

ARKANSAS DEPARTMENT OF TRANSPORTATION



SUBSURFACE INVESTIGATION

STATE JOB NO. 061745

FEDERAL AID PROJECT NO. NHPP-BFP-0043(42)

CROOKED CREEK STR. & APPRS. (S)

STATE HIGHWAY 13 SECTION 9

IN LONOKE 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.



July 10, 2023

**TO:** Mr. Rick Ellis, Bridge Engineer  
**SUBJECT:** Job No. 061745  
Crooked Creek Str. & Apprs. (S)  
Lonoke County  
Route 13, Section 9

### **Introduction**

Submitted herein are the results of the subsurface investigation and geotechnical recommendations for the proposed bridge planned on Highway 13 in Lonoke County.

This project consists of constructing a replacement bridge over Crooked Creek at an offset location east of the existing bridge alignment. The bridge will be a continuous prestressed concrete girder unit with a total bridge length of 110 feet and an out-to-out width of 32.5 feet. 2-Horizontal to 1-vertical (2H:1V) end slopes and (3H:1V) side slopes are planned at the replacement bridge embankments. Embankment height varies from 16 feet at the south abutment to 13 feet at the north abutment.

### **Field Investigation**

A subsurface investigation was requested on April 17, 2023 by the Bridge Division to develop recommendations for bridge foundations and to verify the suitability of bridge abutment embankment configuration. Subsurface conditions were investigated by drilling two (2) borings in the existing roadway. The originally planned boring locations were inaccessible due to swampy and wooded site conditions.

The approximate locations of the borings are presented in the Plan of Borings included in Attachment A. The borings were advanced with a track-mounted Acker Renegade rotary drill rig using a combination of hollow-stem auger and rotary wash 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 the Plan of Borings. A Legend is included 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. The hammer correction factor 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 field.

### **Lab Investigation**

All samples were brought to the Materials laboratory for further evaluation and testing. Soil 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/or gradation. Tested soils were classified by licensed Professional Geologists in accordance with both USCS and AASHTO soil classification systems. The laboratory test and their corresponding ASTM and/or AASHTO test methods are listed in Table 1.

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 Analysis by Sieving	D6913	T 88	Whole Number in the “- No. 200 %” Column (e.g., 12)
Atterberg Limits	D4318	T 89	Plus Sign (+) on the Right for Liquid Limit
		T 90	Plus Sign (+) 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. Detailed particle size distribution curve used for  $D_{50}$  determination is included in Attachment B.

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

Station	Sample Type	Location	$D_{50}$ , mm
113+44, 37' Rt.	Bulk	Creek Bank	<0.075

**Generalized Site, Geological and Subsurface Conditions**

Selected site pictures are included in Attachment C. Crooked Creek flows east through an abandoned channel of the Arkansas River. The topography surrounding the job site is relatively flat and may be subject to flooding. The proposed bridge is to be located to the east of the existing bridge.

The existing roadway embankment appears to be composed of local material extending to a depth of approximately 8.5 to 9.5 feet below ground level (bgl). The embankment material is composed of lean clay with sand, silty clay, and silt.

Alluvium associated with the abandoned channel of the Arkansas River extends to a depth of approximately 22.5 to 25 feet bgl and consists of lean clay/silty clay to fat clay. Some samples in this zone were very soft/very loose with a blow count of zero. Wood was also encountered in this zone.

The clayey soils overlie deposits of the Mississippi River Valley Alluvium (MRVA), which consists primarily of sand to sand with silt. Many samples in this zone contain some gravel. A gravel lens (GW-GM) was encountered in Boring 2 at a depth of 80 to 90 feet bgl.

The MRVA typically overlies Paleogene deposits in this area. Paleogene deposits of the Jackson Group were encountered at 96.5 to 98.5 feet bgl. These deposits most likely represent the White Bluff Formation which correlates to the Moodys Branch Formation of adjacent states. The shallower part of the Jackson Group encountered in the borings to a depth of 115 feet bgl consists of sandy lean clay to lean clay with sand. Below 115 feet bgl, the Jackson Group consists



of lean clay. Numerous calcareous fossils were encountered in the Jackson Group deposits including gastropods, bivalves, and fish otoliths.

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**

Considering the average subsurface conditions as revealed by the borings, a Seismic Site Class D (Stiff Soil profile) is calculated for the project site. 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. These seismic coefficients are summarized below in Table 3. The design Response Spectrum is presented in Attachment E.

Table 3: Summary of Design Ground Motion Acceleration Response Coefficients

Code- Bade Acceleration Coefficient	Value (g)
$A_S$ (Site PGA)	0.217
$S_{DS}$ (0.2 sec)	0.491
$S_{D1}$ (1 sec)	0.237

For the design long-period spectral acceleration coefficient ( $S_{D1}$ ) of 0.237, a Seismic Performance Zone 2 is considered applicable for the project site.

Liquefaction potential of the subsurface soils were evaluated based on the results of the borings and utilizing the current Microsoft Excel<sup>®</sup> spreadsheet developed by University of Arkansas for ARDOT. An Earthquake Moment Magnitude ( $M_w$ ) of 7.0 and the design peak ground acceleration coefficient ( $A_S$ ) of 0.217 were modelled in the analysis. The results of liquefaction analyses are presented in Attachment E as plots of calculated factor of safety against liquefaction versus depth below ground surface at the boring locations. The results of liquefaction analyses indicate overall low liquefaction potential for the design earthquake.

**Approach Embankment**

Settlement Potential and Ground Improvements Design drawings provided by Bridge Division indicate up to 16 feet of fill will be placed on the south abutment (Bent 1) and up to 13 feet of fill will be placed on the north abutment (Bent 3). Based on the results of the borings, consolidation settlement is estimated to be in the range of 5 to 6 inches.

The planned bridge abutments are located in a swampy area. The surface and near-surface soils are weak and unstable and are subject to long-term consolidation settlement. To provide a stable construction platform and to reduce the potential of consolidation settlement, it is recommended the subgrade at the bridge abutments be undercut at least 5 feet below the existing ground surface. For each abutment, undercut should extend at least 5 feet in front of the



toe of the end slope, 5 feet beyond the toes of the side slopes, and 80 feet behind the crest of the end slope.

Undercut should be backfilled with Rock Fill. A project Special Provision for Rock Fill is included in Attachment F. Aggregate Base Coarse (Class 7), in accordance with ARDOT Standard Specifications Section 303, should be utilized in areas where piling is planned.

Embankment Stability Stability analyses have been performed to evaluate the design abutment configuration. Slope stability analyses were performed utilizing a commercial computer program Slide2 (Version 2021) developed by RocScience. Spencer analysis method was utilized to analyze the more critical 2H:1V end slopes at the abutments. 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 0.1085 ( $0.5A_s/g$ ) was utilized for analysis of the Seismic/Pseudo-Static Condition. A surcharge of 250 psf is included to model the live load under long term conditions.

The results of the analyses are presented in Table 4. The graphic results of slope stability analyses are shown in Attachment G. Undercut and Rock Fill were not included in modelling and the analyses are considered conservative. These results of stability analyses indicate the plan abutment configurations are acceptable.

Table 4: Results of Slope Stability Analyses

Slope	Loading Condition	Calculated Min. F.S.	Recommended Min. F.S.
2H:1V End Slope – Bent 1 (South Embankment)	Short Term	1.92	1.3
	Long Term	1.43	1.4
	Seismic ( $k_h = 0.1085$ )	1.35	1.05
2H:1V End Slope – Bent 2 (North Embankment)	Short Term	2.84	1.3
	Long Term	1.39	1.4
	Seismic ( $k_h = 0.1085$ )	1.85	1.05

**Foundation Recommendations**

Axial Capacities Based on the request from Bridge Division, it is understood concrete filled steel shell piles will be utilized to support the foundation loads. Pile diameter and required nominal axial compression pile capacity have not been provided.

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. For single, isolated foundations, a resistance factor ( $\phi_{stat}$ ) of 0.45 is recommended or calculating factored compression resistance and a resistance factor ( $\phi_{up}$ ) of 0.35 is recommended for determining factored uplift resistance. Considering the undercut and backfill with Rock Fill, downdrag on piling is expected to be negligible for piles driven after the embankment is in place. In addition, 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.



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


The piles are expected to be tipped in the predominantly sandy/silty soils that are likely to be liquefied during driving with considerable resistance loss at the end of initial drive. If the required nominal bearing capacity has not been obtained when top of piles is 6 inches above plan grade, considerations may be given to restriking the piles with a warmed-up hammer after a minimum 24-hour waiting time.

Geotechnical Input Parameters for LPile / Group Lateral load analysis will be performed by the Structural Engineer using commercial computer programs LPile and/or Group. The geotechnical input parameters are in Attachment I.

Pile Installation Piles should be installed in accordance with Section 805 (2014 Edition). Prior to beginning pile 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)".

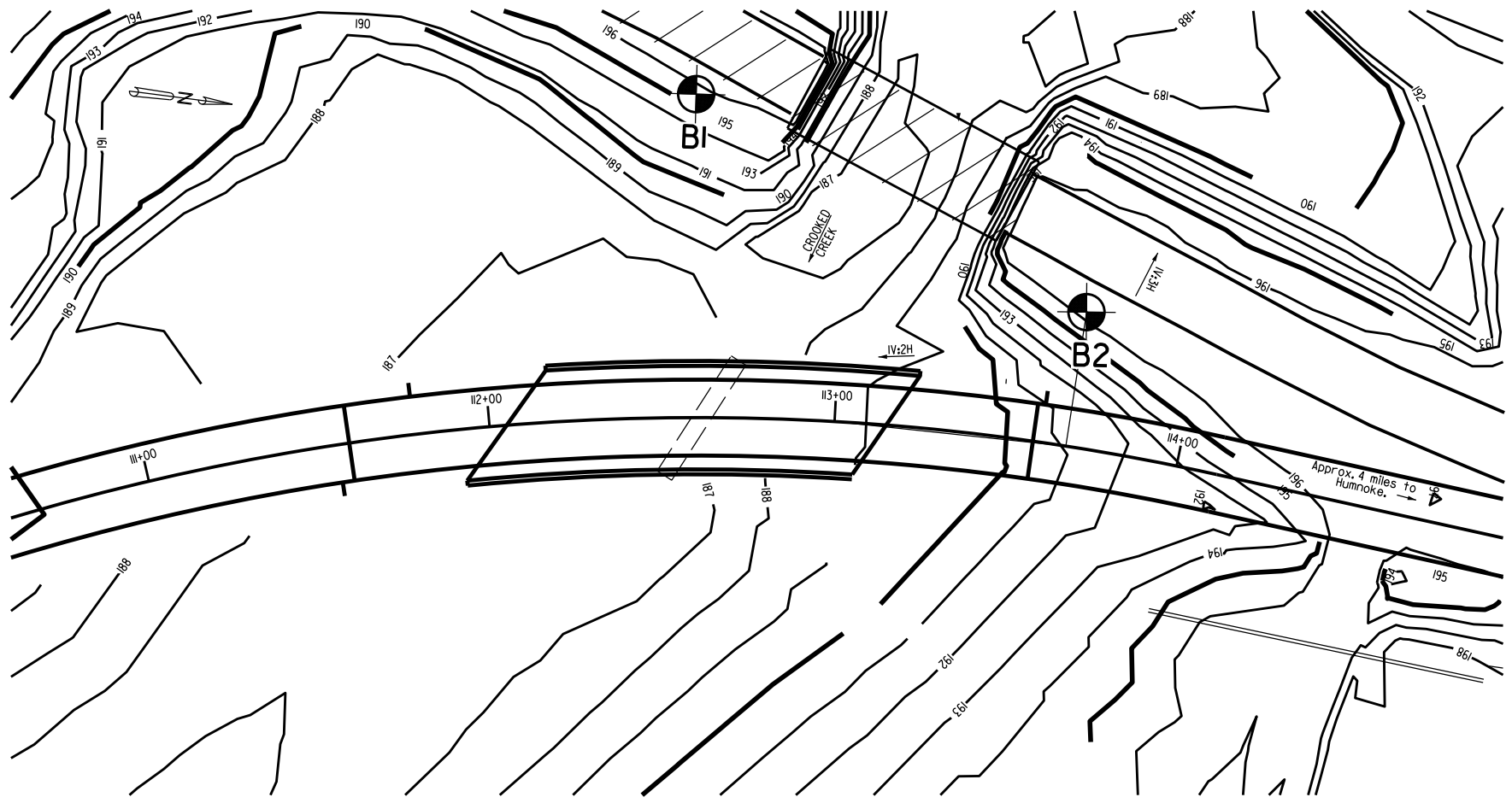
  
for Paul Tinsley  
Materials Engineer

PT:yz:mlg:mbb:jcs

cc: State Construction Engineer  
District 6 Engineer  
G. C. File

## Attachment A

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	AR			
JOB NO.		061745		
PLAN OF BORINGS				



PLAN OF BORINGS	
CROOKED CREEK STR. & APPRS. (S) ROUTE 13, SECTION 9 LONOKE COUNTY FED. AID PROJECT	
JOB NO. 061745	SHEET 1/1

**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 1

PAGE 1 OF 4

JOB NO. 061745 Lonoke County

DATE: April 19, 24, and 25, 2023

JOB NAME: Crooked Creek Str. & Apprs. (S)

TYPE OF DRILLING:

Route 13, Section 9

Hollow Stem Auger - Diamond Core

STATION: 112+60

EQUIPMENT: Acker 2

LOCATION: 94' Left of Construction Centerline

LOGGED BY: Stanley Bates

HAMMER CORRECTION FACTOR: 1.55

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.	% TCR	% RQD
					PL	LL				
			SURFACE ELEVATION: 194.7							
5			Moist, Medium Stiff, Brown Lean Clay with Sand	- CL			78	2 2-4		
			Wet, Soft, Reddish Brown Silty Clay	- CL-ML			90	2 1-2		
			Wet, Stiff, Reddish Brown Silty Clay with Sand	- CL-ML			74	0 0-14		
10			Organic Matter (Wood)	-			92	0 0-0		
			Wet, Very Soft, Gray Lean Clay with Some Organic Matter (Wood)	-						
15			Wet, Soft, Gray Fat Clay with Trace Organic Matter (Wood)	- CH			93	0 1-3		
20			Wet, Soft, Brown and Gray Fat Clay with Sand	- CH			80	0 1-2		
25			Wet, Medium Dense, Brown Poorly Graded Sand with Silt	- SP-SM			12	5 12-14		
30			Wet, Medium Dense, Brown Sand with Silt and Trace Gravel	-				4 11-12		
35										

REMARKS:

**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 1  
PAGE 2 OF 4

JOB NO. 061745 Lonoke County  
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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: 194.7																
40		X	Wet, Medium Dense, Brown Sand with Silt and Some Gravel	-												3	8-12		
45		X	Wet, Medium Dense, Brown Sand with Silt													5	9-9		
50		X	Wet, Dense, Brown Sand with Silt													8	15-16		
55		X	Wet, Medium Dense, Brown Poorly Graded Sand with Silt and Some Gravel	SP-SM												10	5	5-14	
60		X	Wet, Medium Dense, Brown Sand with Gravel													7	14-15		
65		X	Wet, Medium Dense, Brown Sand with Trace Gravel													4	12-12		
70		X	Wet, Dense, Brown Sand with Trace Gravel													11	16-34		

REMARKS:

**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 1  
PAGE 3 OF 4

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					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 194.7																
75		X	Wet, Dense, Brown Sand with Gravel														4 12-21		
80		X	Wet, Medium Dense, Brown Sand with Trace Gravel	-													5 10-12		
85		X	Wet, Dense, Brown Sand with Trace Gravel														12 18-20		
90		X	Wet, Medium Dense, Brown and Gray Sand with Gravel														7 8-8		
95		X	Wet, Medium Dense, Gray Sand with Silt														5 7-13		
100		X	Wet, Dense, Gray Sand with Silt and Trace Gravel														9 15-16		
105		X															4 9-17		

REMARKS:



**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 2

PAGE 1 OF 4

JOB NO. 061745 Lonoke County  
 JOB NAME: Crooked Creek Str. & Apprs. (S)  
 Route 13, Section 9  
 STATION: 113+67  
 LOCATION: 39' Left of Construction Centerline  
 LOGGED BY: Stanley Bates

DATE: April 26, May 2 and 3, 2023  
 TYPE OF DRILLING: Hollow Stem Auger -  
 Rotary Wash - Shelby Tube  
 EQUIPMENT: Acker 2  
 HAMMER CORRECTION FACTOR: 1.55

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: 195.5							
			Moist, Reddish Brown Clay	-	●					
			Wet, Soft, Reddish Brown Lean Clay	CL	—●—		89	$\frac{2}{1-2}$		
5			Moist, Loose, Reddish Brown Silt	ML		●	90	$\frac{3}{3-4}$		
			Wet, Very Soft Gray Lean Clay with Trace Organic Matter	CL	—●—		98	$\frac{0}{0-0}$		
10			Moist, Medium Stiff, Gray Fat Clay	CH	—●—		97	$\frac{0}{2-3}$		
			Gray Fat Clay with Calcareous Nodules	CH	—●—		84			
			Reddish Brown Lean Clay	CL	—●—		96			
15			Moist, Medium Stiff, Brown and Gray Lean Clay	CL	—●—		98	$\frac{0}{2-3}$		
			Moist, Very Soft, Brown and Gray Silty Clay	CL-ML	—●—		96	$\frac{0}{0-0}$		
20			Wet, Medium Dense, Brown Sand with Silt	-				$\frac{5}{8-8}$		
25			Wet, Medium Dense, Brown Poorly Graded Sand with Silt	SP-SM			8	$\frac{4}{8-16}$		
30										
35										

REMARKS:

**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 2

PAGE 2 OF 4

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					PL	10	20	30	40	50	60	70	LL					
			SURFACE ELEVATION: 195.5															
40		X	Wet, Medium Dense, Brown Sand with Silt and Trace Gravel	-											8	11-11		
45		X	Wet, Medium Dense, Brown Sand with Some Gravel	-											9	13-13		
50		X	Wet, Medium Dense, Brown Sand with Some Gravel	-											5	6-9		
55		X	Wet, Medium Dense, Brown Poorly Graded Sand with Gravel	SP											4	8	14-15	
60		X	Wet, Dense, Brown Sand with Gravel	-											10	19-21		
65		X	Wet, Medium Dense, Brown Sand with Gravel	-											8	15-10		
70		X	Wet, Dense, Brown Sand with Some Gravel	-											16	13-22		

REMARKS:

**ARKANSAS DEPARTMENT OF TRANSPORTATION  
MATERIALS DIVISION - GEOTECHNICAL SEC.**

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					PL	10	20	30	40	50	60	70	LL						
			SURFACE ELEVATION: 195.5																
75		X	Wet, Medium Dense, Brown Sand with Some Gravel													5	11-10		
80		X	Wet, Medium Dense, Brown Poorly Graded Sand with Silt and Gravel	SP-SM												11	7	12-15	
85		X	Wet, Medium Dense, Brown Gravel with Silt and Sand	-												5	5-6		
90		X	Wet, Medium Dense, Brown Well Graded Gravel with Silt and Sand	GW-GM												5	6	10-16	
95		X	Wet, Medium Dense, Brown Poorly Graded Sand with Silt and Some Gravel	SP-SM												7	6	14-12	
100		X	Wet, Dense, Brown Poorly Graded Sand with Silt and Some Gravel	SP-SM												5	8	15-18	
105		X	Moist, Hard, Gray Sandy Clay (Cuttings, no sample recovered) (Jackson Group)	-												9	14-18		

REMARKS:

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BORING NO. 2

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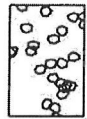
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					PL	LL				
			SURFACE ELEVATION: 195.5							
110	[Diagonal Hatching]	X	Moist, Very Stiff, Gray Lean Clay with Sand	CL			84	6 10-14		
				-					7 9-10	
115	[Diagonal Hatching]	X	Moist, Very Stiff, Gray Lean Clay	CL			97	9 9-9		
120				-					6 9-12	
125			Boring Terminated							
130										
135										
140										

REMARKS:

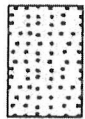
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## SOIL TYPES

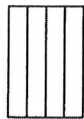
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(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL



SAND



SILT



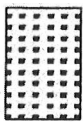
CLAY



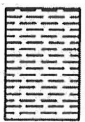
ORGANIC  
MATTER

## ROCK TYPES

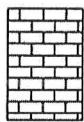
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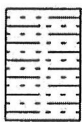
SANDSTONE



SHALE  
or  
SILTSTONE



LIMESTONE  
or  
DOLOMITE



ALTERNATING  
LAYERS of  
SHALE and  
SANDSTONE



OTHER

## SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

### SHELBY TUBE



UNDISTURBED  
SAMPLE  
RECOVERY

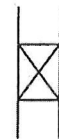


DISTURBED  
SAMPLE  
RECOVERY

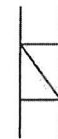


NO  
RECOVERY

### SPLIT SPOON

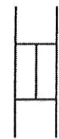


SAMPLE  
RECOVERY



NO  
RECOVERY

### ROCK CORING



% RECOVERY  
INDICATED ON LOGS

## TERMS DESCRIBING CONSISTENCY OR CONDITION

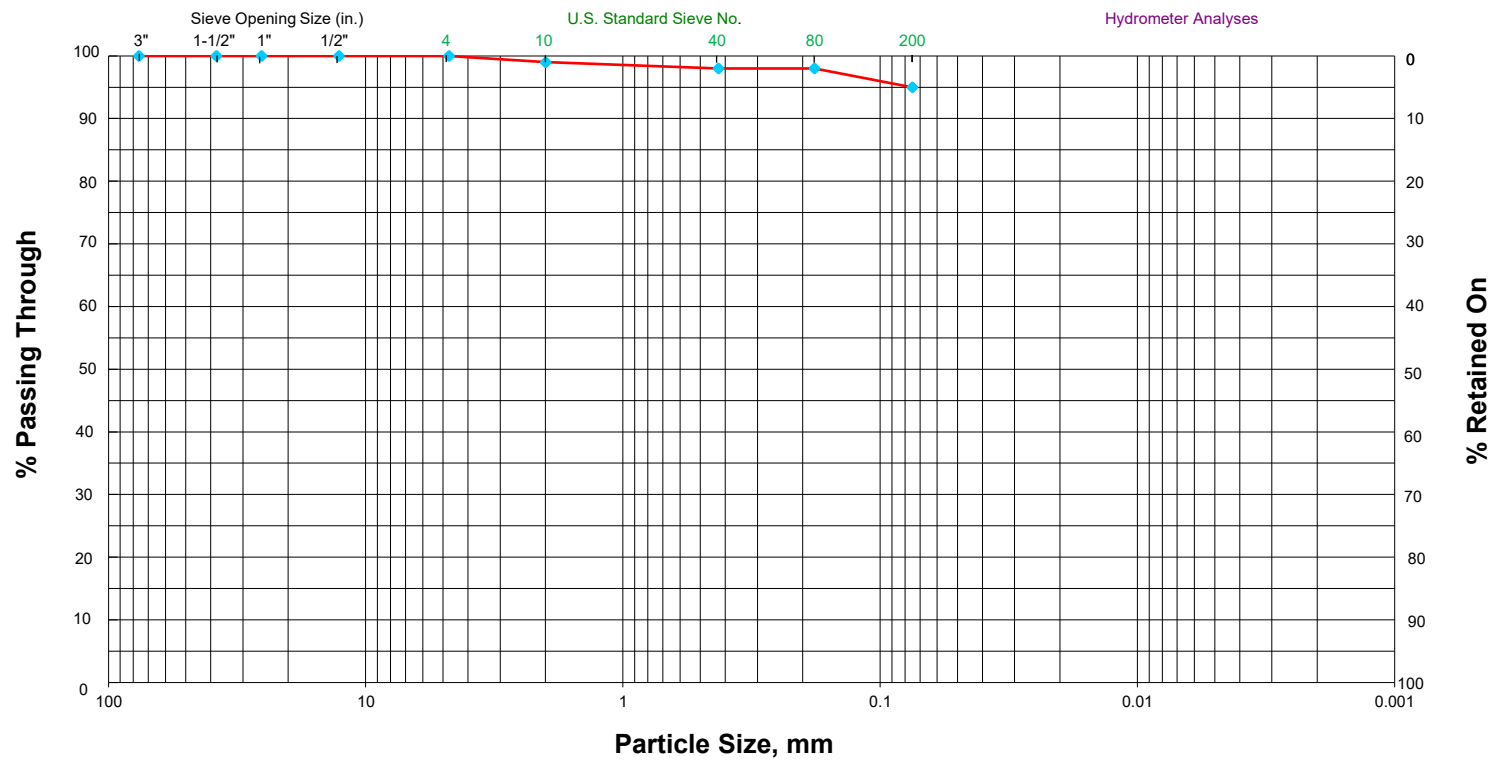
GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
*N <sup>o</sup> Value	Density	*N <sup>o</sup> Value	Consistency	*N <sup>o</sup> Value	Consistency	*N <sup>o</sup> Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium 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:  $\frac{6}{8-9} \Rightarrow 8 + 9 = 17 \text{ blows} / \text{ft}$ . 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 - D<sub>50</sub>**  
**Station 113+44, 37' Rt**



## Attachment C



**SITE PICTURES**

**Job No.: 061745**

**Job Name: Crooked Creek Str. & Apprs. (S)**



**Existing Bridge - Looking North (April 2023)**

**SITE PICTURES**

**Job No.: 061745**

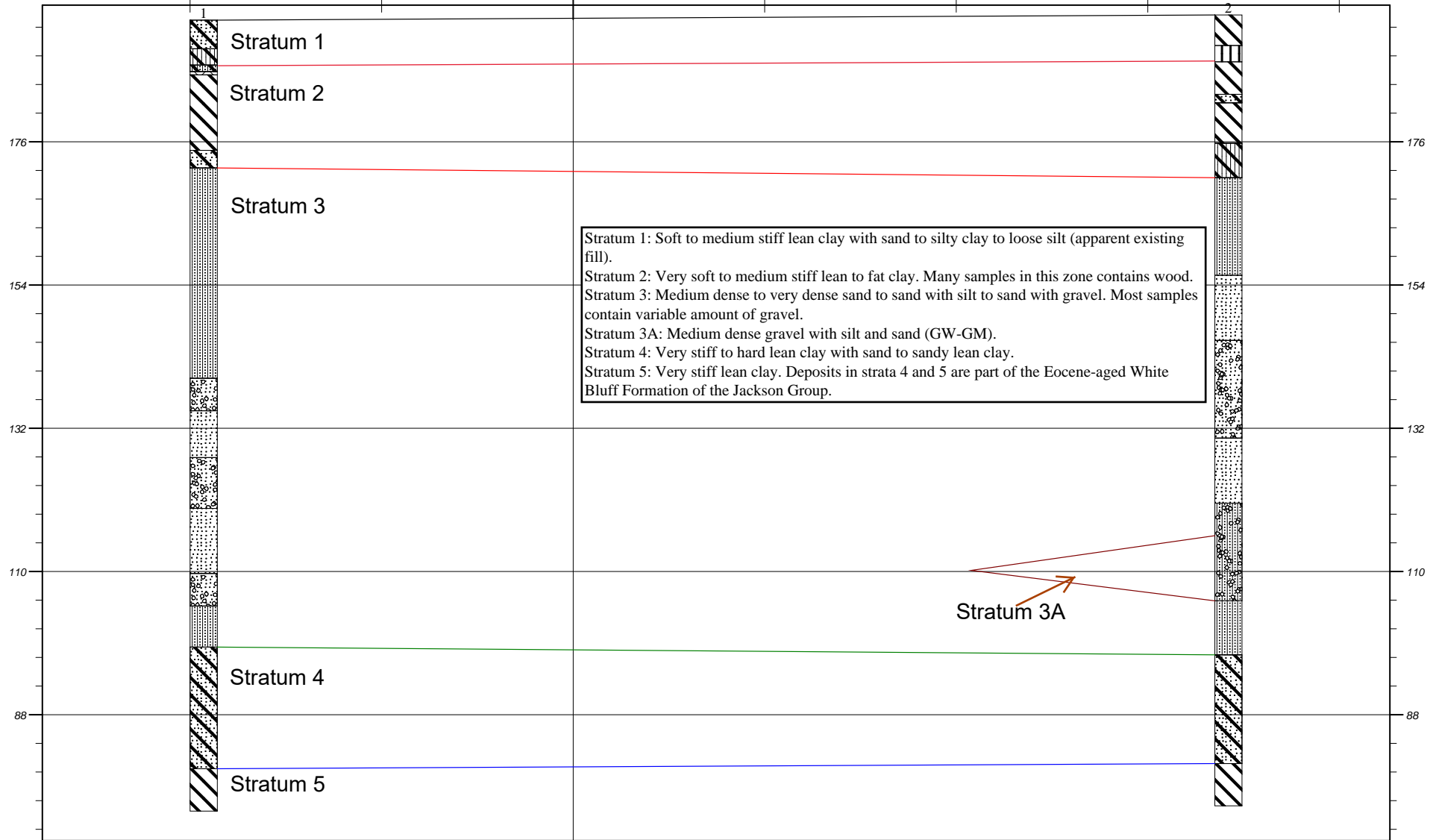
**Job Name: Crooked Creek Str. & Apprs. (S)**



**East Side of the Existing Bridge - Looking North (April 2023)**

## Attachment D

113+00



ELEVATION IN FEET

ELEVATION IN FEET

Plan View

Strata symbols

sandy clay

silty clay

sandy, silty clay

organic matter/lignite

clay

silty sand

sand and gravel

sand

silt

silty sand with gravel

Arkansas Department of Transportation  
Subsurface Profile

HORIZONTAL SCALE: Not to scale  
VERTICAL SCALE: Not to scale

DRAWN BY/APPROVED BY

DATE DRAWN

6/2/2023

Crooked Creek Str. & Apprs. (S)  
Route 13, Section 9

PROJECT NO. 061745  
Lonoke County

FIGURE NUMBER

## Attachment E

Title: 061745

Latitude: 34.486507

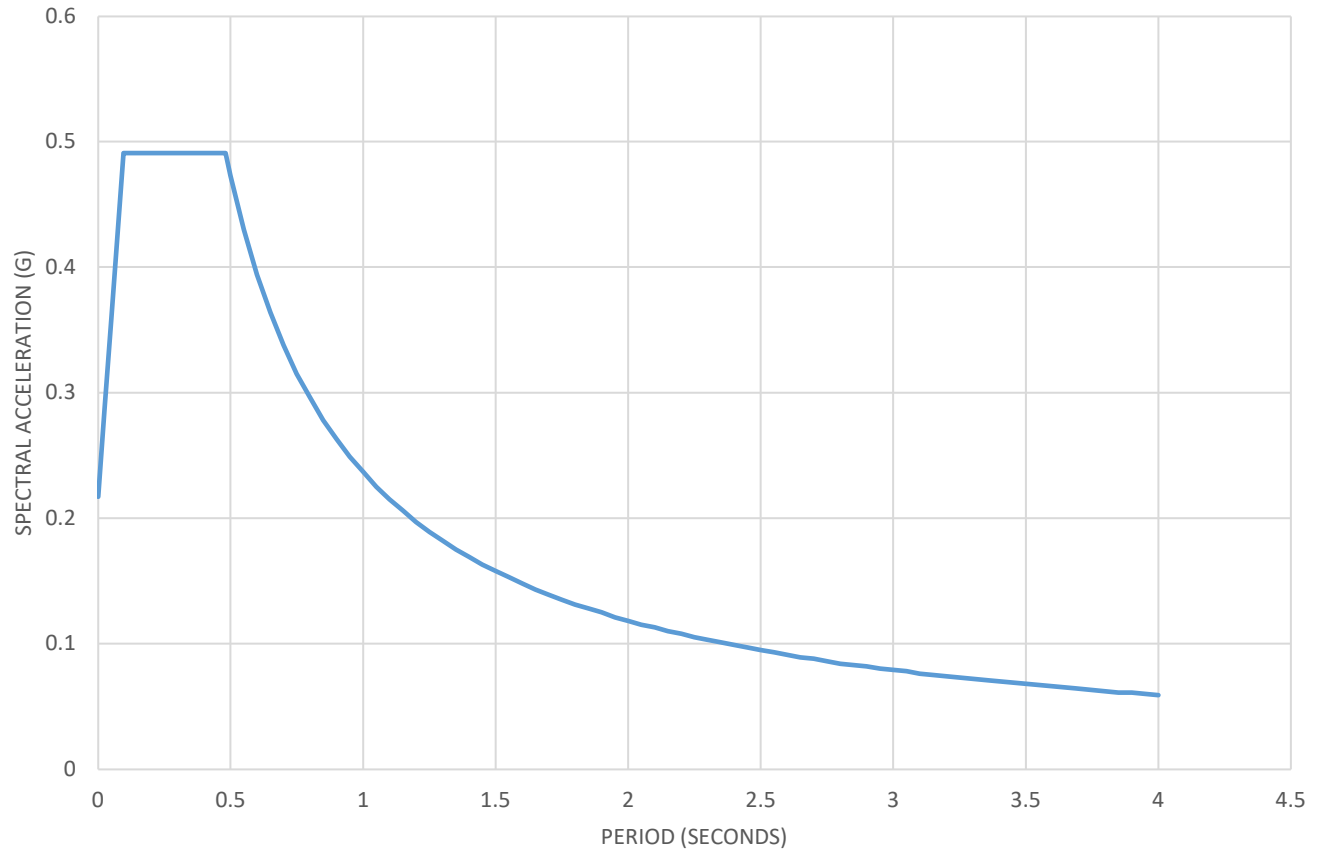
Longitude: -91.758697

Site Class: D

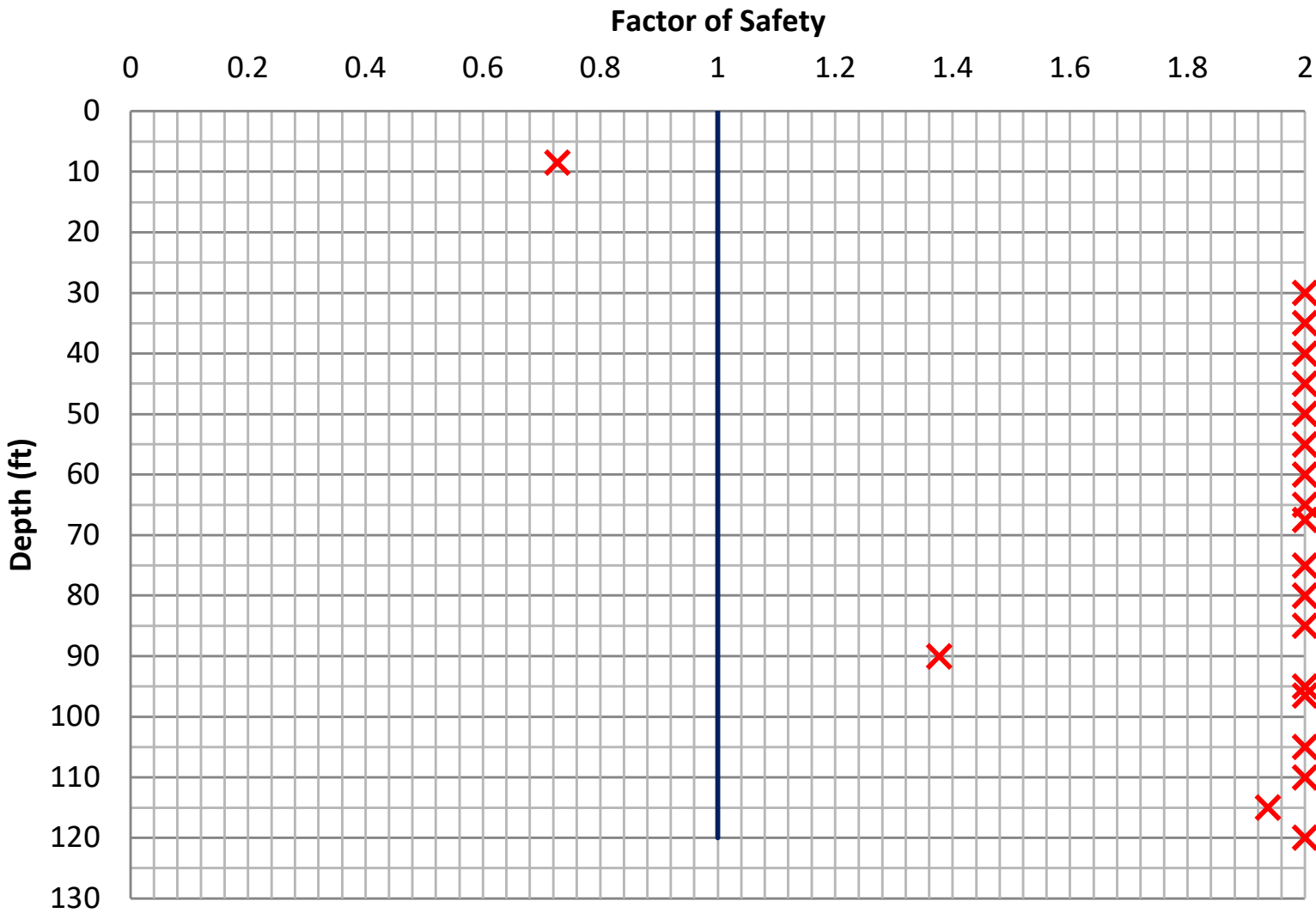
Get USGS Data

PGA:	0.143
F <sub>PGA</sub> :	1.514
A <sub>S</sub> :	0.217
S <sub>S</sub> :	0.317
F <sub>A</sub> :	1.546
S <sub>DS</sub> :	0.491
S <sub>1</sub> :	0.099
F <sub>V</sub> :	2.4
S <sub>D1</sub> :	0.237
S <sub>DC</sub> :	B
T <sub>S</sub> :	0.482
T <sub>0</sub> :	0.096

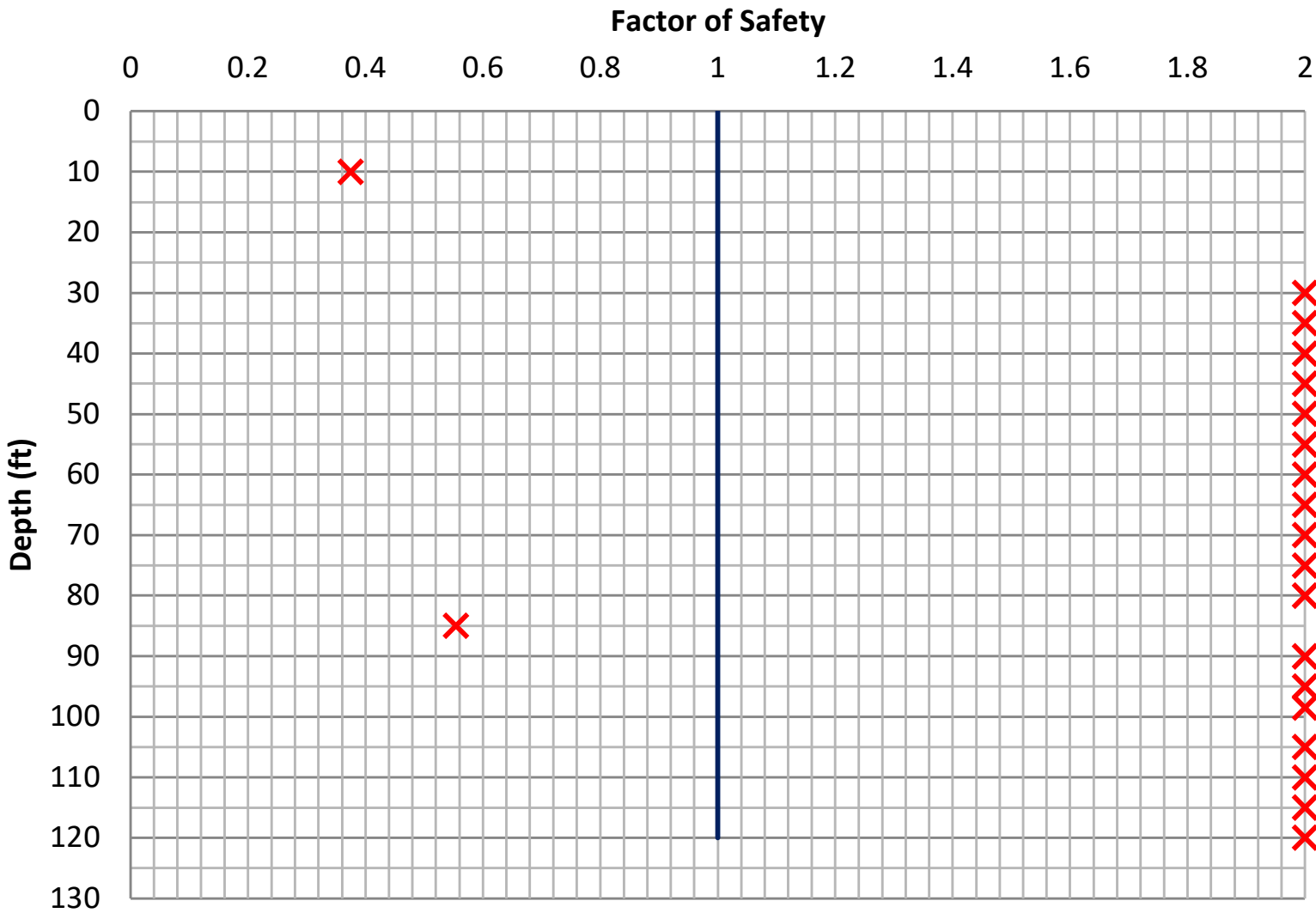
### 061745 DESIGN RESPONSE SPECTRUM



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



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



## Attachment F

**ARKANSAS DEPARTMENT OF TRANSPORTATION****SPECIAL PROVISION****JOB NO. 061745****ROCK FILL**

**Description.** This item shall consist of constructing embankments at the locations shown on the Plans or as directed by the Engineer as Rock Fill. Rock Fill shall comply with Section 210, Excavation and Embankment, of the Standard Specifications, Edition of 2014. Where there is a conflict between this Special Provision and Section 210, this Special Provision shall govern.

**Materials.** Rock Fill shall comply with the following requirements:

- (1) Material for Rock Fill shall include stone obtained from an approved source and shall consist of hard and durable limestone, sandstone, dolomite, or rock-like shale. Shale shall have a minimum slake durability index (SDI) of 95% as tested according to ARDOT Test Method 399. The SDI shall be determined by the Engineer using the above method at a minimum frequency of once per 3000 cubic yards. The stone shall be greater than 1½" and less than 30", reasonably well-graded and angular, with fractured faces on at least 75% of the surface and shall not contain more than 10% overburden or fines less than 1½" in maximum cross-section. The stone shall weigh not less than 140 pounds per solid cubic foot and shall have a percent of wear not greater than 45 by Los Angeles Abrasion Test (AASHTO T 96).

The top layer of Rock Fill shall be reduced in size to meet the gradation requirements of SubSection 802.02(c) for Class B Concrete. The minimum thickness of this layer shall be 1 foot.

- (2) The following shall be added to the third paragraph of Section 801.08 of the Standard Specifications. Rock Fill placed immediately adjacent to Pipe Culverts or Box Culverts including a minimum of 6 inches on top of the culverts, shall meet the gradation requirements of 802.02(c) of the Standard Specifications for Class S concrete coarse aggregate.
- (3) Material placed in the vicinity of piling shall be constructed in accordance with SubSections 303.02, 303.03, and 303.04 of the Standard Specifications, Edition of 2014. It shall meet the material and construction requirements of Aggregate Base Course (Class 7).
- (4) Geotextile Fabric (Type 9) complying with SubSection 625.02 of the Standard Specifications shall be used between Rock Fill and overlying embankment material.

**Construction Requirements.** Embankments requiring Rock Fill to be placed in water or extremely soft areas shall be placed by end dumping and advancing rock placement. All displaced material as it accumulates ahead of the advancing embankment toe shall be removed by excavation. Removal and disposal of displaced material will not be measured and shall be considered subsidiary to the item Rock Fill.

**ARKANSAS DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION**

**JOB NO. 061745**

**ROCK FILL**

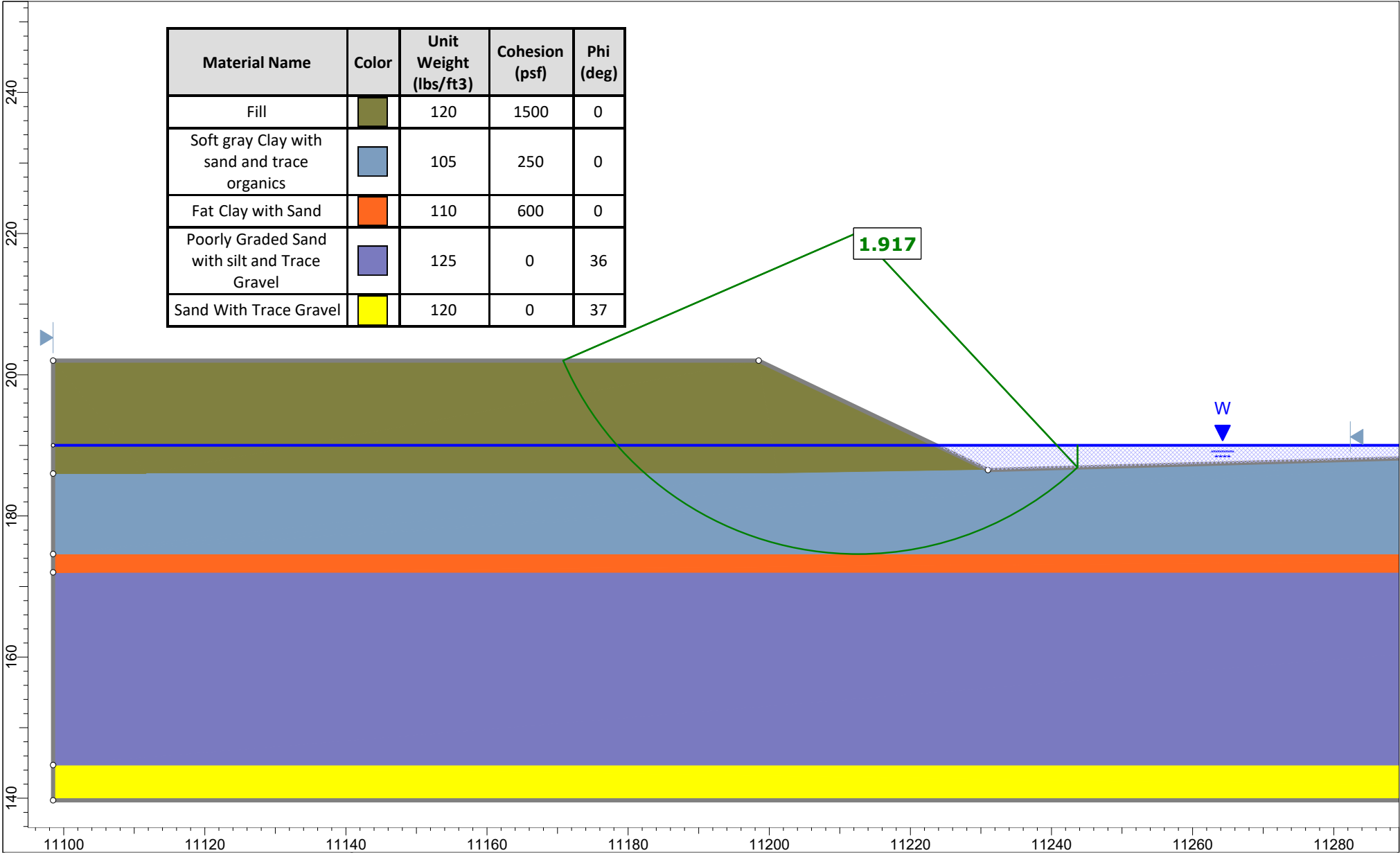
**Method of Measurement.** Rock Fill, which includes all aggregate material types described above, including concrete coarse aggregate and/or Aggregate Base Course (Class 7), will be measured in vehicles by the Ton and paid as Rock Fill. Displaced material removal and disposal will not be measured and shall be considered subsidiary to the item Rock Fill.






**Basis of Payment.** Placement and construction of Rock Fill embankment material shall be paid for under the item “Rock Fill”, which price shall be full compensation for all costs involved in furnishing all materials for constructing the embankments in accordance with Section 210 and this Special Provision; and for all labor, tools, equipment, quality control sampling and testing, and for incidentals necessary to complete the work.

Payment will be made under:


<b>Pay Item</b>	<b>Pay Unit</b>
Rock Fill	Ton
Geotextile Fabric (Type 9)	Square Yard






## Attachment G

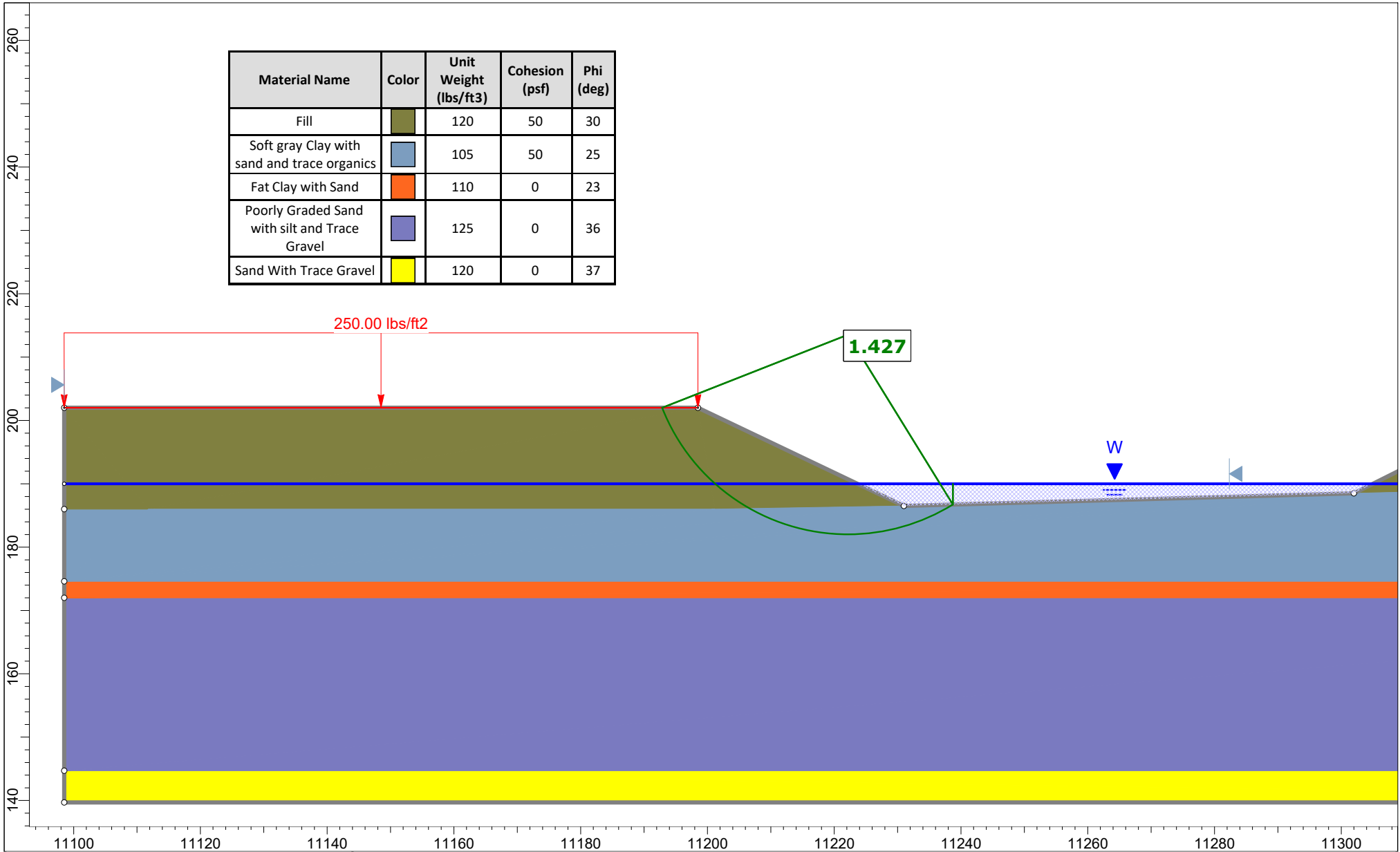


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Soft gray Clay with sand and trace organics		105	250	0
Fat Clay with Sand		110	600	0
Poorly Graded Sand with silt and Trace Gravel		125	0	36
Sand With Trace Gravel		120	0	37

1.917

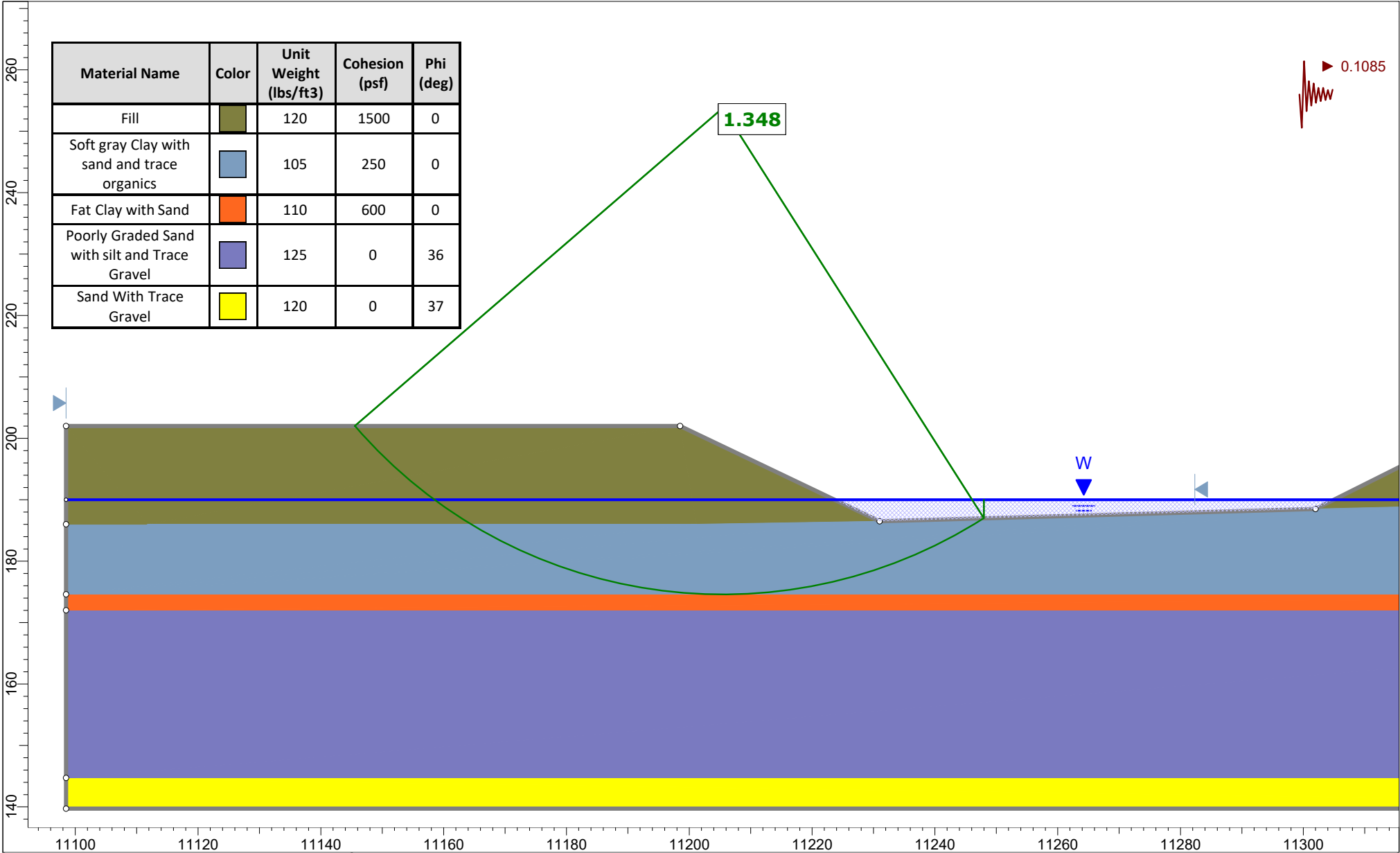
	Project		061745- Crooked Creek STR. & APPRS. (S)	
	Site	1 of 1	Analysis Type	Short Term
	Analyzed By	MBB	Configuration	2H : 1V South End Slope
	Date	6/1/2023		

Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Cohesion (psf)	Phi (deg)
Fill		120	50	30
Soft gray Clay with sand and trace organics		105	50	25
Fat Clay with Sand		110	0	23
Poorly Graded Sand with silt and Trace Gravel		125	0	36
Sand With Trace Gravel		120	0	37



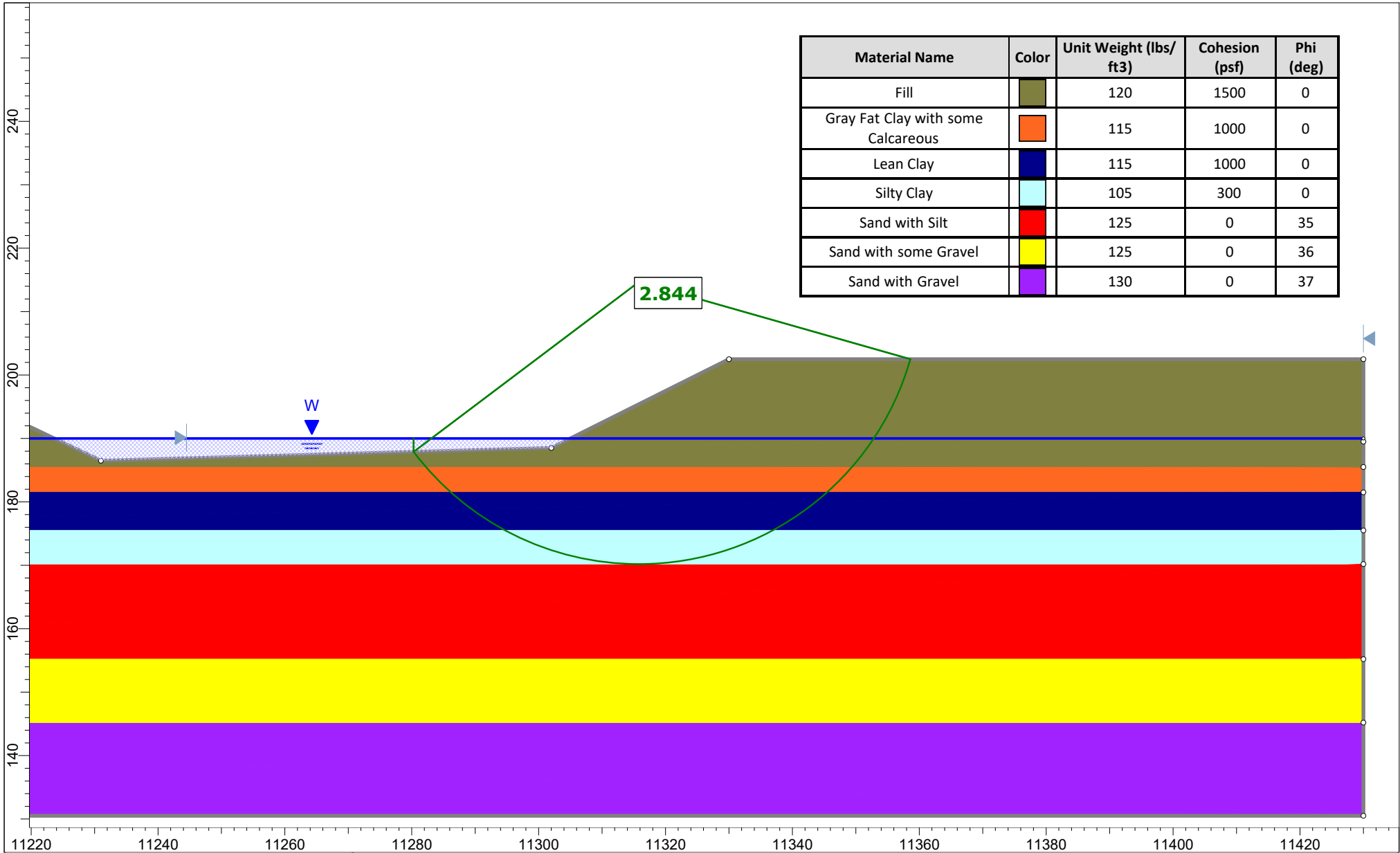
SLIDEINTERPRET 9.019

Project	061745- Crooked Creek STR. & APPRS. (S)		
Site	1 of 1	Analysis Type	Long Term
Analyzed By	MBB	Configuration	2H : 1V South End Slope
Date	6/1/2023		



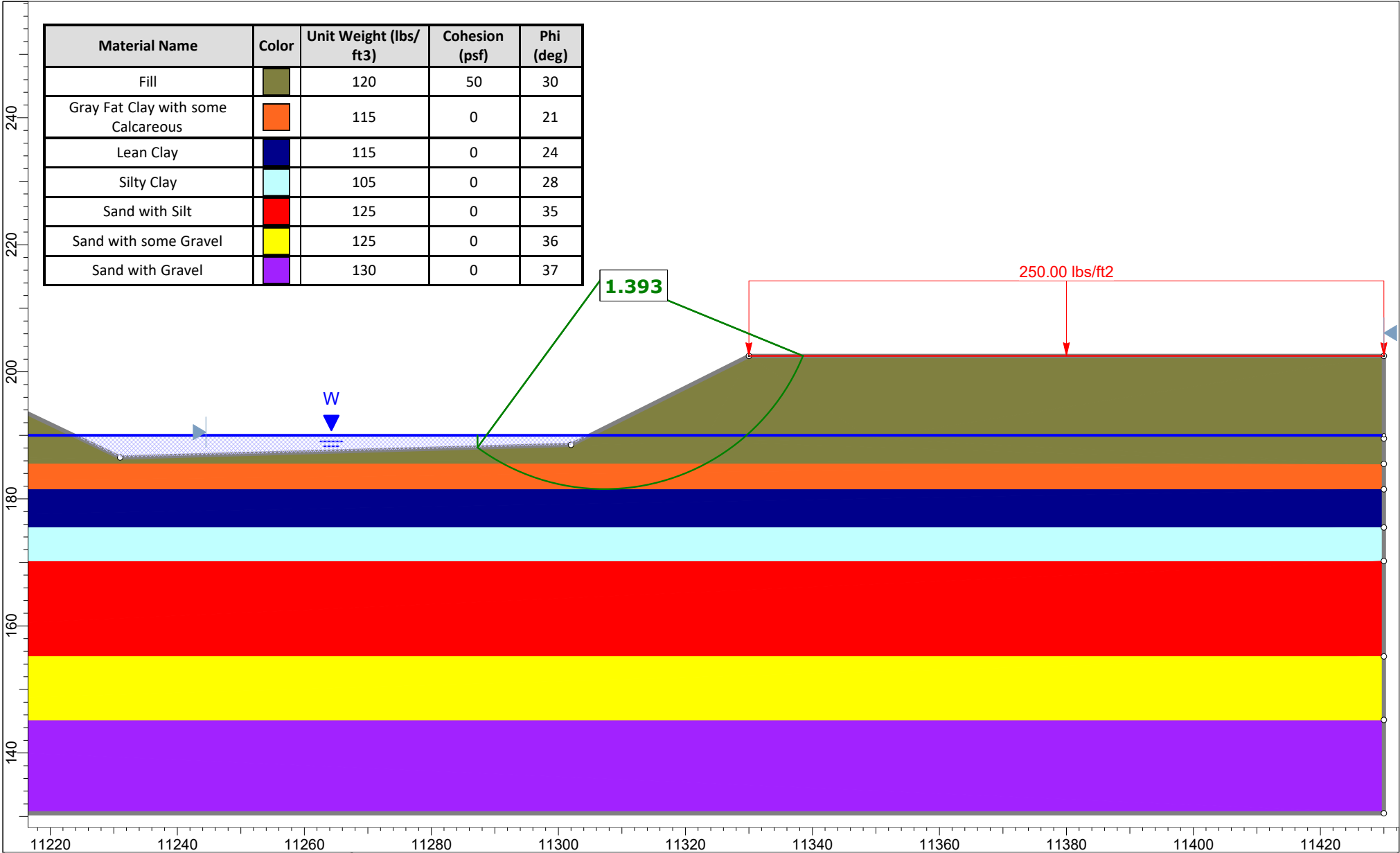
Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Soft gray Clay with sand and trace organics		105	250	0
Fat Clay with Sand		110	600	0
Poorly Graded Sand with silt and Trace Gravel		125	0	36
Sand With Trace Gravel		120	0	37

	Project		061745- Crooked Creek STR. & APPRS. (S)	
	Site	1 of 1	Analysis Type	Seismic Condition
	Analyzed By	MBB	Configuration	2H : 1V South End Slope
	Date	6/1/2023		



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1500	0
Gray Fat Clay with some Calcareous		115	1000	0
Lean Clay		115	1000	0
Silty Clay		105	300	0
Sand with Silt		125	0	35
Sand with some Gravel		125	0	36
Sand with Gravel		130	0	37


	Project		061745- Crooked Creek STR. & APPRS. (S)	
	Site	1 of 1	Analysis Type	Short Term
	Analyzed By	MBB	Configuration	2H : 1V North End Slope
	Date	6/1/2023		

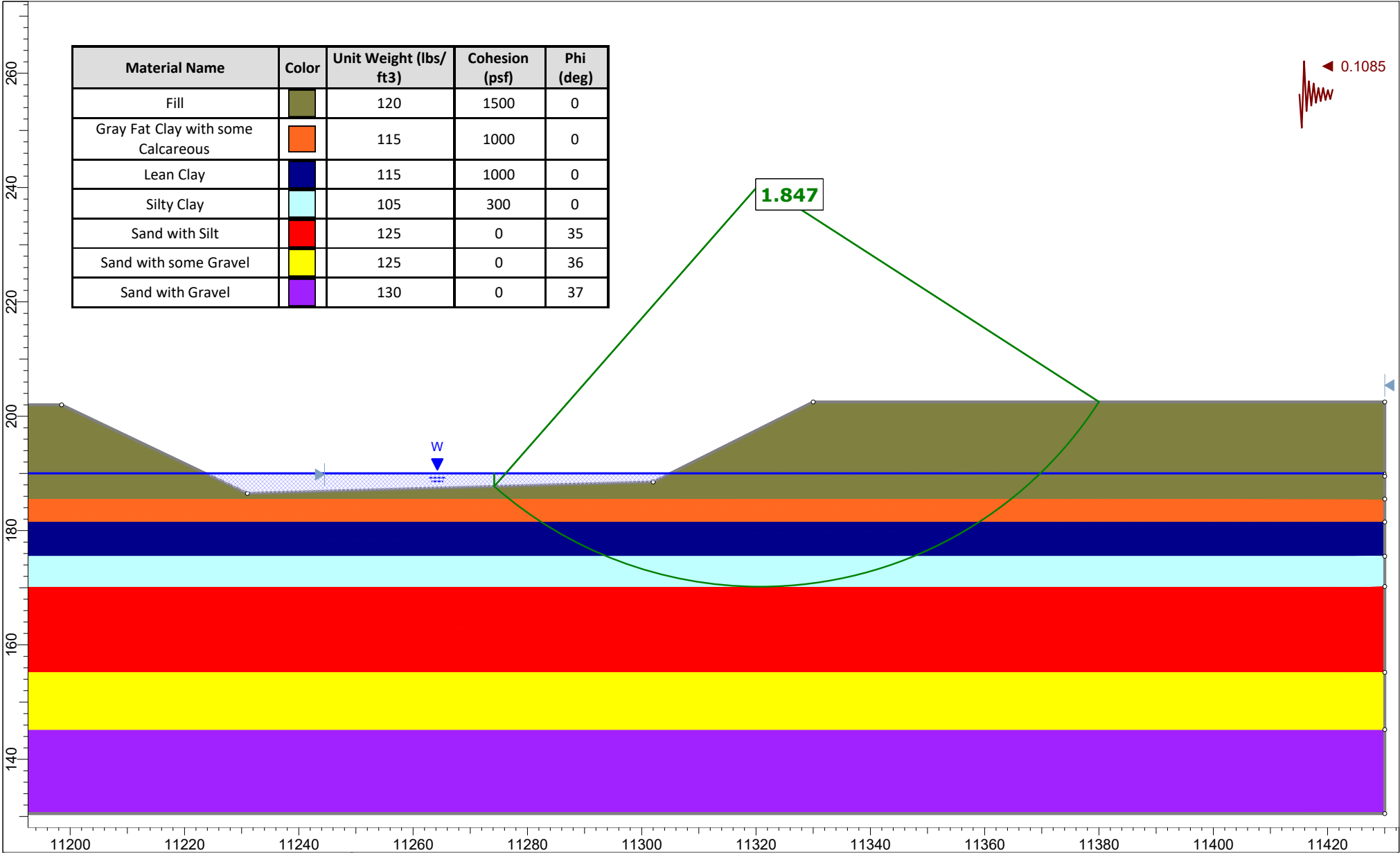


Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Cohesion (psf)	Phi (deg)
Fill	■	120	50	30
Gray Fat Clay with some Calcareous	■	115	0	21
Lean Clay	■	115	0	24
Silty Clay	■	105	0	28
Sand with Silt	■	125	0	35
Sand with some Gravel	■	125	0	36
Sand with Gravel	■	130	0	37


1.393

250.00 lbs/ft<sup>2</sup>

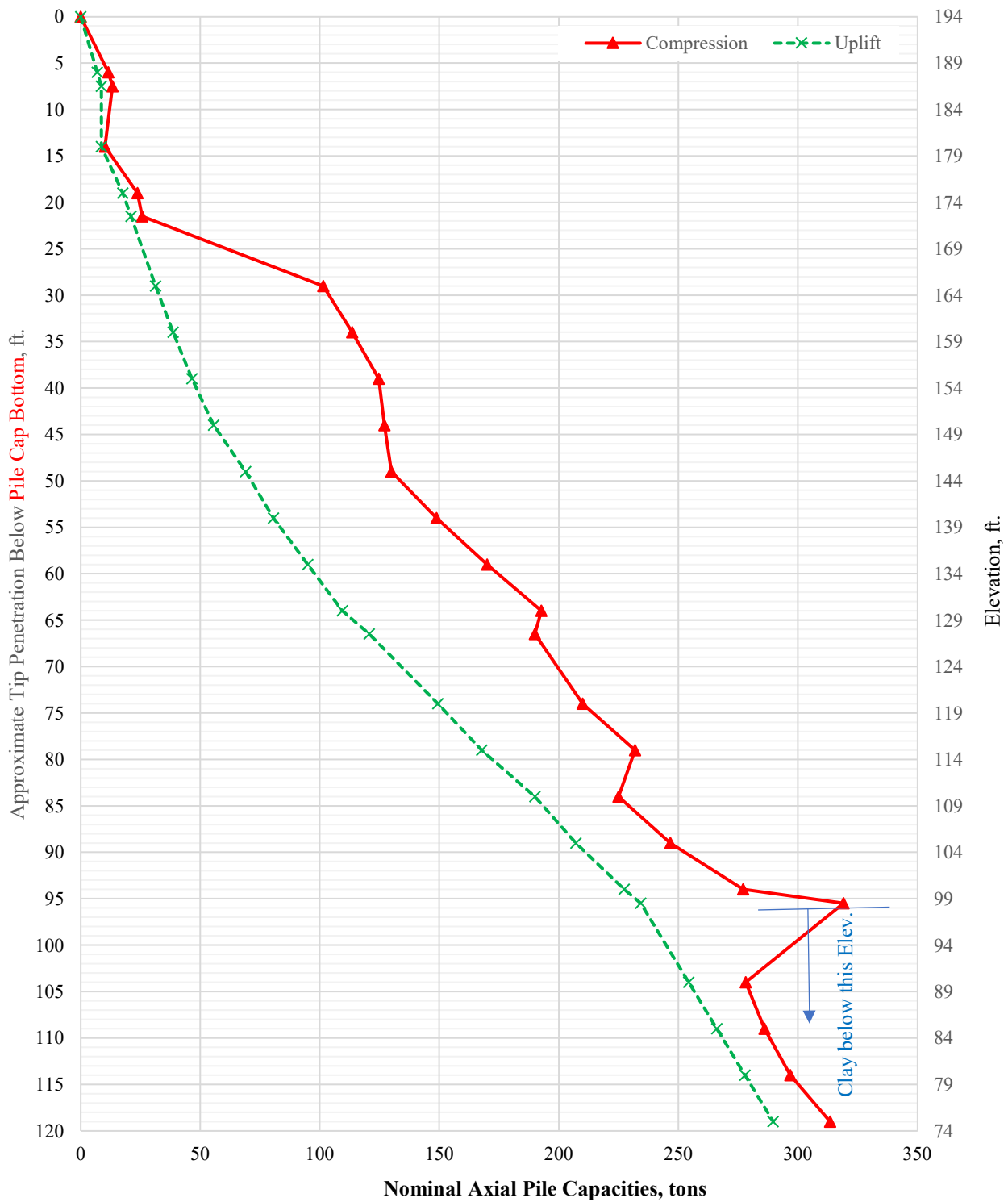
	Project		061745- Crooked Creek STR. & APPRS. (S)	
	Site	1 of 1	Analysis Type	Long Term
	Analyzed By	MBB	Configuration	2H : 1V North End Slope
	Date	6/1/2023		



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill	Green	120	1500	0
Gray Fat Clay with some Calcareous	Orange	115	1000	0
Lean Clay	Dark Blue	115	1000	0
Silty Clay	Light Blue	105	300	0
Sand with Silt	Red	125	0	35
Sand with some Gravel	Yellow	125	0	36
Sand with Gravel	Purple	130	0	37

	Project 061745- Crooked Creek STR. & APPRS. (S)		
	Site 1 of 1	Analysis Type Seismic Condition	
	Analyzed By MBB	Configuration 2H : 1V North End Slope	
	Date 6/1/2023		

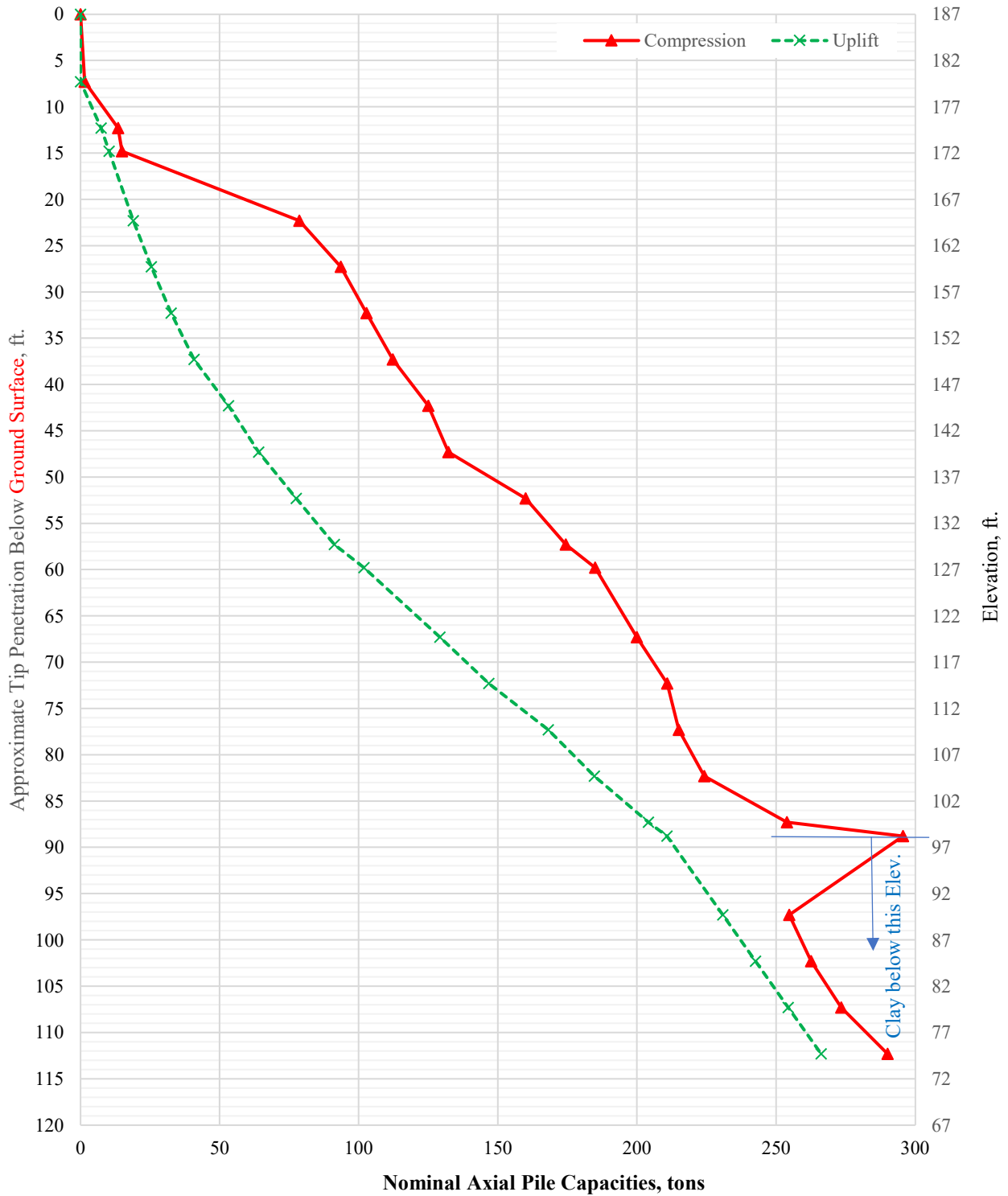
## Attachment H



SINGLE 18"-DIAMETER CLOSED-END STEEL SHELL PILE



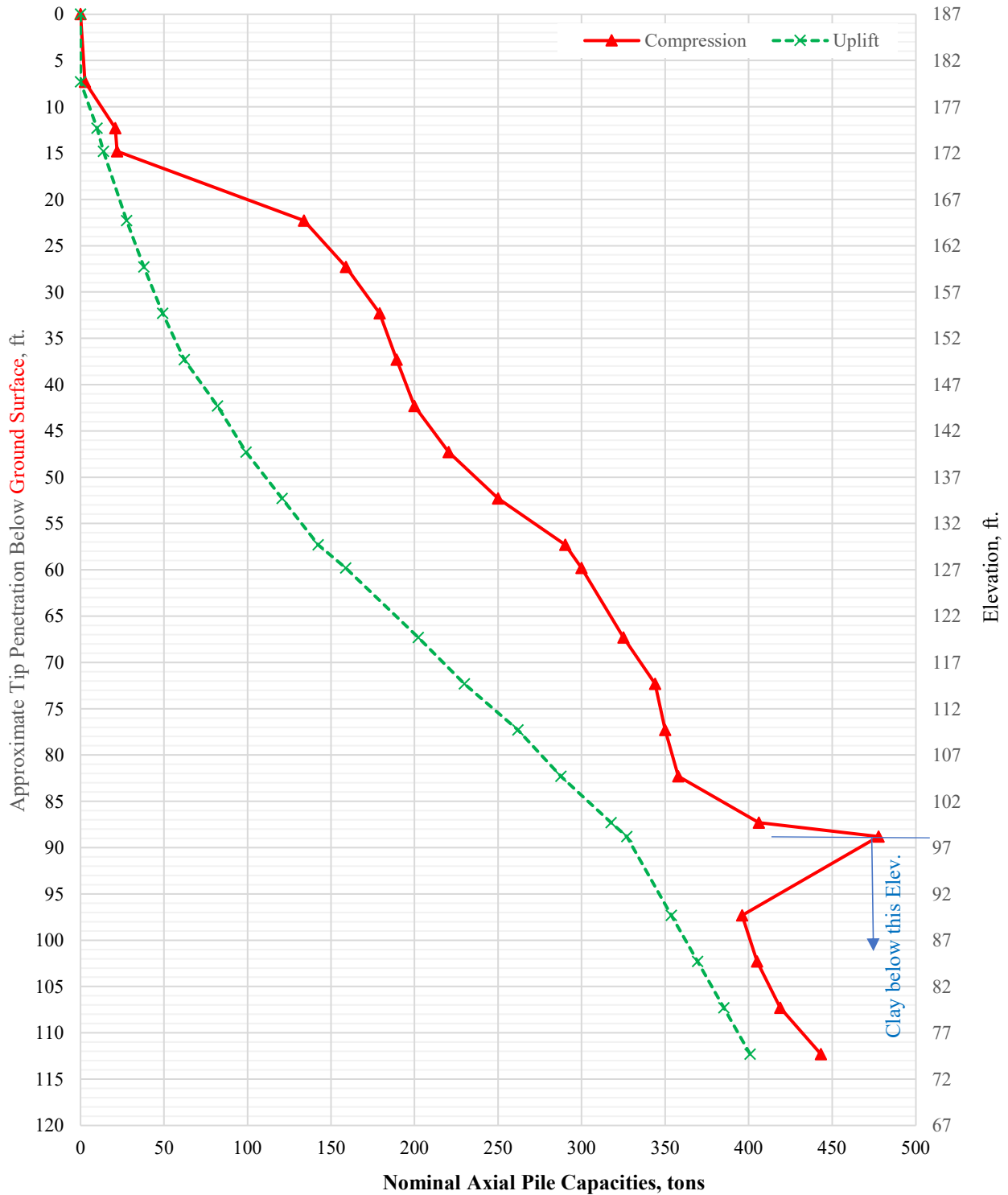
Bent 1  
 Project No.: 061745  
 Location: Lonoke County



SINGLE 18"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 2  
 Project No.: 061745  
 Location: Lenoke County

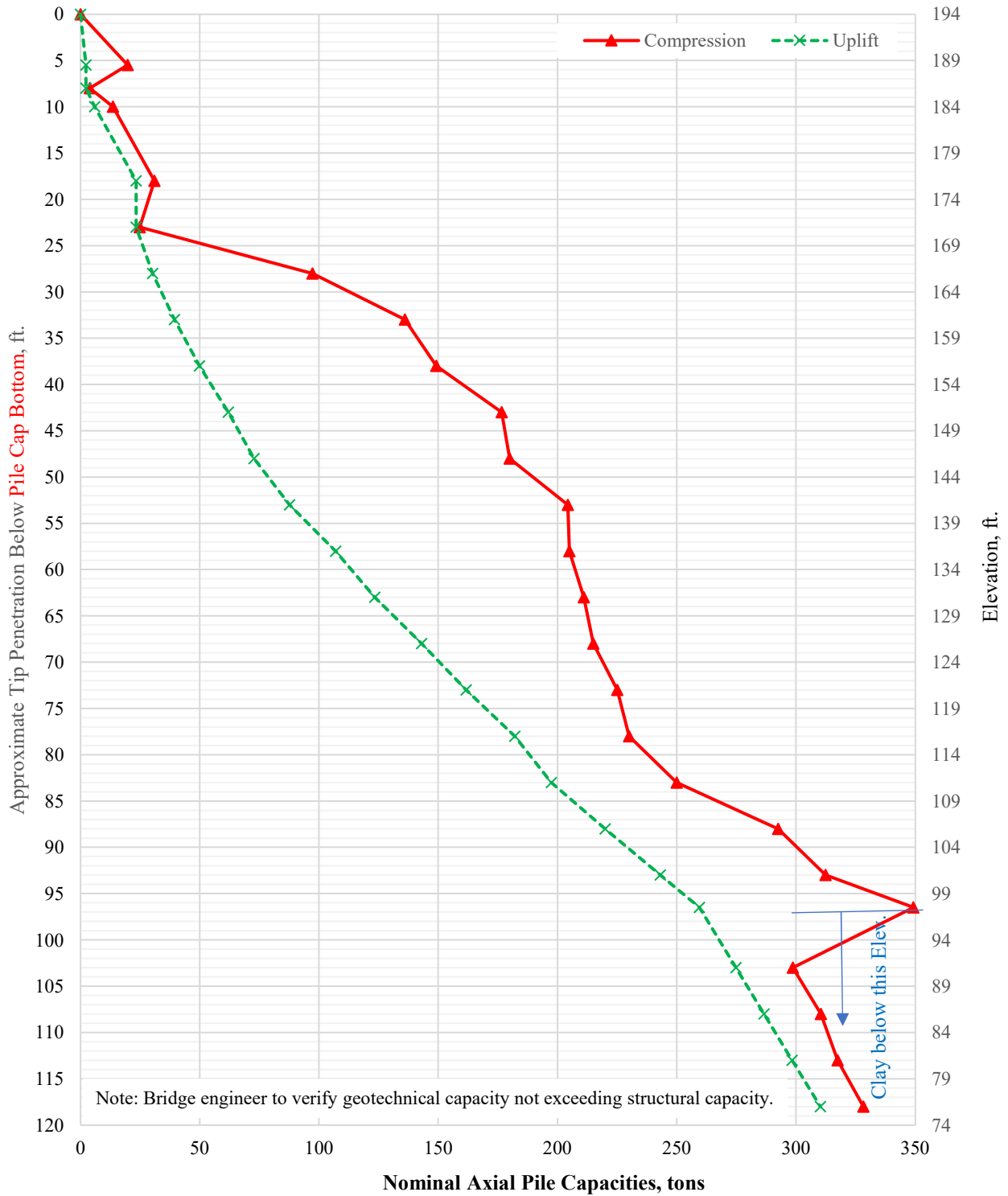




SINGLE 24"-DIAMETER CLOSED-END STEEL SHELL PILE

Bent 2  
 Project No.: 061745  
 Location: Lenoke County





SINGLE 18"-DIAMETER CLOSED-END STEEL SHELL PILE



Bent 3  
 Project No.: 061745  
 Location: Lonoke County

## Attachment I

L-Pile Parameters for Lateral Load Analysis – Bent 1

Elevation (ft.)	p-y Curve Model	Effective Unit Weight ( $\gamma$ ) (pcf)	Undrained Shear Strength ( $C_u$ ) (psf)	Strain Factor ( $\epsilon_{50}$ )	Friction Angle ( $\phi$ ) ( $^\circ$ )	Soil Modulus (k) (pci)
Above Existing Grade (fill)	Soft Clay (Matlock)	120	750	0.01	NA	NA
Existing Grade to 186	Soft Clay (Matlock)	120	1000	0.01	NA	NA
186 to 172	Soft Clay (Matlock)	42	400	0.02	NA	NA
172 to 98	Sand (Reese)	75	NA	NA	35	78
98 to 80	Stiff Clay w/ Free Water (Reese)	73	4000	0.005	NA	1000
Below 80	Stiff Clay w/ Free Water (Reese)	80	4500	0.004	NA	2000

L-Pile Parameters for Lateral Load Analysis – Bent 2

Elevation (ft.)	p-y Curve Model	Effective Unit Weight ( $\gamma$ ) (pcf)	Undrained Shear Strength ( $C_u$ ) (psf)	Strain Factor ( $\epsilon_{50}$ )	Friction Angle ( $\phi$ ) ( $^\circ$ )	Soil Modulus (k) (pci)
Existing Grade to 186	Soft Clay (Matlock)	120	1000	0.01	NA	NA
186 to 172	Soft Clay (Matlock)	42	400	0.02	NA	NA
172 to 98	Sand (Reese)	75	NA	NA	35	78
98 to 80	Stiff Clay w/ Free Water (Reese)	73	4000	0.005	NA	1000
Below 80	Stiff Clay w/ Free Water (Reese)	80	4500	0.004	NA	2000

Pile Parameters for Lateral Load Analysis – Bent 3

Elevation (ft.)	p-y Curve Model	Effective Unit Weight ( $\gamma$ ) (pcf)	Undrained Shear Strength ( $C_u$ ) (psf)	Strain Factor ( $\epsilon_{50}$ )	Friction Angle ( $\phi$ ) ( $^\circ$ )	Soil Modulus (k) (pci)
Above Existing Grade (fill)	Soft Clay (Matlock)	120	750	0.01	NA	NA
Existing Grade to 186	Soft Clay (Matlock)	115	750	0.01	NA	NA
186 To 170	Soft Clay (Matlock)	48	600	0.01	NA	NA
170 to 97	Sand (Reese)	73	NA	NA	35	78
97 to 80	Stiff Clay w/ Free Water (Reese)	80	4500	0.004	NA	2000
Below 80	Stiff Clay w/ Free Water (Reese)	74	3750	0.005	NA	1000