

ARKANSAS DEPARTMENT OF TRANSPORTATION



SUBSURFACE INVESTIGATION

STATE JOB NO. 020738

FEDERAL AID PROJECT NO. FEDERAL AID PROJECT BFPO-STPB-0001(70)

MENARD BAYOU STR. & APPRS. (S)

COUNTY ROAD NO. BENZAL LANE

IN ARKANSAS 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.



March 4, 2025

TO: Mr. Rick Ellis, Bridge Engineer
SUBJECT: Job No. 020738
Menard Bayou Str. & Apprs. (S)
Arkansas County
Benzal Lane/County Road 299

INTRODUCTION

Submitted herein are results of the subsurface investigation and geotechnical recommendations developed for the proposed replacement bridge on Benzal Lane/County Road 299 over the Menard Bayou in Arkansas County.

The proposed structure will be 140 feet in total length and consist of one continuous reinforced concrete slab unit. The proposed structure will have an out-to-out width of 27 feet. The proposed alignment is slightly southwest of the existing alignment.

Based on the geotechnical investigation request from Bridge Division, foundation loads are expected to be supported on concrete filled steel shell piles at all bents. 2-Horizontal to 1-Vertical (2H:1V) end slopes and 2H:1V side slopes are planned at the proposed abutments. Abutment embankments are planned utilizing fill with fill heights of approximately 6 feet for the northwest embankment (Bent 1) and 5 feet for the southeast embankment (Bent 5).

FIELD INVESTIGATION

A subsurface investigation was requested on February 9, 2024, by Bridge Division to develop recommendations for bridge foundations and to verify the suitability of bridge abutment embankment configuration. Two borings were requested and drilled. Both borings were offset due to inaccessibility of the requested locations.

The approximate locations of the borings are presented in the Plan of Borings included in Attachment A. The borings were advanced with a CME 75 truck-mounted rotary drill rig using a combination of hollow-stem auger and rotary wash methods. The boring logs showing the subsurface conditions and the results of field and laboratory tests are also included in Attachment A, immediately following the Plan of Borings. A legend is included following the boring logs to describe 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. The 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 increment of the total 18-inch drive were measured and recorded on the boring logs. SPT N-values are defined as the total number of blows required to advance the split barrel sampler the final 12 inches of the total 18-inch drive depth. The SPT N-values indicated on the logs are raw (uncorrected) blow counts measured in the field. Groundwater was also observed and denoted on the boring logs.

LAB INVESTIGATION

All samples were brought to the Materials Division laboratory for further evaluation and testing. These samples were tested to evaluate index 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 were classified by a licensed Professional Geologist (PG) in accordance with both USCS and AASHTO soil classification systems.

These test results are plotted or indicated on the logs using appropriate denotation (symbols in accordance with scale, number, text, etc.). Table 1 lists the laboratory tests, their corresponding ASTM and AASHTO test methods, and respective denotation on logs.

Table 1: Summary of Laboratory Tests and Methods

Laboratory Test	ASTM	AASHTO	Denotation on Logs
Moisture Content	D2216	T 265	Solid Circle Symbol (●)
Grain Size Distribution	D6913	T 88	Whole Number in the “- No. 200 %” Column (e.g., 12)
Atterberg Limits	D4318	T 89	Plus Symbol (+) on the Right for Liquid Limit
		T 90	Plus Symbol (+) on the Left for Plastic Limit

The particle size through which 50% of particles by weight passing, D_{50} , is summarized below in Table 2. A detailed particle size distribution curve, used for D_{50} determination is included in Attachment B.

Table 2: Summary of D_{50} for Scour Analysis

Hydraulic Feature	Station	Sample Type	Location	D_{50} , mm
Menard Bayou	201+13, 146' LT	Bulk	Creek Bank	≤ 0.075

To determine the corrosive potential of the foundation soils, laboratory pH and resistivity tests were performed on bulk soil samples obtained from Boring 1 (Sta. 199+48) and Boring 2 (Sta. 201+91), from 0 to 20 feet and 5 to 20 feet below ground level (bgl), respectively. The results of pH and resistivity tests are summarized in Table 3.

Table 3: Results of Laboratory pH and Resistivity Tests

Test	Boring	Station	Sample Type	Results (unit)
pH	1	199+48, 8' LT	Bulk	7.1
	2	201+91, 37' LT		7.0
Resistivity	1	199+48, 8' LT		704 (Ohms•Cm)
	2	201+91, 37' LT		930 (Ohms•Cm)

SITE CONDITIONS

The existing bridge is 96.5 feet long, 12.5 feet wide and consists of 3 open grid steel deck on steel w-beam spans supported by a concrete substructure. The new bridge will be constructed slightly southwest of the existing bridge.

Menard Bayou flows from the southwest to the northeast. The existing bridge is closed due to structural integrity. A temporary roadway with culverts has been constructed to the southwest of the existing bridge. The existing embankments of the structure are covered in riprap and has paralleling powerlines to the south. A U.S. Army Corp of Engineers Lock is located approximately 0.3 miles west. It should be noted the existing bridge has been covered by floods in the past. Site pictures can be found in Attachment C.

SITE GEOLOGY AND GENERAL SUBSURFACE CONDITIONS

The project alignment is mapped as Quaternary age point bar deposits. However, the deposits encountered in the borings are more typical of back swamp deposits. These consist of soft to medium stiff, gray fat clays from the surface to approximately 25 feet bgl. Lean to sandy clay was encountered below the fat clay to a depth of 25 to 35 feet, and the rest of the borings consist of wet, loose to dense, gray sand to sand with silt and some gravel and clay lenses.

A generalized Subsurface Profile is included in Attachment D to aid in visualizing subsurface conditions and stratigraphy. Considering natural variations in stratigraphy and subsurface conditions, deviation from these illustrated on the profile must be anticipated.

SEISMIC CONDITIONS

Seismic Site Class and Seismic Performance Zone

Based on the results from the subsurface investigation, a Seismic Site Class D (Stiff Soil Profile) was calculated for the proposed bridge over Menard Bayou. 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}), were determined and are summarized in Table 4. Based on the values summarized in Table 4, a Seismic Performance Zone 2 is considered applicable. Design Response Spectrums are presented in Attachment E.

Table 4: Design Ground Motion Acceleration Response Coefficients

Acceleration Coefficient	Value (g)
A_s (Site PGA)	0.188
S_{DS} (0.2 sec)	0.439
S_{D1} (1 sec)	0.215

Liquefaction Potential

Liquefaction potential of the subsurface soils was evaluated based on the results of the borings and utilizing the current Microsoft Excel® spreadsheet developed for ARDOT by the University of Arkansas. Three procedures are incorporated into this spreadsheet, i.e., Youd et al. (2001) procedure, Cetin et al. (2018) procedure, and Idriss and Boulanger (2014) procedure. The

results of liquefaction analyses performed utilizing the Idriss and Boulanger (2014) procedure are presented in this report.

An earthquake Moment Magnitude (M_w) of 7.0 was modelled in the analyses for this site. Design peak ground acceleration coefficient (A_S) of 0.188g was utilized. Liquefaction potential was analyzed at the location of each boring. The results of liquefaction analyses are presented as a plot of calculated factor of safety against liquefaction versus depth below existing ground surface. These results are provided in Attachment F for Boring 1 and Boring 2, respectively.

Although the spreadsheet was developed with the capability to calculate factor of safety against liquefaction to any depth, research suggests that there has only been one case in which liquefaction has occurred at a depth greater than 50 feet bgl. Liquefaction deeper than 50-foot bgl is generally considered unlikely. Consequently, liquefiable zones greater than 50-foot bgl are recommended to be neglected from design consideration.

Results of the analyses indicate that in Boring 1, the factor of safety against liquefaction was greater than 1.0 at depths ranging from 0 to 50 feet bgl. Boring 2 analyses indicate a factor of safety of just less than 1.0 at a depth of 30 feet bgl. Every other depth ranging from 0 to 50 feet bgl for Boring 2 results in a factor of safety greater than 1.0. Due to the generally acceptable factors of safety against liquefaction in both borings the overall liquefaction potential is considered low for this project.

APPROACH EMBANKMENTS

Embankment Configuration

As noted, 2H:1V end slopes and side slopes are planned for the embankments. Maximum embankment heights vary from 6 feet for the northwest embankment and 5 feet for the southeast embankment.

Settlement Potential

Subsurface soils at the northwest embankment (Bent 1) are mainly comprised of fat clay to lean sandy clay. Due to the proposed fill heights and the presence of an existing stable embankment, long-term consolidation settlement is expected to be insignificant.

Approach Stability

Slope stability analyses were performed utilizing a commercial computer program Slide2 (Version 2021) developed by RocScience. Spencer analysis method was utilized to analyze the northwest and southeast abutment. Three 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 0.094 ($0.5 A_S$) was utilized for analysis of the Seismic/Pseudo-Static Condition. A surcharge of 250 psf was used to model the live load in the Long Term Condition.

Slope stability analyses were performed on the 2H:1V end slopes at each abutment to evaluate suitability of the plan configuration. Table 5 includes the results of the slope stability analyses with the plan abutment configuration. Results of the analyses are included in Attachment G.

Table 5: Results of Slope Stability Analyses Utilizing Plan Configuration

Design Condition	Calculated Factor of Safety		Recommended Factor of Safety
	Northwest Embankment	Southeast Embankment	
Short Term	3.02	1.72	1.30
Long Term	1.45	1.23	1.40
Seismic	2.11	1.40	1.05

Based on results from the slope stability analyses the plan configuration of the embankments produces an acceptable Factor of Safety in every scenario except the Long Term Condition for the Southeast Embankment. For the Long Term Condition, the recommended minimum Factor of Safety is 1.4 and the stability analysis produces a 1.23. This is marginally acceptable to the Materials Division due to the current existing embankment being stable and the construction of the proposed bridge being close to the existing embankment.

FOUNDATION AND DESIGN RECOMMENDATIONS

Concrete Filled Steel Shell Piles

Based on discussions with the Bridge Division, Concrete Filled Steel Shell Piles are being considered to support foundation loads at all bents. Nominal axial capacities (compression and uplift) vs. pile tip penetration/elevation curves for single, 18-inch and 24-inch diameter concrete filled steel shell piles are provided in Attachment H. Utilizing the preferred 4 pile arrangement, the preliminary nominal pile capacities for the 18-inch piles (Bent 1 & 5) are 235 tons and 390 tons for the 24-inch piles (Bents 2-4). These nominal axial capacities have been calculated using the static analysis method. Utilizing the axial pile capacity curves, the estimated shallowest pile tip elevations are summarized in Table 6. 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.

Table 6: Recommended Shallowest Pile Tip Elevation

Bent No.	Boring No.	Pile Diameter, in.	Required Nominal Axial Capacity, ton	Recommended Shallowest Pile Tip Elev., ft.
1	1	18	235	70
2	1	24	390	50
3	1	24	390	41
4	2	24	390	54
5	2	18	235	72



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 detailed pile group configuration is provided.

Pile Installation

Piles should be installed in accordance with Section 805 (2014 Edition). Prior to commencing pile driving operations, 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 would require review and approval 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 the contractor may pursue for information purposes. Nominal bearing capacity should be determined in accordance with Subsection 805.09(b), "Method B – Wave Equation Analysis (WEAP)".

Geotechnical Input Parameters for Lpile/Group

Lateral load analyses will be performed by the Structural Engineer using commercial computer programs Lpile and/or Group. The geotechnical input parameters are included in Attachment I.

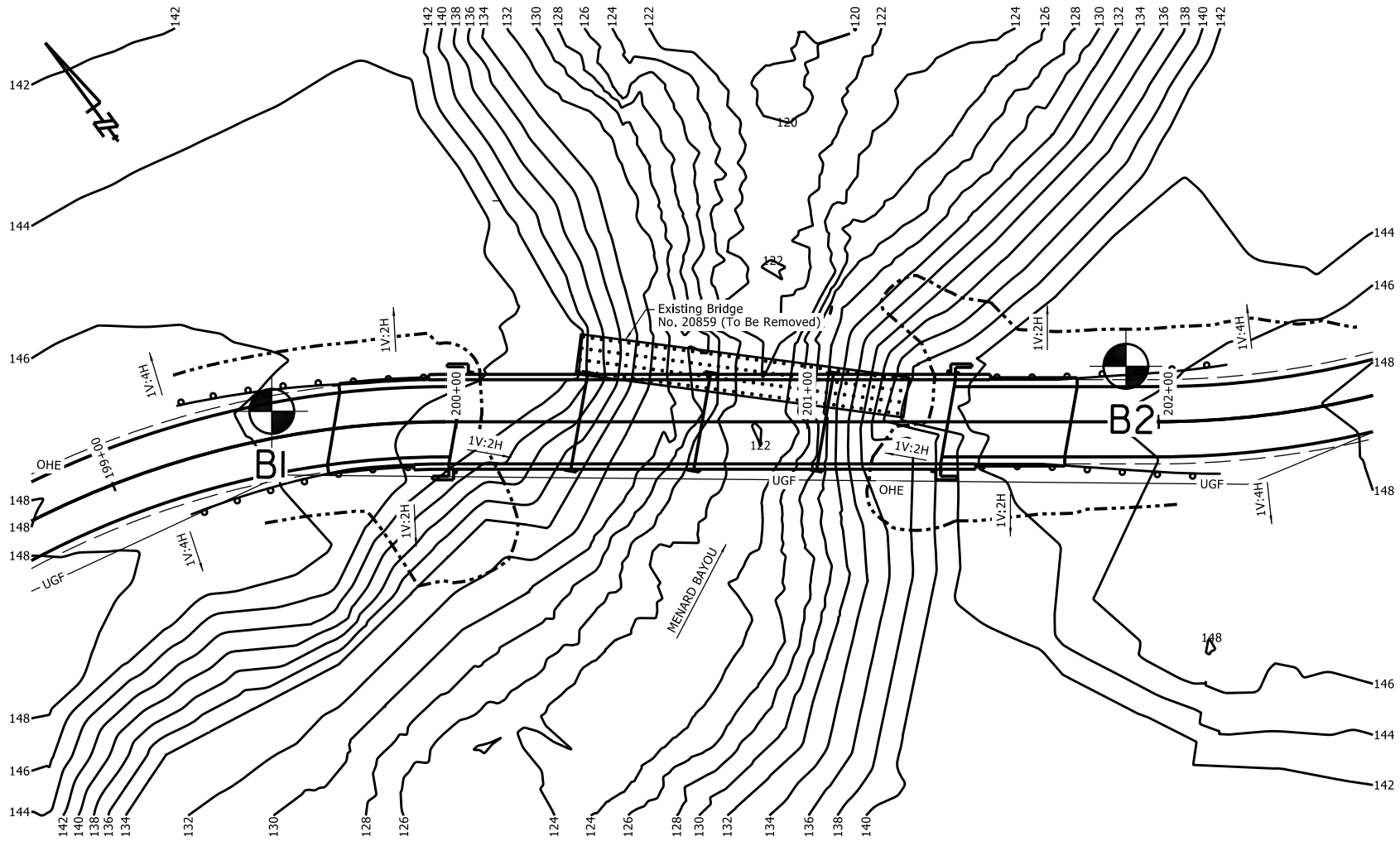
If there are any questions concerning these recommendations, please contact the Materials Division.

Paul Tinsley
Materials Engineer

PT:yz:mbb:pwc
cc: State Construction Engineer
District 2 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.		020738		
PLAN OF BORINGS				



PLAN OF BORINGS	
BENZAL LANE OVER MENARD BAYOU COUNTY ROAD 299 ARKANSAS COUNTY FED. AID PROJECT	
JOB NO. 020738	SHEET 1/1

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 1

PAGE 1 OF 4

JOB NO. 020738 Arkansas County
 JOB NAME: Menard Bayou Str. & Apprs. (S)
 Benzal Lane
 STATION: 199+48
 LOCATION: 8' Left of Construction Centerline
 LOGGED BY: Jeremiah Harjo

DATE: November 18-20, 2024
 TYPE OF DRILLING:
 Hollow Stem Auger
 EQUIPMENT: CME 75
 HAMMER CORRECTION FACTOR: 1.57

COMPLETION DEPTH: 121.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%)		PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D
					PL	LL				
			SURFACE ELEVATION: 145.6							
5		X	Moist, Soft, Gray Clay	-			94	0		
			Moist, Dark Brown Fat Clay	CH			96	1-1		
		X	Moist, Soft, Dark Brown Fat Clay	CH			98	1		
10		X	Moist, Soft, Dark Brown Fat Clay	CH			87	0		
			Moist, Soft, Dark Brown Fat Clay	-				1-2		
15			Moist, Dark Brown Fat Clay	CH			92	0		
		X	Moist, Soft, Light Gray Fat Clay	CH			86	2-2		
20		X	Moist, Medium Stiff, Dark Brown Fat Clay	CH			94	1		
			Moist, Soft, Light Brown Lean Clay with Sand	-				2-4		
25		X	Moist, Soft, Light Brown Lean Clay with Sand	CL			71	0		
			Moist, Medium Stiff, Light Gray Sandy Clay	CL			70	1		
30		X	Moist, Medium Stiff, Light Gray Sandy Clay	-				3-4		
35										

REMARKS: *Water level was measured at 21 feet below ground level on November 20, 2024.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 1
PAGE 2 OF 4

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DATE: November 18-20, 2024
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EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.57

COMPLETION DEPTH: 121.5

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					PL	10	20	30	40	50	60	70	LL					
			SURFACE ELEVATION: 145.6															
40		X	Wet, Medium Dense, Gray Poorly Graded Sand with Silt	SP-SM										7	4 6-11			
				-														
45		X	Wet, Medium Dense, Gray Poorly Graded Sand	SP										4	5 9-12			
50		X													3 6-13			
55		X													7 12-18			
60		X	Wet, Medium Dense, Light Gray Sand with Trace Gravel												6 14-15			
65		X													5 10-15			
70		X	Wet, Very Stiff, Light Gray Clay	SP										94 2	3 10-11			

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**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 1
PAGE 3 OF 4

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HAMMER CORRECTION FACTOR: 1.57

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					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 145.6																
75		X	Wet, Medium Dense, Light Gray Poorly Graded Sand with Trace Gravel	-													7 9-13		
80		X															6 9-11		
85		X	Wet, Dense, Light Gray Poorly Graded Sand	SP												3	7 13-23		
90		X	Wet, Medium Dense, Light Gray Poorly Graded Sand with Silt	SP-SM												5	4 6-11		
95		X															6 9-12		
100		X	Wet, Loose, Brown Poorly Graded Sand	SP												1	3 5-3		
105		X	Wet, Medium Dense, Brown Sand	-													5 9-17		

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**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 1
PAGE 4 OF 4

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					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 145.6																
110		X	Wet, Dense, Light Gray Poorly Graded Sand with Silt and Trace Gravel	SP-SM											5	9 21-29			
115		X	Wet, Dense, Light Gray Sand	-												12 22-27			
120		X	Wet, Very Dense, Gray Sand													8 27-44			
		X	Wet, Very Dense, Gray Sand with Trace Gravel													17 28-53			
125			Boring Terminated																
130																			
135																			
140																			

REMARKS: *Water level was measured at 21 feet below ground level on November 20, 2024.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 2
PAGE 1 OF 3

JOB NO. 020738 Arkansas County
JOB NAME: Menard Bayou Str. & Apprs. (S)
Benzal Lane
STATION: 201+91
LOCATION: 16' Left of Construction Centerline
LOGGED BY: Jeremiah Harjo

DATE: November 6 and 12, 2024
TYPE OF DRILLING:
Hollow Stem Auger
EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.57

COMPLETION DEPTH: 101.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%)		PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D
					PL	LL				
			SURFACE ELEVATION: 145.6							
			Moist, Medium Stiff, Dark Brown Sandy Lean Clay	- CL			61	2 3-3		
5			Moist, Soft, Dark Gray Fat Clay	CH			94	1 1-2		
				CH			98	1 1-2		
10				CH			99	0 1-2		
				CH		102	99	0 1-2		
15			Moist, Soft, Gray Fat Clay	CH			99	1 1-3		
				CH		102	99	1 1-3		
20			Moist, Medium Stiff, Brown and Gray Fat Clay	CH			95	1 2-3		
				CH		81	95	1 2-3		
25			Moist, Very Loose, Gray Clayey Sand	SC			43	0 1-3		
				SC			43	0 1-3		
30			Wet, Medium Dense, Gray Poorly Graded Sand with Silt	SP-SM			11	3 6-10		
				SP-SM			11	3 6-10		
35										

REMARKS: *Water level was measured at 23 feet below ground level on November 12, 2024.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 2
PAGE 2 OF 3

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EQUIPMENT: CME 75
HAMMER CORRECTION FACTOR: 1.57

COMPLETION DEPTH: 101.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%)										PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D	
					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 145.6																
40		X	Wet, Dense, Brown Poorly Graded Sand with Silt	SP-SM											7	10 19-25			
				-															
45		X	Wet, Medium Dense, Gray Poorly Graded Sand with Silt	SP-SM											8	5 11-17			
				-															
50		X	Wet, Medium Dense, Gray Poorly Graded Sand	SP											2	4 8-14			
				-															
55		X	Wet, Very Dense, Gray Poorly Graded Sand with Silt	SP-SM											11	16 25-36			
				-															
60		X	Wet, Medium Dense, Gray Poorly Graded Sand	SP											4	5 11-15			
				-															
65		X		SP											3	6 11-13			
				-															
70		X		SP											4	5 8-10			
				-															

REMARKS: *Water level was measured at 23 feet below ground level on November 12, 2024.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION**

BORING NO. 2
PAGE 3 OF 3

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COMPLETION DEPTH: 101.5

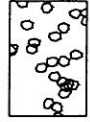
DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%)										PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D	
					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 145.6																
75		X	Wet, Medium Dense, Gray Poorly Graded Sand with Clay Lenses and Some Gravel	SP-SC											11	$\frac{4}{9-8}$			
				-															
80		X	Wet, Medium Dense, Gray Poorly Graded Sand	SP											3	$\frac{6}{7-9}$			
				-															
85		X	Wet, Medium Dense, Gray Poorly Graded Sand with Gravel	SP											3	$\frac{8}{11-14}$			
				-															
90		X	Wet, Medium Dense, Gray Poorly Graded Sand	SP											3	$\frac{6}{10-15}$			
				-															
95		X	Wet, Medium Dense, Gray Poorly Graded Sand with Silt and Trace Gravel	SP-SM											5	$\frac{7}{12-17}$			
				-															
100		X	Wet, Medium Dense, Gray Well Graded Sand with Clay Lenses and Trace Gravel	SW-SC											10	$\frac{8}{13-12}$			
				-															
		X	Wet, Dense, Gray Poorly Graded Sand	SP											3	$\frac{7}{18-27}$			
			Boring Terminated																
105																			

REMARKS: *Water level was measured at 23 feet below ground level on November 12, 2024.

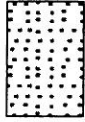
LEGEND

SOIL TYPES

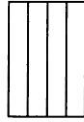
(SHOWN IN SYMBOL COLUMN)
(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL



SAND



SILT



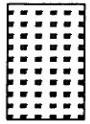
CLAY



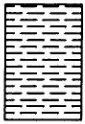
ORGANIC
MATTER

ROCK TYPES

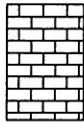
(SHOWN IN SYMBOL COLUMN)



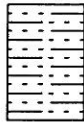
SANDSTONE



SHALE
or
SILTSTONE



LIMESTONE
or
DOLOMITE



ALTERNATING
LAYERS of
SHALE and
SANDSTONE



OTHER

SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE



UNDISTURBED
SAMPLE
RECOVERY

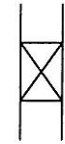


DISTURBED
SAMPLE
RECOVERY

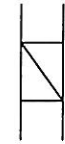


NO
RECOVERY

SPLIT SPOON

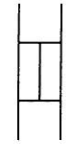


SAMPLE
RECOVERY



NO
RECOVERY

ROCK CORING



% RECOVERY
INDICATED ON LOGS

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	

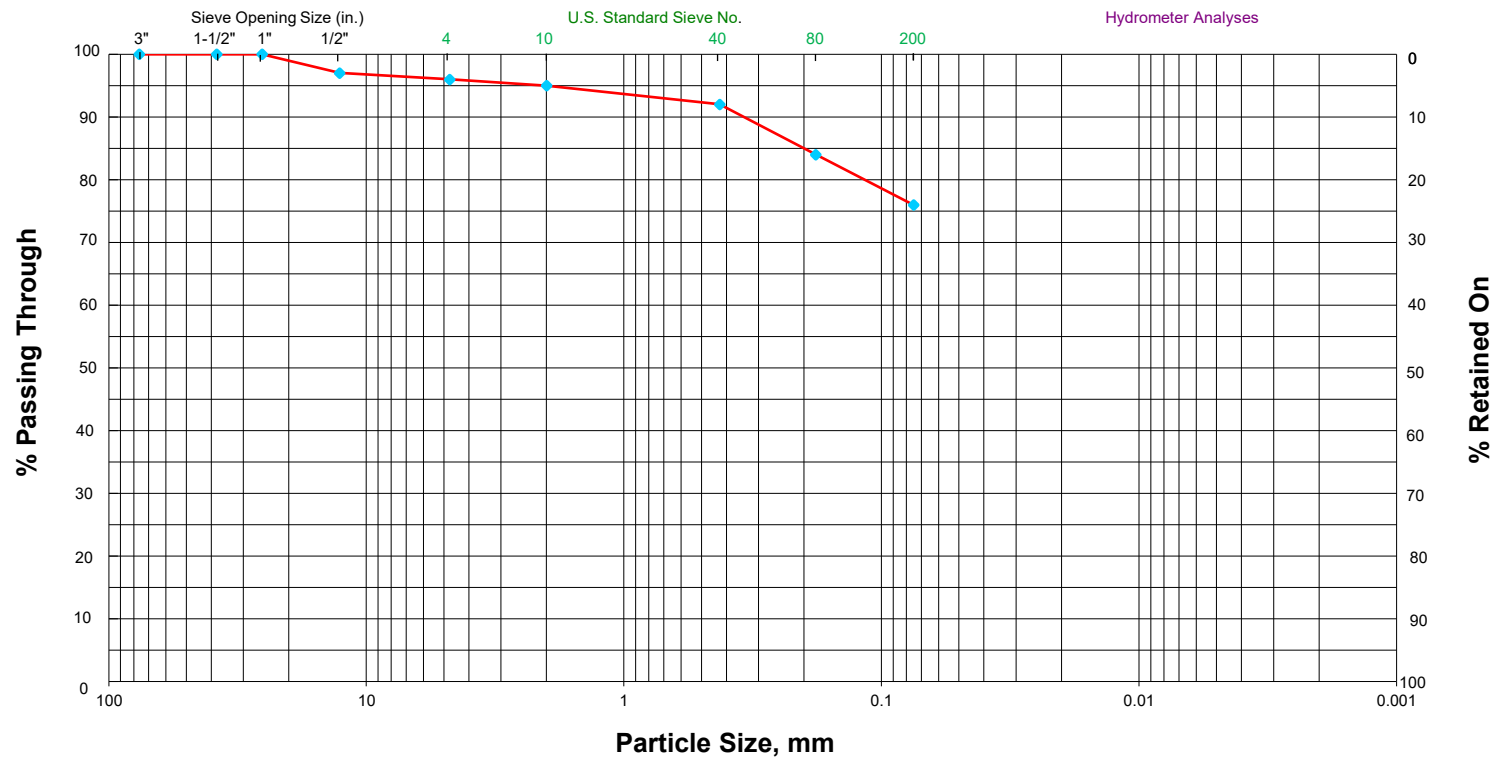
1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical 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: $\frac{6}{8-9} \Rightarrow 8+9 = 17 \text{ blows/ft}$. 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



Particle Size Distribution Curve for D₅₀ Sample
Station 201+13, 146' Left of CL



Attachment C



Looking at existing bridge from west bridge end (October 2024)



Looking at existing bridge from east bridge end (October 2024)



South side of bridge, looking upstream (October 2024)

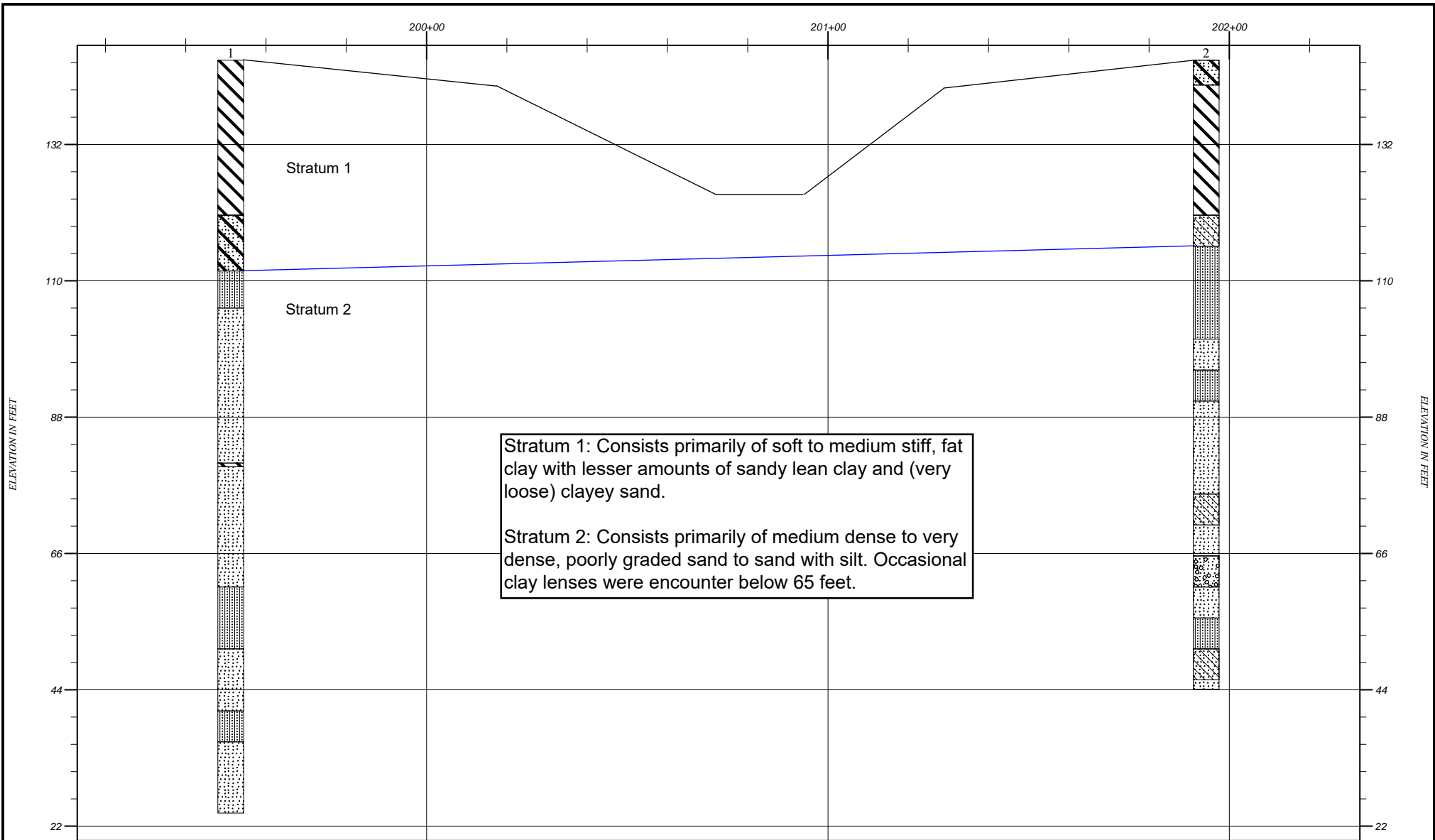


Looking north (downstream) from the bridge (October 2024)



Looking south (upstream) from bridge at detour structure (October 2024)

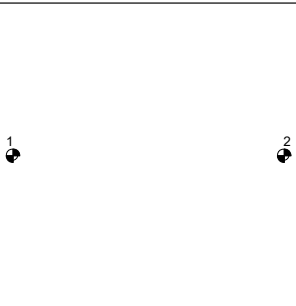
Attachment D



Stratum 1: Consists primarily of soft to medium stiff, fat clay with lesser amounts of sandy lean clay and (very loose) clayey sand.



Stratum 2: Consists primarily of medium dense to very dense, poorly graded sand to sand with silt. Occasional clay lenses were encounter below 65 feet.

Plan View



Strata symbols

-  clay
-  sandy clay
-  silty sand
-  sand

-  clayey sand
-  sand and gravel

Arkansas Department of Transportation		
Generalized Subsurface Profile		
HORIZONTAL SCALE: Not to scale	DRAWN BY/APPROVED BY James Carson Sloan/Masan Brown	DATE DRAWN 12/18/2024
Menard Bayou Str. & Apprs. (S)		
Benzal Lane		
PROJECT NO. 020738		FIGURE NUMBER
Arkansas County		

Attachment E

Title: 020738

Latitude: 34.016098

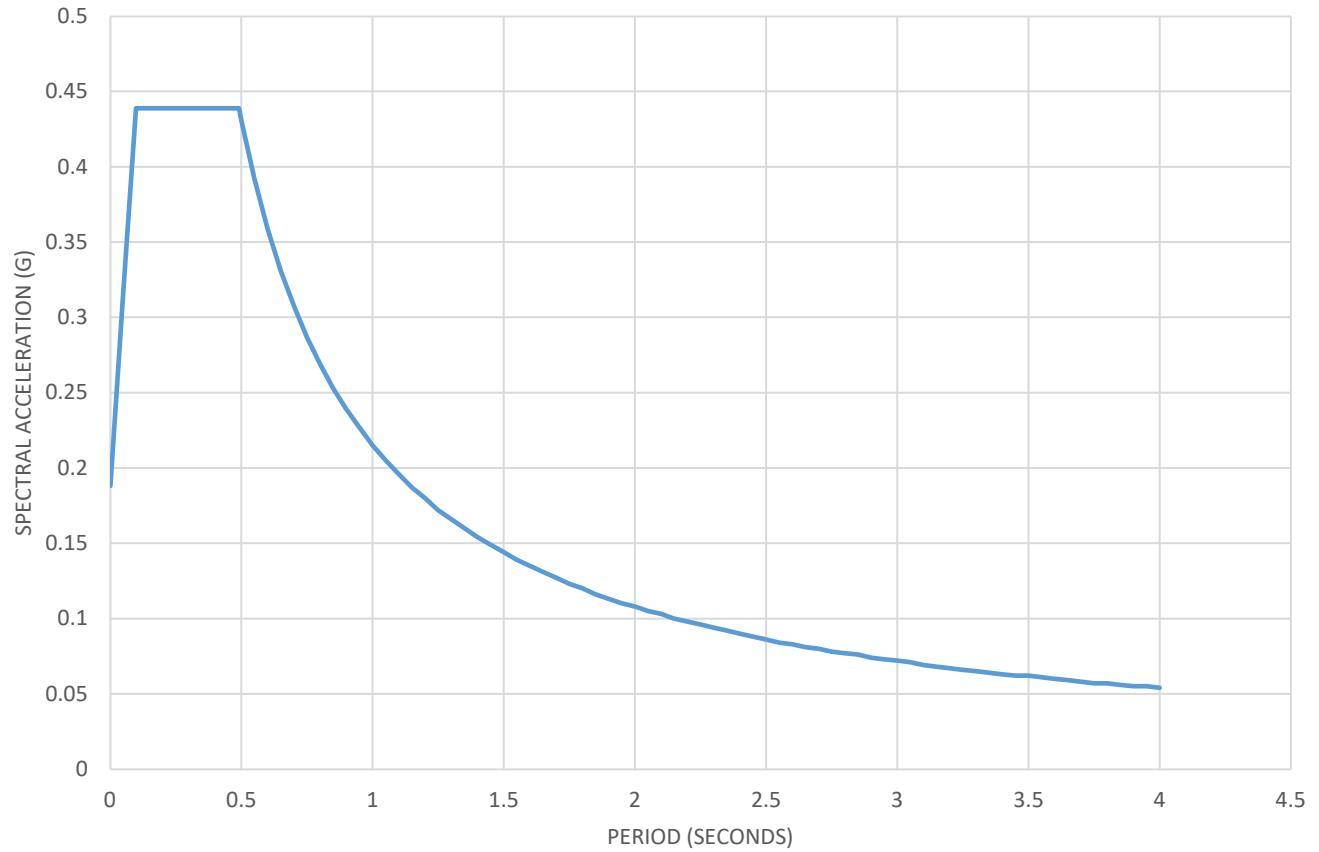
Longitude: -91.188423

Site Class: D

Get USGS Data

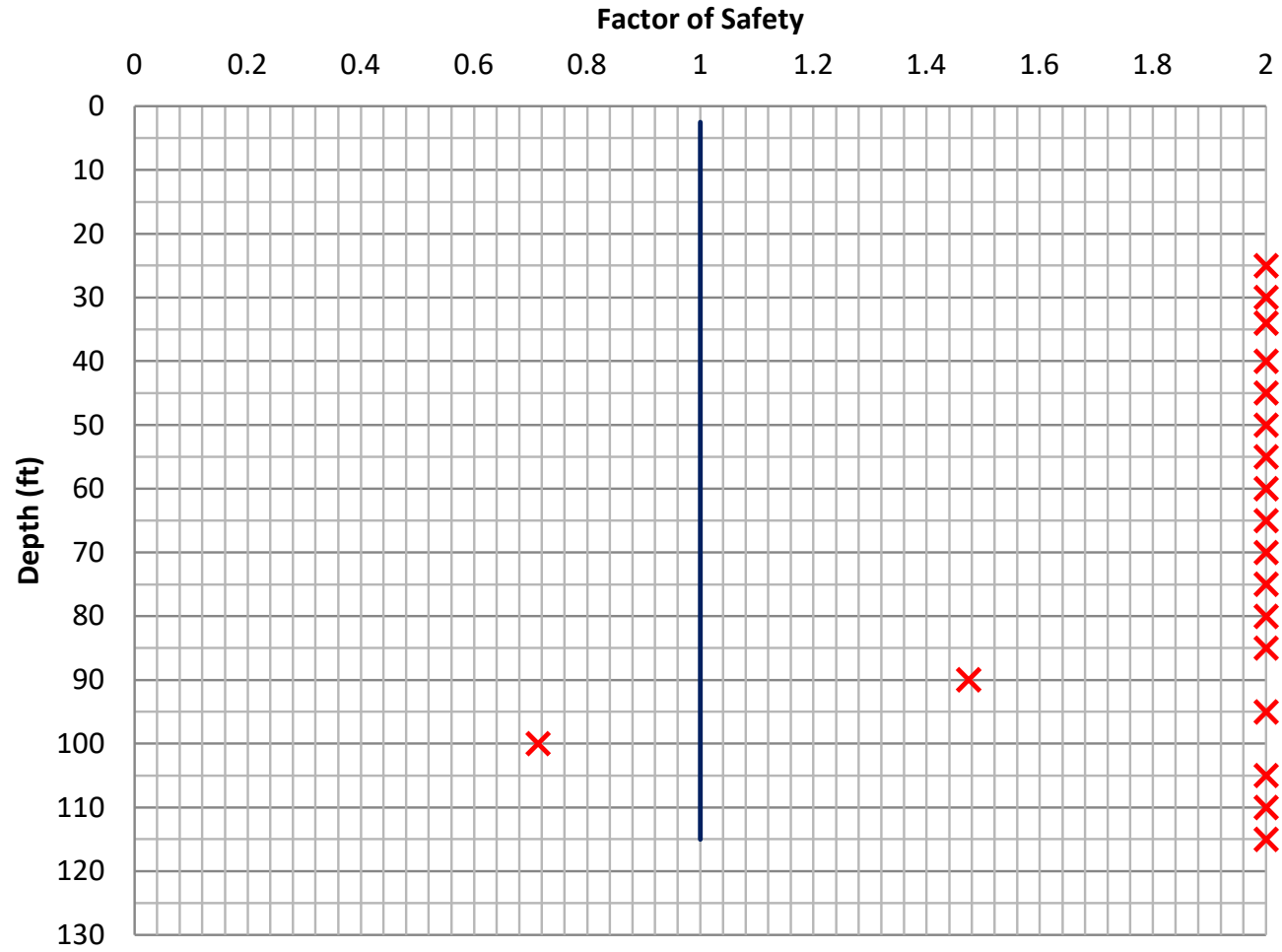
PGA:	0.121
F _{PGA} :	1.558
A _S :	0.188
S _S :	0.278
F _A :	1.577
S _{DS} :	0.439
S ₁ :	0.09
F _V :	2.4
S _{D1} :	0.215
S _{DC} :	B
T _S :	0.491
T ₀ :	0.098

020738 DESIGN RESPONSE SPECTRUM

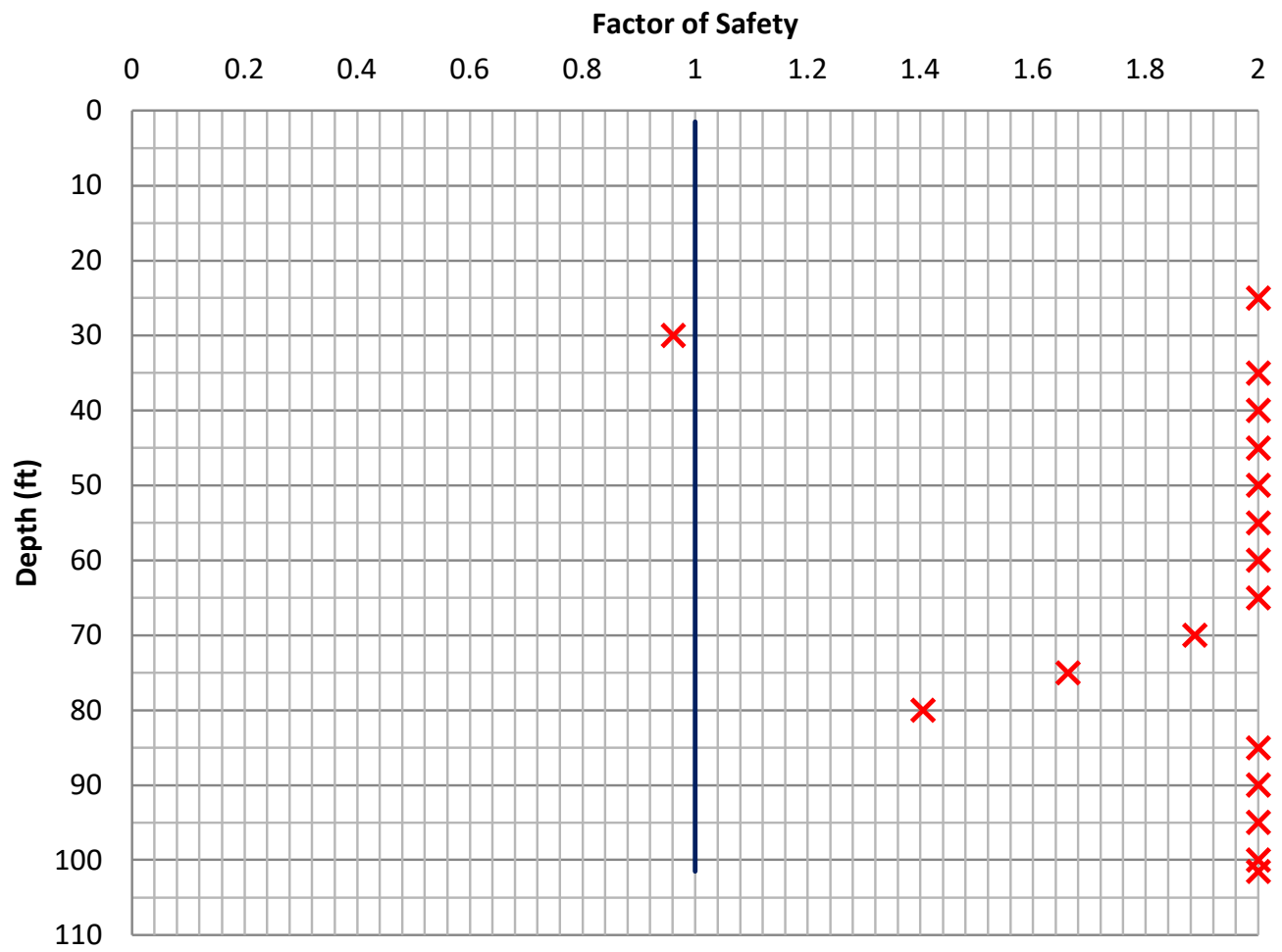


Attachment F






Factor of Safety Idriss and Boulanger (2014) - Boring 1

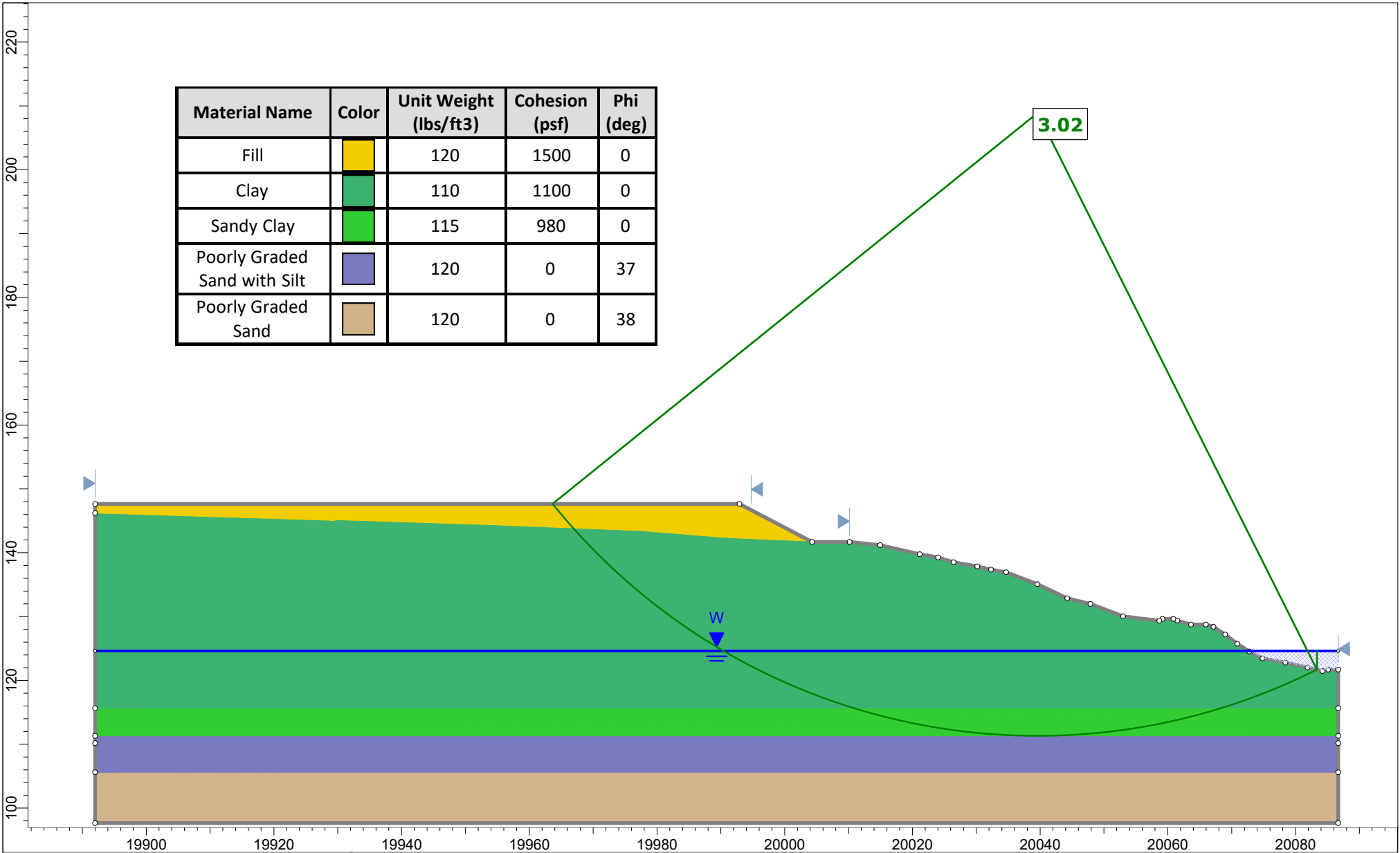



Factor of Safety Idriss and Boulanger (2014) - Boring 2







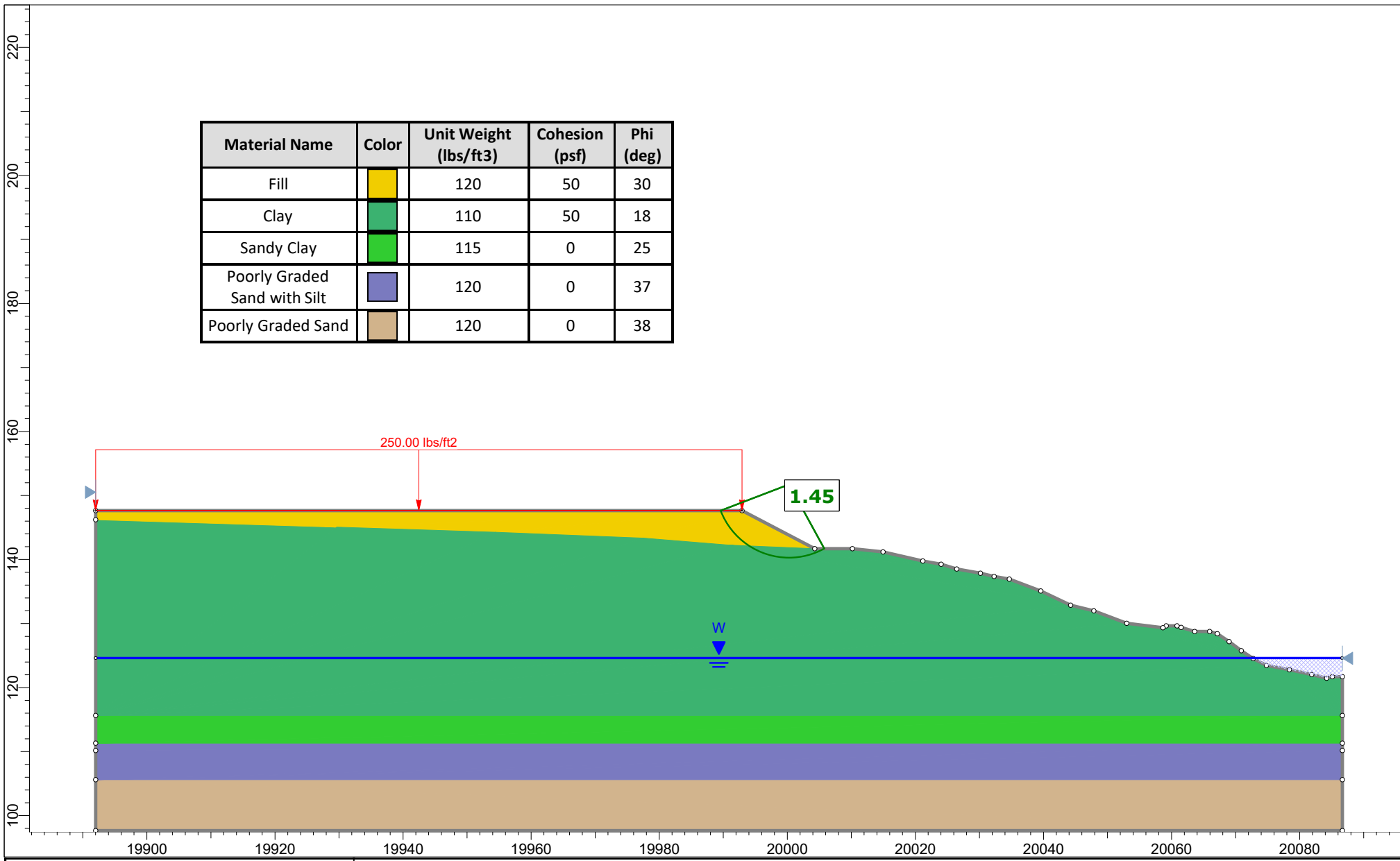
Attachment G

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Clay		110	1100	0
Sandy Clay		115	980	0
Poorly Graded Sand with Silt		120	0	37
Poorly Graded Sand		120	0	38



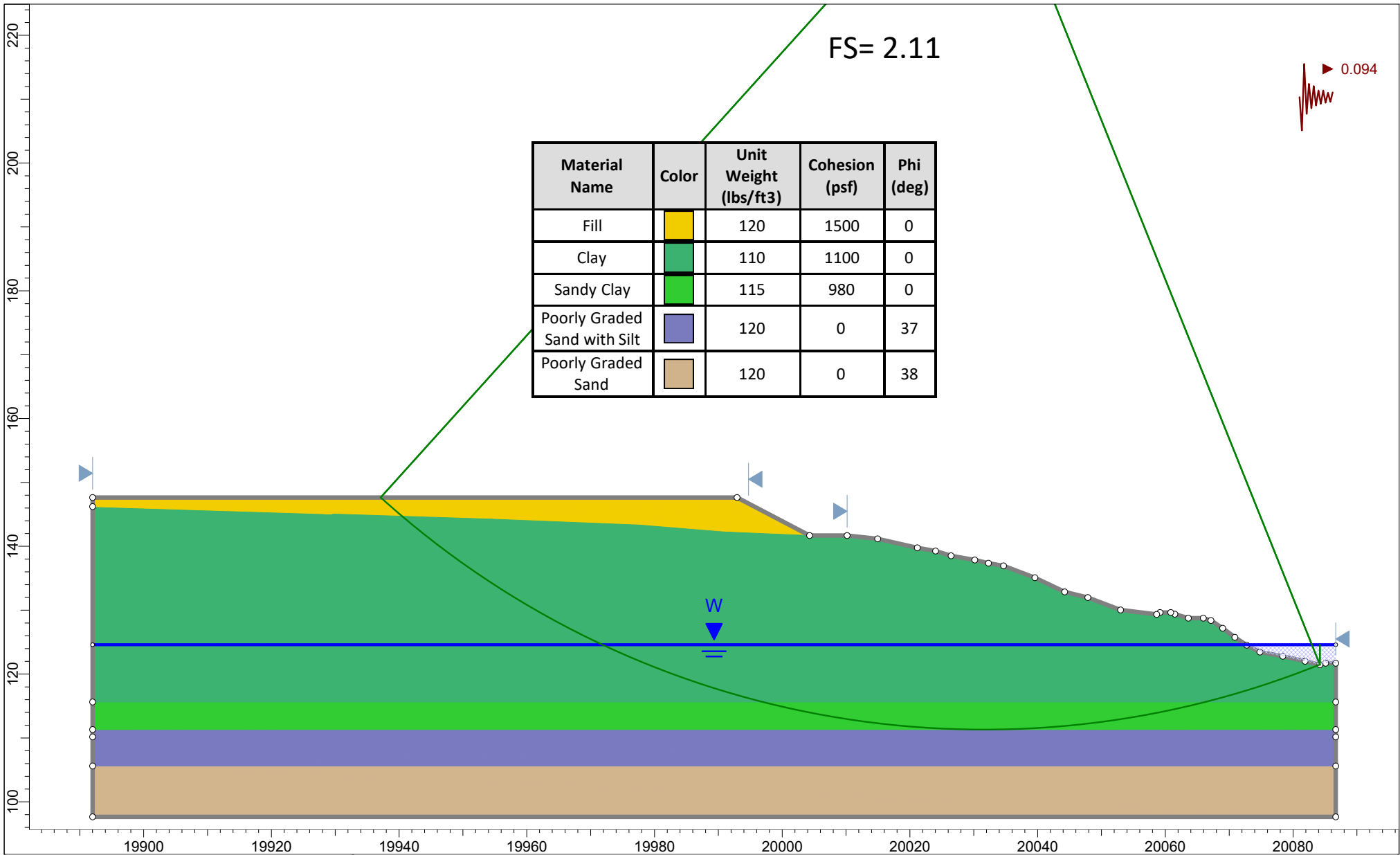
	Project		020738 Menard Bayou	
	Site	Site 1/1	Analysis Type	Short Term
	Analyzed By	VW	Configuration	2:1 End Slopes Northwest Embankment
	Date	2/13/2025		

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Clay		110	50	18
Sandy Clay		115	0	25
Poorly Graded Sand with Silt		120	0	37
Poorly Graded Sand		120	0	38

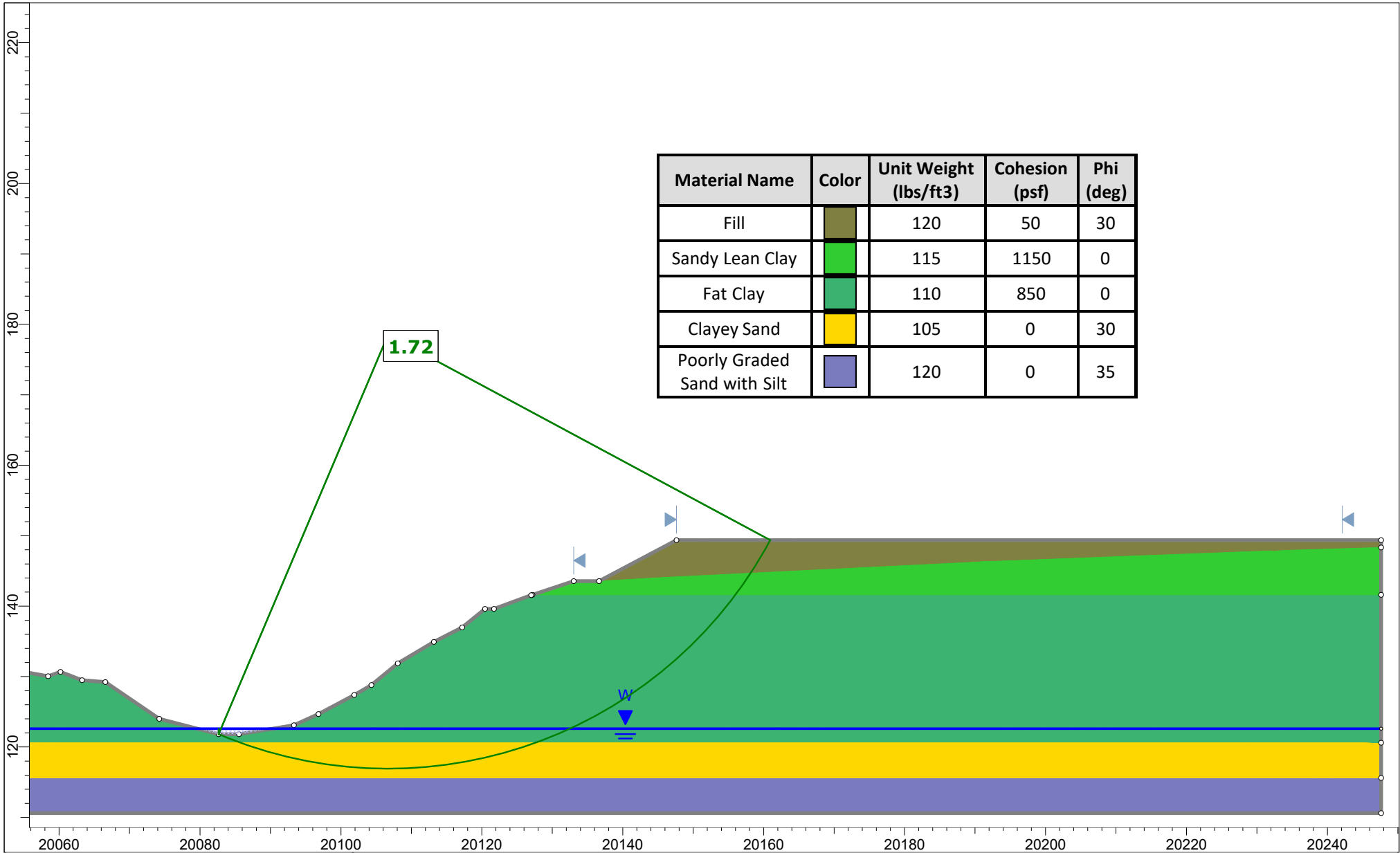







SLIDEINTERPRET 9.019

Project	020738 Menard Bayou		
Site	Site 1/1	Analysis Type	Long Term
Analyzed By	VW	Configuration	2:1 End Slopes Northwest Embankment
Date	2/13/2025		



	Project 020738 Menard Bayou		
	Site Site 1/1	Analysis Type Seismic	
	Analyzed By VW	Configuration 2:1 End Slopes Northwest Embankment	
	Date 2/13/2025		



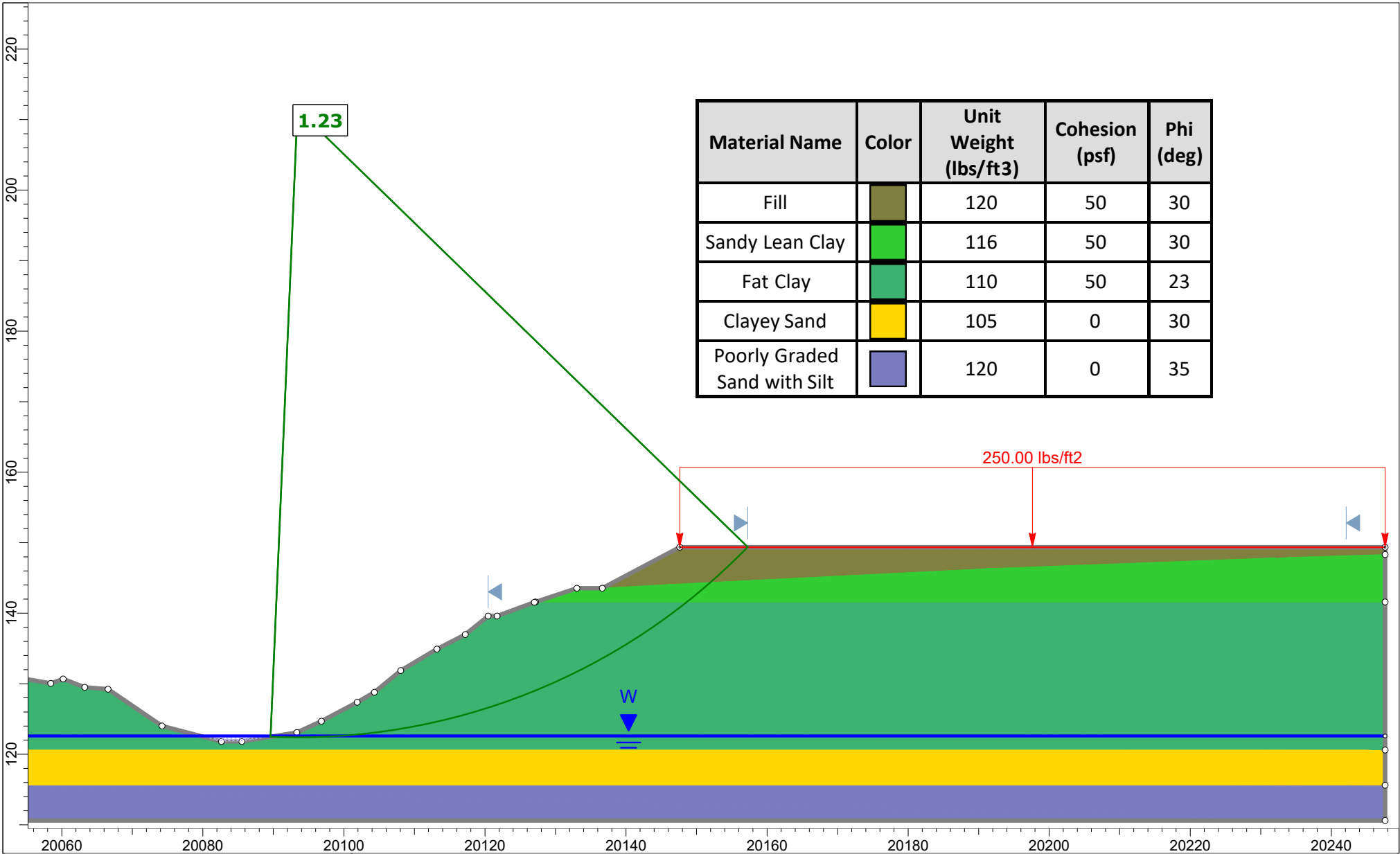
Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Sandy Lean Clay		115	1150	0
Fat Clay		110	850	0
Clayey Sand		105	0	30
Poorly Graded Sand with Silt		120	0	35


1.72

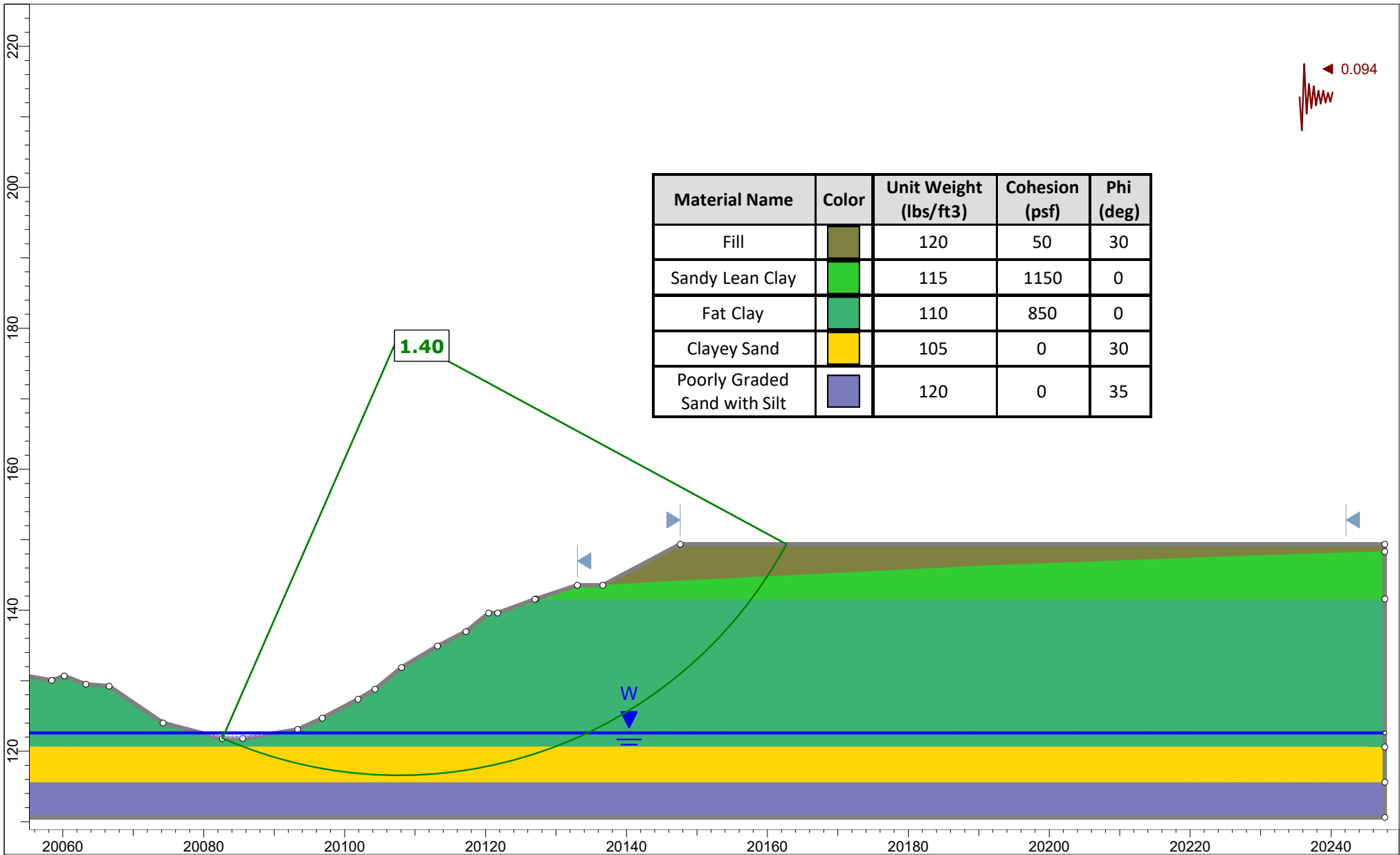







SLIDEINTERPRET 9.019


Project	020738 Menard Bayou		
Site	Site 1/1	Analysis Type	Short
Analyzed By	Veeck Watson	Configuration	2:1 End Slope Southeast Embankment
Date	1/22/2025		



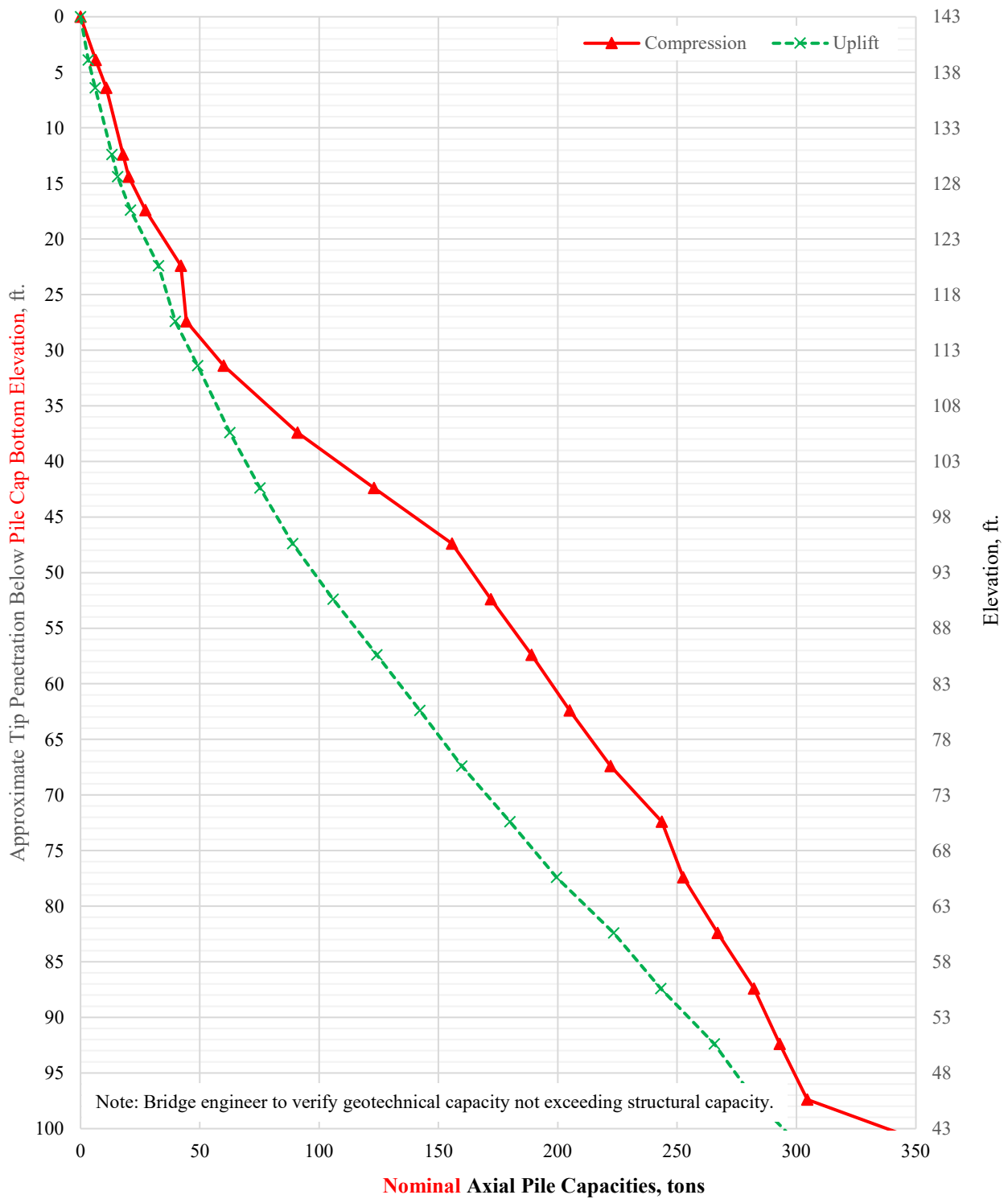
	Project		020738 Menard Bayou	
	Site	Site 1/1	Analysis Type	Long Term
	Analyzed By	Veeck Watson	Configuration	2:1 End Slope Southeast Embankment
	Date	1/22/2025		



Material Name	Color	Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Sandy Lean Clay		115	1150	0
Fat Clay		110	850	0
Clayey Sand		105	0	30
Poorly Graded Sand with Silt		120	0	35

	Project		020738 Menard Bayou	
	Site	Site 1/1	Analysis Type	Seismic
	Analyzed By	Veeck Watson	Configuration	2:1 End Slope Southeast Embankment
	Date	1/23/2025		

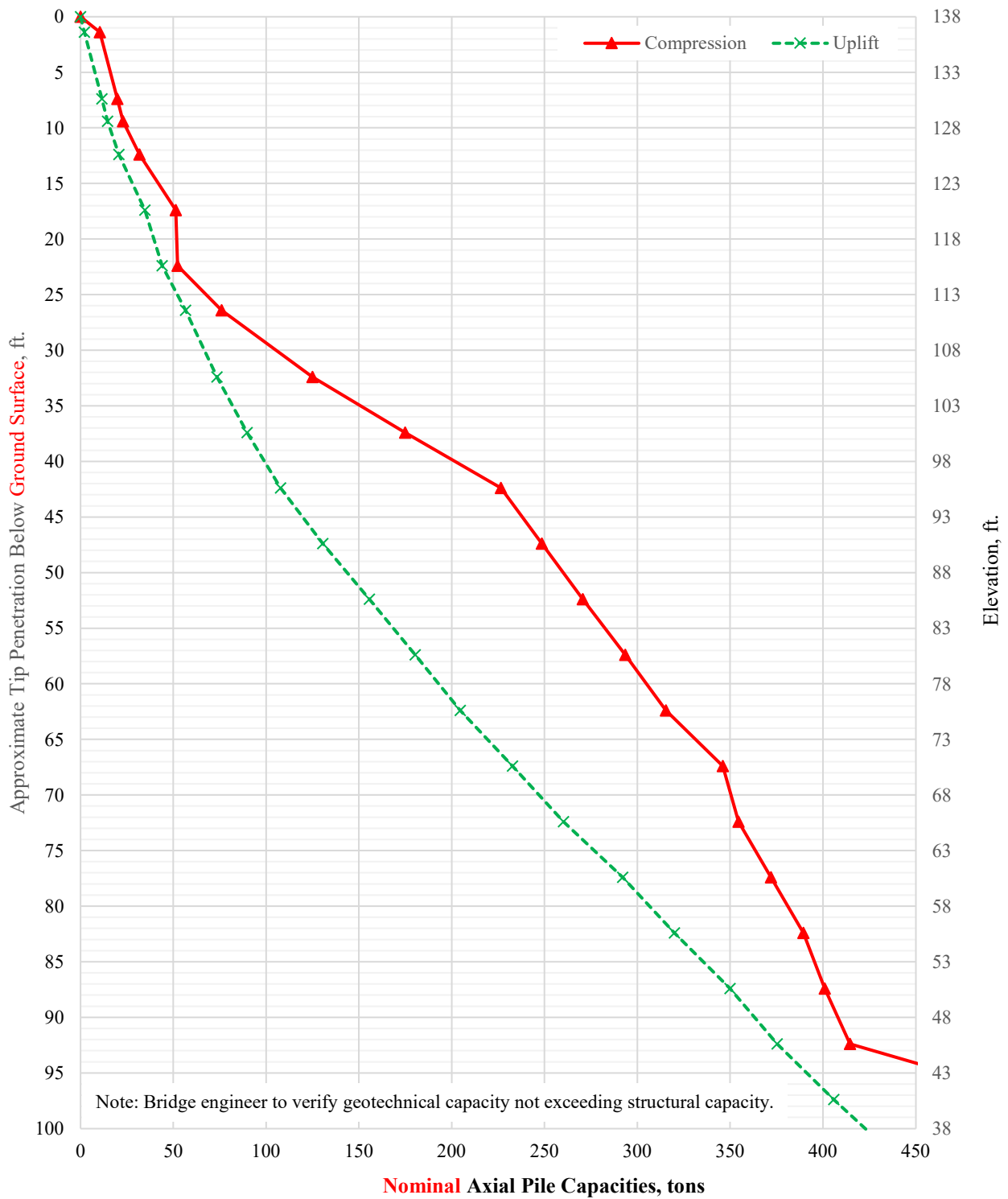
Attachment H



SINGLE 18"-DIAMETER CONCRETE FILLED STEEL SHELL PILE

Bent 1
 Project No.: 020738
 Location: Arkansas County



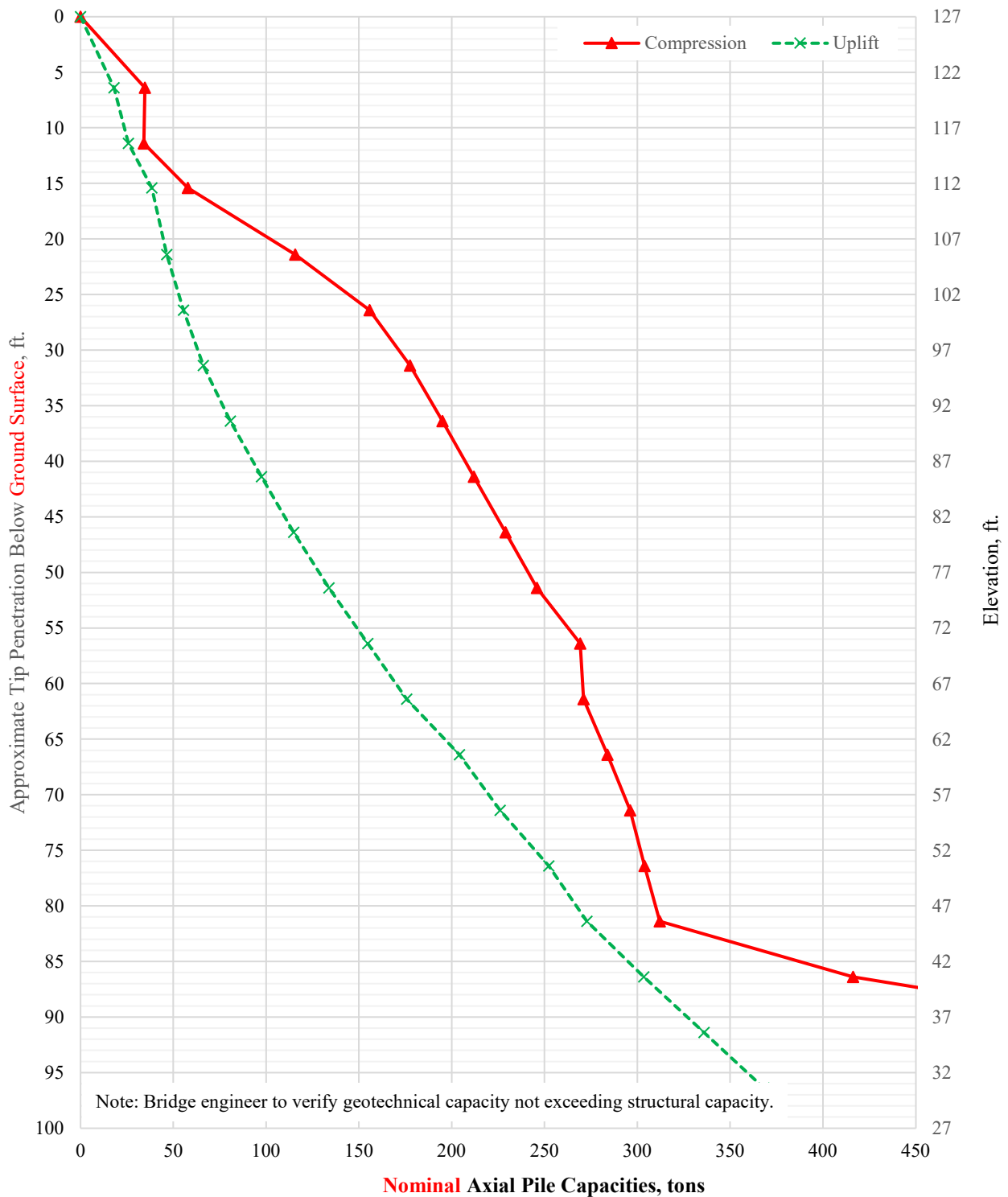


Note: Bridge engineer to verify geotechnical capacity not exceeding structural capacity.

SINGLE 24"-DIAMETER CONCRETE FILLED STEEL SHELL PILE

Bent 2
 Project No.: 020738
 Location: Arkansas County





Note: Bridge engineer to verify geotechnical capacity not exceeding structural capacity.

SINGLE 24"-DIAMETER CONCRETE FILLED STEEL SHELL PILE

Bent 3
 Project No.: 020738
 Location: Arkansas County



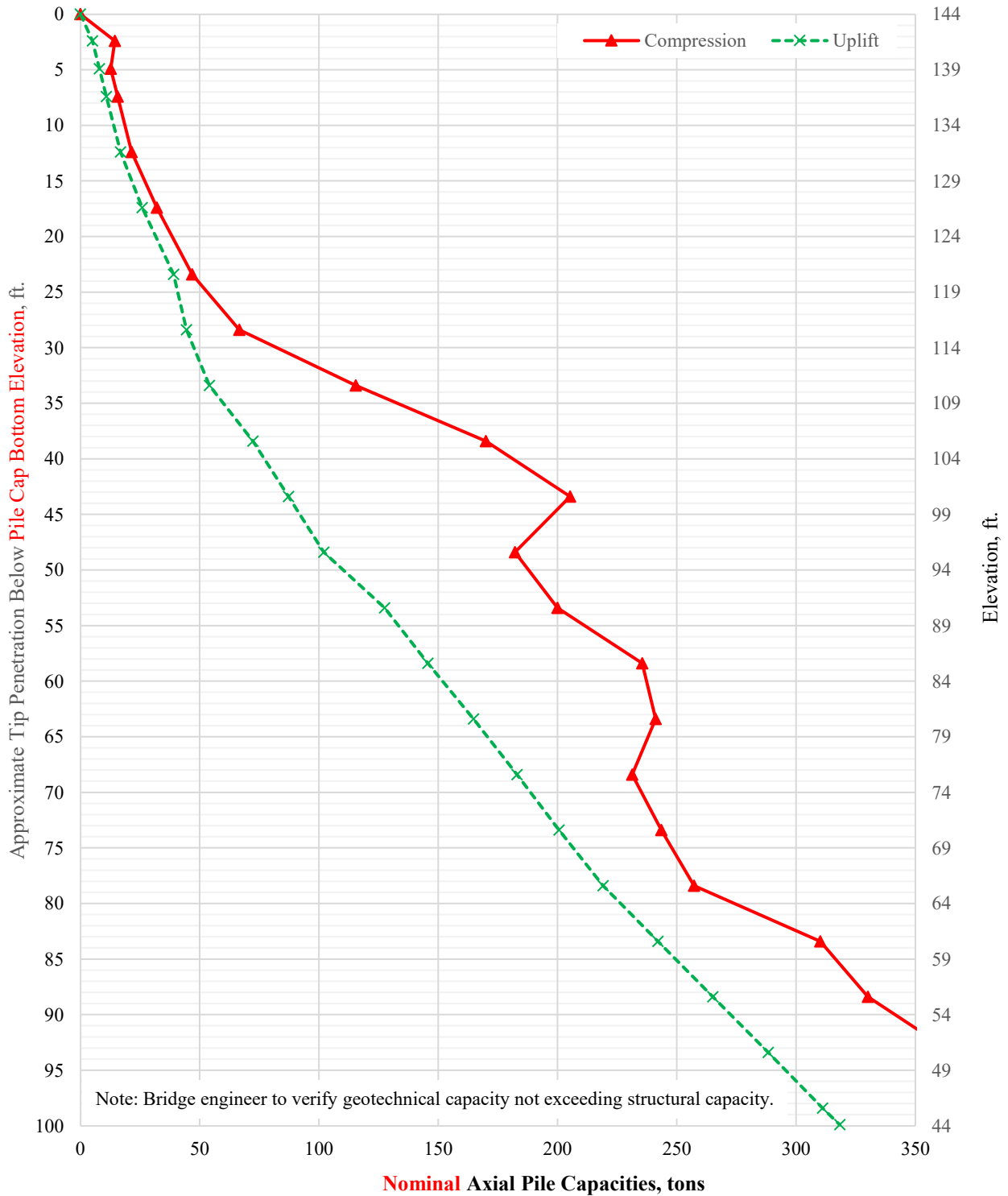


Note: Bridge engineer to verify geotechnical capacity not exceeding structural capacity.

SINGLE 24"-DIAMETER CONCRETE FILLED STEEL SHELL PILE

Bent 4
 Project No.: 020738
 Location: Arkansas County





SINGLE 18"-DIAMETER CONCRETE FILLED STEEL SHELL PILE

Bent 5
 Project No.: 020738
 Location: Arkansas County



Attachment I



Job No.:	020738
Site No.:	1/1

Input by:	MBB	9/16/2024
Checked by:	MLG	2/6/2025
Back-checked by:	YZ	2/21/2025

Bent 1 - Boring 1

Elevation, ft		Material	Model	Effective Unit Weight, γ' ,pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ϵ_{50} for Soil) / k_m for Rock	Friction Angle, ϕ , °	Soil Modulus, k, pci
Top	Bottom							
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.010	NA	NA
Ground Surface	125	Fat Clay	Soft Clay (Matlock)	105	550	0.010	NA	NA
125	121	Fat Clay	Stiff Clay with Free Water (Reese)	50	1150	0.007	NA	500
121	112	Lean Clay with Sand	Soft Clay (Matlock)	50	950	0.010	NA	NA
112	106	Sand with Silt	Sand (Reese)	65	NA	NA	36	92
106	61	Sand to Sand with Trace Gravel	Sand (Reese)	70	NA	NA	37	104
61	51	Sand with Silt	Sand (Reese)	65	NA	NA	35	78
51	46	Loose Sand	Sand (Reese)	60	NA	NA	32	40
below 46		Sand with Silt and Trace Gravel	Sand (Reese)	90	NA	NA	38	119

Bent 2 - Boring 1

Elevation, ft		Material	Model	Effective Unit Weight, γ' ,pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ϵ_{50} for Soil) / k_m for Rock	Friction Angle, ϕ , °	Soil Modulus, k, pci
Top	Bottom							
Ground Surface	125	Fat Clay	Soft Clay (Matlock)	105	550	0.007	NA	NA
125	121	Fat Clay	Stiff Clay with Free Water (Reese)	50	1150	0.007	NA	500
121	112	Lean Clay with Sand	Soft Clay (Matlock)	50	950	0.010	NA	NA
112	106	Sand with Silt	Sand (Reese)	65	NA	NA	36	92
106	61	Sand to Sand with Trace Gravel	Sand (Reese)	70	NA	NA	37	104
61	51	Sand with Silt	Sand (Reese)	65	NA	NA	35	78
51	46	Loose Sand	Sand (Reese)	60	NA	NA	32	40
below 46		Sand with Silt and Trace Gravel	Sand (Reese)	90	NA	NA	38	119

Bent 3 - Boring 1

Elevation, ft		Material	Model	Effective Unit Weight, γ' ,pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ϵ_{50} for Soil) / k_m for Rock	Friction Angle, ϕ , °	Soil Modulus, k, pci
Top	Bottom							
Ground Surface	125	Fat Clay to Clay	Soft Clay (Matlock)	105	550	0.007	NA	NA
125	121	Fat Clay to Clay	Stiff Clay with Free Water (Reese)	50	1150	0.007	NA	500.0
121	112	Lean Clay with Sand	Soft Clay (Matlock)	50	950	0.010	NA	NA
112	106	Sand with Silt	Sand (Reese)	65	NA	NA	36	92
106	61	Sand to Sand with Trace Gravel	Sand (Reese)	70	NA	NA	37	104
61	51	Sand with Silt	Sand (Reese)	65	NA	NA	35	78
51	46	Loose Sand	Sand (Reese)	60	NA	NA	32	40
below 46		Sand with Silt and Trace Gravel	Sand (Reese)	90	NA	NA	38	119

Bent 4 - Boring 2

Elevation, ft		Material	Model	Effective Unit Weight, γ' ,pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ϵ_{50} for Soil) / k_m for Rock	Friction Angle, ϕ , °	Soil Modulus, k, pci
Top	Bottom							
Ground Surface	142	Sandy Lean Clay	Stiff Clay w/o Free Water (Reese)	115	1150	0.007	NA	NA
142	123	Fat Clay	Soft Clay (Matlock)	110	750	0.010	NA	NA
123	116	Clayey Sand	Sand (Reese)	55	NA	NA	31	26
116	91	Sand with Silt	Sand (Reese)	80	NA	NA	38	119
91	66	Sand to Sand with Clay Lenses and some Gravel	Sand (Reese)	70	NA	NA	36	92
66	61	Sand with Gravel	Sand (Reese)	70	NA	NA	37	104
below 61		Sand to Sand with Silt and Trace Gravel and Clay lenses	Sand (Reese)	75	NA	NA	38	119

Bent 5 - Boring 2

Elevation, ft		Material	Model	Effective Unit Weight, γ' ,pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ϵ_{50} for Soil) / k_m for Rock	Friction Angle, ϕ , °	Soil Modulus, k, pci
Top	Bottom							
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.010	NA	NA
Ground Surface	142	Sandy Lean Clay	Stiff Clay w/o Free Water (Reese)	115	1150	0.007	NA	NA
142	123	Fat Clay	Soft Clay (Matlock)	110	750	0.010	NA	NA
123	116	Clayey Sand	Sand (Reese)	55	NA	NA	31	26
116	91	Sand with Silt	Sand (Reese)	80	NA	NA	38	119
91	66	Sand to Sand with Clay Lenses and some Gravel	Sand (Reese)	70	NA	NA	36	92
66	61	Sand with Gravel	Sand (Reese)	70	NA	NA	37	104
below 61		Sand to Sand with Silt and Trace Gravel and Clay lenses	Sand (Reese)	75	NA	NA	38	119