samples were obtained in the existing travel lanes and the ditch line. There are no paved shoulders within the project limits.

The subgrade soils consist primarily of silt and clay. The proposed grade line closely matches that of the existing roadway. The subgrade soils should provide a stable working platform with conventional processing if the weather is favorable during construction.

Irrigation ditches parallel the road on both sides and may contain water. The detour crosses the wooded portion of Boat Gunwale Slash. The detour area and existing ditches are expected to contain soft unstable organic material and should be undercut prior to embankment construction. Two feet of undercut is expected to remove enough organic material to facilitate embankment construction.

Additional earthwork recommendations will be made upon request when plans are further developed and cross sections are available.

Listed below is the additional information requested for use in developing the plans:

1. The Qualified Products List (QPL) indicates that Aggregate Base Course (Class CL-7) is available from commercial producers located at the river port near Helena-West Helena.

2. Asphalt Concrete Hot Mix for **PG 64-22**

Type	Asphalt Cement %	Mineral Aggregate %
Surface Course	5.1	94.9
Binder Course	4.2	95.8
Base Course	4.0	96.0

Jonathan A. Annable
Materials Engineer

JAA:yz:bjj
Attachment
cc: State Constr. Eng. – Master File Copy
District 1 Engineer
System Information and Research
G. C. File

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
JONATHAN A. ANNABLE, MATERIALS ENGINEER
*** SOIL SURVEY STRENGTH TEST REPORT ***

DATE - 01/21/2021
JOB NUMBER - 110706

SEQUENCE NO. - 1
MATERIAL CODE - SSRV
SPEC. YEAR - 2014
SUPPLIER ID. - 1
COUNTY/STATE - 48
DISTRICT NO. - 01

JOB NAME - BOAT GUNWALE SLASH STR.& APPRS.(S)

STATION LIMITS	R-VALUE AT 240 psi
BEGIN JOB - END JOB	LESS THAN 5
RESILIENT MODULUS	
STA. 112+00	11412

REMARKS -
-

AASHTO TESTS : T190

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION

AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED SAMPLES

Job No.	110706	**Material Code**	SSRVPS
Date Sampled:	11/10/2020	**Station No.:**	112+00
Date Tested:	January 5, 2021	**Location:**	18'LT
Name of Project:	BOAT GUNWALE SLASH STR. & APPRS. (S)		
County:	**Code:** 48 **Name:** MONROE		
Sampled By:	DICKERSON / CAMPBELL / MCCOLLUM	**Depth:**	0-5
Lab No.:	20202288	**AASHTO Class:**	A-4 (3)
Sample ID:	RV478	**Material Type (1 or 2):**	2
LATITUDE:		**LONGITUDE:**	

1. Testing Information:

Preconditioning - Permanent Strain > 5% (Y=Yes or N= No)	N
Testing - Permanent Strain > 5% (Y=Yes or N=No)	N
Number of Load Sequences Completed (0-15)	15

2. Specimen Information:

Specimen Diameter (in):	
Top	3.95
Middle	3.95
Bottom	3.95
Average	3.95
Membrane Thickness (in):	0.01
Height of Specimen, Cap and Base (in):	8.02
Height of Cap and Base (in):	0.00
Initial Length, Lo (in):	8.02
Initial Area, Ao (sq. in):	12.18
Initial Volume, AoLo (cu. in):	97.68

3. Soil Specimen Weight:

Weight of Wet Soil Used (g):	3289.00

4. Soil Properties:

Optimum Moisture Content (%):	11.8
Maximum Dry Density (pcf):	118.9
95% of MDD (pcf):	113.0
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3289.00
Compaction Moisture content (%):	12.1
Compaction Wet Density (pcf):	128.29
Compaction Dry Density (pcf):	114.44
Moisture Content After Mr Test (%):	11.9

6. Quick Shear Test (Y=Yes, N=No, N/A=Not Applicable): #VALUE!

7. Resilient Modulus, Mr: 10268(Sc)^-0.06432(S3)^0.30623

8. Comments _____

9. Tested By: GW **Date:** January 5, 2021

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION

AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED SAMPLES

Job No.	110706	**Material Code**	SSRVPS
Date Sampled:	11/10/2020	**Station No.:**	112+00
Date Tested:	January 5, 2021	**Location:**	18'LT
Name of Project:	BOAT GUNWALE SLASH STR. & APPRS. (S)		
County:	**Code:** 48 **Name:** MONROE		
Sampled By:	DICKERSON / CAMPBELL / MCCOLLUM	**Depth:**	0-5
Lab No.:	20202288	**AASHTO Class:**	A-4 (3)
Sample ID:	RV478	**Material Type (1 or 2):**	2
LATITUDE:		**LONGITUDE:**	

PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_{avg}	ε_r	M_r
UNIT	psi	psi	lbs	lbs	lbs	psi	psi	psi	in	in/in	psi
Sequence 1	6.0	2.0	25.0	22.5	2.5	2.1	1.8	0.2	0.00086	0.00011	17,221
Sequence 2	6.0	4.0	47.2	44.6	2.6	3.9	3.7	0.2	0.00176	0.00022	16,674
Sequence 3	6.0	6.0	70.3	66.9	3.4	5.8	5.5	0.3	0.00273	0.00034	16,136
Sequence 4	6.0	8.0	94.7	88.7	6.0	7.8	7.3	0.5	0.00381	0.00047	15,341
Sequence 5	6.0	10.0	118.7	110.2	8.5	9.7	9.0	0.7	0.00491	0.00061	14,776
Sequence 6	4.0	2.0	25.1	22.4	2.8	2.1	1.8	0.2	0.00094	0.00012	15,614
Sequence 7	4.0	4.0	47.2	44.4	2.8	3.9	3.6	0.2	0.00199	0.00025	14,713
Sequence 8	4.0	6.0	69.3	66.5	2.8	5.7	5.5	0.2	0.00309	0.00038	14,186
Sequence 9	4.0	8.0	93.5	88.3	5.2	7.7	7.3	0.4	0.00424	0.00053	13,700
Sequence 10	4.0	10.0	117.8	110.2	7.6	9.7	9.0	0.6	0.00541	0.00067	13,415
Sequence 11	2.0	2.0	25.0	22.3	2.8	2.1	1.8	0.2	0.00128	0.00016	11,439
Sequence 12	2.0	4.0	47.0	44.3	2.8	3.9	3.6	0.2	0.00251	0.00031	11,587
Sequence 13	2.0	6.0	68.8	66.0	2.8	5.7	5.4	0.2	0.00380	0.00047	11,453
Sequence 14	2.0	8.0	92.1	87.9	4.3	7.6	7.2	0.3	0.00507	0.00063	11,412
Sequence 15	2.0	10.0	115.9	109.2	6.7	9.5	9.0	0.5	0.00630	0.00079	11,418

TESTED BY GW DATE January 5, 2021

REVIEWED BY _____ DATE _____

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

MATERIALS DIVISION

AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS

RECOMPACTED / THINWALL TUBE SAMPLES

Job No.	110706	**Material Code**	SSRVPS
Date Sampled:	11/10/2020	**Station No.:**	112+00
Date Tested:	January 5, 2021	**Location:**	18'LT
Name of Project:	BOAT GUNWALE SLASH STR. & APPRS. (S)		
County:	**Code:** 48 **Name:** MONROE		
Sampled By:	DICKERSON / CAMPBELL / MCCOLLUM	**Depth:**	0-5
Lab No.:	20202288	**AASHTO Class:**	A-4 (3)
Sample ID:	RV478	**Material Type (1 or 2):**	2
LATITUDE:		**LONGITUDE:**	

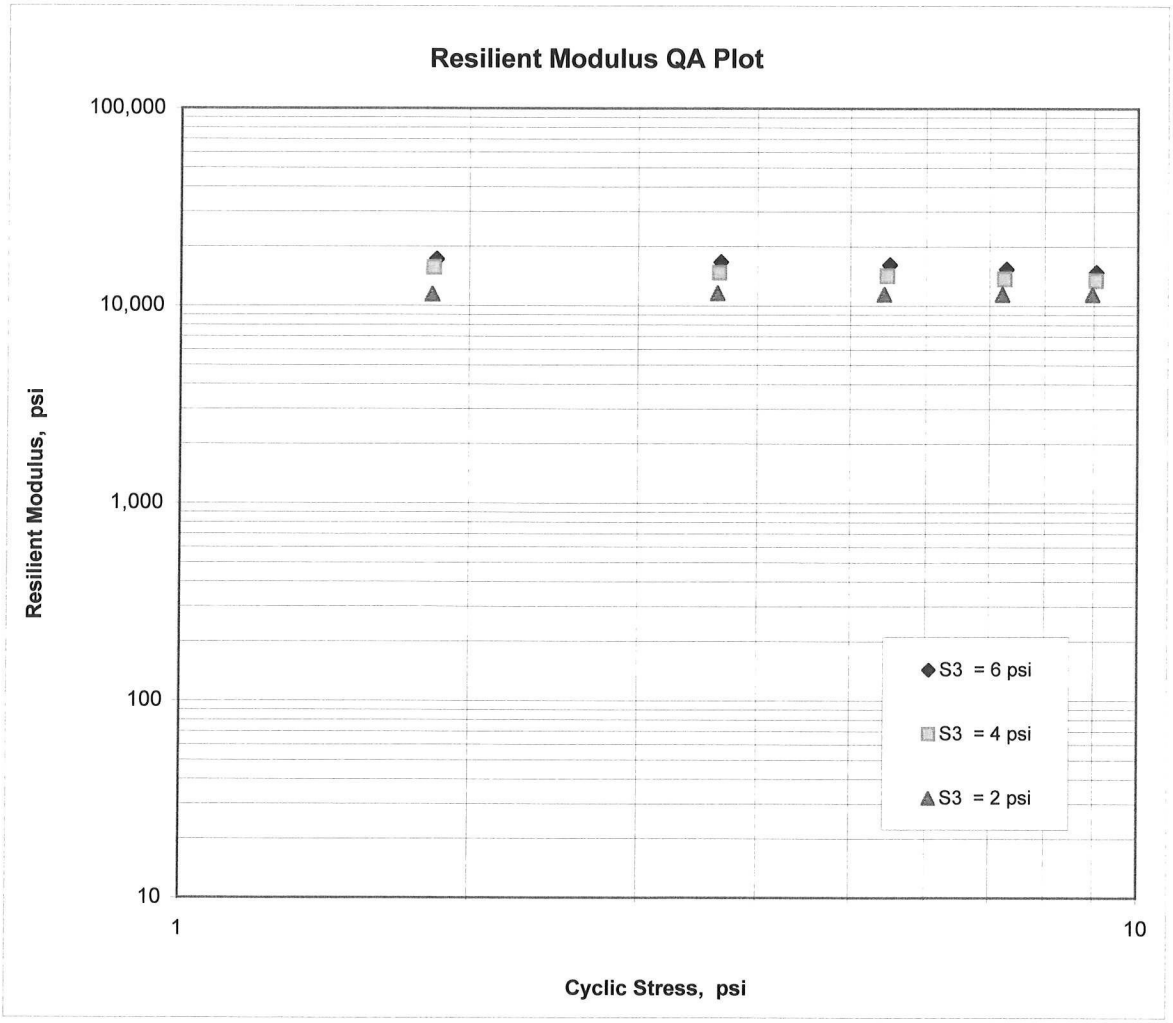
$$M_R = K1\ (S_C)^{K2}\ (S_3)^{K5}$$

K1 = 10,268

K2 = -0.06432

K5 = 0.30623

R^2 = 0.97



ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
JONATHAN A. ANNABLE, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 01/21/21
JOB NUMBER - 110706
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - BOAT GUNWALE SLASH STR.& APPRS.(S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - MONROE, COUNTY
SAMPLED BY - DICKERSON, CAMPBELL, MCCU
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 1
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2014
SUPPLIER ID. - 1
COUNTY/STATE - 48
DISTRICT NO. - 01

DATE SAMPLED - 11/10/20
DATE RECEIVED - 11/12/20
DATE TESTED - 01/21/21

LAB NUMBER	20202284	20202285	20202286
SAMPLE ID	S474	S475	S476
TEST STATUS	INFORMATION ONLY	INFORMATION ONLY	INFORMATION ONLY
STATION	103+00	103+00	112+00
LOCATION	06 RT	15 RT	06 LT
DEPTH IN FEET	0-5	0-5	0-5
MAT'L COLOR	BROWN	BROWN	BROWN
MAT'L TYPE			
LATITUDE DEG-MIN-SEC	34 32 52.50	34 32 52.50	34 33 1.20
LONGITUDE DEG-MIN-SEC	91 10 27.60	91 10 27.50	91 10 27.50
% PASSING 2 IN.			
1 1/2 IN.			
3/4 IN.		100	
3/8 IN.		98	
NO. 4	100	96	100
NO. 10		95	
NO. 40		93	
NO. 80		90	
NO. 200	91	83	94
LIQUID LIMIT	38	27	38
PLASTICITY INDEX	20	11	18
AASHTO SOIL	A-6(18)	A-6(7)	A-6(18)
UNIFIED SOIL			
% MOISTURE CONTENT	26.6	27.8	25.8
ACHMSC (IN)	4.50X	---	5.0
SAND ASPHALT (IN)	2.0	---	2.0
AGG.BASE CRS,CL-5 (IN)	11.0	---	10.0

REMARKS - X=STRIPPED

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
JONATHAN A. ANNABLE, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE	- 01/21/21	SEQUENCE NO.	- 2
JOB NUMBER	- 110706	MATERIAL CODE	- SSRVPS
FEDERAL AID NO.	- TO BE ASSIGNED	SPEC. YEAR	- 2014
PURPOSE	- SOIL SURVEY SAMPLE	SUPPLIER ID.	- 1
SPEC. REMARKS	- NO SPECIFICATION CHECK	COUNTY/STATE	- 48
SUPPLIER NAME	- STATE	DISTRICT NO.	- 01
NAME OF PROJECT	- BOAT GUNWALE SLASH STR.& APPRS.(S)		
PROJECT ENGINEER	- NOT APPLICABLE		
PIT/QUARRY	- ARKANSAS		
LOCATION	- MONROE, COUNTY	DATE SAMPLED	- 11/10/20
SAMPLED BY	- DICKERSON, CAMPBELL, MCCU	DATE RECEIVED	- 11/12/20
SAMPLE FROM	- TEST HOLE	DATE TESTED	- 01/21/21

MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

LAB NUMBER	-	20202287	-	-
SAMPLE ID	-	S477	-	-
TEST STATUS	-	INFORMATION ONLY	-	-
STATION	-	112+00	-	-
LOCATION	-	18 LT	-	-
DEPTH IN FEET	-	0-5	-	-
MAT'L COLOR	-	BROWN	-	-
MAT'L TYPE	-		-	-
LATITUDE DEG-MIN-SEC	-	34 33 1.20	-	-
LONGITUDE DEG-MIN-SEC	-	91 10 27.60		
% PASSING 2 IN.	-		-	-
1 1/2 IN.	-		-	-
3/4 IN.	-	100	-	-
3/8 IN.	-	99	-	-
NO. 4	-	97	-	-
NO. 10	-	96	-	-
NO. 40	-	93	-	-
NO. 80	-	91	-	-
NO. 200	-	87		
LIQUID LIMIT	-	30	-	-
PLASTICITY INDEX	-	10	-	-
AASHTO SOIL	-	A-4(8)	-	-
UNIFIED SOIL	-		-	-
% MOISTURE CONTENT	-	26.6		

REMARKS - X=STRIPPED

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
JONATHAN A. ANNABLE, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE	- 01/21/21	SEQUENCE NO.	- 1
JOB NUMBER	- 110706	MATERIAL CODE	- RV
FEDERAL AID NO.	- TO BE ASSIGNED	SPEC. YEAR	- 2014
PURPOSE	- SOIL SURVEY SAMPLE	SUPPLIER ID.	- 1
SPEC. REMARKS	- NO SPECIFICATION CHECK	COUNTY/STATE	- 48
SUPPLIER NAME	- STATE	DISTRICT NO.	- 01
NAME OF PROJECT	- BOAT GUNWALE SLASH STR.& APPRS.(S)		
PROJECT ENGINEER	- NOT APPLICABLE		
PIT/QUARRY	- ARKANSAS		
LOCATION	- MONROE, COUNTY	DATE SAMPLED	- 11/10/20
SAMPLED BY	- DICKERSON, CAMPBELL, MCCU	DATE RECEIVED	- 11/12/20
SAMPLE FROM	- TEST HOLE	DATE TESTED	- 01/21/21

MATERIAL DESC. - SOIL SURVEY - RESISTANCE R-VALUE ACTUAL RESULTS

LAB NUMBER	- 20202288	-	-
SAMPLE ID	- RV478	-	-
TEST STATUS	- INFORMATION ONLY	-	-
STATION	- 112+00	-	-
LOCATION	- 18 LT	-	-
DEPTH IN FEET	- 0-5	-	-
MAT'L COLOR	- BROWN	-	-
MAT'L TYPE	-	-	-
LATITUDE DEG-MIN-SEC	- 34 33 1.20	-	-
LONGITUDE DEG-MIN-SEC	- 91 10 27.60		
% PASSING 2 IN.	-	-	-
1 1/2 IN.	-	-	-
3/4 IN.	- 100	-	-
3/8 IN.	- 93	-	-
NO. 4	- 88	-	-
NO. 10	- 84	-	-
NO. 40	- 78	-	-
NO. 80	- 73	-	-
NO. 200	- 69		
LIQUID LIMIT	- 25	-	-
PLASTICITY INDEX	- 8	-	-
AASHTO SOIL	- A-4(3)	-	-
UNIFIED SOIL	-	-	-
% MOISTURE CONTENT	-		
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-

REMARKS - X=STRIPPED

AASHTO TESTS : T24 T88 T89 T90 T265

JOB: 110706

JOB NAME: BOAT GUNWALE SLASH STR.& APPRS.(S)

COUNTY NO. 48 **DATE TESTED** 1/21/2021

Arkansas State Highway Transporation Department

Materials Division

Jonathan Annable, Materials Engineer

STA.#	LOC.	DEPTH	COLOR	#4	#10	#40	#80	#200	L.L.	P.I.	SOIL CLASS	LAB #:	%MOISTURE
				S	I	E	V	E S					
112+00	18 LT	0-5	BROWN	88	84	78	73	69	25	8	A-4(3)	RV478	
103+00	06 RT	0-5	BROWN	100				91	38	20	A-6(18)	S474	26.6
103+00	15 RT	0-5	BROWN	96	95	93	90	83	27	11	A-6(7)	S475	27.8
112+00	06 LT	0-5	BROWN	100				94	38	18	A-6(18)	S476	25.8
112+00	18 LT	0-5	BROWN	97	96	93	91	87	30	10	A-4(8)	S477	26.6

comments: X=STRIPPED

Tuesday, February 2, 2021

JOB: 110706

JOB NAME: BOAT GUNWALE SLASH STR.& APPRS.(S)

COUNTY NO. 48

STA.# LOC.

Arkansas State Highway Transporation Department
Materials Division
Jonathan Annable, Materials Engineer

DATE TESTED
1/21/2021

PAVEMENT SOUNDINGS

103+00	06 RT	ACHMSC	SAND ASPHALT	AGG.BASE CRS,CL-5
		4.50X	**2.0**	**11.0**
103+00	15 RT	ACHMSC	SAND ASPHALT	AGG.BASE CRS,CL-5
		---	---	---
112+00	06 LT	ACHMSC	SAND ASPHALT	AGG.BASE CRS,CL-5
		5.0	**2.0**	**10.0**

comments: X=STRIPPED

Tuesday, February 2, 2021

ARKANSAS DEPARTMENT OF TRANSPORTATION
ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
MATERIALS DIVISION
11301 West Baseline Road | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2185 | Fax: 501.569.2368

November 1, 2022

TO: Mr. Rick Ellis, Bridge Engineer

SUBJECT: Job No. 110706
Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
Monroe County

Introduction

Submitted herein are results of subsurface investigation performed and geotechnical recommendations developed for the proposed replacement bridge over Arkansas Highway 17 in Monroe County. It is understood the existing Arkansas Highway 17 bridge (Bridge No. M0465) over Boat Gunwale Slash will be demolished and a replacement bridge will be constructed in the same alignment. The proposed bridge will be a 120-foot Integral Precast Prestressed Concrete Beam Unit with three (3) 40-foot equal spans and an out-to-out width of 32.5 feet. Foundation loads at all the bridge bents are expected to be supported on close-ended, steel shell piles.

2-Horizontal to 1-vertical (2H:1V) configuration is planned for the end slopes while 3H:1V configuration is designed for the side slopes. The end slopes will be formed by cutting back into the existing embankment with minor fill placement. The existing side slope configuration will be utilized to the extent possible.

Field Investigation

A subsurface investigation was requested on July 26, 2021, by Bridge Division personnel to develop recommendations for bridge foundations and to evaluate abutment embankment configuration. A total of four (4) borings were requested and two (2) borings were drilled. The requested borings at the intermediate bents were not performed due to site inaccessibility.

The approximate locations of the borings are presented in the Plan of Borings included in Attachment A. The borings were advanced with a truck-mounted CME 75 rotary drill rig using a combination of hollow-stem auger and rotary wash drilling methods. The boring logs, showing the subsurface conditions encountered in the borings and the results of field and laboratory tests, are also included in Attachment A, immediately following corresponding Plan of Borings. A Legend is attached after the boring logs to interpret / explain the symbols, terms, and conventions used on logs. Standard Penetration Tests (SPT) were conducted in accordance with ASTM D1586 for field testing and soil sampling. Correction factor for the hammer is indicated on the boring logs. Liners were not used inside the standard split-barrel samplers.

The number of blows required to drive the standard split-barrel sampler for each 6-inch penetration of the total 18-inch drive were counted and shown on the logs. SPT N-values are defined as the number of blows required to advance the split barrel the final 12 inches. The SPT N-values indicated on the logs are raw (uncorrected) blow count measured in field.

Undisturbed samples of cohesive soils were obtained for laboratory determination of engineering properties using thin-wall tube samplers (Shelby tubes) hydraulically inserted into the subsurface soils. Groundwater was also observed during the drilling process. Groundwater observations are noted on the logs.

Lab Investigation

All samples were brought to the Materials Division laboratory for further evaluation and testing. These samples were tested to evaluate index and engineering properties and to verify soil type and classification. Lab tests were performed on representative soil samples to determine moisture content, Atterberg limits, and gradation. Tested soils are classified by licensed geologists in accordance with both USCS and AASHTO soil classification systems. Strength of cohesive soils was evaluated by unconsolidated-undrained (UU) triaxial compression tests on undisturbed Shelby tube samples.

The laboratory test results are presented in Attachment B. These test results are also plotted or indicated on logs using appropriate denotation (symbols in accordance with scale, number, text, etc.). Table 1a lists the laboratory tests performed for this project, their corresponding ASTM and AASHTO test methods, and respective denotation on logs.

Table 1a: Summary of Laboratory Tests

Laboratory Test	ASTM	AASHTO	Denotation on Logs
Moisture Content	D2216	T 265	Solid Circle Symbol (●)
Atterberg Limits	D4318	T 89	Plus Symbol (+) on the Right for Liquid Limit
		T 90	Plus Symbol (+) on the Left for Plastic Limit
Grain Size Distribution	D6913	T 88	Whole Number in the "- No. 200 %" Column (e.g., 12)
Unconsolidated Undrained Triaxial Compression	D2850	T 296	Su for Undrained Shear Strength in psi (e.g., Su=12.3psi); γ_d for Dry Unit Weight in pcf (γ_d=123.4pcf)

The particle size through which 50% of particles by weight passing, D_{50}, is summarized below in Table 1b. Detailed particle size distribution curve used for D_{50} determination is also included in Attachment B.

Table 1b: Summary of D_{50} for Scour Analysis

Hydraulic Feature Name	Station	Sample Type	Location	D_{50}, mm
Boat Gunwale Slash	135 + 91, 8 Rt.	Bulk	Creek Bank	<0.075

Site Conditions

The existing Bridge over Boat Gunwale Slash is 25 feet wide and 95 feet long and consists of five (5), 19-foot precast concrete spans supported by timber piles. The proposed replacement bridge will be located along centerline of the existing bridge. The meandering Boat Gunwale Slash was nearly stagnant (September 2022) though the bridge layout indicates it flows from the east to the west. The bank of the creek is thickly wooded with underbrush and trees. Overhead power lines are located to the west of the bridge alignment. Selected site pictures are included as Attachment C.

Site Geology and General Subsurface Conditions

The soil at the proposed job site consists of meandering stream alluvium from 0 to 20 feet below ground level. The meandering stream alluvium at the job site consist of very loose to loose silt to sandy silt and soft to stiff clay to sandy clay. The meandering stream deposits overlie braided deposits that extend in borings from 20 to 115 feet below ground level. The braided stream deposits consist of medium dense to very dense sand with silt to sand with gravel. Two samples in this zone consist of clayey sand (Boring 2, samples at 75 and 95 feet below ground level). Eocene-aged, medium dense, plastic silt was encountered in Boring 2 at 115 feet below ground level. This silt may be from the lower part of the Jackson Group.

Seismic Conditions

Seismic Site Class and Seismic Performance Zone. In light of the average subsurface conditions as revealed by the borings, a **Seismic Site Class D (Stiff Soil Profile)** is calculated. Utilizing the Seismic Site Class D and the approximate GPS coordinates of the project site, the following design peak ground acceleration coefficient (A_S), design short-period spectral acceleration coefficient (S_{DS}), as well as design long-period spectral acceleration coefficient (S_{D1}), are determined for this site. These seismic coefficients are summarized in Table 2. For the design long-period spectral acceleration coefficient (S_{D1}) of 0.267g, a **Seismic Performance Zone 2** is considered applicable to the project site.

Table 2: Design Ground Motion Acceleration Response Coefficients

Acceleration Coefficient	Value (g)
A_S (Site PGA)	0.258
S_{DS} (0.2 sec)	0.578
S_{D1} (1 sec)	0.267

These seismic coefficients have been determined based on design earthquake ground motions that have a 7% probability of exceedance in 75 years (or a return period of 1000 years). The Design Response Spectrum for 1000 years of return period is presented in Attachment D.

Liquefaction Potential. Liquefaction potential of the subsurface soils were evaluated based on the results of the borings and utilizing the current Microsoft Excel© spreadsheet developed for ARDOT by University of Arkansas. Three (3) procedures are incorporated into this spreadsheet, i.e., Youd et al. (2001) procedure, Cetin et al. (2004) procedure, and Idriss and Boulanger (2008) procedure. Results of the analysis using the Youd et al. (2001) procedure and the Cetin et al. (2004) procedure are presented since the spreadsheet contains an error associated with the Idriss and Boulanger (2008) procedure.

An earthquake Moment Magnitude (M_w) of 7.0 was modelled in the analyses for the project site. Design peak ground acceleration coefficient (A_S) of 0.258g were utilized in evaluation of the project site. The results of liquefaction analyses are presented as plots of calculated factor of safety against liquefaction versus depth below existing ground surface at the boring locations. These results are also provided in Attachment D.

Although the spreadsheet was developed with the capability to calculate factor of safety against liquefaction to any depth, researchers reported there has been so far only one (1) case

history in which liquefaction occurred at a depth greater than 50 feet. Liquefaction below 50-foot depth is generally considered unlikely. Consequently, it is recommended liquefiable zones below 50-foot-depth be neglected from design consideration.

The results of analyses indicate there are localized zones that are potentially liquefiable for the design seismic parameters. However, the overall liquefaction potential at the project site (Attachment D) is generally considered to be low for the design seismic event. **In addition, it is Materials Division's opinion that seismic analysis and design of geotechnical features (liquefaction, slope stability, etc.) for less significant structures (2042 ADT = 530 for this project) may consider utilizing lower seismic coefficients associated with shorter design return period.**

Approach Embankments

As noted, 2H:1V end slopes are planned for both bridge abutments while 3H:1V configuration is designed for the side slopes. Abutment embankment height is in the order of 8 to 9 feet. The existing embankment will be utilized to the extent possible with minor, less than 1 foot of fill placement. Consequently, settlement of the embankments due to the additional fill loading is anticipated to be negligible.

Stability analyses have been performed to evaluate the more critical, 2H:1V end slopes. The slope stability analyses were performed utilizing a commercial computer program Slide2 (Version 2021) developed by RocScience. Spencer analysis method was chosen in the analyses. Three (3) general loading conditions were analyzed with respect to slope stability: Short Term / End of Construction Condition, Long Term Condition, and Seismic / Pseudo-Static condition. A horizontal acceleration coefficient (k_h) of 0.129 (0.5 A_S/g), was utilized for analysis of the Seismic / Pseudo-Static Condition. A surcharge of 250 psf is included to model the live load.

Results of slope stability analyses are summarized below in Table 3a and Table 3b for the south abutment and north abutment, respectively. These results are presented graphically in Attachment E1 for the south abutment and Attachment E2 for the north abutment.

Table 3a: Slope Stability of Unreinforced Embankment – South Abutment (Bent 1)

Slope	Loading Condition	Calculated Min. F.S.	Recommended Min. F.S.
2H:1V End Slope	Short Term	2.63	1.3
	Long Term	1.80	1.4
	Seismic (k_h = 0.129)	1.56	1.05

Table 3b: Slope Stability of Unreinforced Embankment – North Abutment (Bent 4)

Slope	Loading Condition	Calculated Min. F.S.	Recommended Min. F.S.
2H:1V End Slope	Short Term	2.90	1.3
	Long Term	1.56	1.4
	Seismic (k_h = 0.129)	2.16	1.05

The results of stability analyses indicate the design slope configurations are acceptable.

Deep Foundations

Axial Capacities. Based on the conversations with Bridge personnel, it is understood that close-ended, steel shell piles are to be utilized to support the foundation loads at the abutment and intermediate bents. It is also understood 16-in.-diameter or 18-in.-diameter piles are tentatively planned at the abutments to achieve the design nominal axial compression pile capacity of 160 tons per pile. At the intermediate bents, design nominal axial compression pile capacity of 320 tons per pile is required and 24-in.-diameter piles are considered.

Nominal axial capacities (compression and uplift) vs. pile tip penetration / elevation curves for single, 16-in.-diameter, 18-in.-diameter and 24-in.-diameter steel shell piles are provided in Attachment F. These nominal axial capacities have been calculated using static analysis method. Utilizing the axial pile capacity curves included in Attachment F, the following required pile length is recommended and summarized in Table 4 below to achieve the required design nominal axial compression pile capacities.

Table 4: Recommended Pile Length / Penetration

Bent No.	Required Nominal Axial Resistance, tons	Pile Diameter, inch	Recommended Pile Length, feet
1	160	16	50
		18	45
2	320	24	60
3	320	24	60
4	160	16	50
		18	50

For single, isolated foundations, a resistance factor (φ_{stat}) of 0.45 is recommended for calculating factored compression resistance and a resistance factor (φ_{up}) of 0.35 is recommended for determining factored uplift resistance.

Considering the existing embankment that has been in place and minor site grading, downdrag on piling is expected to be negligible. It should be noted that these capacities are determined for piles driven to the required penetration / elevation. If jetting or other methods are used to assist in advancing the piles, re-evaluation of these pile capacities will be warranted.

The nominal capacities are based on single, isolated foundations. Group effect on pile resistance should be evaluated in accordance with AASHTO LRFD Sections 10.7.3.9 and 10.7.3.10 for compression resistance and uplift resistance respectively. For evaluation of pile

group settlement, Section 10.7.2.3 applies. Materials Division is available to assist in evaluating group effect upon request when a detailed pile group configuration is provided.

It is understood drivability analysis will be performed by the structural engineer. Materials Division is available to provide geotechnical input parameters upon request.

Geotechnical Input Parameters for Lateral Load Analysis Using Lpile. Lateral load analysis will be performed by the Structural Engineer using commercial computer program LPile. The following geotechnical input parameters are recommended for use in LPile lateral load analysis.

Table 5a: Recommended Geotechnical Parameters for LPile Analysis – Bents 1

Elevation, ft	p-y Curve Model	Effective Unit Weight, γ', pcf	Undrained Shear Strength, c_u, psf	Strain Factor, ε_{50}	Friction Angle, ϕ, °	Soil Modulus, k, pci
Above ground (fill)	Stiff Clay w/o Free Water	125	1500	0.007	NA	NA
Ground to 162	Soft Clay (Matlock)	115	500	0.02	NA	NA
162 to 150	Soft Clay (Matlock)	60	600	0.01	NA	NA
Below 150	Sand (Reese)	70	NA	NA	34	65

Table 5b: Recommended Geotechnical Parameters for LPile Analysis – Bent 2

Elevation, ft	p-y Curve Model	Effective Unit Weight, γ', pcf	Undrained Shear Strength, c_u, psf	Strain Factor, ε_{50}	Friction Angle, ϕ, °	Soil Modulus, k, pci
Ground to 150	Soft Clay (Matlock)	60	600	0.01	NA	NA
Below 150	Sand (Reese)	70	NA	NA	34	65

Table 5c: Recommended Geotechnical Parameters for LPile Analysis – Bent 3

Elevation, ft	p-y Curve Model	Effective Unit Weight, γ', pcf	Undrained Shear Strength, c_u, psf	Strain Factor, ε_{50}	Friction Angle, ϕ, °	Soil Modulus, k, pci
Ground to 150	Stiff Clay w/ Free Water	60	1000	0.01	NA	100
150 to 125	Sand (Reese)	65	NA	NA	32	40
Below 150	Sand (Reese)	70	NA	NA	34	65

ARKANSAS DEPARTMENT OF TRANSPORTATION
ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
MATERIALS DIVISION
11301 West Baseline Road | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2185 | Fax: 501.569.2368

Table 5d: Recommended Geotechnical Parameters for LPile Analysis – Bents 4

Elevation, ft	p-y Curve Model	Effective Unit Weight, γ', pcf	Undrained Shear Strength, c_u, psf	Strain Factor, ε_{50}	Friction Angle, ϕ, °	Soil Modulus, k, pci
Above ground (fill)	Stiff Clay w/o Free Water	125	1500	0.007	NA	NA
Ground to 162	Soft Clay (Matlock)	115	800	0.01	NA	NA
162 to 150	Stiff Clay w/ Free Water	60	1000	0.01	NA	100
150 to 125	Sand (Reese)	65	NA	NA	32	40
Below 150	Sand (Reese)	70	NA	NA	34	65

Pile Installation. Piles should be installed in accordance with Section 805 (2014 Edition). Prior to driving piles, hammer systems furnished by the Contractor should be evaluated and approved by the Engineer.

Prebore is not anticipated to be required. Water jetting, vibrating, or other means for the purpose of assisting pile penetration are generally not expected. If warranted by specific subsurface conditions, the use of water jetting or vibrating should be approved by the Engineer. In addition, the final 5 feet of pile penetration should be achieved by driving.

Piling should be observed and recorded by the Engineer. Test piles are not required but may be driven for the Contractor's information. Nominal bearing capacity should be determined in accordance with Subsection 805.09(b), "Method B - Wave Equation Analysis (WEAP)".

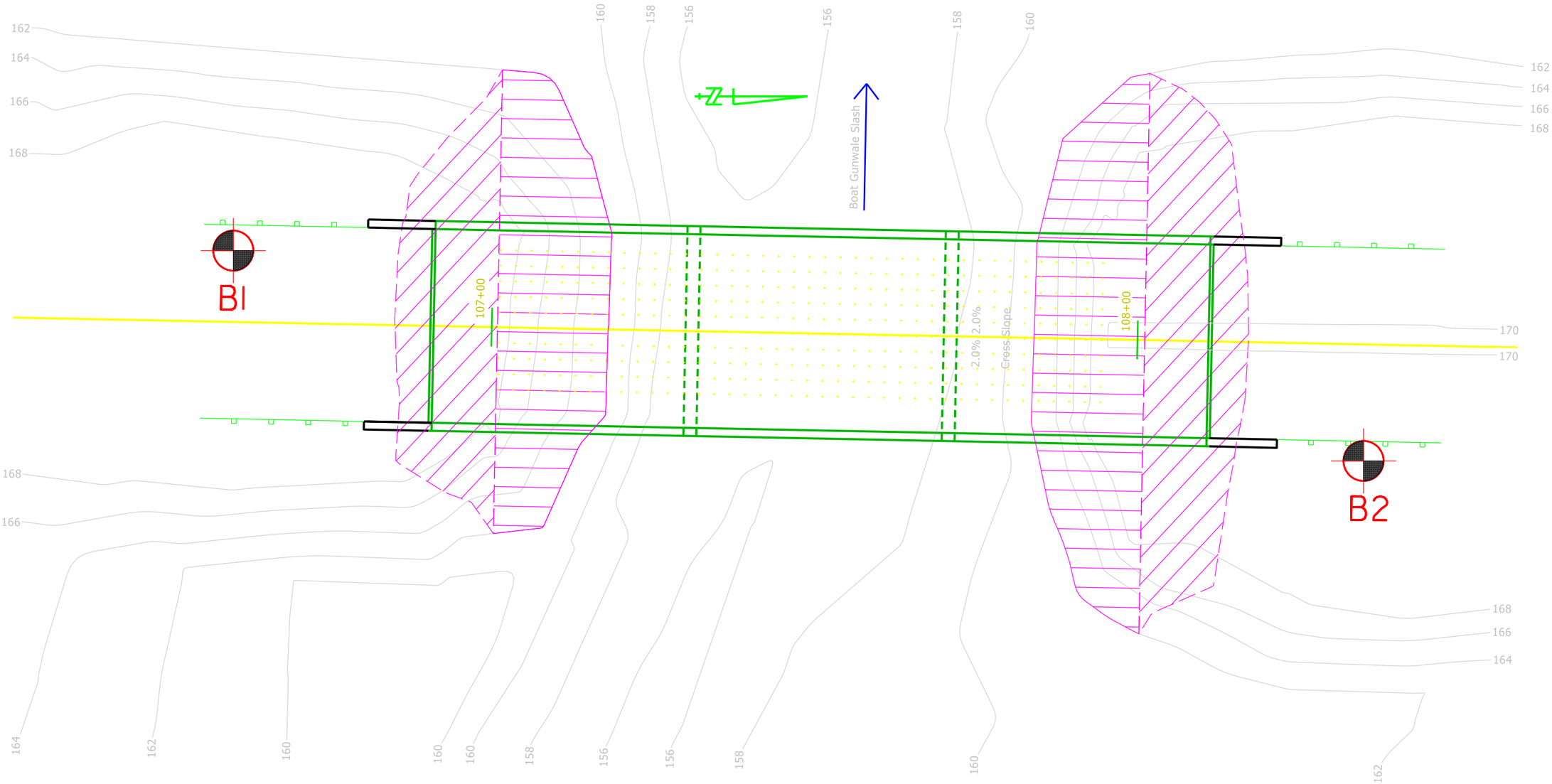
Paul Tinsley
Materials Engineer

PT:yz:mbb:jcs
cc: State Construction Engineer
District 1 Engineer
Roadway Design Engineer
G. C. File

Attachment A

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	AR			
JOB NO.		110706		

PLAN OF BORINGS



BORING	STATION	OFFSET
1	106+60	11' LEFT CL
2	108+35	18' RIGHT CL

PLAN OF BORINGS

BOAT GUNWALE SLASH STR. & APPRS. (S)
ROUTE 17, SECTION 01
MONROE COUNTY
FED. AID PROJECT

JOB NO. 110706	SHEET 1/1

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 1
PAGE 1 OF 3

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 106+60
LOCATION: 11' Left of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 4, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 101.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL–LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
5			Moist, Soft, Brown Silty Clay with Sand (samples at 2.5 and 4.2 combined to ensure enough sample to test)	-					
				CL-ML		82	2 1-2		
				-			1 2-1		
10			Moist, Brown Silty Clay with Sand (Manganese Nodules)	CL-ML		82			
				ML		86			
			Wet, Gray Silt with Some Organic Matter (Wood)	-					
15			Wet, Medium Stiff, Gray Lean Clay	CL		94	2 2-3		
				-					
20			Moist, Gray Lean Clay with Sand	CL		75			
				-					
25			Wet, Medium Dense, Gray Poorly Graded Sand with Silt	SP-SM		11	8 12-13		
				-					
30			Wet, Medium Dense, Gray Sand with Clay	-		11	6 9-7		
35			Wet, Medium Dense, Gray Poorly Graded Sand	SP		4	3 8-8		
				-					

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 1
PAGE 2 OF 3

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 106+60
LOCATION: 11' Left of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 4, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75

HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 101.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL — LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
40			Wet, Medium Dense, Gray Well Graded Sand with Silt	SW-SM -		6	5 13-12		
45			Wet, Medium Dense, Gray Poorly Graded Sand with Some Gravel	SP -		3	7 10-12		
50				SP -		3	5 11-14		
55			Wet, Medium Dense, Gray Poorly Graded Sand with Trace Gravel	SP -		4	6 9-15		
60				SP -		4	6 12-13		
65			Sand with Gravel	SP -		4	8 7-9		
70			Wet, Medium Dense, Gray Poorly Graded Sand with Trace Gravel	SP -		3	8 11-13		

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 1
PAGE 3 OF 3

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 106+60
LOCATION: 11' Left of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 4, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75

HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 101.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL 10 20 30 40 50 60 70 LL	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
75			Wet, Medium Dense, Gray Poorly Graded Sand with Trace Gravel and Trace Organic Matter (Wood)	SP -		3	8 9-12		
80			Wet, Medium Dense, Gray Poorly Graded Sand	SP -		4	5 9-9		
85				SP -		2	7 13-13		
90			Wet, Medium Dense, Gray Poorly Graded Sand with Some Gravel	SP -		3	9 13-14		
95				SP -		2	10 11-14		
100			Wet, Medium Dense, Gray Poorly Graded Sand with Trace Gravel	SP -		4	10 13-16		
			Wet, Dense, Gray Poorly Graded Sand with Silt	SP-SM		5	12 19-19		
105			Boring Terminated						

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 2
PAGE 1 OF 4

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 108+35
LOCATION: 18' Right of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 5, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75

HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 116.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL — LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
5			Moist, Medium Stiff, Brown Sandy Clay	-			2 2-3 2 2-3		
			Moist, Very Loose, Brown Sandy Silt				2 1-3		
10			Moist, Gray Silt with Sand	ML		83			
			Moist, Stiff, Brown Sandy Clay	-			2 3-7		
15				CL		58			
20			Moist, Gray Sandy Lean Clay (Manganese Nodules)	-					
25			Wet, Medium Dense, Gray Poorly Graded Sand	SP		3	3 5-9		
30			Wet, Loose, Gray Sand with Silt				5 5-4		
35			Wet, Loose, Gray Sand with Some Organic Matter (Wood)				2 2-5		

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 2
PAGE 2 OF 4

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 108+35
LOCATION: 18' Right of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 5, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 116.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL — LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
40			Wet, Medium Dense, Gray Sand with Silt	-			3 5-7		
45			Wet, Medium Dense, Gray Sand with Trace Gravel				5 6-8		
50							5 10-13		
55			Wet, Dense, Gray Sand with Trace Gravel				7 20-25		
60			Wet, Medium Dense, Gray Sand				5 9-12		
65			Wet, Medium Dense, Gray Sand with Some Gravel				6 9-12		
70			Wet, Medium Dense, Gray Sand with Some Gravel	SP		1	6 2-9		

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 2
PAGE 3 OF 4

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 108+35
LOCATION: 18' Right of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 5, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 116.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL — LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	%TCR	%RQD
75			Wet, Medium Dense, Gray Sand with Silt	-			5 8-11		
80			Wet, Medium Dense, Gray Clayey Sand with Trace Gravel			32	2 8-10		
85			Wet, Dense, Gray Sand and Trace Gravel	SP		4	13 20-15		
90			Wet, Medium Dense, Gray Sand				6 7-8		
95			Wet, Medium Dense, Gray Sand with Trace Gravel	-			8 9-10		
100			Wet, Medium Dense, Gray Clayey Sand				8 12-13		
105			Wet, Medium Dense, Gray Sand with Silt and Some Gravel				11 15-14		

REMARKS:

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 2
PAGE 4 OF 4

JOB NO. 110706 Monroe County
JOB NAME: Boat Gunwale Slash Str. & Apprs. (S)
Route 17, Section 1
STATION: 108+35
LOCATION: 18' Right of Construction Centerline
LOGGED BY: Stanley Bates and Coty Campbell

DATE: October 5, 2022
TYPE OF DRILLING: Hollow Stem Auger - Shelby Tube - Rotary Wash
EQUIPMENT: CME 75

HAMMER CORRECTION FACTOR: 1.41

COMPLETION DEPTH: 116.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 169.6	SOIL GROUP	MOISTURE CONTENT (%) PL — LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
110			Wet, Dense, Brown Sand with Gravel	SP		3	11 14-18		
115			Wet, Dense, Brown Sand with Gravel	-			14 20-28		
			Moist, Medium Dense, Gray Silt (Jackson Group?)				8 15-15		
			Boring Terminated						
120									
125									
130									
135									
140									

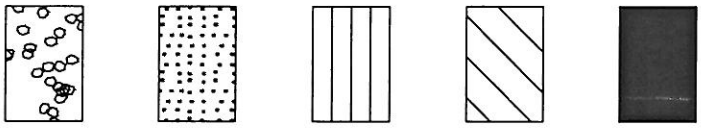
REMARKS:

LEGEND

SOIL TYPES

(SHOWN IN SYMBOL COLUMN)

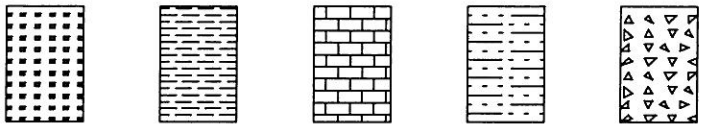
(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL | SAND | SILT | CLAY | ORGANIC MATTER

ROCK TYPES

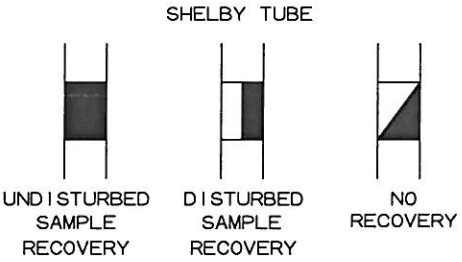
(SHOWN IN SYMBOL COLUMN)



SANDSTONE | SHALE or SILTSTONE | LIMESTONE or DOLOMITE | ALTERNATING LAYERS of SHALE and SANDSTONE | OTHER

SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
'N' Value	Density	'N' Value	Consistency	'N' Value	Consistency	'N' Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium Stiff	Over 60	
31-50	Dense	9-15	Stiff	9-15	Stiff	More than 2'	
Over 50	Very Dense	16-30	Very Stiff	16-30	Very Stiff	Penetration	
		31-60	Hard	31-60	Hard	in 60 Blows:	Medium Hard
		Over 60	Very Hard	Over 60	Very Hard	Less than 2'	
						Penetration	
						in 60 Blows:	Hard

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6 inches of penetration on the drill log. The field "N" Value (N_f) can be obtained by adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9=17 blows/ft$. The "N" Value corrected to 60% efficiency (N_{60}) can be obtained by multiplying N_f by the hammer correction factor published on the boring log.

Attachment B

aterials Division

Results of Classification Tests
ARDOT Project No.: 110706
Project: Boat Gunwale Slash Strs. & Apprs. (S)
Site 1 : Route 17 Section 01 County: Monroe

Summarized by: Sloan
Checked by: Zhao

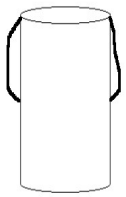
Sample Identification				Atterberg Limits			% Fines	Soil Classification	
Boring	Station	Offset	Depth, ft	LL	PL	PI		USCS	AASHTO
1	106+60	11' Lt	2.5-4.0	25	20	5	82	CL-ML	A-4
1	106+60	11' Lt	6.7-7.7	25	21	4	82	CL-ML	A-4
1	106+60	11' Lt	7.7-8.7	18	18	0	86	ML	A-4
1	106+60	11' Lt	11.2-12.7	29	18	11	94	CL	A-6
1	106+60	11' Lt	15.2-17.2	32	15	17	75	CL	A-6
1	106+60	11' Lt	20.0-21.5	Non-Plastic			11	SP-SM	A-2-4
1	106+60	11' Lt	25.0-26.5	Non-Plastic			11	SP-SM	A-2-5
1	106+60	11' Lt	30.0-31.5	Non-Plastic			4	SP	A-3
1	106+60	11' Lt	35.0-36.5	Non-Plastic			6	SW-SM	A-1-b
1	106+60	11' Lt	40.0-41.5	Non-Plastic			3	SP	A-3
1	106+60	11' Lt	45.0-46.5	Non-Plastic			3	SP	A-1-b
1	106+60	11' Lt	50.0-51.5	Non-Plastic			4	SP	A-3
1	106+60	11' Lt	55.0-56.5	Non-Plastic			4	SP	A-3
1	106+60	11' Lt	60.0-61.5	Non-Plastic			4	SP	A-3
1	106+60	11' Lt	65.0-66.5	Non-Plastic			3	SP	A-1-b
1	106+60	11' Lt	70.0-71.5	Non-Plastic			3	SP	A-1-b
1	106+60	11' Lt	75.0-76.5	Non-Plastic			4	SP	A-3
1	106+60	11' Lt	80.0-81.5	Non-Plastic			2	SP	A-3
1	106+60	11' Lt	85.0-86.5	Non-Plastic			3	SP	A-1-b
1	106+60	11' Lt	90.0-91.5	Non-Plastic			2	SP	A-1-b
1	106+60	11' Lt	95.0-96.5	Non-Plastic			4	SP	A-1-b
1	106+60	11' Lt	100.0-101.5	Non-Plastic			5	SP-SM	A-3
2	108+35	18' Rt	8.3-9.3	20	17	3	83	ML	A-4
2	108+35	18' Rt	13.3-15.3	26	18	8	58	CL	A-4
2	108+35	18' Rt	20.0-21.5	Non-Plastic			3	SP	A-3
2	108+35	18' Rt	65.0-66.5	Non-Plastic			1	SP	A-1-b
2	108+36	18' Rt	75.0-76.6	Non-Plastic			32	SC	A-2-4
2	108+35	18' Rt	80.0-81.5	Non-Plastic			4	SP	A-3
2	108+35	18' Rt	105.0-106.5	Non-Plastic			3	SP	A-1-b
2	108+35	18' Rt	115.0-116.5	34	25	9	NA	ML	A-4

Unconsolidated Undrained Test

AASHTO T-@96

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Membrane Thickness (in)	0.012							
Initial Cell Pressure (psi)	7.0							
Height (in)	6.000							
Diameter (in)	2.875							
Water Content (%)	25.4							
Wet Density (Units)	120.2							
Dry Density (pcf)	95.8							
Degree of Saturation (%)	90.5							
Void Ratio	0.759							
Height To Diameter Ratio	2.087							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Comp. Strength at Failure (psi)	5.8							
σ1 at Failure (psi)	12.8							
σ3 at Failure (psi)	7.0							
Rate of Strain (in/min)	0.016000							
Axial Strain at Failure (%)	10.2							
After Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Final Water Content (%)	29.5							

Project:	Boat Gunwale Slash Str. & Apprs. (S)
Project Number:	
Sampling Date:	
Sample Number:	3
Sample Depth:	6.7-7.7 ft
Location:	106+60/11' Rt
Location:	1
Client Name:	ARDOT
Project Remarks:	82% Passing #200

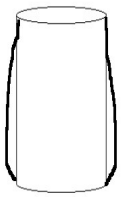
Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconsolidated Undrained Test

AASHTO T-296

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Membrane Thickness (in)	0.012							
Initial Cell Pressure (psi)	8.0							
Height (in)	5.667							
Diameter (in)	2.875							
Water Content (%)	25.2							
Wet Density (Units)	121.3							
Dry Density (pcf)	96.9							
Degree of Saturation (%)	92.0							
Void Ratio	0.740							
Height To Diameter Ratio	1.971							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Comp. Strength at Failure (psi)	5.8							
σ1 at Failure (psi)	13.8							
σ3 at Failure (psi)	8.0							
Rate of Strain (in/min)	0.032000							
Axial Strain at Failure (%)	15.0							
After Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Final Water Content (%)	25.7							

Project:	Boat Gunwale Slash Str. & Apprs. (S)
Project Number:	
Sampling Date:	
Sample Number:	3A
Sample Depth:	7.7-8.7 ft
Location:	106+60/11' Lt
Location:	Boring 1
Client Name:	ARDOT
Project Remarks:	86% Passing #200

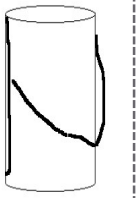
Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Unconsolidated Undrained Test

AASHTO T-296

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Membrane Thickness (in)	0.012							
Initial Cell Pressure (psi)	16.5							
Height (in)	5.990							
Diameter (in)	2.875							
Water Content (%)	28.2							
Wet Density (Units)	119.9							
Dry Density (pcf)	93.6							
Degree of Saturation (%)	94.0							
Void Ratio	0.815							
Height To Diameter Ratio	2.083							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Comp. Strength at Failure (psi)	9.3							
σ1 at Failure (psi)	25.8							
σ3 at Failure (psi)	16.5							
Rate of Strain (in/min)	0.032000							
Axial Strain at Failure (%)	15.2							
After Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Final Water Content (%)	29.7							

Project:	Boat Gunwale Slash Str. & Apprs. (S)
Project Number:	
Sampling Date:	
Sample Number:	5
Sample Depth:	15.2-17.2 ft
Location:	106+60/11' Rt
Location:	Boring 1
Client Name:	ARDOT
Project Remarks:	75% Passing #200

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

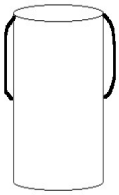
Unconsolidated Undrained Test

AASHTO T-296

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Membrane Thickness (in)	0.012							
Initial Cell Pressure (psi)	9.0							
Height (in)	5.860							
Diameter (in)	2.875							
Water Content (%)	26.4							
Wet Density (Units)	118.3							
Dry Density (pcf)	93.6							
Degree of Saturation (%)	89.0							
Void Ratio	0.800							
Height To Diameter Ratio	2.038							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Comp. Strength at Failure (psi)	3.7							
σ1 at Failure (psi)	12.7							
σ3 at Failure (psi)	9.0							
Rate of Strain (in/min)	0.016000							
Axial Strain at Failure (%)	10.1							
After Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Final Water Content (%)	30.7							

Project:	Boat Gunwale Slash Str. & Apprs. (S)
Project Number:	
Sampling Date:	
Sample Number:	
Sample Depth:	8.3-10.3 ft
Location:	108+35/18' Rt
Location:	Boring 2
Client Name:	ARDOT
Project Remarks:	83% Passing #200

Specimen 1 Failure Sketch



Specimen 2 Failure Sketch

Specimen 3 Failure Sketch

Specimen 4 Failure Sketch

Specimen 5 Failure Sketch

Specimen 6 Failure Sketch

Specimen 7 Failure Sketch

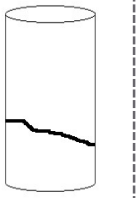
Specimen 8 Failure Sketch

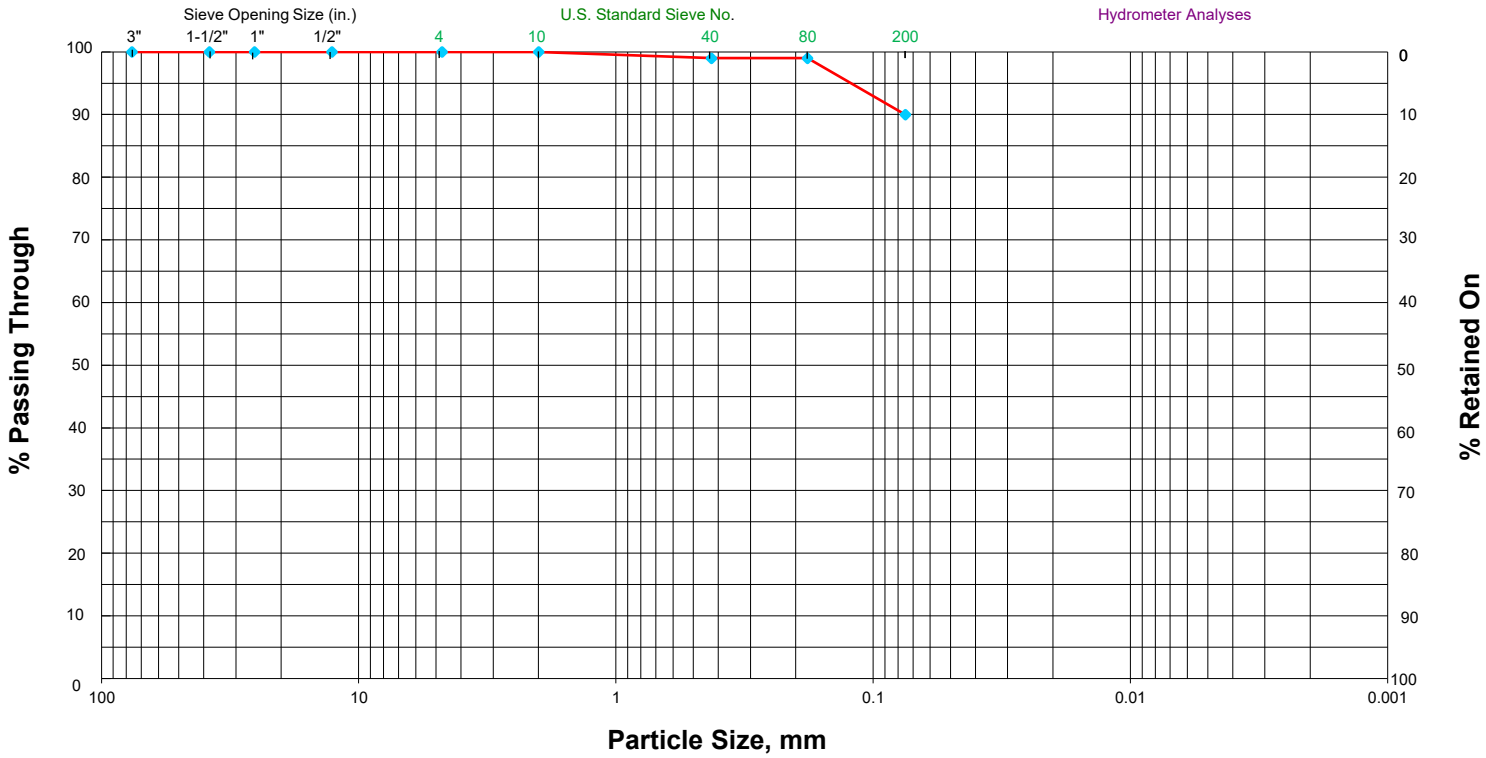
Unconsolidated Undrained Test

AASHTO T-296

Before Test	Specimen Number 1	2	3	4	5	6	7	8
Membrane Thickness (in)	0.012							
Initial Cell Pressure (psi)	14.0							
Height (in)	5.993							
Diameter (in)	2.875							
Water Content (%)	22.7							
Wet Density (Units)	123.3							
Dry Density (pcf)	100.5							
Degree of Saturation (%)	90.3							
Void Ratio	0.677							
Height To Diameter Ratio	2.085							
Test Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Comp. Strength at Failure (psi)	6.8							
σ1 at Failure (psi)	20.8							
σ3 at Failure (psi)	14.0							
Rate of Strain (in/min)	0.016000							
Axial Strain at Failure (%)	10.0							
After Test	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Final Water Content (%)	25.2							

Project:	Boat Gunwale Slash Str. & Apprs. (S)
Project Number:	
Sampling Date:	
Sample Number:	6
Sample Depth:	13.3-15.3 ft
Location:	108+35/18' Rt
Location:	Boring 2
Client Name:	ARDOT
Project Remarks:	58% Passing #200

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							



Particle Size Distribution Curve for D_{50} Sample

Station 135+91/8' Rt of CL

Attachment C

SITE PICTURES

Job No.: 110706

Bridge Deck (September 2022)
Looking North from the South

SITE PICTURES

Job No.: 110706

West Side f Bridge (September 2022) Looking North from the South

SITE PICTURES **Job No.: 110706**

East Side of Bridge (September 2022) Looking North from the South

SITE PICTURES **Job No.: 110706**

South Bridge End (September 2022)
Looking South from the North

SITE PICTURES **Job No.: 110706**

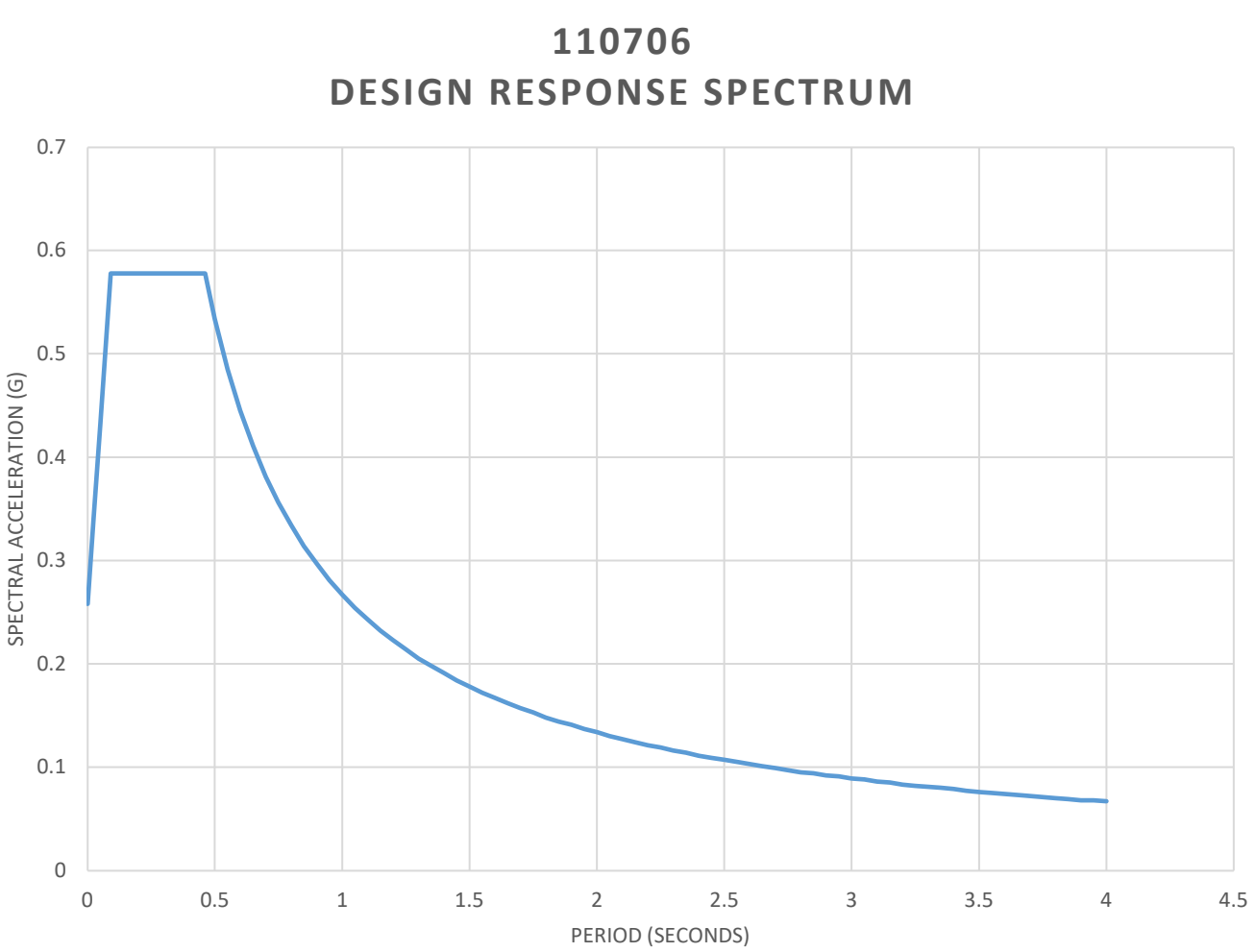
Substructure (September 2022)
Looking North from the South

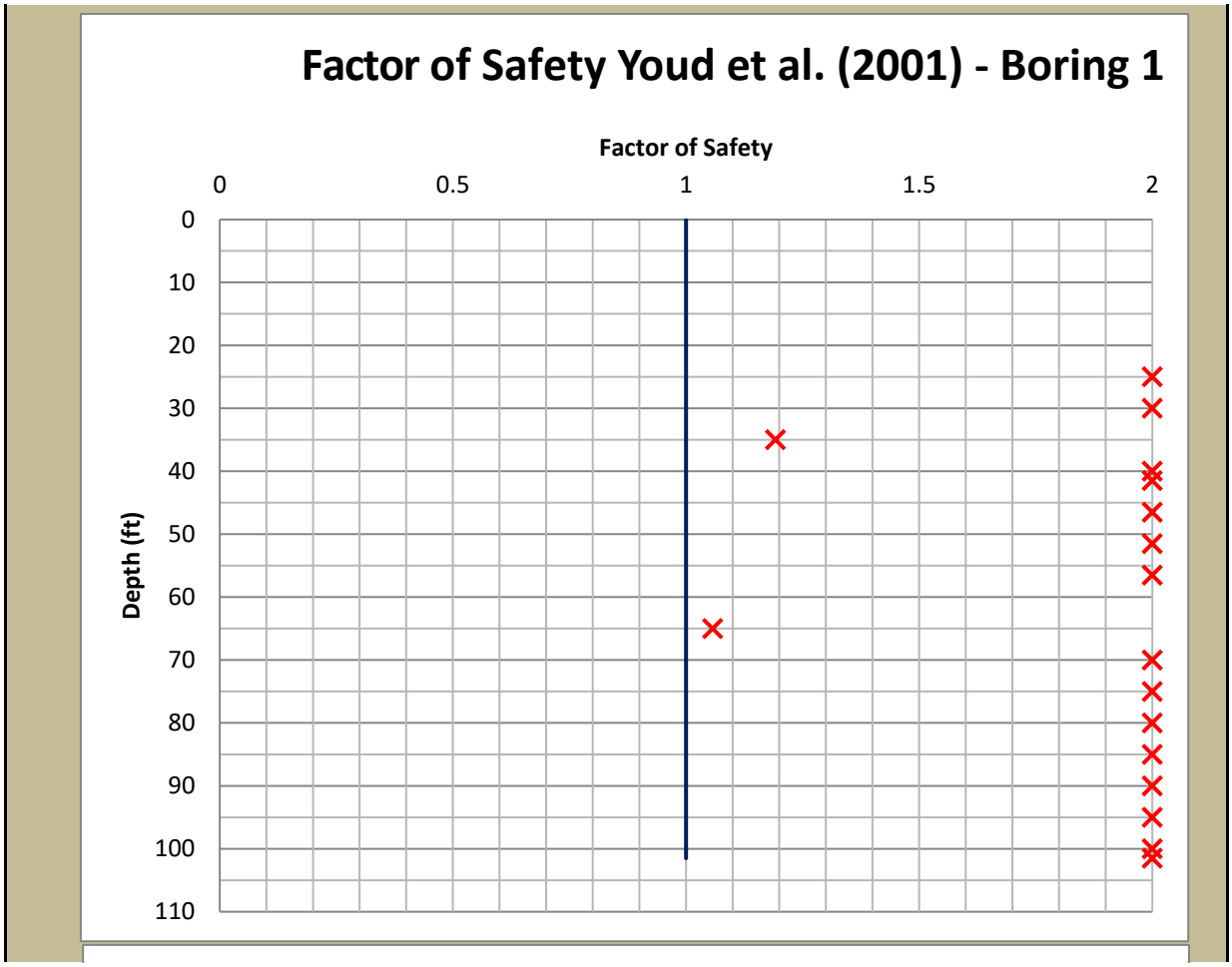
Attachment D

Title:	110706
Latitude:	34.549195
Longitude:	-91.174362
Site Class	D

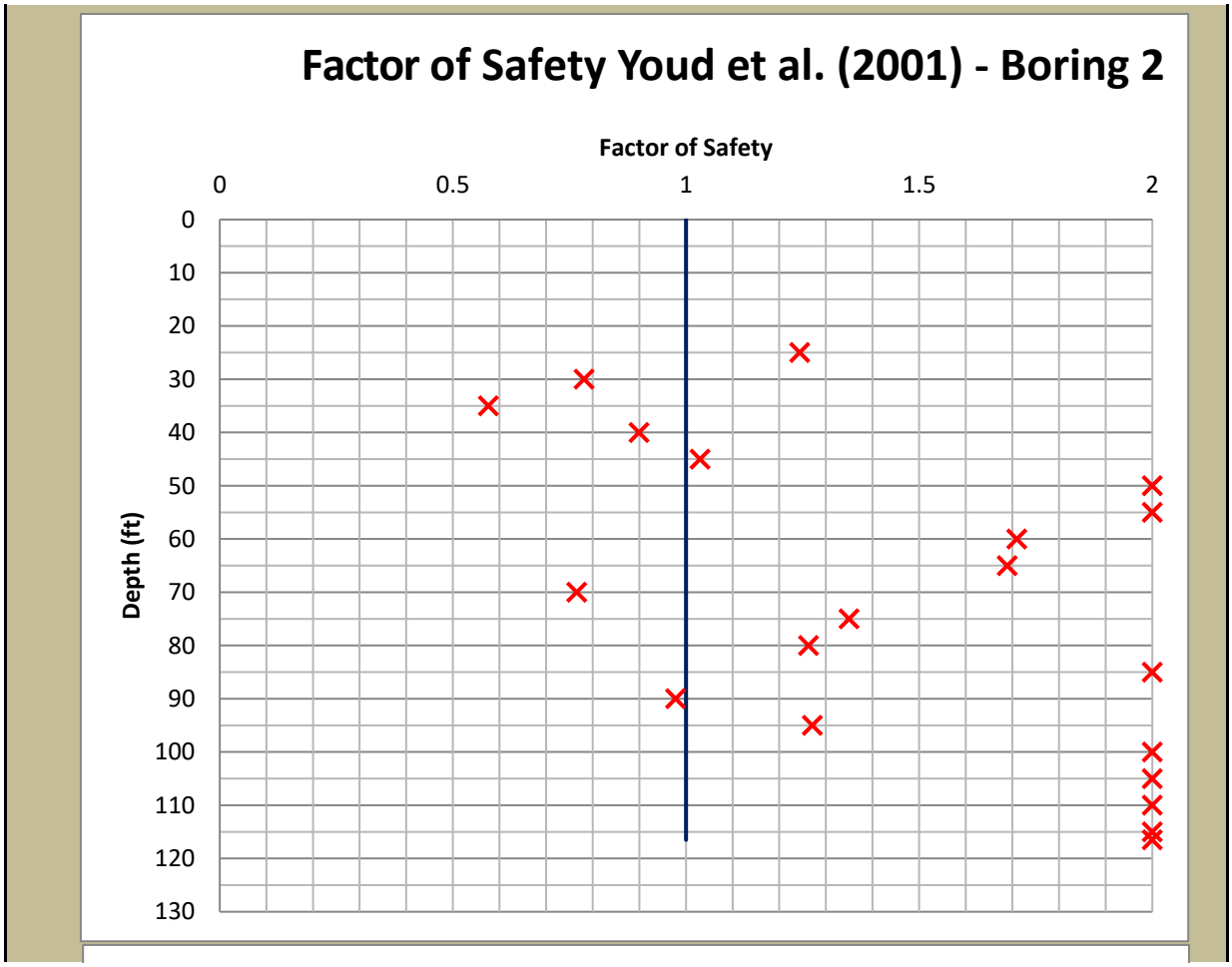
Get USGS Data

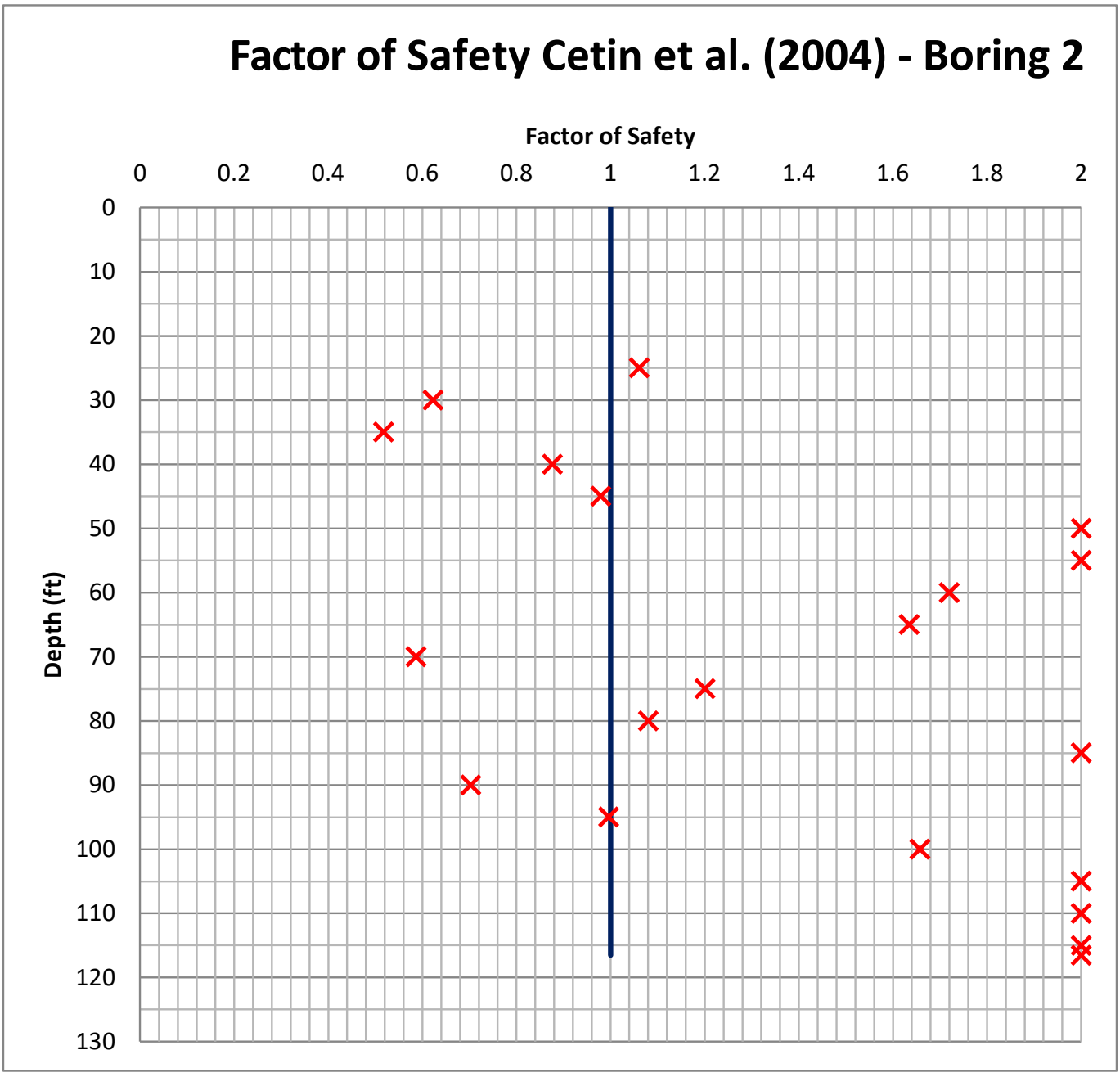
PGA:	0.179
F_{PGA}:	1.443
A_S:	0.258
S_S:	0.388
F_A:	1.49
S_{DS}:	0.578
S_1:	0.114
F_V:	2.344
S_{D1}:	0.267
S_{Dc}:	B
T_S:	0.462
T_0:	0.092




Factor of Safety Youd et al. (2001) - Boring 1
Factor of Safety
0
0.5
1
1.5
2
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110

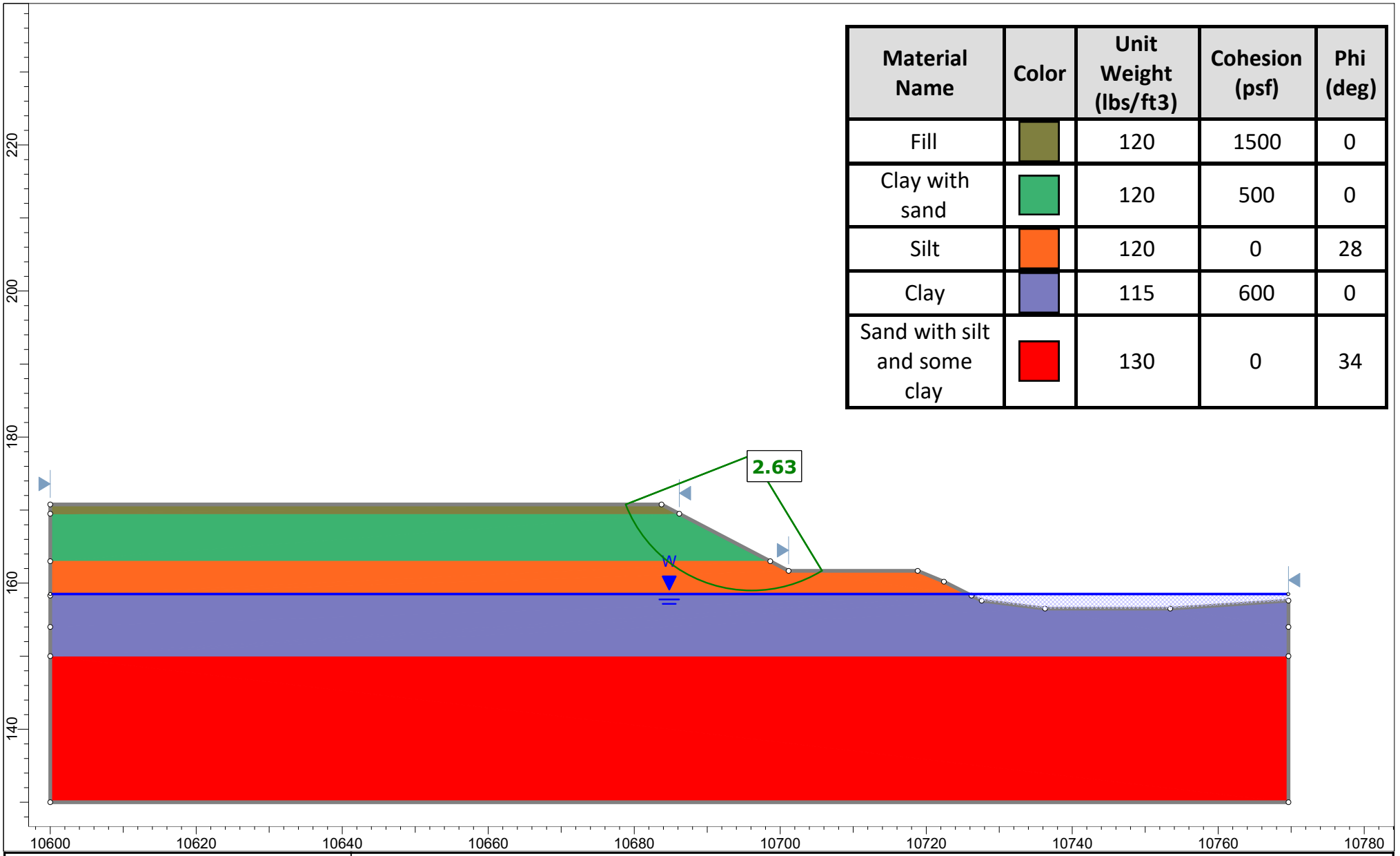

Factor of Safety Cetin et al. (2004) - Boring 1
Factor of Safety
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110


Factor of Safety Youd et al. (2001) - Boring 2
Factor of Safety
0
0.5
1
1.5
2
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130


Factor of Safety Cetin et al. (2004) - Boring 2
Factor of Safety
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130

Attachment E1

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Clay with sand		120	500	0
Silt		120	0	28
Clay		115	600	0
Sand with silt and some clay		130	0	34



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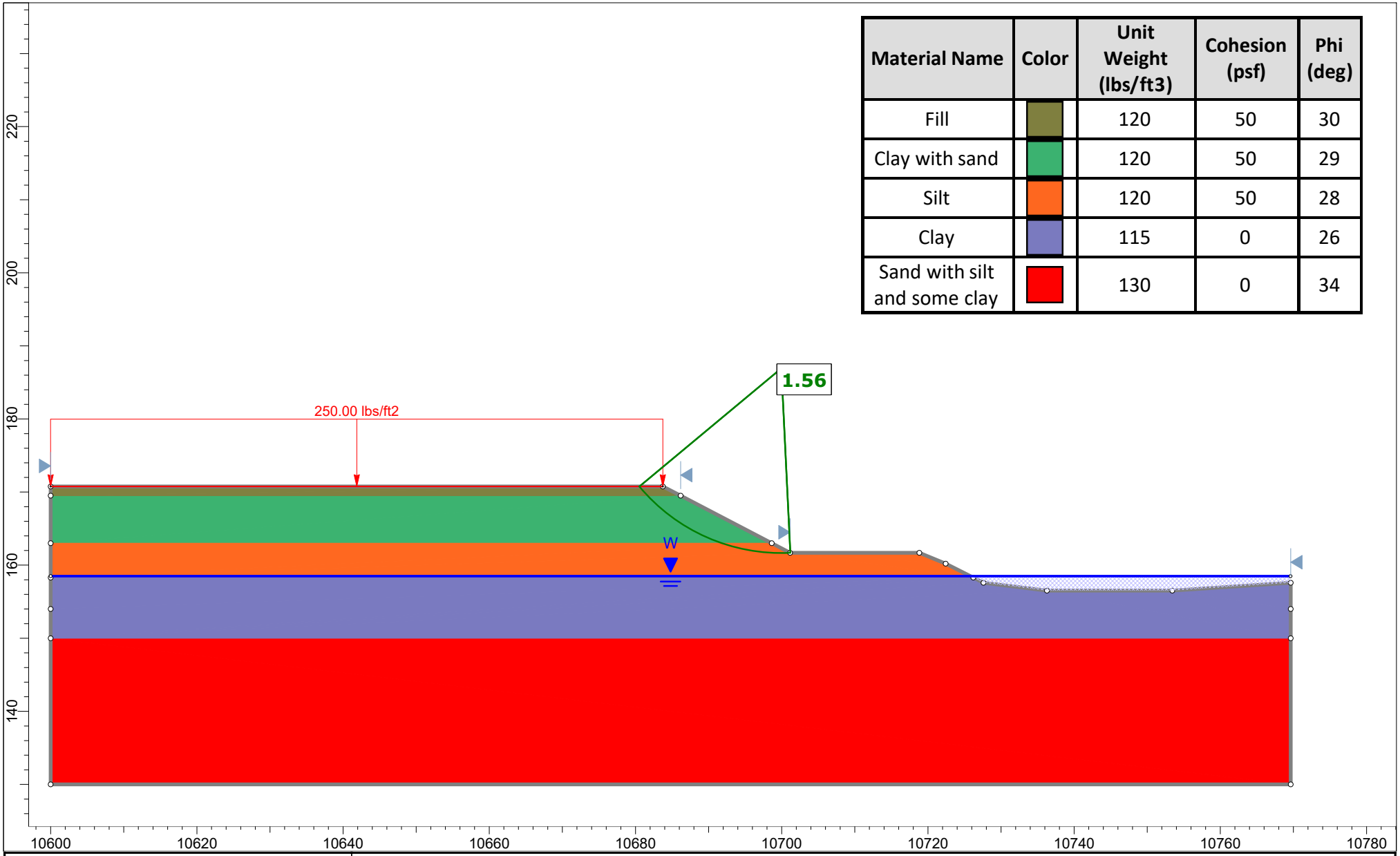
SLIDEINTERPRET 9.019

Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Short term
Analyzed By	MBB	Configuration	2H:1V West Embankment
Date	11/1/2022		

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Clay with sand		120	50	29
Silt		120	50	28
Clay		115	0	26
Sand with silt and some clay		130	0	34



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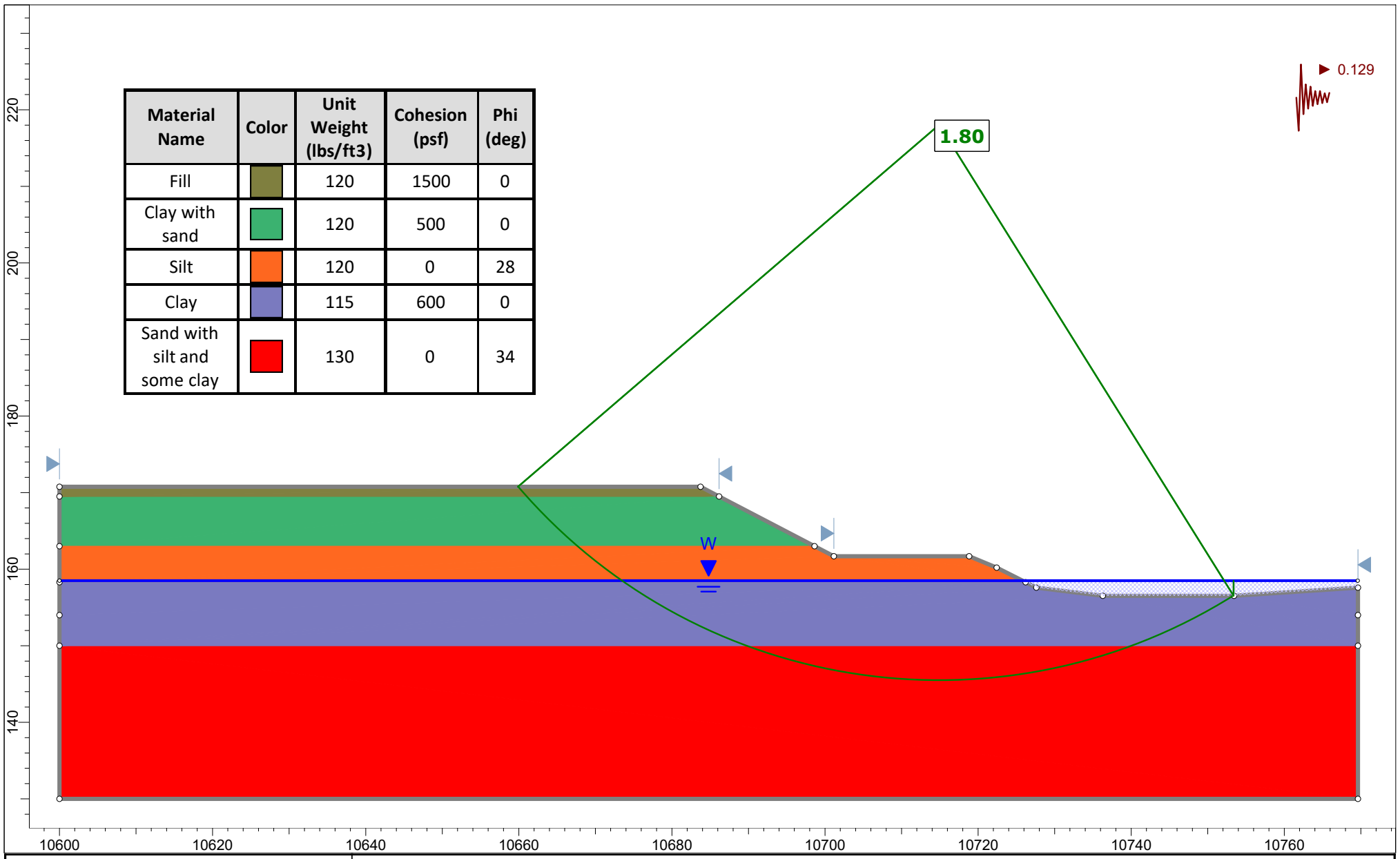
SLIDEINTERPRET 9.019

Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Long Term
Analyzed By	MBB	Configuration	2H:1V West Embankment
Date	11/1/2022		

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Clay with sand		120	500	0
Silt		120	0	28
Clay		115	600	0
Sand with silt and some clay		130	0	34



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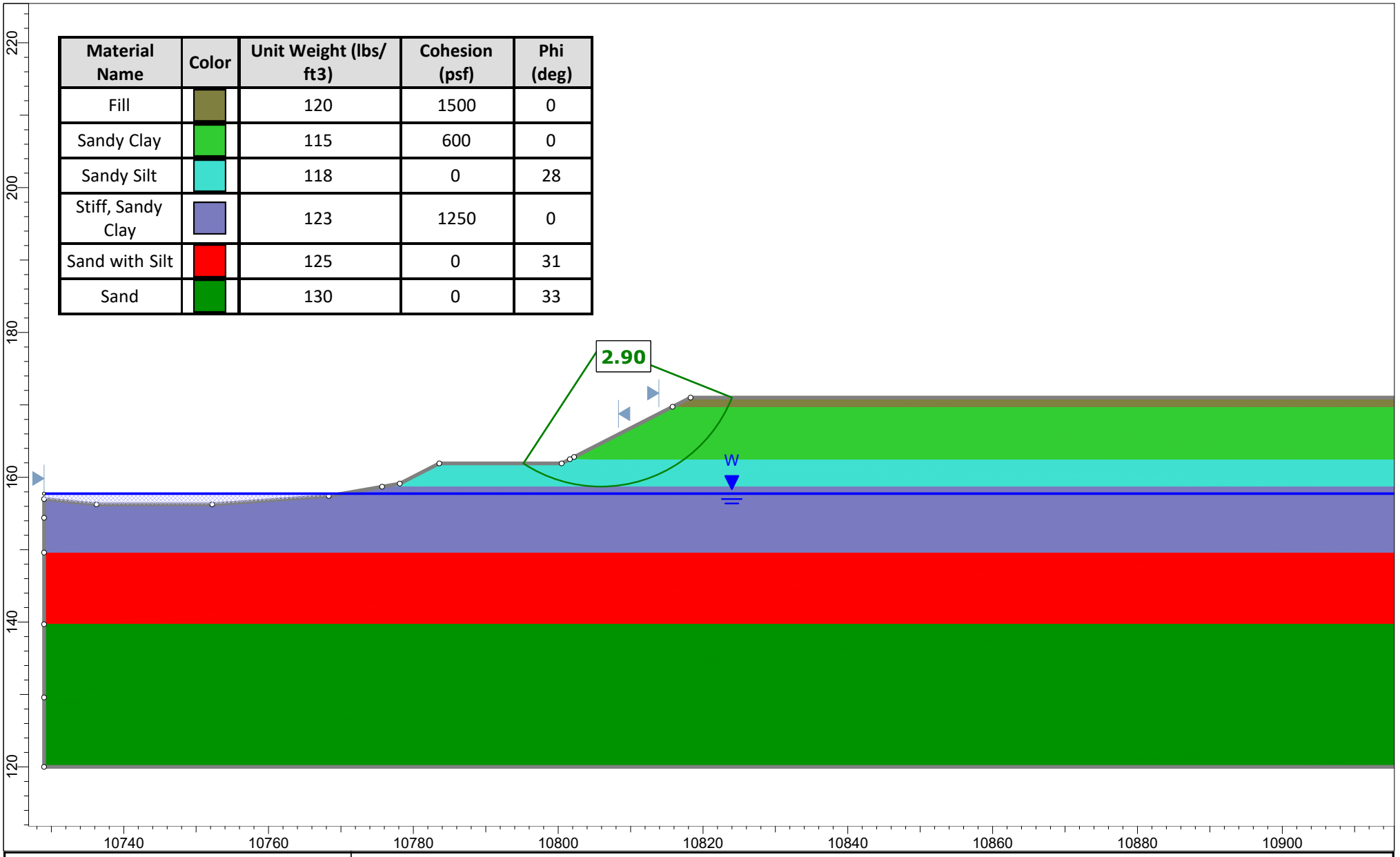
SLIDEINTERPRET 9.019

Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Seismic
Analyzed By	MBB	Configuration	2H:1V West End Embankment
Date	11/1/2022		

Attachment E2

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Sandy Clay		115	600	0
Sandy Silt		118	0	28
Stiff, Sandy Clay		123	1250	0
Sand with Silt		125	0	31
Sand		130	0	33



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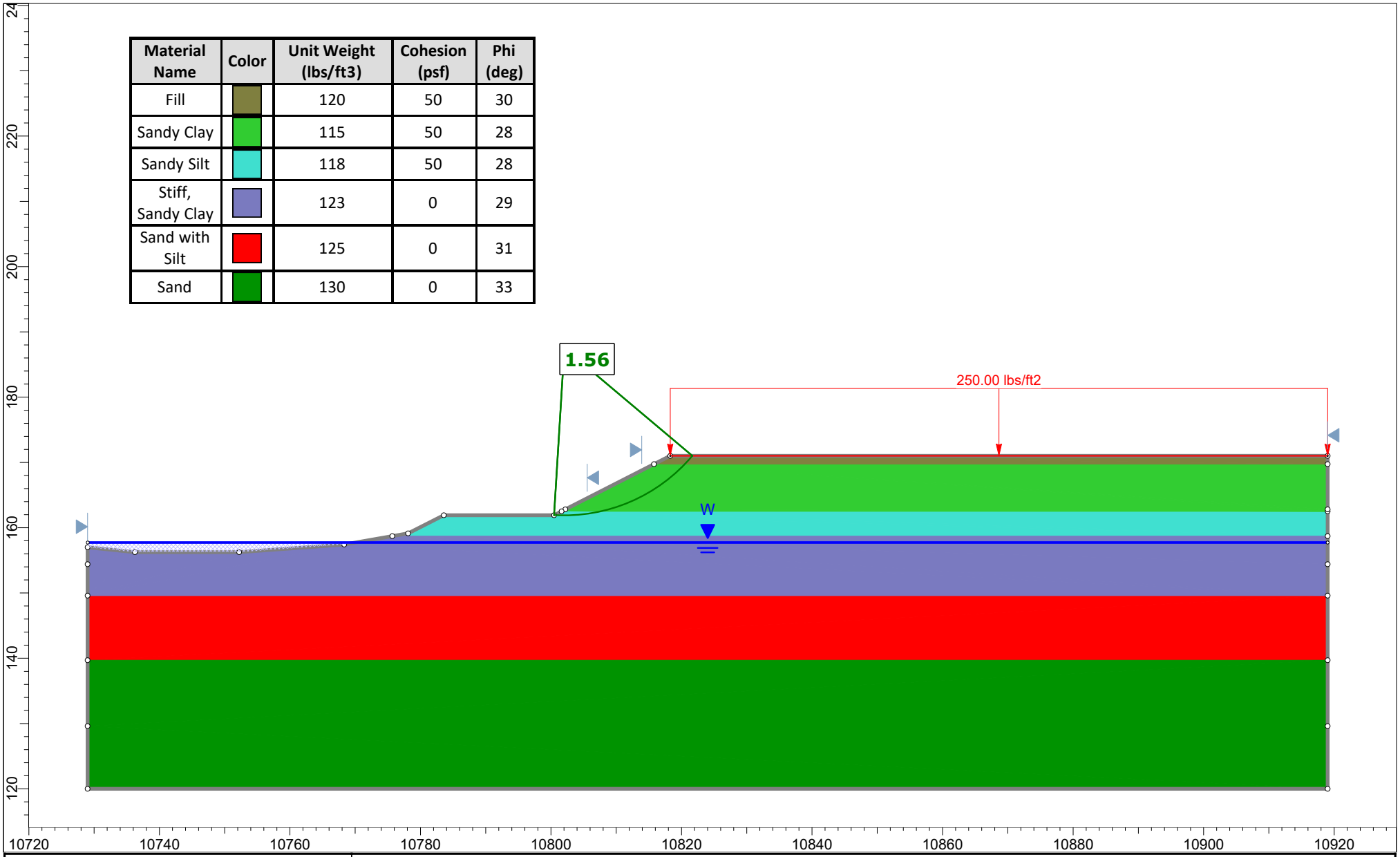
SLIDEINTERPRET 9.019

Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Short
Analyzed By	MBB	Configuration	2H:1V East Embankment
Date	11/1/2022		

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Sandy Clay		115	50	28
Sandy Silt		118	50	28
Stiff, Sandy Clay		123	0	29
Sand with Silt		125	0	31
Sand		130	0	33



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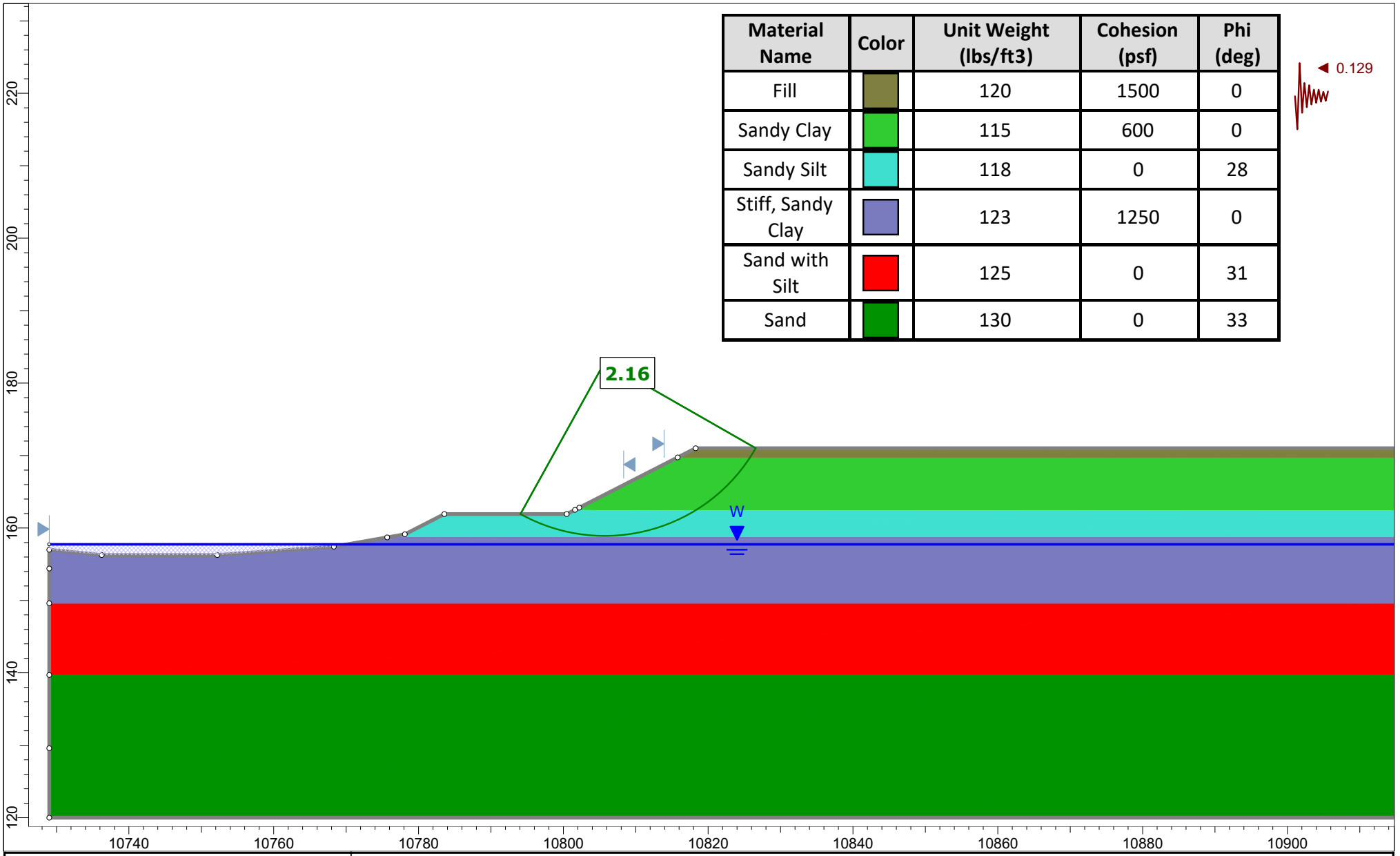
SLIDEINTERPRET 9.019

Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Long Term
Analyzed By	MBB	Configuration	2H:1V East Embankment
Date	11/1/2022		

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Sandy Clay		115	600	0
Sandy Silt		118	0	28
Stiff, Sandy Clay		123	1250	0
Sand with Silt		125	0	31
Sand		130	0	33



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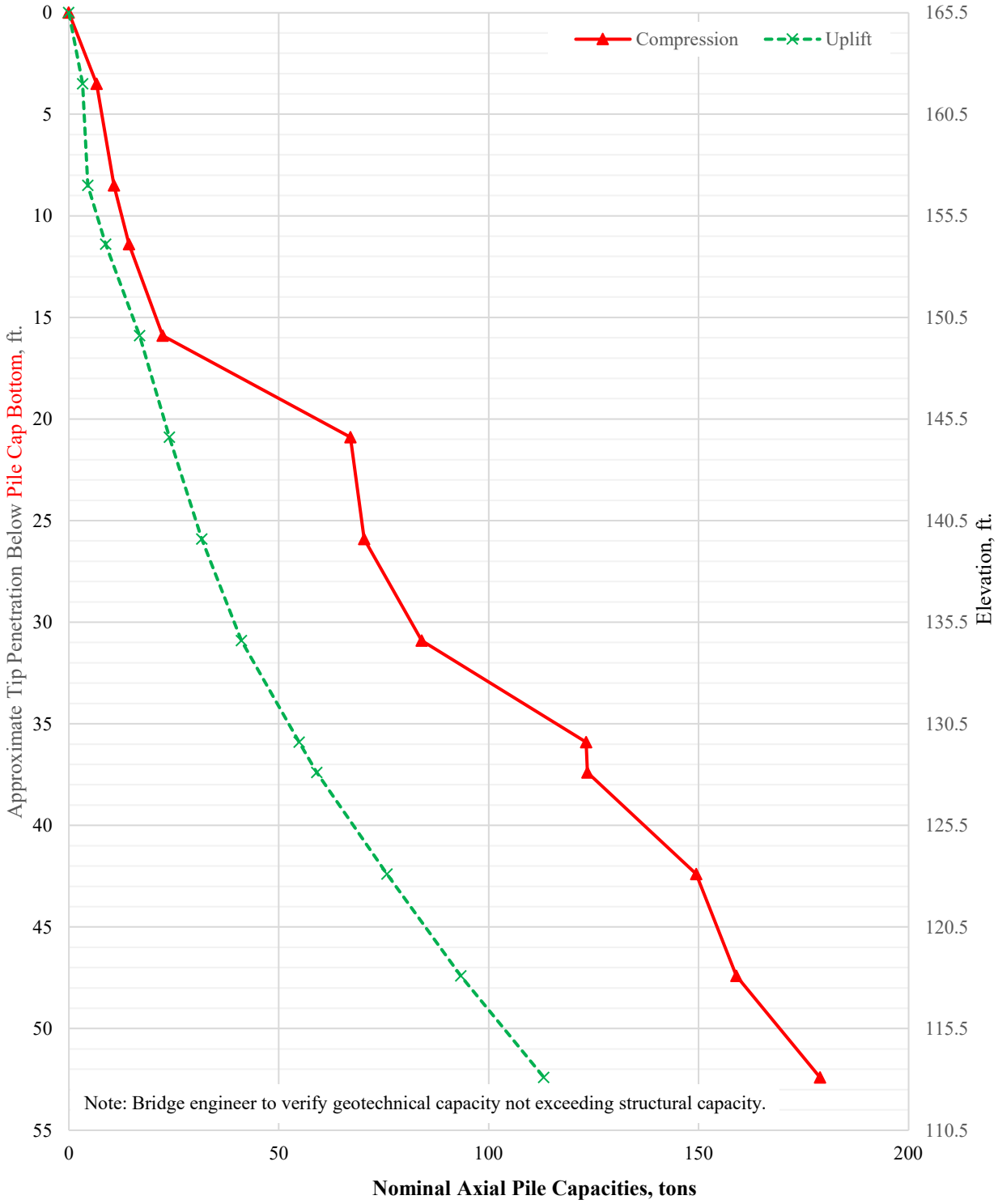
SLIDEINTERPRET 9.019

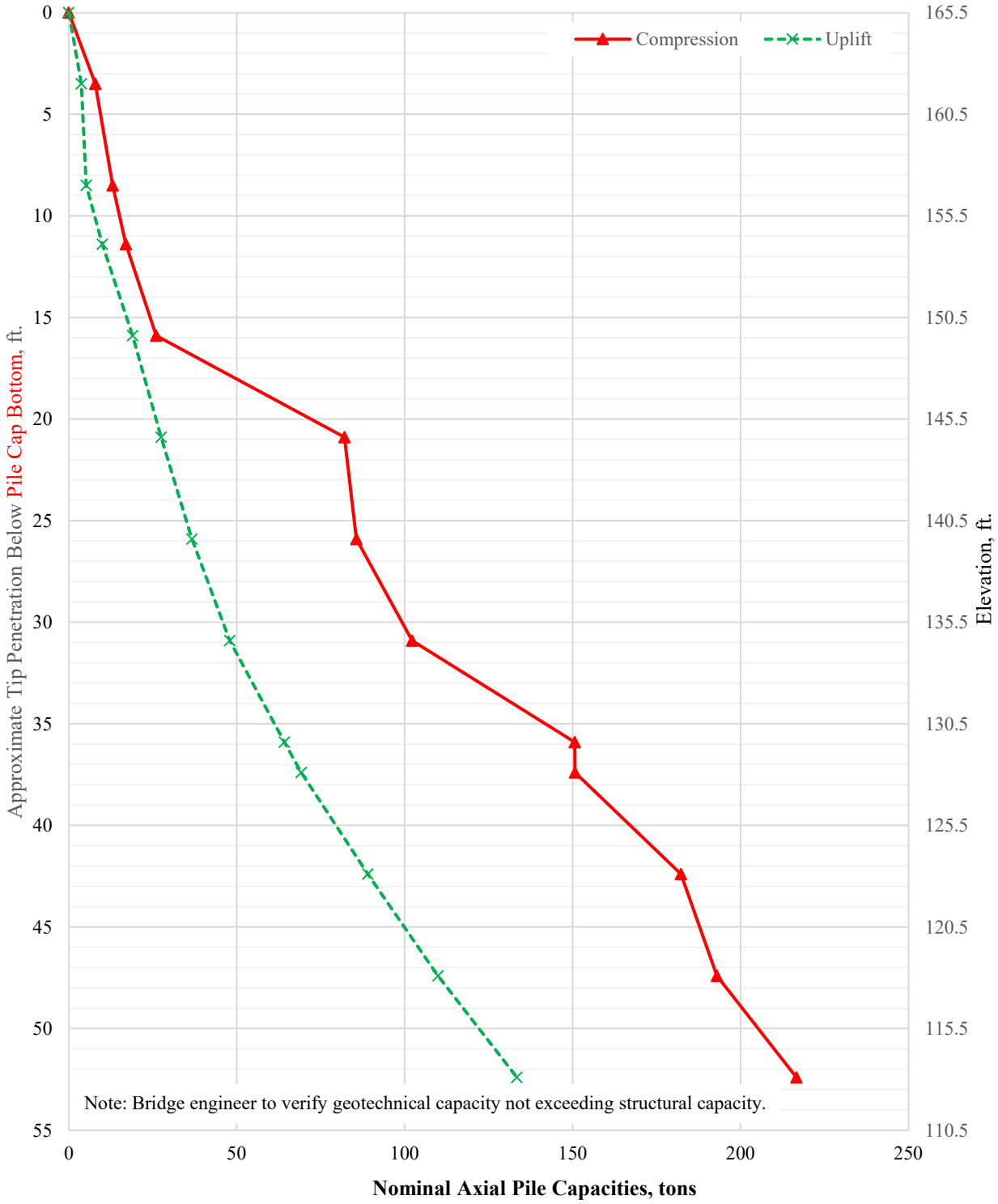
Project	110706: Boat Gunwale Slash Slope Anyalsis		
Site	Boat Gunwale Slash	Analysis Type	Seismic
Analyzed By	MBB	Configuration	2H:1V East Embankment
Date	11/1/2022		

Attachment F



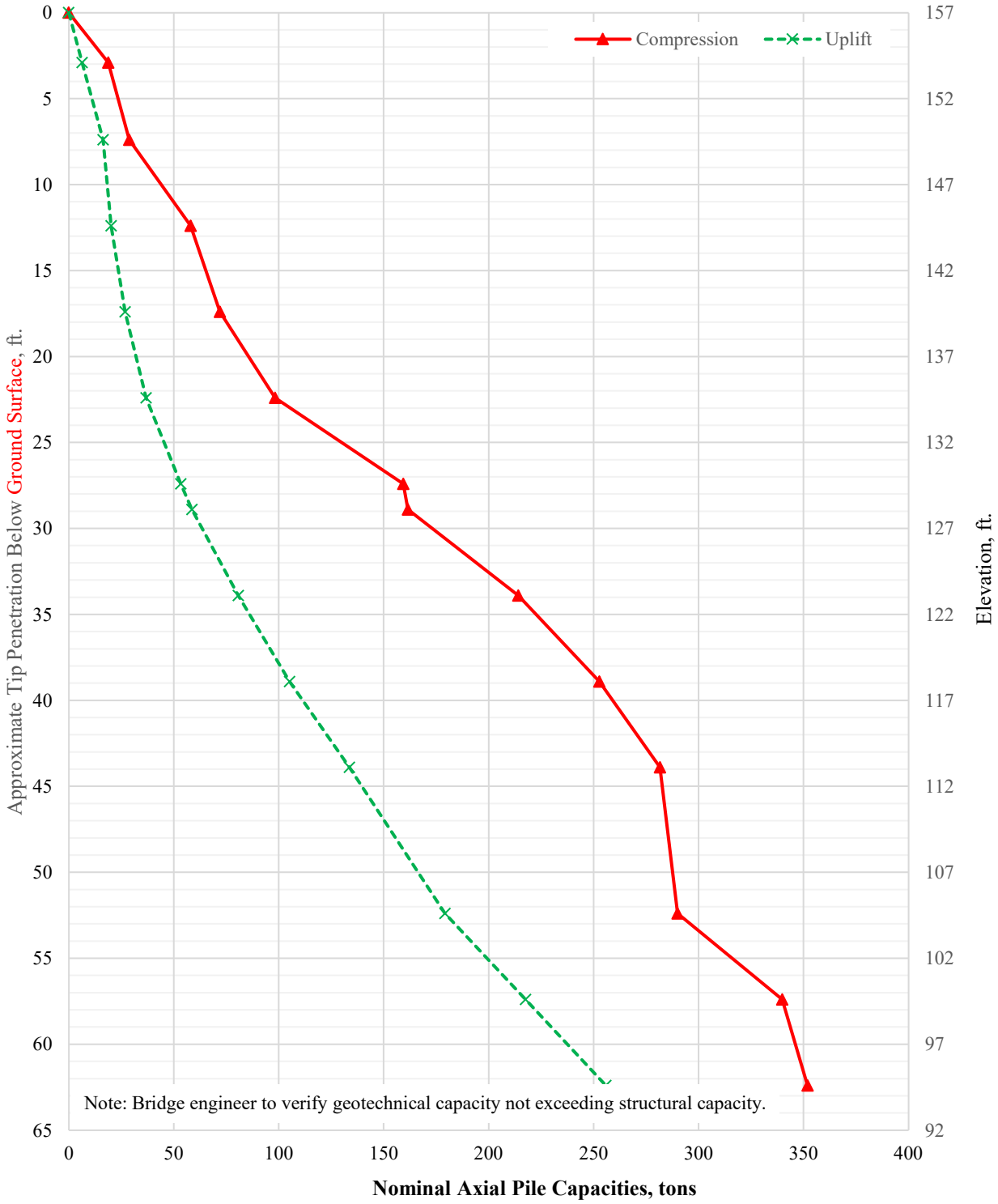
SINGLE 16"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 1 - Sta. 106+90
Project No.: 110706
Location: Moroe County



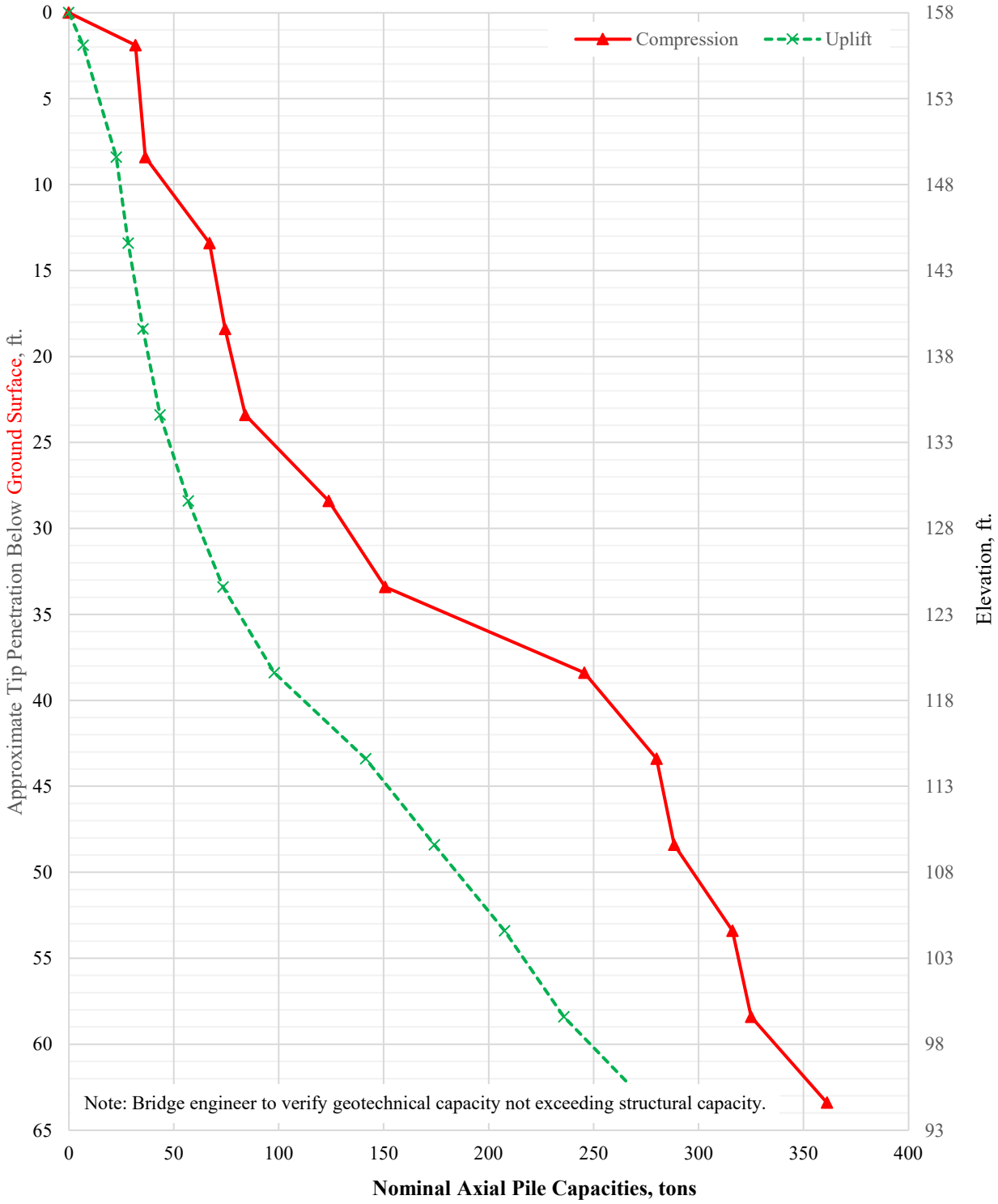
SINGLE 18"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 1 - Sta. 106+90
Project No.: 110706
Location: Moroe County



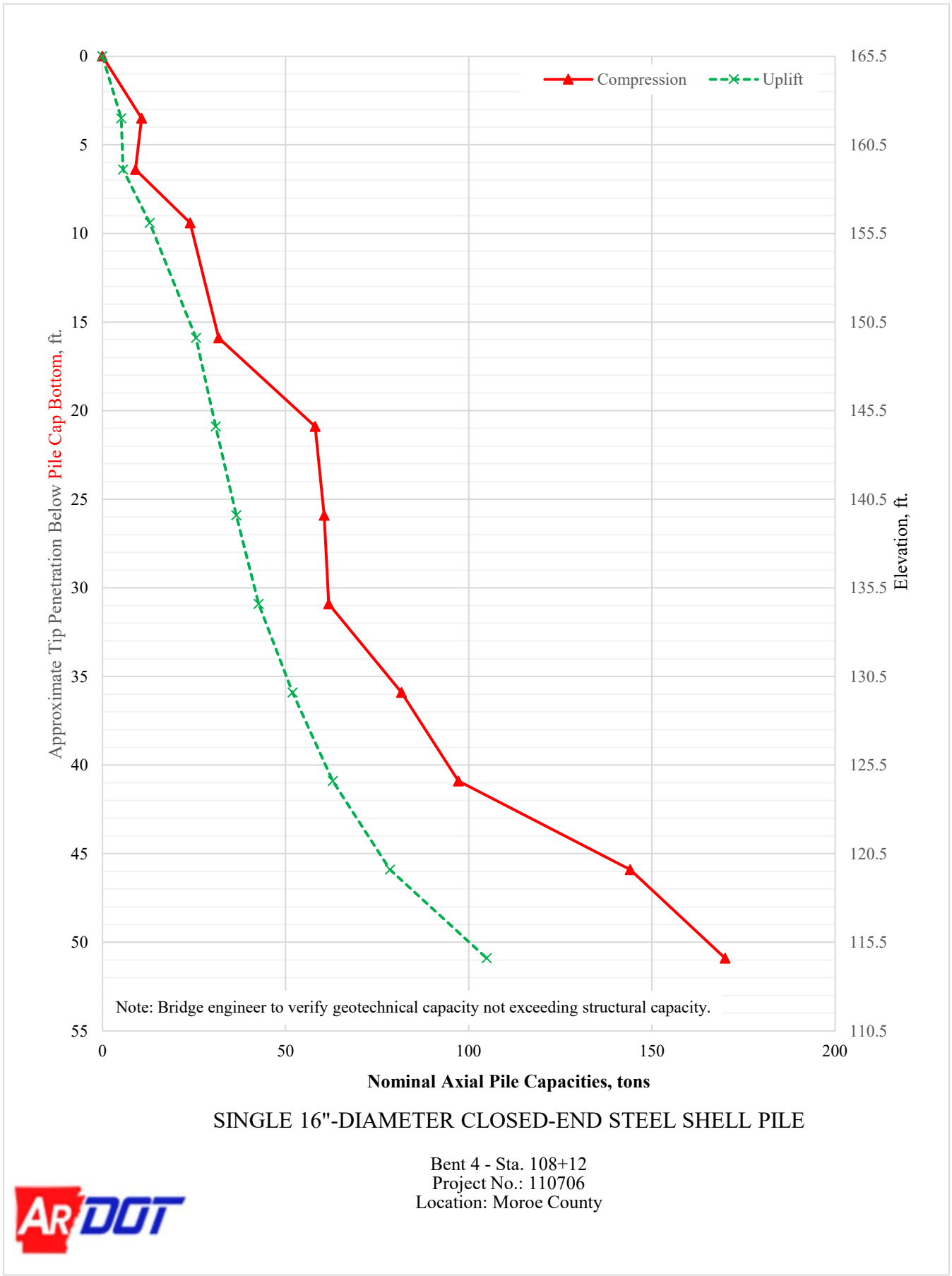
SINGLE 24"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 2 - Sta. 107+31
Project No.: 110706
Location: Moroe County



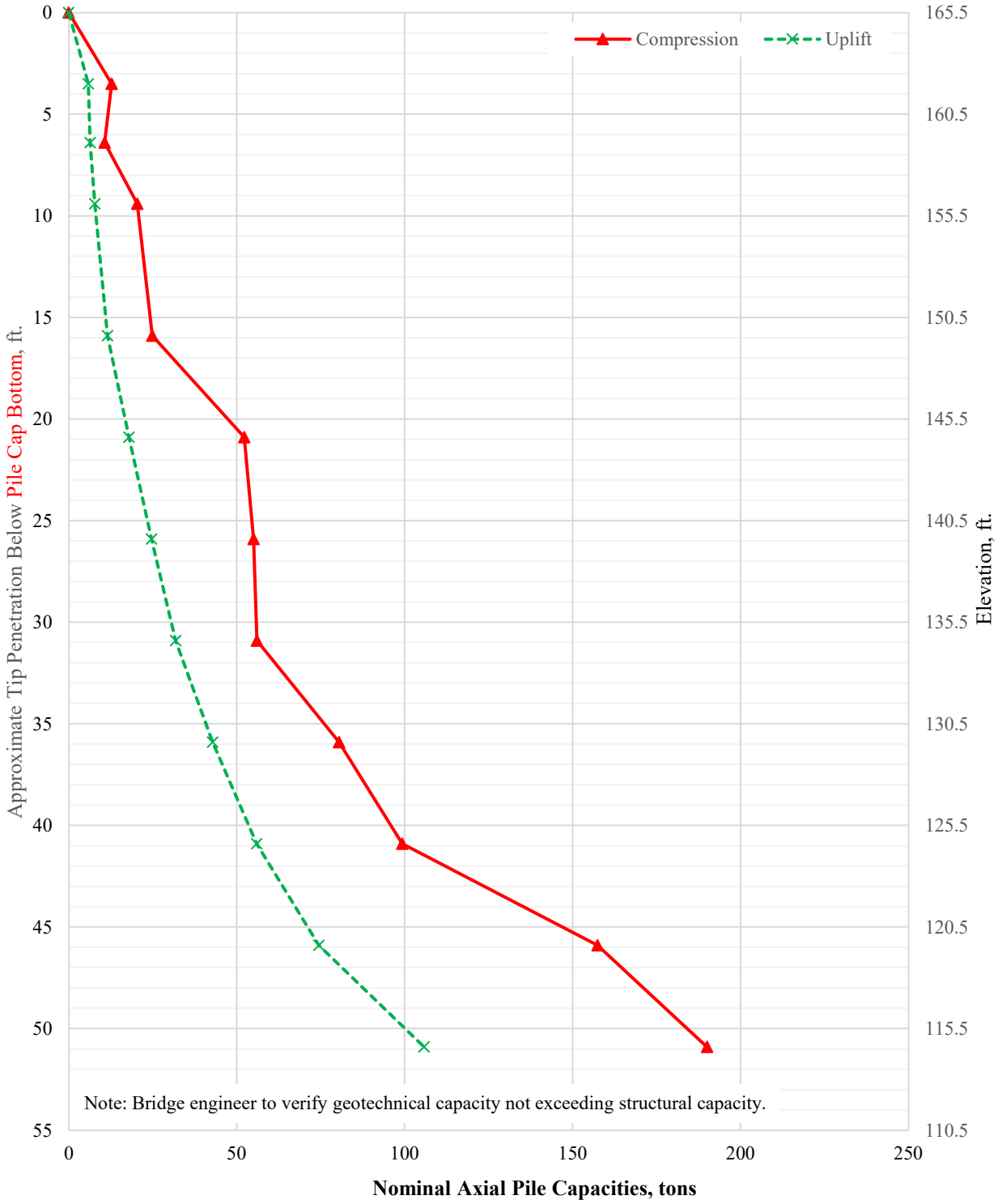
SINGLE 24"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 3 - Sta. 107+71
Project No.: 110706
Location: Moroe County



SINGLE 16"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 4 - Sta. 108+12
Project No.: 110706
Location: Moroe County



SINGLE 18"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 4 - Sta. 108+12
Project No.: 110706
Location: Moroe County