

ARKANSAS DEPARTMENT OF TRANSPORTATION



SUBSURFACE INVESTIGATION

STATE JOB NO. 100657

FEDERAL AID PROJECT NO. ACCMAQ-9227(74)

I-555-HWY. 49 (DR. MARTIN LUTHER KING JR. DR. EXTENSION) (S)

STATE HIGHWAY 18 SECTION 4S

IN CRAIGHEAD 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 | Scott E. Bennett, 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

September 24, 2018

TO: Mr. Trinity Smith, Engineer of Roadway Design

SUBJECT: Job No. 100657
I-555 – Hwy. 49 (Commerce Dr. Extension)(Jonesboro) (S)
Route 18 Section 4S
Craighead County

Transmitted herewith is the requested Soil Survey, strength data and Resilient Modulus test results for the above referenced job. The project consists of widening existing Commerce Drive to five lanes and extending Commerce Drive to Highway 49 on new locations. Samples were taken in the existing travel lanes, ditch line and along the new location.

Based on laboratory results of samples obtained, the subgrade soils consist primarily of moderately plastic sandy clay. Isolated locations of highly plastic clay were encountered within the project limits. Cross sections are not currently available, but it is assumed the construction grade line will closely match that the existing roadway. The subgrade soils are expected to provide a stable working platform with conventional processing if the weather is favorable during construction. There were not any slide areas observed within the project limits.


The new location traverses agricultural fields growing soy beans and rice. Prior to embankment construction any standing water should be drained and all soft unstable organic material should be undercut. Undercut requirements may vary based on seasonal conditions but are anticipated not to exceed two feet. Further earthwork recommendations will be made when cross sections become 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 in the vicinity of Black Rock.

2. Asphalt Concrete Hot Mix

Type	Asphalt Cement %	Mineral Aggregate %
Surface Course	5.2	94.8
Binder Course	4.1	95.9
Base Course	3.9	96.1


Michael C. Benson
Materials Engineer

MCB:pt:bjj
Attachment

cc: State Constr. Eng. – Master File Copy
District 10 Engineer
System Information and Research Div.
G. C. File

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY STRENGTH TEST REPORT ***

DATE - 09/13/2018
JOB NUMBER - 100657

SEQUENCE NO. - 1
MATERIAL CODE - SSRV
SPEC. YEAR - 2014
SUPPLIER ID. - 1
COUNTY/STATE - 16
DISTRICT NO. - 10

JOB NAME - I-555-HWY.49 (COMMERCE DR.EXTENSION) (JONESBORO) (S)

* STATION LIMITS R-VALUE AT 240 psi *

BEGIN JOB - END JOB LESS THAN 5

RESILIENT MODULUS	
STA. 124 + 00	8386
STA. 187 + 00	7558
STA. 235 + 00	7832
STA. 613 + 00	7174
STA. 710 + 00	7416

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.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	124+00
Date Tested:	August 14, 2018	Location:	27'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER	Depth:	0-5
Lab No.:	20181692	AASHTO Class:	A-6 (9)
Sample ID:	RV440	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	3.96
Middle	3.96
Bottom	3.95
Average	3.96
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):	12.22
Initial Volume, AoLo (cu. in):	98.01

3. Soil Specimen Weight:

Weight of Wet Soil Used (g):	3211.10
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4. Soil Properties:

Optimum Moisture Content (%):	14.7
Maximum Dry Density (pcf):	111.1
95% of MDD (pcf):	105.5
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3211.10
Compaction Moisture content (%):	15.0
Compaction Wet Density (pcf):	124.83
Compaction Dry Density (pcf):	108.55
Moisture Content After Mr Test (%):	14.8

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

7. Resilient Modulus, Mr: 10301(Sc)^{-0.17524}(S3)^{0.23864}

8. Comments

9. Tested By: GW **Date:** August 14, 2018

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No. 100657 **Material Code** SSRVPS
Date Sampled: 7/23/18 **Station No.:** 124+00
Date Tested: August 14, 2018 **Location:** 27LT
Name of Project: I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)
County: Code: 16 **Name:** CRAIGHEAD
Sampled By: DICKERSON/FRAZIER **Depth:** 0-5
Lab No.: 20181692 **AASHTO Class:** A-6 (9)
Sample ID: RV440 **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
			P _{max} lbs	S _{cyclic} psi	P _{cyclic} lbs	P _{contact} lbs							
Sequence 1	6.0	2.0	25.1	22.4	22.4	2.7	2.1	1.8	0.2	0.00103	0.00013	14,257	
Sequence 2	6.0	4.0	47.2	44.5	44.5	2.7	3.9	3.6	0.2	0.00220	0.00027	13,285	
Sequence 3	6.0	6.0	69.9	66.4	66.4	3.5	5.7	5.4	0.3	0.00357	0.00044	12,214	
Sequence 4	6.0	8.0	93.3	87.3	87.3	6.0	7.6	7.1	0.5	0.00521	0.00065	10,994	
Sequence 5	6.0	10.0	116.3	107.9	107.9	8.4	9.5	8.8	0.7	0.00700	0.00087	10,121	
Sequence 6	4.0	2.0	25.1	22.4	22.4	2.7	2.1	1.8	0.2	0.00117	0.00015	12,566	
Sequence 7	4.0	4.0	47.1	44.3	44.3	2.7	3.9	3.6	0.2	0.00248	0.00031	11,742	
Sequence 8	4.0	6.0	68.6	65.9	65.9	2.7	5.6	5.4	0.2	0.00398	0.00050	10,865	
Sequence 9	4.0	8.0	92.1	87.0	87.0	5.1	7.5	7.1	0.4	0.00565	0.00070	10,112	
Sequence 10	4.0	10.0	114.9	107.3	107.3	7.6	9.4	8.8	0.6	0.00745	0.00093	9,458	
Sequence 11	2.0	2.0	25.0	22.2	22.2	2.8	2.0	1.8	0.2	0.00141	0.00018	10,372	
Sequence 12	2.0	4.0	46.9	44.0	44.0	2.8	3.8	3.6	0.2	0.00294	0.00037	9,832	
Sequence 13	2.0	6.0	68.2	65.4	65.4	2.8	5.6	5.3	0.2	0.00462	0.00058	9,281	
Sequence 14	2.0	8.0	90.4	86.0	86.0	4.4	7.4	7.0	0.4	0.00643	0.00080	8,781	
Sequence 15	2.0	10.0	113.6	106.8	106.8	6.8	9.3	8.7	0.6	0.00836	0.00104	8,386	

TESTED BY _____ DATE August 14, 2018
 REVIEWED BY _____ DATE _____
 GW _____

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED / THINWALL TUBE SAMPLES**

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	124+00
Date Tested:	August 14, 2018	Location:	27'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER	Depth:	0-5
Lab No.:	20181692	AASHTO Class:	A-6 (9)
Sample ID:	RV440	Material Type (1 or 2):	2
LATITUDE:		LONGITUDE:	

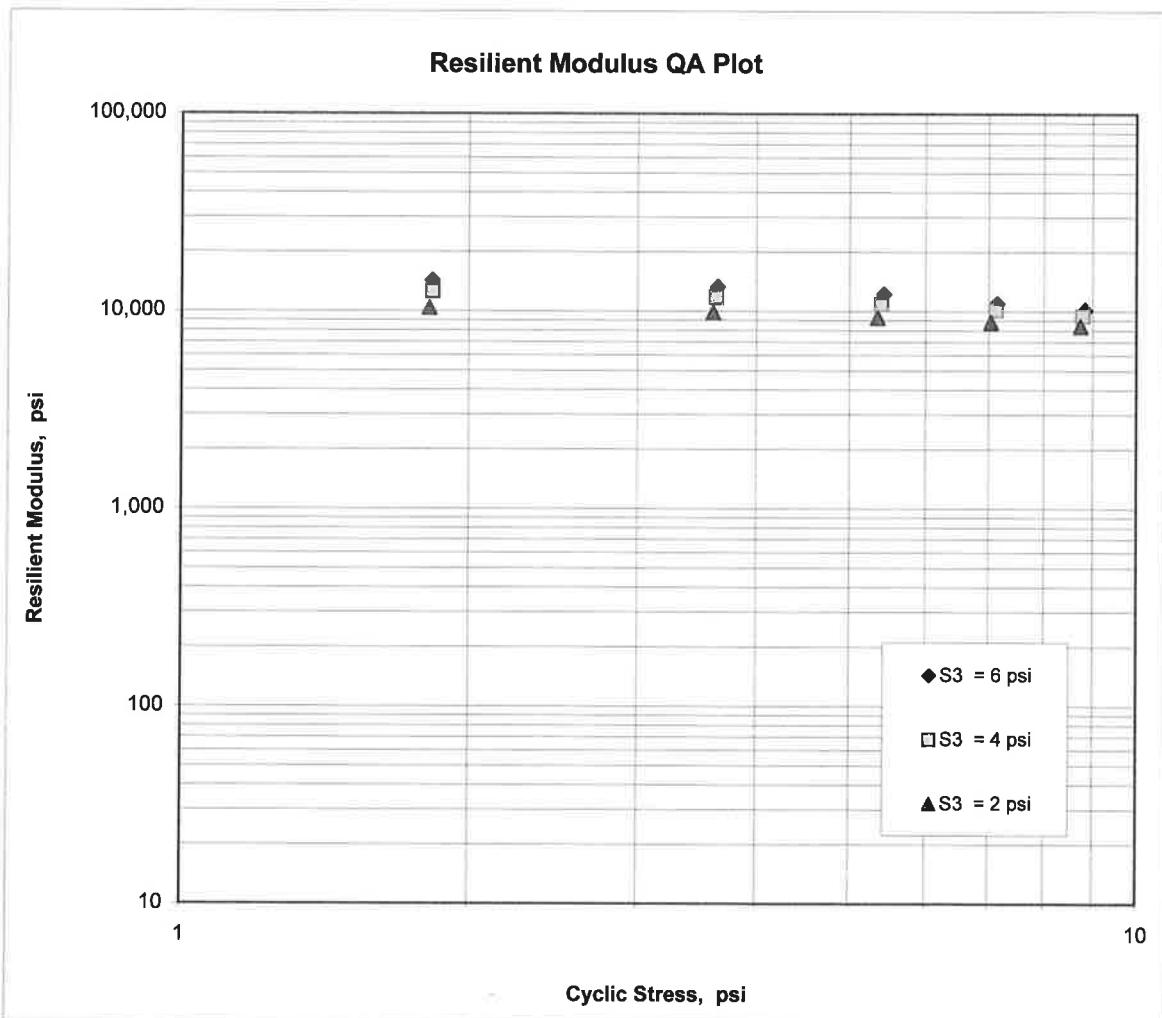
$$M_R = K_1 (S_c)^{K_2} (S_3)^{K_5}$$

$$K_1 = 10,301$$

$$K_2 = -0.17524$$

$$K_5 = 0.23864$$

$$R^2 = 0.95$$



**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	187+00
Date Tested:	August 14, 2018	Location:	15'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name: CRAIGHEAD	
Sampled By:	DICKERSON/FRAZIER		Depth: 0-5
Lab No.:	20181693	AASHTO Class:	A-4 (5)
Sample ID:	RV441	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):	3112.50
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4. Soil Properties:

Optimum Moisture Content (%):	15.7
Maximum Dry Density (pcf):	108.9
95% of MDD (pcf):	103.5
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3112.50
Compaction Moisture content (%):	15.7
Compaction Wet Density (pcf):	121.41
Compaction Dry Density (pcf):	104.93
Moisture Content After Mr Test (%):	15.4

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

7. Resilient Modulus, Mr: 7652(S_c)^{-0.11485}(S₃)^{0.31283}

8. Comments

9. Tested By: GW **Date:** August 14, 2018

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No. 100657 **Material Code** SSRVPS
Date Sampled: 7/23/18 **Station No.:** 187+00
Date Tested: August 14, 2018 **Location:** 15'LT
Name of Project: I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)
County: Code: 16 **Name:** CRAIGHEAD
Sampled By: DICKERSON/FRAZIER
Lab No.: 20181693
Sample ID: RV441
LATITUDE:

Depth: 0-5
AASHTO Class: A-4 (5)
Material Type (1 or 2): 2
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
	S ₃ psi	S _{cyclic} psi	P _{max} lbs	P _{cyclic} lbs	P _{contact} lbs	S _{max} psi	S _{cyclic} psi	S _{contact} psi	H _{avg} in	ε _r in/in	M _r psi
Sequence 1	6.0	2.0	25.2	22.5	2.6	2.1	1.9	0.2	0.00119	0.00015	12,512
Sequence 2	6.0	4.0	47.2	44.5	2.7	3.9	3.7	0.2	0.00246	0.00031	11,921
Sequence 3	6.0	6.0	69.8	66.3	3.5	5.7	5.4	0.3	0.00384	0.00048	11,376
Sequence 4	6.0	8.0	93.5	87.5	6.0	7.7	7.2	0.5	0.00542	0.00068	10,636
Sequence 5	6.0	10.0	117.3	108.8	8.5	9.6	8.9	0.7	0.00709	0.00088	10,105
Sequence 6	4.0	2.0	25.1	22.2	2.8	2.1	1.8	0.2	0.00133	0.00017	11,014
Sequence 7	4.0	4.0	46.7	43.9	2.8	3.8	3.6	0.2	0.00284	0.00035	10,182
Sequence 8	4.0	6.0	68.4	65.4	2.9	5.6	5.4	0.2	0.00448	0.00056	9,629
Sequence 9	4.0	8.0	91.8	86.5	5.3	7.5	7.1	0.4	0.00614	0.00077	9,271
Sequence 10	4.0	10.0	115.4	107.7	7.7	9.5	8.8	0.6	0.00784	0.00098	9,040
Sequence 11	2.0	2.0	24.8	21.9	2.8	2.0	1.8	0.2	0.00167	0.00021	8,656
Sequence 12	2.0	4.0	46.2	43.3	2.9	3.8	3.6	0.2	0.00348	0.00043	8,201
Sequence 13	2.0	6.0	67.3	64.5	2.9	5.5	5.3	0.2	0.00537	0.00067	7,905
Sequence 14	2.0	8.0	90.0	85.6	4.4	7.4	7.0	0.4	0.00729	0.00091	7,733
Sequence 15	2.0	10.0	113.1	106.2	6.9	9.3	8.7	0.6	0.00926	0.00115	7,558

TESTED BY _____ DATE August 14, 2018
 REVIEWED BY _____ DATE _____

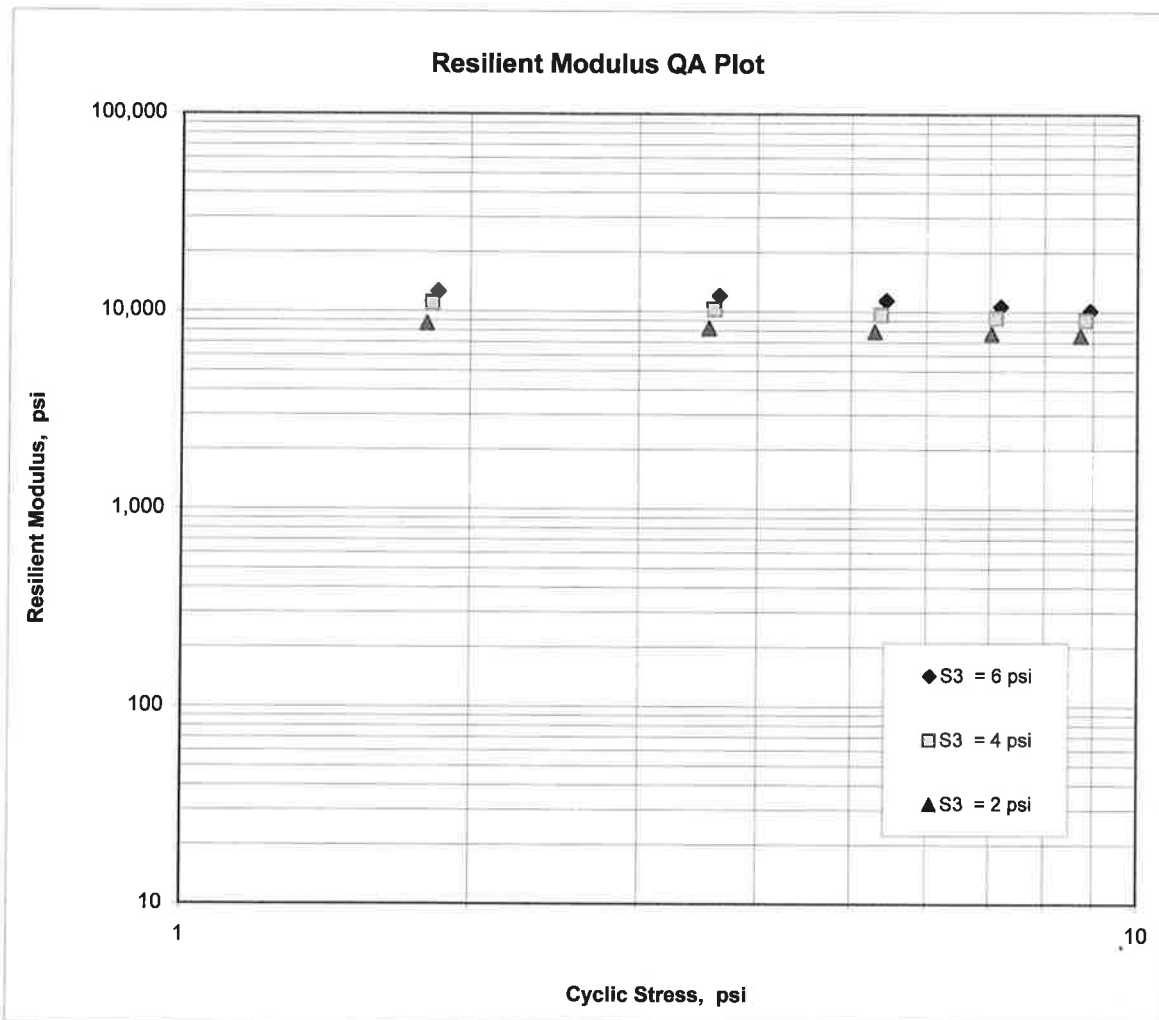
**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED / THINWALL TUBE SAMPLES**

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	187+00
Date Tested:	August 14, 2018	Location:	15'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER	Depth:	0-5
Lab No.:	20181693	AASHTO Class:	A-4 (5)
Sample ID:	RV441	Material Type (1 or 2):	2
LATITUDE:		LONGITUDE:	

$$M_R = K_1 (S_c)^{K_2} (S_3)^{K_5}$$

$K_1 = 7,652$
 $K_2 = -0.11485$
 $K_5 = 0.31283$
 $R^2 = 0.99$



**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	235+00
Date Tested:	August 14, 2018	Location:	10'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER	Depth:	0-5
Lab No.:	20181694	AASHTO Class:	A-4 (0)
Sample ID:	RV442	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):	3034.30
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4. Soil Properties:

Optimum Moisture Content (%):	16.2
Maximum Dry Density (pcf):	105.5
95% of MDD (pcf):	100.2
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3034.30
Compaction Moisture content (%):	15.9
Compaction Wet Density (pcf):	118.36
Compaction Dry Density (pcf):	102.12
Moisture Content After Mr Test (%):	15.9

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

#VALUE!

7. Resilient Modulus, Mr:

8350(Sc)^{-0.12050(S3)^{0.27189}}

8. Comments

9. Tested By:

GW

Date: August 14, 2018

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No. 100657 **Material Code** SSRVPS
Date Sampled: 7/23/18 **Station No.:** 235+00
Date Tested: August 14, 2018 **Location:** 10'LT
Name of Project: I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)
County: Code: 16 **Name:** CRAIGHEAD
Sampled By: DICKERSON/FRAZIER
Lab No.: 20181694
Sample ID: RV442
LATITUDE:
Depth: 0-5
AASHTO Class: A-4 (0)
Material Type (1 or 2): 2
LONGITUDE:

PARAMETER	Chamber Confining Pressure	Normal 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
	S ₃ psi	S _{cyclic} psi	P _{max} lbs	P _{cyclic} lbs	P _{contact} lbs	S _{max} psi	S _{cyclic} psi	S _{contact} psi	H _{avg} in	ε _r in/in	M _r psi
Sequence 1	6.0	2.0	25.2	22.4	2.8	2.1	1.8	0.2	0.00120	0.00015	12,331
Sequence 2	6.0	4.0	47.4	44.7	2.8	3.9	3.7	0.2	0.00249	0.00031	11,805
Sequence 3	6.0	6.0	70.2	66.6	3.6	5.8	5.5	0.3	0.00386	0.00048	11,355
Sequence 4	6.0	8.0	94.1	88.1	6.0	7.7	7.2	0.5	0.00540	0.00067	10,736
Sequence 5	6.0	10.0	118.1	109.7	8.4	9.7	9.0	0.7	0.00688	0.00086	10,492
Sequence 6	4.0	2.0	25.1	22.5	2.6	2.1	1.8	0.2	0.00132	0.00016	11,238
Sequence 7	4.0	4.0	46.9	44.1	2.7	3.8	3.6	0.2	0.00284	0.00035	10,225
Sequence 8	4.0	6.0	68.4	65.6	2.7	5.6	5.4	0.2	0.00444	0.00055	9,738
Sequence 9	4.0	8.0	92.3	87.2	5.1	7.6	7.2	0.4	0.00598	0.00075	9,597
Sequence 10	4.0	10.0	116.2	108.8	7.5	9.5	8.9	0.6	0.00761	0.00095	9,406
Sequence 11	2.0	2.0	24.8	22.5	2.3	2.0	1.8	0.2	0.00152	0.00019	9,711
Sequence 12	2.0	4.0	46.2	43.7	2.4	3.8	3.6	0.2	0.00331	0.00041	8,695
Sequence 13	2.0	6.0	66.8	64.3	2.5	5.5	5.3	0.2	0.00524	0.00065	8,081
Sequence 14	2.0	8.0	89.2	85.2	4.0	7.3	7.0	0.3	0.00715	0.00089	7,855
Sequence 15	2.0	10.0	112.9	106.4	6.6	9.3	8.7	0.5	0.00894	0.00111	7,832

TESTED BY _____
 REVIEWED BY _____

GW _____
 DATE August 14, 2018
 DATE _____

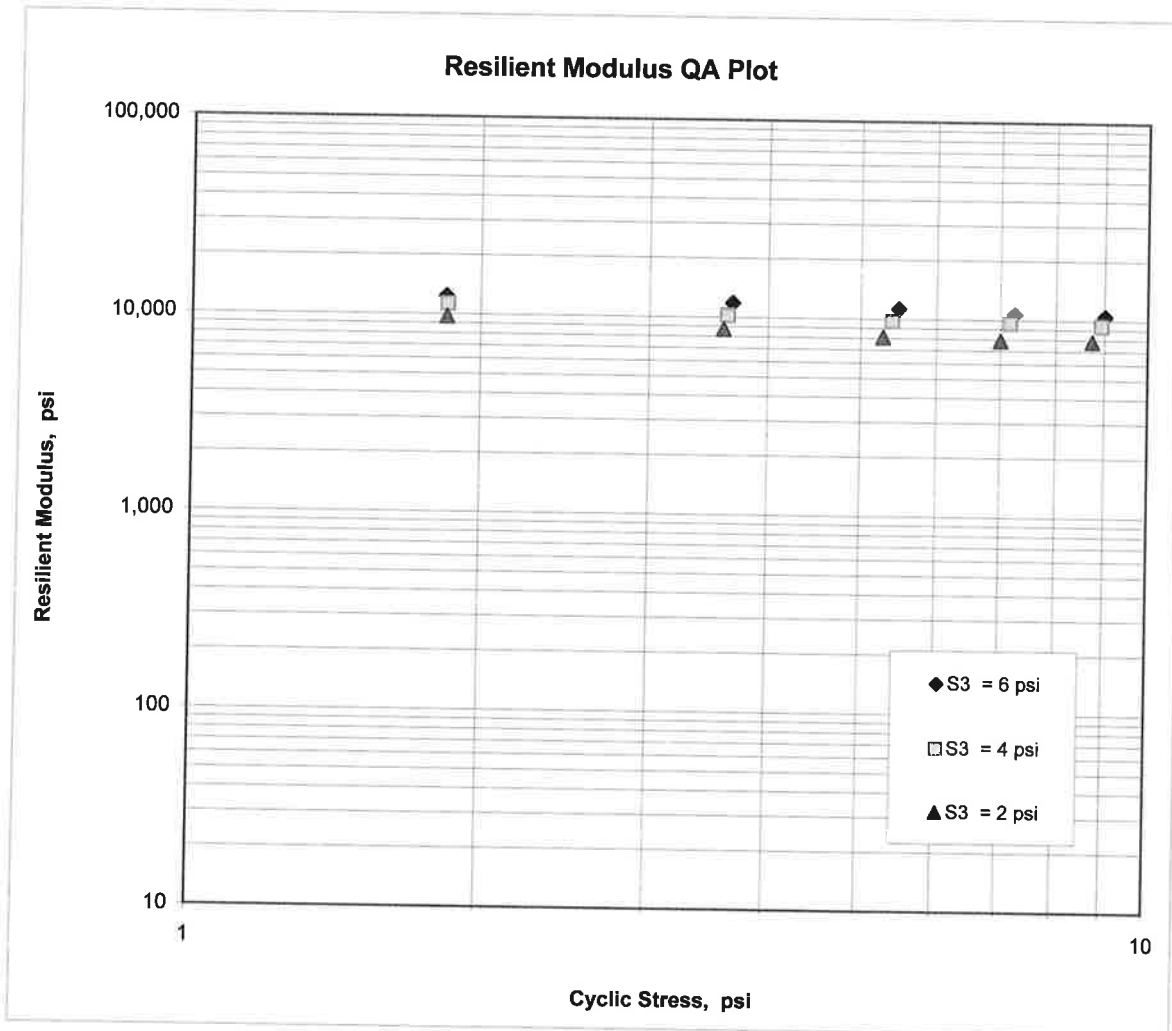
**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED / THINWALL TUBE SAMPLES**

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	235+00
Date Tested:	August 14, 2018	Location:	10'LT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER		Depth: 0-5
Lab No.:	20181694	AASHTO Class:	A-4 (0)
Sample ID:	RV442	Material Type (1 or 2):	2
LATITUDE:		LONGITUDE:	

$$M_R = K_1 (S_c)^{K_2} (S_3)^{K_5}$$

K1 =	8,350
K2 =	-0.12050
K5 =	0.27189
R ² =	0.99



**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	613+00
Date Tested:	August 15, 2018	Location:	14'RT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER		
Lab No.:	20181695	Depth:	0-5
Sample ID:	RV443	AASHTO Class:	A-4 (5)
LATITUDE:		Material Type (1 or 2):	2
		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):	3195.80
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4. Soil Properties:

Optimum Moisture Content (%):	15.5
Maximum Dry Density (pcf):	110.1
95% of MDD (pcf):	104.6
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3195.80
Compaction Moisture content (%):	15.7
Compaction Wet Density (pcf):	124.66
Compaction Dry Density (pcf):	107.74
Moisture Content After Mr Test (%):	15.6

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

7. Resilient Modulus, Mr: 8549(Sc)^{-0.18879}(S3)^{0.30612}

8. Comments

9. Tested By: GW **Date:** August 15, 2018

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AAASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED SAMPLES**

Job No. 100657 **Material Code** SSRVPS
Date Sampled: 7/23/18 **Station No.:** 613+00
Date Tested: August 15, 2018 **Location:** 14'RT
Name of Project: I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)
County: Code: 16 **Name:** CRAIGHEAD
Sampled By: DICKERSON/FRAZIER
Lab No.: 20181695
Sample ID: RV443
LATITUDE:
Depth: 0-5
AAASHTO Class: A-4 (5)
Material Type (1 or 2): 2
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
Sequence 1	6.0	2.0	25.3	22.4	2.8	2.1	1.8	0.2	0.00114	0.00014	12,973
Sequence 2	6.0	4.0	47.4	44.6	2.8	3.9	3.7	0.2	0.00240	0.00030	12,247
Sequence 3	6.0	6.0	70.0	66.4	3.7	5.7	5.4	0.3	0.00389	0.00049	11,227
Sequence 4	6.0	8.0	93.6	87.5	6.1	7.7	7.2	0.5	0.00572	0.00071	10,070
Sequence 5	6.0	10.0	117.1	108.6	8.5	9.6	8.9	0.7	0.00753	0.00094	9,494
Sequence 6	4.0	2.0	25.1	22.3	2.8	2.1	1.8	0.2	0.00128	0.00016	11,434
Sequence 7	4.0	4.0	47.0	44.1	2.9	3.9	3.6	0.2	0.00282	0.00035	10,290
Sequence 8	4.0	6.0	68.3	65.4	2.9	5.6	5.4	0.2	0.00458	0.00057	9,411
Sequence 9	4.0	8.0	91.9	86.7	5.2	7.5	7.1	0.4	0.00643	0.00080	8,883
Sequence 10	4.0	10.0	115.4	107.7	7.7	9.5	8.8	0.6	0.00838	0.00104	8,463
Sequence 11	2.0	2.0	25.0	22.2	2.8	2.1	1.8	0.2	0.00157	0.00020	9,331
Sequence 12	2.0	4.0	46.3	43.5	2.8	3.8	3.6	0.2	0.00342	0.00043	8,368
Sequence 13	2.0	6.0	66.9	64.1	2.8	5.5	5.3	0.2	0.00542	0.00068	7,781
Sequence 14	2.0	8.0	89.2	84.8	4.3	7.3	7.0	0.4	0.00761	0.00095	7,337
Sequence 15	2.0	10.0	112.2	105.4	6.8	9.2	8.7	0.6	0.00967	0.00121	7,174

TESTED BY _____ DATE August 15, 2018
 REVIEWED BY _____ DATE _____
 GW _____

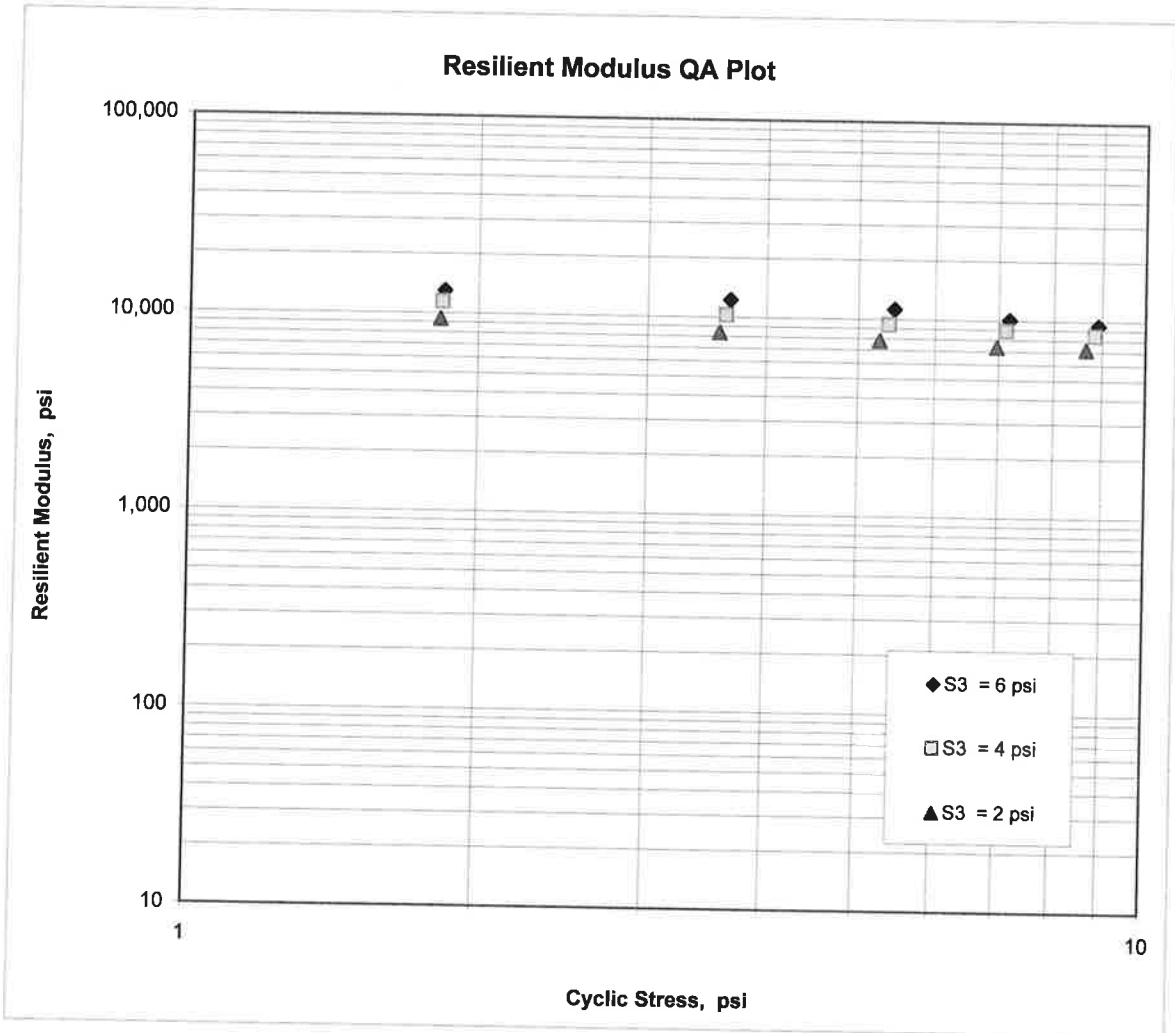
**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED / THINWALL TUBE SAMPLES**

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	613+00
Date Tested:	August 15, 2018	Location:	14'RT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER		Depth: 0-5
Lab No.:	20181695	AASHTO Class:	A-4 (5)
Sample ID:	RV443	Material Type (1 or 2):	2
LATITUDE:		LONGITUDE:	

$$M_R = K_1 (S_c)^{K_2} (S_3)^{K_5}$$

K1 =	<u>8,549</u>
K2 =	<u>-0.18879</u>
K5 =	<u>0.30612</u>
R² =	<u>0.98</u>



**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	710+00
Date Tested:	August 15, 2018	Location:	12'RT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name: CRAIGHEAD	
Sampled By:	DICKERSON/FRAZIER		
Lab No.:	20181696	Depth:	0-5
Sample ID:	RV444	AASHTO Class:	A-4 (7)
LATITUDE:		Material Type (1 or 2):	2
		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):	3017.40
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4. Soil Properties:

Optimum Moisture Content (%):	17.5
Maximum Dry Density (pcf):	104.4
95% of MDD (pcf):	99.2
In-Situ Moisture Content (%):	N/A

5. Specimen Properties:

Wet Weight (g):	3017.40
Compaction Moisture content (%):	17.7
Compaction Wet Density (pcf):	117.70
Compaction Dry Density (pcf):	100.00
Moisture Content After Mr Test (%):	17.7

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

#VALUE!

7. Resilient Modulus, Mr:

8291(S_c)^{-0.16234}(S₃)^{0.32214}

8. Comments

9. Tested By: GW

Date: August 15, 2018

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

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

Job No. 100657 **Material Code** SSRVPS
Date Sampled: 7/23/18 **Station No.:** 710+00
Date Tested: August 15, 2018 **Location:** 12'RT
Name of Project: I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)
County: Code: 16 **Name:** CRAIGHEAD
Sampled By: DICKERSON/FRAZIER
Lab No.: 20181696
Sample ID: RV444
LATITUDE:
Depth: 0-5
AASHTO Class: A-4 (7)
Material Type (1 or 2): 2
LONGITUDE:

PARAMETER	Chamber Confining Pressure	S ₃ psi	Nominal Maximum Axial Stress	S _{cyclic} psi	Actual Applied Max. Axial Load	P _{max} lbs	Actual Applied Cyclic Load	P _{cyclic} lbs	Actual Applied Contact Load	P _{contact} lbs	Actual Applied Max. Axial Stress	S _{max} psi	Actual Applied Cyclic Stress	S _{cyclic} psi	Actual Applied Contact Stress	S _{contact} psi	Average Recov Def. LVDT 1 and 2	H _{avg} in	Resilient Strain	ε _r in/in	Resilient Modulus	M _r psi
Sequence 1	6.0	2.0	2.0	25.4	25.4	22.6	22.6	22.6	2.7	2.7	2.1	2.1	1.9	1.9	0.2	0.2	0.00113	0.00113	0.00014	0.00014	13,220	13,220
Sequence 2	6.0	4.0	4.0	47.5	47.5	44.7	44.7	44.7	2.8	2.8	3.9	3.9	3.7	3.7	0.2	0.2	0.00235	0.00235	0.00029	0.00029	12,513	12,513
Sequence 3	6.0	6.0	6.0	70.1	70.1	66.5	66.5	66.5	3.6	3.6	5.8	5.8	5.5	5.5	0.3	0.3	0.00379	0.00379	0.00047	0.00047	11,548	11,548
Sequence 4	6.0	8.0	8.0	93.9	93.9	87.8	87.8	87.8	6.1	6.1	7.7	7.7	7.2	7.2	0.5	0.5	0.00540	0.00540	0.00067	0.00067	10,704	10,704
Sequence 5	6.0	10.0	10.0	117.0	117.0	108.4	108.4	108.4	8.6	8.6	9.6	9.6	8.9	8.9	0.7	0.7	0.00713	0.00713	0.00089	0.00089	10,012	10,012
Sequence 6	4.0	2.0	2.0	25.1	25.1	22.3	22.3	22.3	2.8	2.8	2.1	2.1	1.8	1.8	0.2	0.2	0.00127	0.00127	0.00016	0.00016	11,593	11,593
Sequence 7	4.0	4.0	4.0	47.0	47.0	44.2	44.2	44.2	2.9	2.9	3.9	3.9	3.6	3.6	0.2	0.2	0.00276	0.00276	0.00034	0.00034	10,547	10,547
Sequence 8	4.0	6.0	6.0	68.5	68.5	65.6	65.6	65.6	2.9	2.9	5.6	5.6	5.4	5.4	0.2	0.2	0.00439	0.00439	0.00055	0.00055	9,832	9,832
Sequence 9	4.0	8.0	8.0	92.1	92.1	86.8	86.8	86.8	5.2	5.2	7.6	7.6	7.1	7.1	0.4	0.4	0.00619	0.00619	0.00077	0.00077	9,243	9,243
Sequence 10	4.0	10.0	10.0	115.6	115.6	107.9	107.9	107.9	7.7	7.7	9.5	9.5	8.9	8.9	0.6	0.6	0.00795	0.00795	0.00099	0.00099	8,942	8,942
Sequence 11	2.0	2.0	2.0	24.9	24.9	22.1	22.1	22.1	2.8	2.8	2.0	2.0	1.8	1.8	0.2	0.2	0.00157	0.00157	0.00020	0.00020	9,246	9,246
Sequence 12	2.0	4.0	4.0	46.3	46.3	43.4	43.4	43.4	2.8	2.8	3.8	3.8	3.6	3.6	0.2	0.2	0.00335	0.00335	0.00042	0.00042	8,535	8,535
Sequence 13	2.0	6.0	6.0	67.0	67.0	64.2	64.2	64.2	2.8	2.8	5.5	5.5	5.3	5.3	0.2	0.2	0.00535	0.00535	0.00067	0.00067	7,895	7,895
Sequence 14	2.0	8.0	8.0	89.2	89.2	84.9	84.9	84.9	4.3	4.3	7.3	7.3	7.0	7.0	0.4	0.4	0.00732	0.00732	0.00091	0.00091	7,634	7,634
Sequence 15	2.0	10.0	10.0	112.6	112.6	105.8	105.8	105.8	6.7	6.7	9.2	9.2	8.7	8.7	0.6	0.6	0.00940	0.00940	0.00117	0.00117	7,416	7,416

TESTED BY _____ DATE August 15, 2018
 REVIEWED BY _____ DATE _____
 GW _____

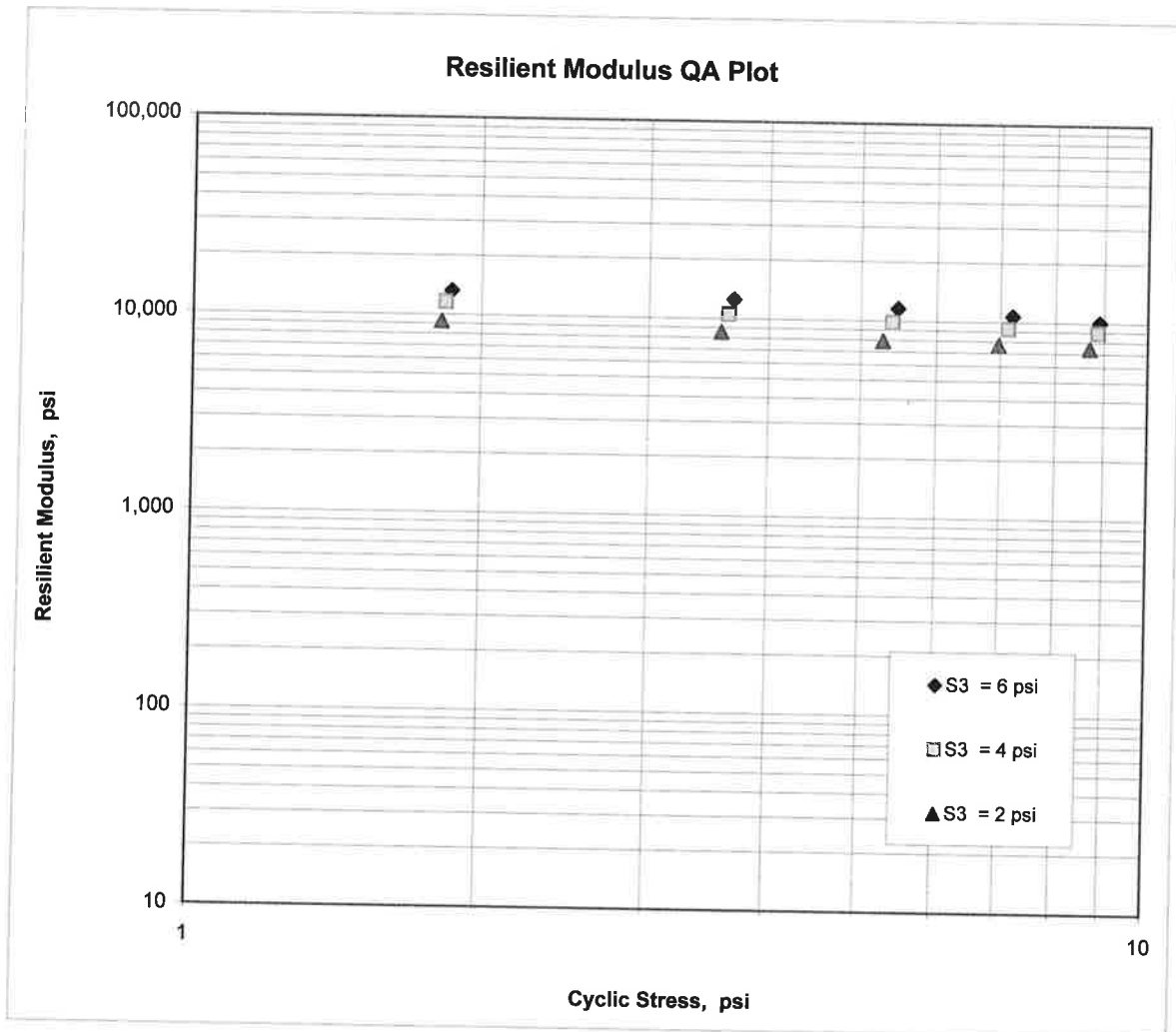
**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED / THINWALL TUBE SAMPLES**

Job No.	100657	Material Code	SSRVPS
Date Sampled:	7/23/18	Station No.:	710+00
Date Tested:	August 15, 2018	Location:	12'RT
Name of Project:	I-555-HWY. 49 (COMMERCE DR. EXTENSION) (JONESBORO)(S)		
County:	Code: 16	Name:	CRAIGHEAD
Sampled By:	DICKERSON/FRAZIER		Depth: 0-5
Lab No.:	20181696	AASHTO Class:	A-4 (7)
Sample ID:	RV444	Material Type (1 or 2):	2
LATITUDE:		LONGITUDE:	

$$M_R = K_1 (S_C)^{K_2} (S_3)^{K_5}$$

$K_1 =$	<u>8,291</u>
$K_2 =$	<u>-0.16234</u>
$K_5 =$	<u>0.32214</u>
$R^2 =$	<u>0.99</u>



STA.#	LOC.	DEPTH	COLOR	#4 #10 #40 #80 #200					L.L.	P.I.	SOIL CLASS	LAB #:	%MOISTURE
				S	I	E	V	E					
124+00	27 LT		BR/GR	98	96	91	83	79	31	13	A-6(9)	RV440	
187+00	15 LT	0-5	BR/GR					93	27	07	A-4(5)	RV441	
235+00	10 LT	0-5	BROWN					97	ND	NP	A-4(0)	RV442	
613+00	14 RT	0-5	BROWN	98	95	92	84	81	26	08	A-4(5)	RV443	
710+00	12 RT	0-5	BROWN	97	94	91	87	86	31	09	A-4(7)	RV444	
115+00	06 RT		BROWN					91	22	7	A-4(4)	S401	23.8
115+00	27 RT		BROWN	98	97	93	53	37	ND	NP	A-4(0)	S402	13.5
124+00	06 LT		BR/GR					95	30	13	A-6(11)	S403	22.6
124+00	27 LT		BR/GR	98	89	79	72	64	31	14	A-6(6)	S404	23.7
131+00	06 RT		BROWN					94	36	16	A-6(15)	S405	25.4
131+00	27 RT		BROWN					93	33	15	A-6(13)	S406	25.6
138+00	06 LT		BR/GR	97	90	83	77	65	25	10	A-4(4)	S407	22.5
138+00	18 LT		BROWN	98	97	90	89	88	27	10	A-4(7)	S408	23.5
147+00	06 RT		BR/GR					90	40	23	A-6(21)	S409	20.5
155+00	06 LT		BROWN	95	92	89	85	81	29	13	A-6(9)	S410	22.8
155+00	18 LT		BROWN	95	94	92	89	85	34	19	A-6(15)	S411	21.5
164+00	06 RT		GRAY					99	31	15	A-6(14)	S412	20.4
170+00	06 LT	0-5	BR/GR	94	88	77	70	67	ND	NP	A-4(0)	S413	23.1
179+00	09 RT	0-5	GRAY					96	26	6	A-4(5)	S414	22.7
187+00	06 LT	0-5	BR/GR	94	92	89	87	83	23	5	A-4(2)	S415	19.8
187+00	15 LT	0-5	BR/GR	91	90	89	88	88	30	12	A-6(9)	S416	20.1
195+00	06 RT	0-5	GRAY					94	30	13	A-6(11)	S417	20.9
203+00	06 LT	0-5	BR/GR					93	29	13	A-6(11)	S418	23.5
203+00	15 LT	0-5	BR/GR					93	33	15	A-6(13)	S419	19.7
211+00	06 RT	0-5	GRAY					99	31	13	A-6(12)	S420	24.7
219+00	06 LT	0-5	BR/GR					93	27	8	A-4(6)	S421	21

comments: W=MULTIPLE LAYERS, X=STRIPPED

Friday, September 21, 2018

STA.#	LOC.	DEPTH	COLOR	#200					L.L.	P.I.	SOIL CLASS	LAB #:	%MOISTURE
				S	I	E	V	S					
226+00	06 RT	0-5	BR/GR					96	33	18	A-6(17)	S422	21.7
235+00	10 LT	0-5	BROWN					98	ND	NP	A-4(0)	S423	10.6
241+00	CL	0-5	BROWN					98	29	11	A-6(10)	S424	22.7
253+50	CL	0-5	BROWN					95	27	8	A-4(7)	S425	27.2
255+00	CL	0-5	BROWN					96	28	7	A-4(6)	S426	28.1
267+00	150 LT	0-5	BROWN					97	48	31	A-7-6(32)	S427	34.6
275+80	30 LT	0-5	BROWN					99	ND	NP	A-4(0)	S428	23.5
283+00	CL	0-5	BROWN					99	ND	NP	A-4(0)	S429	22
291+00	CL	0-5	BROWN					97	27	6	A-4(5)	S430	10.4
299+00	70 LT	0-5	BROWN					96	30	12	S-4(11)	S431	17.5
304+00	CL	0-5	BROWN					99	35	18	A-6(18)	S432	25.1
317+00	CL	0-5	BROWN					93	ND	NP	A-4(0)	S433	23.4
339+00	CL	0-5	BROWN					93	ND	NP	A-4(0)	S434	11.9
347+12	CL	0-5	BROWN	96	91	82	79	76	36	20	A-6(13)	S435	20.2
347+30	CL	0-5	BROWN	81	73	63	60	58	29	14	A-6(5)	S436	27.6
355+00	06 LT	0-5	BROWN					94	28	8	A-4(7)	S437	23.6
613+00	05 RT	0-5	BROWN	98	96	92	89	88	30	12	A-6(9)	S438	27.6
710+00	05 RT	0-5	BROWN					92	40	22	A-6(21)	S439	23.5

comments: W=MULTIPLE LAYERS, X= STRIPPED

Friday, September 21, 2018

STA.# LOC.

PAVEMENT SOUNDINGS

203+00	06 LT	ACHMSC 4.5W	AGG. BASE CRS CL-7 10.0
203+00	15 LT	ACHMSC	
211+00	06 RT	ACHMSC 6.0WX	
219+00	06 LT	ACHMSC 10.0W	
226+00	06 RT	ACHMSC 6.5W	
235+00	10 LT	ACHMSC	
241+00	CL	ACHMSC	
339+00	CL	ACHMSC	AGG. BASE CRS.CL-5
347+12	CL	ACHMSC 7.0WX	AGG. BASE CRS.CL-5 36.0
347+30	CL	ACHMSC	AGG. BASE CRS.CL-5
355+00	06 LT	CHIP SEAL	AGG. BASE CRS.CL-5 6.0
613+00	05 RT	CHIP SEAL .25	AGG. BASE CRS.CL-5 7.0
710+00	05 RT	CHIP SEAL	AGG. BASE CRS.CL-5 8.0

comments: W=MULTIPLE LAYERS, X= STRIPPED

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION

MICHAEL BENSON, MATERIALS ENGINEER

*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE	- 09/13/18	SEQUENCE NO.	- 2
JOB NUMBER	- 100657	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	- 16
SUPPLIER NAME	- STATE	DISTRICT NO.	- 10
NAME OF PROJECT	- I-555-HWY.49 (COMMERCE DR.EXTENSION) (JONESBORO) (S)		
PROJECT ENGINEER	- NOT APPLICABLE		
PIT/QUARRY	- ARKANSAS		
LOCATION	- CRAIGHEAD COUNTY		
SAMPLED BY	- DICKERSON/FRAZIER	DATE SAMPLED	- 07/23/18
SAMPLE FROM	- TEST HOLE	DATE RECEIVED	- 07/26/18
MATERIAL DESC.	- SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS	DATE TESTED	- 09/13/18

LAB NUMBER	- 20181656	- 20181657	- 20181658
SAMPLE ID	- S404	- S405	- S406
TEST STATUS	- INFORMATION ONLY	- INFORMATION ONLY	- INFORMATION ONLY
STATION	- 124+00	- 131+00	- 131+00
LOCATION	- 27 LT	- 06 RT	- 27 RT
DEPTH IN FEET	-	-	-
MAT'L COLOR	- BR/GR	- BROWN	- BROWN
MAT'L TYPE	-	-	-
LATITUDE DEG-MIN-SEC	- 35 48 25.10	- 35 48 32.00	- 35 48 32.00
LONGITUDE DEG-MIN-SEC	- 90 37 28.80	- 90 37 28.20	- 90 37 28.00
% PASSING	2 IN. -	-	-
	1 1/2 IN. -	-	-
	3/4 IN. - 100	-	-
	3/8 IN. - 99	- 100	- 100
	NO. 4 - 98	-	-
	NO. 10 - 89	-	-
	NO. 40 - 79	-	-
	NO. 80 - 72	-	-
	NO. 200 - 64	- 94	- 93
LIQUID LIMIT	- 31	- 36	- 33
PLASTICITY INDEX	- 14	- 16	- 15
AASHTO SOIL	- A-6(6)	- A-6(15)	- A-6(13)
UNIFIED SOIL	-	-	-
% MOISTURE CONTENT	- 23.7	- 25.4	- 25.6
ACHMSC (IN)	- ---	- 15.5W	- ---
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-

REMARKS - W=MULTIPLE LAYERS, X=STRIPPED
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-
-

AASHTO TESTS : T24 T88 T89 T90 T265
;

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION

MICHAEL BENSON, MATERIALS ENGINEER

*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE	- 09/18/18	SEQUENCE NO.	- 5
JOB NUMBER	- 100657	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	- 16
SUPPLIER NAME	- STATE	DISTRICT NO.	- 10
NAME OF PROJECT	- I-555-HWY.49 (COMMERCE DR.EXTENSION) (JONESBORO) (S)		
PROJECT ENGINEER	- NOT APPLICABLE		
PIT/QUARRY	- ARKANSAS		
LOCATION	- CRAIGHEAD COUNTY	DATE SAMPLED	- 07/23/18
SAMPLED BY	- DICKERSON/FRAZIER	DATE RECEIVED	- 07/26/18
SAMPLE FROM	- TEST HOLE	DATE TESTED	- 09/13/18
MATERIAL DESC.	- SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS		

LAB NUMBER	- 20181665	- 20181666	- 20181667
SAMPLE ID	- S413	- S414	- S415
TEST STATUS	- INFORMATION ONLY	- INFORMATION ONLY	- INFORMATION ONLY
STATION	- 170+00	- 179+00	- 187+00
LOCATION	- 06 LT	- 09 RT	- 06 LT
DEPTH IN FEET	- 0-5	- 0-5	- 0-5
MAT'L COLOR	- BR/GR	- GRAY	- BR/GR
MAT'L TYPE	-	-	-
LATITUDE DEG-MIN-SEC	- 35 49 10.70	- 35 49 19.30	- 35 49 27.50
LONGITUDE DEG-MIN-SEC	- 90 37 27.10	- 90 37 26.40	- 90 37 26.20
% PASSING	2 IN. -	-	-
	1 1/2 IN. -	100	-
	3/4 IN. - 100	-	100
	3/8 IN. - 99	-	99
	NO. 4 - 94	-	94
	NO. 10 - 88	-	92
	NO. 40 - 77	-	89
	NO. 80 - 70	-	87
	NO. 200 - 67	96	83
LIQUID LIMIT	- ND	- 26	- 23
PLASTICITY INDEX	- NP	- 6	- 5
AASHTO SOIL	- A-4 (0)	- A-4 (5)	- A-4 (2)
UNIFIED SOIL	-	-	-
% MOISTURE CONTENT	- 23.1	- 22.7	- 19.8
ACHMSC (IN)	- 4.0	- ---	- ---
ACHMBC (IN)	- 2.0	- ---	- ---
ACHMSC (IN)	- 2.5	- ---	- ---
ACHMBC (IN)	- 3.5	- ---	- ---
CHIP SEAL (IN)	- ---	- .25	- ---
ACHMSC (IN)	- ---	- 6.5WX	- ---
	-	-	-
	-	-	-
	-	-	-

REMARKS - W=MULTIPLE LAYERS, X=STRIPPED

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION

MICHAEL BENSON, MATERIALS ENGINEER

*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE	- 09/13/18	SEQUENCE NO.	- 7
JOB NUMBER	- 100657	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	- 16
SUPPLIER NAME	- STATE	DISTRICT NO.	- 10
NAME OF PROJECT	- I-555-HWY.49 (COMMERCE DR.EXTENSION) (JONESBORO) (S)		
PROJECT ENGINEER	- NOT APPLICABLE		
PIT/QUARRY	- ARKANSAS		
LOCATION	- CRAIGHEAD COUNTY	DATE SAMPLED	- 07/23/18
SAMPLED BY	- DICKERSON/FRAZIER	DATE RECEIVED	- 07/26/18
SAMPLE FROM	- TEST HOLE	DATE TESTED	- 09/13/18
MATERIAL DESC.	- SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS		

LAB NUMBER	- 20181671	- 20181672	- 20181673
SAMPLE ID	- S419	- S420	- S421
TEST STATUS	- INFORMATION ONLY	- INFORMATION ONLY	- INFORMATION ONLY
STATION	- 203+00	- 211+00	- 219+00
LOCATION	- 15 LT	- 06 RT	- 06 LT
DEPTH IN FEET	- 0-5	- 0-5	- 0-5
MAT'L COLOR	- BR/GR	- GRAY	- BR/GR
MAT'L TYPE	-	-	-
LATITUDE DEG-MIN-SEC	- 35 49 43.10	- 35 49 51.00	- 35 49 59.00
LONGITUDE DEG-MIN-SEC	- 90 37 25.90	- 90 37 25.50	- 90 37 25.50
% PASSING			
2 IN.	-	-	-
1 1/2 IN.	- 100	- 100	- 100
3/4 IN.	-	-	-
3/8 IN.	-	-	-
NO. 4	-	-	-
NO. 10	-	-	-
NO. 40	-	-	-
NO. 80	-	-	-
NO. 200	- 93	- 99	- 93
LIQUID LIMIT	- 33	- 31	- 27
PLASTICITY INDEX	- 15	- 13	- 8
AASHTO SOIL	- A-6(13)	- A-6(12)	- A-4(6)
UNIFIED SOIL	-	-	-
% MOISTURE CONTENT	- 19.7	- 24.7	- 21.0
ACHMSC (IN)	- ---	- 6.0WX	- 10.0W
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-

REMARKS - W=MULTIPLE LAYERS, X=STRIPPED



**GEOTECHNICAL EXPLORATION
PROPOSED BRIDGE OVER ROUTE 901/
UNION PACIFIC RAILROAD
HWY. 49 (DR. MARTIN LUTHER KING JR.
DRIVE) EXTENSION
CRAIGHEAD COUNTY, ARKANSAS**

**ARKANSAS DEPARTMENT OF TRANSPORTATION
STATE PROJECT No. 100657**

Prepared for:
**ARKANSAS DEPARTMENT OF TRANSPORTATION
LITTLE ROCK, ARKANSAS**

Prepared by:
**GEO TECHNOLOGY, INC.
MEMPHIS, TENNESSEE**

Date:
JANUARY 14, 2021

Geotechnology Project No.:
J037334.01

**SAFETY
QUALITY
INTEGRITY
PARTNERSHIP
OPPORTUNITY
RESPONSIVENESS**



January 14, 2021

Mr. Paul Tinsley, P.E.
Arkansas Department of Transportation
10324 Interstate 30
Little Rock, Arkansas 72209

Re: Geotechnical Exploration
ARDOT 100657
Proposed Bridge over Route 901/Union Pacific Railroad
Hwy. 49 (Dr. Martin Luther King Jr. Drive) Extension
Craighead County, Arkansas
Geotechnology Project No. J037334.01

Dear Mr. Tinsley:

Presented in this report are the results of the geotechnical exploration performed by Geotechnology, Inc. for the referenced project. The report includes our understanding of the project, observed site conditions, conclusions and/or recommendations, and support data as listed in the Table of Contents.

We appreciate the opportunity to provide geotechnical services for this project. If you have any questions regarding this report please do not hesitate to contact us. We will finalize the report once comments are provided by ARDOT.

Respectfully submitted,

GEOTECHNOLOGY, INC.



Ashraf S. Elsayed, Ph.D., P.E., D.GE
Chief Engineer – South Region

DFB/ASE:dfb

Copies submitted: PDF



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- Appendix E – AASHTO and USCS Classifications
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**Geotechnical Exploration
Proposed Bridge over Route 901/Union Pacific Railroad
Hwy. 49 (Dr. Martin Luther King Jr. Drive) Extension
Craighead County, Arkansas
January 14, 2021 | Geotechnology Project No. J037334.01**

CHAPTER 1. SCOPE OF SERVICES

Presented in this report are the results of the geotechnical exploration and recommendations for design, construction, and other related features for a new, three-span bridge on the proposed Hwy. 49 (Dr. Martin Luther King Jr. Drive) Extension in Craighead County, Arkansas. The Project is designated as ARDOT Job No. 100657. A general overview of the project is shown on Figure 1 included in Appendix B.

The recommendations presented in this report are based on the geology, topography, and the results of the geotechnical exploration. Results of borings, in-situ testing, sampling, and laboratory testing are included in the report. A total of four borings were drilled in the vicinity of the bridge structure, as shown on Figure 2 included in Appendix B. The boring logs, along with field and laboratory test results, are enclosed. The collected data have been analyzed and the physical properties of the in-situ soils summarized. General site conditions are discussed, along with recommendations for subgrade preparation. Important information prepared by the Geotechnical Business Council (GBC) of the Geoprofessional Business Association for studies of this type is presented in Appendix A for your review.



CHAPTER 2. GENERAL INFORMATION

Planned Modifications

ARDOT prepared a Preliminary Layout of Bridge dated April 1, 2020, and an Interoffice Memorandum dated May 21, 2020. These documents describe a two-lane, three-span structure, approximately 454 feet in length and 73 feet in width, that will span over County Route 901 (Kathleen Street) and the Union Pacific Railroad. The bridge will extend from Sta. 330+76.83 to Sta. 335+50.18. A minimum clearance above top of rail of approximately 24 feet is required for the bridge. The preliminary bridge layout indicates fill embankments up to 32 feet in height will be required to construct the approaches to the new bridge. Embankment spill and side slopes are proposed at one vertical unit for every three horizontal units (1V:3H).

Topography

Based on the preliminary plan, the topography along the proposed bridge alignment varies from approximately El 252¹ to El 258. Overall, the site slopes gradually downward from north to south.

Drainage

The site drains to the south and east towards Bridger Creek, which flows south to join Whitten Creek. These creeks have been ditched and straightened. Whitten Creeks flows south to join the St. Francis River, which continues south and joins the Mississippi River north of Helena, Arkansas.

Geology

Craighead County is located in northeastern Arkansas, in the Mississippi Embayment. The Mississippi Embayment is a trough-like depression dipping southward along an axis approximately following the Mississippi River. The City of Jonesboro is located on a linear upland within the embayment known as Crowley's Ridge. The ridge trends south-southwest; the project site is located on the southeast flank of the ridge. The site geology consists of alluvial deposits of clay and silt underlain by fine-grained sand.

¹ Elevations are in units of feet referenced to the North American Vertical Datum of 1988 (NAVD 88).



CHAPTER 3. GEOTECHNICAL EXPLORATION

The borings were drilled between September 21 and September 25, 2020, with an all-terrain rotary drill rig (CME 550X) using hollow-stem auger and wash rotary drilling methods. The borings were drilled to approximate depths of approximately 100 and 130 feet. Sampling procedures included Standard Penetration Test (SPT) and thin-wall (Shelby) tube methods. SPT's were conducted at 2.5-, 5-, and 10-foot depth intervals using automatic hammers. Thin-walled Shelby tube samples were collected in cohesive soils at selected depths. Groundwater observations were made during drilling operations.

The collected samples were visually examined by field staff and transported to our laboratory for further evaluation and testing. The samples were examined in the laboratory by a geotechnical professional who prepared descriptive logs of the materials encountered. The boring logs are presented in Appendix C. An explanation of the terms and symbols used on the boring logs is also provided in Appendix C. Included on each boring log are ground surface elevation data estimated from topography shown on the preliminary bridge layout. Included in Table 1 are in situ tests and measurements made as part of the fieldwork and recorded on the boring logs.

Table 1. Field Tests and Measurements

Item	Test Method
Soil Classification	ASTM D 2488/ D 3282/ AASHTO M145
Standard Penetration Test (SPT)	ASTM D 1586/ AASHTO T206
Thin-Walled (Shelby) Tube Sampling	ASTM D 1587/ AASHTO T207
Phreatic Surface Level Measurement in Boring	ASTM D4750



CHAPTER 4. LABORATORY REVIEW AND TESTING

Laboratory testing was performed on soil samples to assess engineering and index properties. Most of the laboratory test results are presented on the boring logs in Appendix C. Atterberg limits, grain size analyses, unconsolidated-undrained triaxial compression (UU), direct shear, pH, and soil electrical resistivity test results are also provided in Appendix D. The laboratory tests and corresponding test method standards are listed in Table 2.

Table 2. Summary of Laboratory Tests and Methods.

Laboratory Test	ASTM	AASHTO
Moisture Content	D 2216	T 265
Atterberg Limits	D 4318	T 98
Grain Size Analysis by Sieving	D 6913	T 88
Grain Size Analysis by Hydrometer	D 7928	T 88
Unconfined Compression	D 2166	T 208
Unconsolidated-Undrained Triaxial Compression	D 2850	T 296
One-Dimensional Consolidation	D 2435	T 216
Direct Shearing of Soils under Consolidated-Drained Conditions	D 3080	T 236
pH of Soil	D 4972	T 289
Soil Electrical Resistivity	G 57	T 288



CHAPTER 5. SUBSURFACE CONDITIONS

Subgrade Materials

The stratigraphy consists generally of fine-grained soil to approximate depths of 33 to 48 feet, underlain by coarse-grained soil, underlain in turn by mixed fine-grained and coarse-grained soils to the 130-foot maximum depth of exploration. Detailed soil descriptions are provided on the boring logs presented in Appendix C. USCS and AASHTO classifications of the soils based on laboratory testing are presented in Appendix E.

The fine-grained soils are classified as fat clay (CH), lean clay (CL), and silt (ML) by the Unified Soil Classification System (USCS) and A-7-6, A-6, and A-4 by the AASHTO classification system, respectively. The cohesive soil layers are very stiff to soft in consistency based on SPT N-values and UU test results.

The coarse-grained soils are classified as poorly-graded sand (SP or SP-SM), silty sand (SM), and clayey sand (SC) by the USCS, and A-3, A-2-4, and A-2-6 by AASHTO. Based on field test results, the coarse-grained soils are loose to medium dense. In Borings B-3 and B-4, layers of stiff, lean clay and dense to very dense, silty sand occur below approximate depths of 108 and 83 feet, respectively.

Groundwater

Groundwater was observed during drilling operations in Boring B-3 at an approximate depth of 39 feet (approximately El 215). The presence of groundwater in the other borings was obscured by the use of mud rotary drilling methods, which introduces fluid into the borehole. Groundwater levels could vary significantly over time due to seasonal variation in precipitation, recharge, or other factors not evident at the time of exploration.

Corrosion Potential

Soil pH and resistivity tests were performed on selected samples. The purpose of corrosion testing is to provide soil data for use by a structural engineer for analysis of necessary protection to concrete steel reinforcement and piling. Corrosion protection guidelines for steel piling are set forth in Section 10.7.5 of the AASHTO LRFD Bridge Design Specifications. From the specifications, the following soil conditions indicate potential pile corrosion and deterioration:

- Resistivity less than 2,000 ohm-cm.
- pH less than 5.5.
- pH between 5.5 and 8.5 in soils with high organic content.

Corrosion potential test results are included in Appendix D and summarized Table 3.



Table 3. Results of Soil pH and Resistivity Testing.

Boring	Sample No.	Sample Depth (foot)	pH	Soil Resistivity (ohm-cm)
B-1	ST1	1	4.68 ^a	1,197 ^a
	SS6	18.5	7.28	798 ^a
	ST7	23	7.09	798 ^a
B-2	ST2	3	4.45 ^a	2,166
	ST5	10	7.90	1,340 ^a
	ST7	15	6.38	1,169 ^a
	ST12	30	7.22	713 ^a
B-3	ST17	58	7.12	2,850
B-4	SS8	23.5	6.77	1,026 ^a

^a potential for corrosion of steel piles.

Based on the sample results annotated in Table 3, the cohesive soils have a potential for corrosion of steel piling. Interpretation of the corrosion test data and the need for corrosion protection of bridge structural components should be performed by the design team.

Low resistivity soil that could corrode steel piles was tested to an approximate depth of 30 feet. Geotechnology recommends increasing the thickness of pipe piles to compensate for anticipated steel corrosion, in accordance with the AASHTO publication “LRFD Bridge Design Specifications” Eighth Edition (2017). Pipe protective coatings, which can be removed or damaged during pile driving, would be a less effective solution.

Soil with low pH was tested to an approximate depth of 5 feet. Based on the preliminary plans, little if any soil will be removed to construct the fill embankments. Some soil will be removed to construct the intermediate bents.



CHAPTER 6. ENGINEERING EVALUATION, ANALYSIS, AND RECOMMENDATIONS

Site Preparation and Earthwork

The following procedures are recommended for site preparation and compaction of cut and fill areas. These recommendations do not supersede the latest ARDOT Standard Specification for Highway Construction.

Site Preparation. In general, cut areas and areas to receive new fill should be stripped of topsoil, vegetation, and other deleterious materials. Topsoil should be placed in landscaped areas or disposed off-site. Vegetation and tree roots should be over-excavated.

The exposed subgrade should be proof-rolled using a tandem axle dump truck loaded to approximately 20,000 pounds per axle (or equivalent proof-rolling equipment). Soft areas that develop should be over-excavated and backfilled with select fill, which is defined as soil conforming to A-4 or better material, and compacted to the unit weights specified in subsequent paragraphs. ARDOT Type 8 geotextile fabric should be placed between the subgrade soil and select fill.

Side Slopes. Slopes steeper than 1V:4H must be benched prior to placing new fill. Slope ratios of 1V:3H or flatter are recommended for all cut and fill slopes along the proposed alignment, based on the results of global stability analyses (discussed in a subsequent section).

Fill Materials. Fill material can consist of natural soils classified as AASHTO A-6 or better. Fine-grained soils (AASHTO A-4 through A-6) and coarse-grained soils with fines can have a maximum liquid limit (LL) of 40 percent and a plasticity index (PI) between 10 and 20 percent. Such materials should be free from organic matter, debris, or other deleterious materials and have a maximum particle size of 3 inches.

Cohesive soil fill embankments constructed to ARDOT standard specifications provide the shear strength required to meet slope stability requirements, as well as the stiffness criterion for passive resistance in Section 6.2.2.1 of the Caltrans Seismic Design Criteria Version 1.7 (2013).

Fill and Backfill Placement. Fill and backfill should be placed in level lifts up to 10 inches in loose thickness. For fill and backfill exhibiting a well-defined moisture-density relationship, each lift should be moisture-conditioned to within $\pm 2\%$ of the optimum moisture content and compacted with a sheepsfoot roller or self-propelled compactor to a minimum of 95% of the maximum dry unit weight as determined by the standard Proctor test. Moisture-conditioning can include: aeration and drying of wetter soils, wetting drier soils, and/or mixing wetter and drier soils into a uniform blend.

For fill and backfill that do not exhibit a well-defined moisture-density relationship, each lift should be compacted to at least 70% of the relatively density as evaluated from the maximum and minimum index densities measured by ASTM D4253 and D4254, respectively.



Moisture Considerations. Maintaining the moisture content of bearing and subgrade soils within the acceptable range is important during and after construction for the proposed structure. Silty and clayey subgrade soils should not be allowed to become wet or dry during or after construction, and measures should be taken to hinder water from ponding on these soils.

Water from surface runoff and drains should be collected and discharged through a storm water collection system. Positive drainage should be established around the proposed structures to promote drainage of surface water away from the structures and reduce ponding of water adjacent to these structures.

Seismic Considerations

Earthquake Risk. The project area is located within the New Madrid Seismic Zone (NMSZ). The NMSZ is located in the northern part of the Mississippi Embayment and trends in a northeast to southwest direction from southern Illinois to northeast Arkansas. In December 1811, a series of large magnitude earthquakes occurred, which were centered near New Madrid, Missouri. Three strong earthquakes occurred over a 3-month period and smaller aftershocks continued until at least 1817. According to researchers, the magnitudes of these three events ranged from 7.5 to 8.0.

Earthquake Forces. It is our understanding the bridge and approaches will be designed in accordance with the AASHTO publication “LRFD Bridge Design Specifications” Eighth Edition (2017).

Seismic Design Parameters. Presented in Table 4 are seismic design parameters based on a seismic hazard with 5% probability of exceedance in 50 years and the field and laboratory testing results. Geotechnology used Design Method C to calculate an average shear strength of 1,440 psf for the cohesive soil layers and an average N-value of 16 bpf for the coarse-grained soil layers. As such, Seismic Site Class D can be used for this project.



Table 4. Seismic Design Parameters (5% Probability of Exceedance in 50 years).

Latitude 35.860325°N/Longitude 90.613403°W		
Category/ Parameter	Designation/ Value	Reference
Seismic Site Class	D	AASHTO LRFD 2017 Table 3.10.3.1-1
S _S	1.188g	Ground motion parameters obtained from the computer program supplied with the AASHTO Guidelines for the Seismic Design of Highway Bridges (2007) using the indicated latitude and longitude coordinates of the project site and the seismic site class based on boring data.
S ₁	0.307g	
F _a	1.02	
F _v	1.79	
F _{PGA}	1.00	
t _s	0.453	
t ₀	0.052	
S _{DS}	1.212	
S _{D1}	0.549	
PGA	0.656	
As	0.656	

Liquefaction and Dynamic Settlement. A study was performed to evaluate the liquefaction and dynamic settlement potential at the site. Field and laboratory data were used to perform the analysis. The field measurements included the depth of groundwater and SPT N-values. The laboratory data included USCS classification and soil unit weight. An earthquake magnitude (M_w) of 7.7 with a probability of exceedance of 5% in 50 years was considered. A peak ground acceleration of 0.656g was utilized as obtained from the referenced Seismic Design Maps.

Subsurface conditions (as characterized by field and laboratory data) and earthquake characteristics were used to estimate the safety factors against liquefaction in each soil layer, as well as the associated dynamic settlement during the design seismic event. For the liquefaction analysis, groundwater was applied at El 214 based on the groundwater level measured during drilling in Boring B-3. The analysis results indicate there is a high potential for liquefaction at the site as summarized in Table 5.

Table 5. Results of Liquefaction Analyses.

Boring No.	Depth of Boring (ft.)	Depth Intervals (feet) with Liquefaction Factor of Safety Less than 1.0	Estimated Dynamic Settlement (in.)	
			Upper 50 Feet	Total Depth of Boring
B-1	110	38-108	4	19
B-2	100	48-100	2	18
B-3	130	38-108	7	23
B-4	110	33-58, 78-83	12	17



The current state of practice for liquefaction hazard assessment is based on what is known as “the Simplified Method” as introduced by Seed (1971) and subsequent modifications/revisions by many researchers (Seed 1982, Idriss 1999, Youd 2001, and Idriss and Boulanger 2014, among others). The simplified method was based on observations and assessments of soil zones that either liquefied or did not liquefy in the upper 40 feet (12 m). There are reported uncertainties in the values of one of the inputs to the method (the stress reduction factor, or r_d) at depths greater than 50 feet. The occurrence of substantial liquefaction in deeper sand deposits is unlikely.

Liquefaction hazard mitigation can be accomplished using ground improvement or compaction piles (including large displacement piles such as driven closed-end pipe piles) to reduce dynamic settlement and downdrag on piles. Ground improvement techniques such as earthquake drains, aggregate piers, and deep dynamic compaction are proprietary, typically performed by specialty contractors on a design/build basis. Geotechnology can provide additional guidance if liquefaction hazard mitigation will be considered.

When calculating downdrag on piles, Geotechnology recommends ignoring potentially liquefiable zones below a depth of 50 feet. A discussion of liquefaction impact and downdrag from dynamic settlement on pile resistance is included in a subsequent section titled “Deep Foundations.”

Approach Embankment Settlement

Settlement analyses were performed to assess fill-induced settlement of the approach embankments. Based on the preliminary layout of bridge, up to 33 feet of fill will be placed to raise the south and north bridge approaches to approximately El 285 and El 287, respectively. Settlement analysis results are summarized in Table 6.

Table 6. Summary of Calculated Settlement.

Analysis Location	Applicable Borings	Maximum Fill Height (feet)	Calculated Settlement (inches)		
			Immediate	Consolidation	Total
South Abutment	B-1, B-2	30	4	3	7
North Abutment	B-3, B-4	32	5	4	9

The results of the settlement analyses indicate immediate and consolidation settlement from fill placement. We anticipate immediate and recompression settlement will occur within one month after fill placement. Our settlement models indicate practical completion of soil consolidation approximately 3 to 4 months after fill placement.

It is our professional opinion that settlement generally takes less time than predicted by theoretical calculations. If the predicted duration of settlement is considered prohibitive to efficient completion of the project, a settlement monitoring program can be implemented and the survey data forwarded to Geotechnology to determine when construction of structures can begin.



Global Stability

Geotechnology performed stability analyses for deep-seated, global failure of spill slopes and side slopes at the bridge abutments based on existing ground elevations indicated on the preliminary plans. The computer program SLOPE/W 2018 was used to model short-term, long-term, and seismic stability using Spencer's method to compute factors of safety for the proposed spill slopes.

Calculated minimum factors of safety are summarized in Table 7. A pseudo-static seismic acceleration of 0.328g, corresponding to one-half the peak ground acceleration, was utilized (per FHWA Publication HI-99-012). Section profiles with calculated critical failure arcs and utilized soil parameters are presented in Appendix F for the analyses.

Table 7. Results of Slope Stability Analyses.

Analysis Location, Applicable Borings	Description	Anticipated Maximum Slope Height (ft.)	Calculated Factor of Safety		
			Short- Term Static ^a	Long- Term Static ^a	Seismic ^b
South Abutment, Borings B-1 and B-2	Spill and Side Slopes, 1V:3H	30	1.96	2.16	1.20
North Abutment, Borings B-3 and B-4	Spill and Side Slopes, 1V:3H	32	1.88	2.16	1.19

^a Target factor of safety = 1.5, approximately equivalent to a global stability resistance factor = 0.65.

^b Target factor of safety = 1.1, approximately equivalent to a global stability resistance factor = 0.9.

Sufficient factors of safety (FOS) against global stability failure were computed at the abutments for the proposed spill and side slopes under short-term, long-term, and seismic conditions. Prior to placing new fill, existing slopes should be benched to reduce the potential for development of slip planes between new and existing fill.

Cohesive soil fill embankments constructed to ARDOT standard specifications provide the shear strength required to meet slope stability requirements, as well as the stiffness criterion for passive resistance in Section 6.2.2.1 of the Caltrans Seismic Design Criteria Version 1.7 (2013).

Driven Pile Foundations

Foundation design recommendations are provided herein based on the AASHTO LRFD Bridge Design Specifications (2017). We understand that the three-span bridge may be supported using 18-inch diameter, closed-end, steel pipe piles.

Synthetic profiles were prepared for each abutment and intermediate bent location based upon the soil profile encountered in the borings, approximate boring elevations, and the proposed final grades. Soil parameters for LPILE lateral analysis of piles are presented in Appendix G.



Graphs of nominal compressive resistance versus depth are presented for 18-inch diameter pipe piles in Appendix H. Graphs for 24-inch diameter pipe piles are also provided at the intermediate bent locations. Graphs are provided for axial resistance from side (skin) friction and total axial resistance (side friction + end bearing) for 18-inch diameter pipe piles. Uplift resistance (tension) can be calculated from the side friction resistance. The graphs do not consider downdrag forces due to liquefaction of shallow (depths less than 50 feet), loose sand layers during the design earthquake. Downdrag on pile foundations is discussed in the following section.

Resistance Factors. Resistance factors must be applied to the nominal resistances provided. Based solely on the static analysis methods used to calculate nominal pile resistances, the factors presented in Table 8 can be applied.

Table 8. Resistance Factors Based on Static Analysis Methods.

Deep Foundation and Condition	Clay		Sand	
	Side Resistance	End-Bearing	Side Resistance	End-Bearing
Nominal Compressive Resistance of Single Pile	0.35	0.35	0.45	0.45
Uplift Resistance of Single Pile	0.25	--	0.35	--

Based on AASHTO LRFD (2017) Table 10.5.5.2.3-1, a higher resistance factor can be used in accordance with the method of pile testing performed as indicated in Table 9.



Table 9. Resistance Factors for Driven Piles

Condition/Resistance Determination Method		Resistance Factor
Nominal Bearing Resistance of Single Pile – Dynamic Analysis and Static Load Test Methods	Driving criteria established by successful static load test of at least one pile per site condition and dynamic testing of at least two piles per site, but no less than 2% of the production piles*	0.80
	Driving criteria established by successful static load test of at least one pile per site condition without dynamic testing	0.75
	Driving criteria established by dynamic testing conducted on 100% of production piles*	0.75
	Driving criteria established by dynamic testing, quality control by dynamic testing of at least two piles per site condition, but no less than 2% of production piles*	0.65
	Wave equation analysis, without pile dynamic measurements or load test but with field confirmation of hammer performance	0.50
	FHWA-modified Gates dynamic pile formula (End of Drive condition only)	0.40
Uplift Resistance of Single Pile	Dynamic test with signal matching	0.50

* Dynamic testing requires signal matching, and estimates of nominal resistance are made from a restrrike. Dynamic tests are calibrated to a static load test, when available.

Pile Group Considerations. The settlement of pile groups should be evaluated as per AASHTO LRFD (2017) Section 10.7.2.3. Settlement analysis of the pile groups can be performed when the foundation configurations and service loads are available. AASHTO LRFD (2017) Section 10.7.3.9 addresses pile group resistance. Group capacity considerations for different pile groups, center-to-center spacings, and other conditions (cap contact with ground, softness of surface soil, etc.) are given in AASHTO LRFD (2017) Sections 10.7.3.9 and 10.7.3.11.

Driven Pile Construction Considerations. Piles should be driven with a pile hammer developing appropriate energy that will not cause damage to the pile. Alternatively, driving criteria can be developed using wave equation analyses after the pile hammer is selected. Geotechnology can perform a pile drivability analysis upon request.

Static Pile Load Testing. At least one static pile compression load test should be performed for each bent or abutment location. The testing should be performed in accordance with ASTM D 1143 using the quick loading procedure and AASHTO LRFD (2017) Section 10.7.3.8.2. Please refer to Table 9 for additional guidance regarding the minimum number of tests and alternate resistance factors associated with other field methods for determining resistance.



If the piles are to support net uplift loads, at least one tension load test should be performed for each location. The test should be performed in accordance with ASTM D 3689. Piles should be tested to the required nominal uplift resistances.

Load tests are required to verify recommended nominal pile resistance and will not be used to increase the design pile resistance. The piles used in the load tests should not be used for support of any structures. Geotechnology should be consulted regarding the locations of the test piles.

Dynamic Testing of Driven Piles. As an alternative to static pile load testing, high-strain dynamic pile testing can be performed according to AASHTO LRFD (2017) Section 10.7.3.8.3 and the procedures given in ASTM D4945. Different resistance factors correspond to different load testing combinations as illustrated in Table 9. We recommend that the test piles be identified according to AASHTO LRFD (2017) Table 10.5.5.2.3-1 or 2 percent of the production piles, whichever results in a larger number of tests. We recommend that the identified piles be tested at the end of initial drive (EIOD) and a restrike performed at a minimum seven days after EIOD.

Pile driving monitoring should be performed by an engineer with a minimum 3 years dynamic pile testing and analysis experience and who has achieved Basic or better certification under the High-Strain Dynamic Pile Testing Examination and Certification process of the Pile Driving Contractors Association and Foundation QA. Pile driving modeling and analyses should be performed by an engineer with a minimum five years dynamic pile testing and analysis experience and who has achieved Advanced or better certification under the High-Strain Dynamic Pile Testing Examination and Certification process of the Pile Driving Contractors Association and Foundation QA.

Dynamic tests are required to monitor hammer and drive system performance, assess driving stresses and structural integrity and to evaluate pile resistance, and should not be used to increase design pile resistance. Dynamic tests should be performed on production piles with the lowest driving resistance. Geotechnology will be available to assist with development of specifications for this program and should be on site to perform or observe the testing and establish the pile driving criteria.

Settlement. Settlement of pile foundations depends on the loads applied and the foundation configuration. In general, settlement of deep foundations supporting static loads and designed in accordance with the recommendations provided in this report is expected to be approximately ½-inch or less. However, a calculation of the expected settlement of the pile foundations can be performed when the applied service loads and foundation configuration become available.

Uplift Resistance. Uplift forces can be resisted by the effective weight of the piles and caps, and frictional resistance between the piles and surrounding soil. If the anticipated maximum level of groundwater is higher than the tip of the pile then the buoyant unit weight of the pile must be used in computing uplift resistance for pile lengths extending below the design groundwater level.

Lateral Resistance. The lateral resistance of pile foundations depends on the length and dimensions of the foundation and the soil characteristics. The lateral resistance of pile foundations can be computed using the computer program LPILE to model the behavior of a single pile. Soil parameters



are provided in Appendix G for the various strata and soil strengths present at the site. Soil parameters are based on field and laboratory test results and empirical correlations with SPT N-values. Soil parameters are provided in a second table for cyclically softened cohesive soils and liquefied cohesionless soils.

The effects of group interaction must be considered when evaluating pile group horizontal movement. The lateral resistance for individual piles calculated by LPILE must be reduced by the P-multipliers provided in Section 10.7.2.4 of the AASHTO LRFD (2017) to determine lateral resistance of a pile group. Alternatively, the GROUP software can be used to evaluate the lateral resistance of the pile groups. The resistance factor for lateral resistance of single piles or pile groups is 1.0.

Downdrag on Pile Foundations

Downdrag occurs as the soil strata move downward relative to the foundations due to settlement of the soil layers. Downdrag can result from consolidation of cohesive soils under fill embankments and from dynamic settlement due to liquefaction of granular soils. The AASHTO LRFD Bridge Design Specifications (2017) suggest that settlement of 0.4-inch or greater could produce downdrag on pile foundations.

Downdrag from consolidation settlement can be ignored if settlement monitoring is performed to determine that pile installations take place after consolidation settlement is effectively complete. However, based on our liquefaction analysis results, dynamic settlement of approximately 4 to 12 inches is anticipated during the design earthquake event. We did not consider densification of the soil that occurs during driving closed-end pipe piles, which would reduce the amount of settlement from liquefaction adjacent to the piles.

Nominal axial resistance curves for the post-liquefaction condition for 18- and 24-inch diameter pipe piles are included with the static axial resistance curves in Appendix H. The post-liquefaction resistance (red lines) were not reduced by the downdrag load.

A summary of static and post-liquefaction axial resistance versus depth is presented in Table 10 for 18- and 24-inch diameter pipe piles. Included in Table 10 are drag load values that should be subtracted from the post-liquefaction resistance of the piles. Calculated drag loads at the abutments are larger due to dynamic settlement of the fill embankments relative to the piles.



Table 10. Static and Post-Liquefaction Axial Resistance of Driven Piles

Bent Location	Pile Type/ Diameter (inches)	Embedment Length (feet)	Nominal Static Axial Resistance (tons)			Nominal Post-Liquefaction Axial Resistance (tons)	
			Side Friction	End Bearing	Total	Total*	Drag Load
South Abutment, Boring B-1	18" Closed- End Pipe, Top El 276	85	269	44	313	234	110
		95	350	44	394	316	110
		105	438	44	482	403	110
South Intermediate Bent, Boring B-2	18" Closed- End Pipe, Top El 246	60	120	44	164	156	46
		70	170	44	214	206	46
		80	226	44	270	262	46
	24" Closed- End Pipe, Top El 246	60	168	78	246	234	63
		70	240	78	318	306	63
		80	320	78	398	386	63
North Intermediate Bent, Boring B-3	18" Closed- End Pipe, Top El 246	60	122	24	146	117	28
		70	167	44	211	183	28
		80	223	44	267	239	28
	24" Closed- End Pipe, Top El 246	60	168	42	210	170	33
		70	233	78	311	271	33
		80	313	78	391	351	33
North Abutment, Boring B-4	18" Closed- End Pipe, Top El 276	95	285	44	329	248	99
		105	369	26	395	314	99
		115	421	25	446	364	99

*Nominal post-liquefaction axial resistance has not been reduced by the drag load.



CHAPTER 7. RECOMMENDED ADDITIONAL SERVICES

The conclusions and recommendations given in this report are based on: Geotechnology's understanding of the proposed design and construction, as outlined in this report; site observations; interpretation of the exploration data; and our experience. Since the intent of the design recommendations is best understood by Geotechnology, we recommend Geotechnology be included in the final design and construction process, and be retained to review the project plans and specifications to confirm the recommendations given in this report have been correctly implemented. We recommend Geotechnology be retained to participate in pre-bid and preconstruction conferences to reduce the risk of misinterpretation of the conclusions and recommendations in this report relative to the proposed construction of the subject project.

Since actual subsurface conditions between boring locations could vary from those encountered in the borings, our design recommendations are subject to adjustment in the field based on the subsurface conditions encountered during construction. Therefore, we recommend Geotechnology be retained to provide construction observation services as a continuation of the design process to confirm the recommendations in this report and to revise them accordingly to accommodate differing subsurface conditions. Construction observation is intended to enhance compliance with project plans and specifications. It is not insurance, nor does it constitute a warranty or guarantee of any type. Regardless of construction observation, contractors, suppliers, and others are solely responsible for the quality of their work and for adhering to plans and specifications.



CHAPTER 8. LIMITATIONS

This report has been prepared on behalf of, and for the exclusive use of, the client for specific application to the named project as described herein. If this report is provided to other parties, it should be provided in its entirety with all supplementary information. In addition, the client should make it clear the information is provided for factual data only, and not as a warranty of subsurface conditions presented in this report.

Geotechnology has attempted to conduct the services reported herein in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. The recommendations and conclusions contained in this report are professional opinions. The report is not a bidding document and should not be used for that purpose.

Our scope for this phase of the project did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client. Our scope did not include an assessment of the effects of flooding and erosion of creeks or rivers adjacent to or on the project site.

Our scope did not include: any services to investigate or detect the presence of mold or any other biological contaminants (such as spores, fungus, bacteria, viruses, and the by-products of such organisms) on and around the site; or any services, designed or intended, to prevent or lower the risk of the occurrence of an infestation of mold or other biological contaminants.

The analyses, conclusions, and recommendations contained in this report are based on the data obtained from the geotechnical exploration. The field exploration methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Consequently, subsurface conditions could vary gradually, abruptly, and/or nonlinearly between sample locations and/or intervals.

The conclusions or recommendations presented in this report should not be used without Geotechnology's review and assessment if the nature, design, or location of the facilities is changed, if there is a lapse in time between the submittal of this report and the start of work at the site, or if there is a substantial interruption or delay during work at the site. If changes are contemplated or delays occur, Geotechnology must be allowed to review them to assess their impact on the findings, conclusions, and/or design recommendations given in this report. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party's interpretations of the subsurface data or with reuse of the subsurface data or engineering analyses in this report.

The recommendations included in this report have been based in part on assumptions about variations in site stratigraphy that can be evaluated further during earthwork and foundation



construction. Geotechnology should be retained to perform construction observation and continue its geotechnical engineering service using observational methods. Geotechnology cannot assume liability for the adequacy of its recommendations when they are used in the field without Geotechnology being retained to observe construction.



APPENDIX A
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it.* A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* *Confront the risk of moisture infiltration* by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*

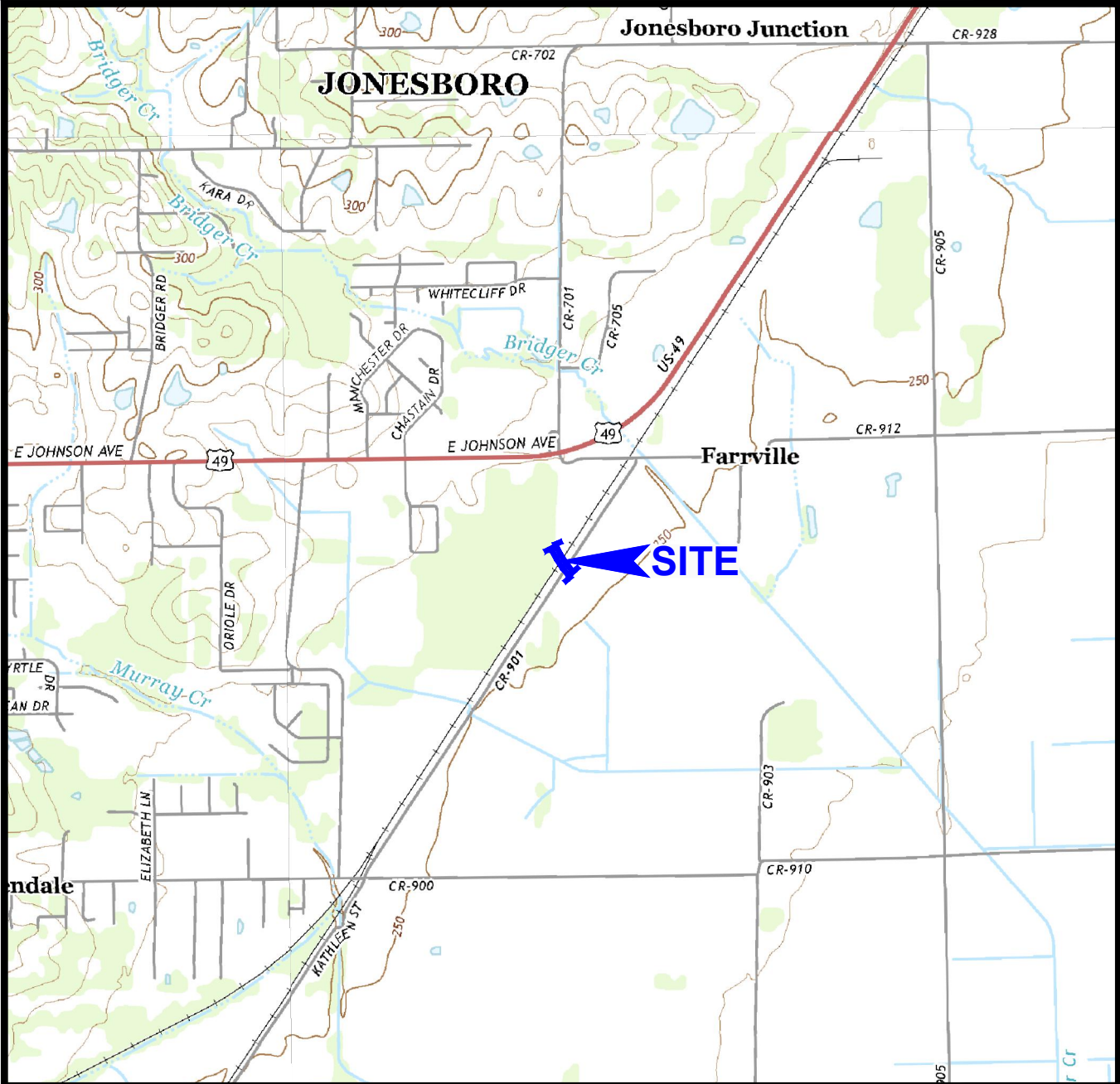


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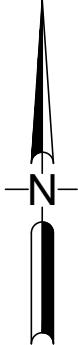


APPENDIX B
FIGURES

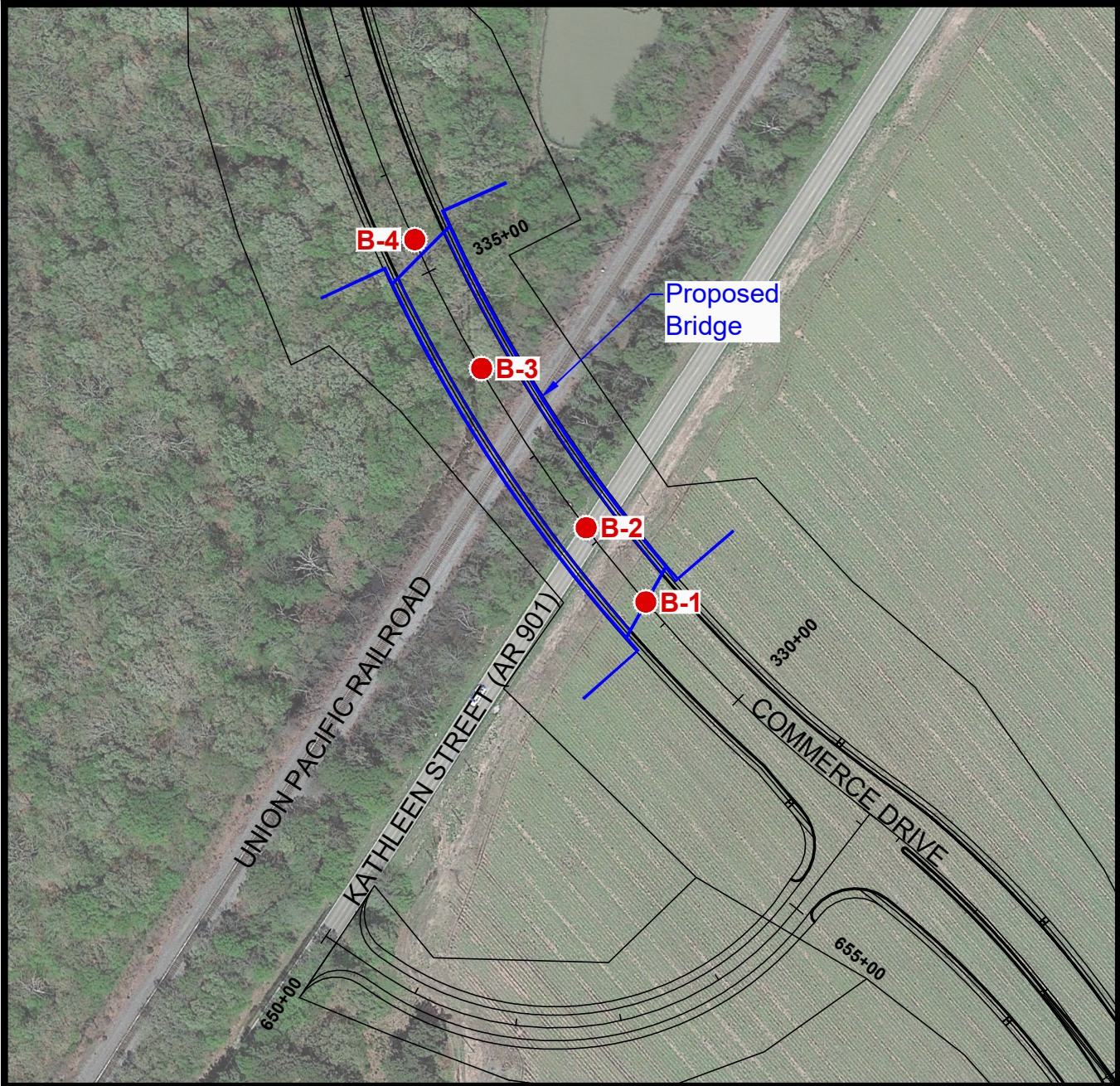


NOTES

- 1. Plan adapted from 7.5 minute U.S.G.S. maps for Needham, Jonesboro, Brookland, and Lorado, Arkansas quadrangles, last revised in 2014.



Drawn By: WAH	Ck'd By: DFB	App'vd By: ASE
Date: 10-1-20	Date: 11-28-20	Date: 11-30-20
<p>Proposed Bridge over Route 901/ Union Pacific Railroad I-555 - Hwy. 49 Extension Craighead County, Arkansas</p>		
<p>SITE LOCATION AND TOPOGRAPHY</p>		
Project Number J037334.01		FIGURE 1

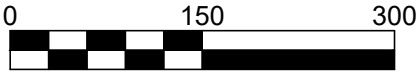


NOTES

1. Plan adapted from an April 11, 2019 aerial photograph courtesy of Google Earth and a drawing dated April 9, 2020, titled "Soil Boring Request Highway 18 over UPRR and Kathleen Street", prepared by Arkansas State Highway Commission.
2. Borings were located in the field with reference to site features and are shown approximate only.

LEGEND

● Boring Location



SCALE IN FEET



Drawn By: WAH	Ck'd By: DFB	App'vd By: ASE
Date: 10-1-20	Date: 11-28-20	Date: 11-30-20



Proposed Bridge over
Route 901/ Union Pacific Railroad
I-555 - Hwy. 49 Extension
Craighead County, Arkansas

**AERIAL PHOTOGRAPH OF SITE
AND BORING LOCATIONS**

Project Number
J037334.01

FIGURE 2



APPENDIX C
BORING INFORMATION

Surface Elevation: 252.024

Completion Date: 9/25/20

Datum: NAVD88

Station: 331+44.61

Offset: -4.57

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL | 10 20 30 40 50 | LL

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf	STANDARD PENETRATION RESISTANCE	WATER CONTENT, %
		Topsoil: 5 inches						
5	247	Medium stiff to stiff, brown and gray, LEAN CLAY - (CL)		102	ST1			
				2-2-3	SS2			
				2-4-4	SS3			
10	242			100	ST4			
15	237	very stiff		6-8-9	SS5			
20	232			3-4-6	SS6			
25	227	97.4 percent passing No. 200 sieve		93	ST7			
30	222	soft		1-2-1	SS8			
35	217	Soft, gray SILT - ML 99.5 percent passing No. 200 sieve		2-2-2	SS9			
40	212	Stiff, gray, sandy SILT - ML 54.0 percent passing No. 200 sieve		5-4-8	SS10			
45	207				ST* 11			
50	202	Medium dense, brown, fine SAND, trace silt - (SP-SM) 7.1 percent passing No. 200 sieve		5-9-9	SS12			
55	197			6-7-7	SS13			
60	192			7-8-9	SS14			
65	187	Medium dense, brown, fine SAND - (SP) 4.8 percent passing No. 200 sieve		5-6-9	SS15			
				7-7-10	SS16			

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 30 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM Checked by: DFB App'vd. by: ASE
Date: 9/25/20 Date: 11/19/20 Date: 11/25/20



Proposed Bridge over Route 901 and UPRR Hwy. 49 Extension Craighead County, Arkansas

LOG OF BORING: B-1

Geotechnology Project No. J037334.01

Surface Elevation: 252.024

Completion Date: 9/25/20

Datum: NAVD88

Station: 331+44.61

Offset: -4.57

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PLI | 10 20 30 40 50 | LL

DEPTH
IN FEET

ELEVATION
IN FEET

DESCRIPTION OF MATERIAL

GRAPHIC LOG

DRY UNIT WEIGHT (pcf)
SPT BLOW COUNTS
CORE RECOVERY/RQD

SAMPLES

Medium dense, brown, fine SAND - (SP) (continued)

75 — 177

7-9-9 SS17

80 — 172

7-9-10 SS18

85 — 167

3.9 percent passing No. 200 sieve

7-8-9 SS19

90 — 162

8-9-11 SS20

95 — 157

Medium dense, gray, SILTY SAND - SM

7-9-10 SS21

100 — 152

8-10-10 SS22

105 — 147

Stiff, gray, LEAN CLAY - CL

5-7-8 SS24

Boring terminated at 110 feet.

115 — 137

120 — 132

125 — 127

130 — 122

135 — 117

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 30 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM Checked by: DFB App'vd. by: ASE
Date: 9/25/20 Date: 11/19/20 Date: 11/25/20



Proposed Bridge over Route 901 and UPRR Hwy. 49 Extension Craighead County, Arkansas

CONTINUATION OF LOG OF BORING: B-1

Geotechnology Project No. J037334.01

Surface Elevation: 255.311

Completion Date: 9/24/20

Datum: NAVD88

Station: 332+09.30

Offset: -20.75

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL | 10 20 30 40 50 | LL

DEPTH
IN FEET

ELEVATION
IN FEET

DESCRIPTION OF MATERIAL

GRAPHIC LOG

DRY UNIT WEIGHT (pcf)
SPT BLOW COUNTS
CORE RECOVERY/RQD

SAMPLES

Asphalt: 4 inches
Base Material: 8 inches of crushed rock
Subbase Material: sand and gravel
Medium stiff to very stiff, brown and gray, LEAN CLAY - CL

with black, sandy, trace gravel

Medium stiff, brown and gray SILT - ML

Medium stiff, brown, red and gray, LEAN CLAY - (CL)

Medium stiff to soft, gray SILT, little to trace sand - (ML)
86.3 percent passing No. 200 sieve
85.3 percent passing No. 200 sieve

Loose to medium dense, brown, fine SAND, trace silt - (SP-SM)
5.4 percent passing No. 200 sieve

Medium dense, brown, fine SAND - (SP)
4.1 percent passing No. 200 sieve

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 20 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM Checked by: DFB App'vd. by: ASE
Date: 9/25/20 Date: 11/19/20 Date: 11/25/20



Proposed Bridge over Route 901 and UPRR Hwy. 49 Extension Craighead County, Arkansas

LOG OF BORING: B-2

Geotechnology Project No. J037334.01

Surface Elevation: 255.311

Completion Date: 9/24/20

Datum: NAVD88

Station: 332+09.30

Offset: -20.75

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL | 10 20 30 40 50 | LL

DEPTH
IN FEET

ELEVATION
IN FEET

DESCRIPTION OF MATERIAL

GRAPHIC LOG

DRY UNIT WEIGHT (pcf)
SPT BLOW COUNTS
CORE RECOVERY/RQD

SAMPLES

Medium dense, brown, fine SAND - (SP) (continued)

Medium dense, brown, fine SAND, trace silt - (SP-SM)

5.0 percent passing No. 200 sieve

Boring terminated at 100 feet.

8-9-11 SS22
8-9-10 SS23
6-8-11 SS24
6-8-10 SS25
8-7-10 SS26
8-10-10 SS27

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 20 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM Checked by: DFB App'vd. by: ASE
Date: 9/25/20 Date: 11/19/20 Date: 11/25/20



Proposed Bridge over Route 901 and UPRR Hwy. 49 Extension Craighead County, Arkansas

CONTINUATION OF LOG OF BORING: B-2

Geotechnology Project No. J037334.01

Surface Elevation: 254.509

Completion Date: 9/21/20

Datum: NAVD88

Station: 334+04.22

Offset: 7.81

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf				
						STANDARD PENETRATION RESISTANCE (ASTM D 1586)				
						WATER CONTENT, %				
		FILL: very stiff, brown and gray SILT, some gravel, little sand - ML								
5	250	Medium stiff to stiff, brown and gray, LEAN CLAY - (CL)		9-8-6	SS1					
				3-6-8	SS2					
				3-4-7	SS3					
10	245			2-2-4	SS4					
15	240			3-6-9	SS5					
20	235	very stiff		5-7-10	SS6					
25	230			3-3-6	SS7					
				115	ST8					
30	225			2-4-4	SS9					
				95	ST10					
35	220	Soft, gray, FAT CLAY - (CH)		1-1-2	SS11					
				81	ST12					
40	215	Loose, brown and gray, fine SAND, trace silt - (SP-SM) 5.3 percent passing No. 200 sieve		2-2-6	SS13					
45	210			1-2-7	SS14					
50	205	Loose to medium dense, brown, fine SAND - (SP) 4.8 percent passing No. 200 sieve		2-3-6	SS15					
55	200			5-5-7	SS16					
60	195				ST17					
65	190			6-6-10	SS18					
		2.4 percent passing No. 200 sieve		5-5-5	SS19					

GROUNDWATER DATA

DRILLING DATA

ENCOUNTERED AT 39 FEET ∇

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 40 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM	Checked by: DFB	App'vd. by: ASE
Date: 9/24/20	Date: 11/19/20	Date: 11/25/20



**Proposed Bridge over Route
901 and UPRR
Hwy. 49 Extension
Craighead County, Arkansas**

LOG OF BORING: B-3

**Geotechnology Project No.
J037334.01**

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

Surface Elevation: 254.509

Completion Date: 9/21/20

Datum: NAVD88

Station: 334+04.22

Offset: 7.81

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL | 10 20 30 40 50 | LL

DEPTH
IN FEET

ELEVATION
IN FEET

DESCRIPTION OF MATERIAL

GRAPHIC LOG

DRY UNIT WEIGHT (pcf)
SPT BLOW COUNTS
CORE RECOVERY/RQD

SAMPLES

Loose to medium dense, brown, fine SAND - (SP)
(continued)

75 — 180

6-8-10 SS20

80 — 175

7-9-13 SS21

85 — 170

6-10-11 SS22

90 — 165

7-7-13 SS23

95 — 160

6-6-9 SS24

100 — 155

Medium dense, gray, fine SAND, trace clay -
(SP-SC)
5.3 percent passing No. 200 sieve

8-8-13 SS25

105 — 150

Stiff, gray, LEAN CLAY - (CL)

4-6-6 SS26

115 — 140

sandy

5-7-6 SS27

125 — 130

Very dense, brown, SILTY SAND - SM
Boring terminated at 130 feet.

5-20-39 SS28

135 — 120

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

ENCOUNTERED AT 39 FEET ∇

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 40 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM	Checked by: DFB	App'vd. by: ASE
Date: 9/24/20	Date: 11/19/20	Date: 11/25/20



**Proposed Bridge over Route
901 and UPRR
Hwy. 49 Extension
Craighead County, Arkansas**

CONTINUATION OF
LOG OF BORING: B-3

Geotechnology Project No.
J037334.01

Surface Elevation: 254.391

Completion Date: 9/21/20

Datum: NAVD88

Station: 335+00.63

Offset: 21.13

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

DEPTH IN FEET	ELEVATION IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf					
						Δ - UU/2	○ - QU/2	□ - SV	STANDARD PENETRATION RESISTANCE (ASTM D 1586)		
						▲ N-VALUE (BLOWS PER FOOT)					
						PL ----- LL					
						10	20	30	40	50	
		Stiff, brown and gray SILT - ML trace roots									
					5-5-9	SS1					
5	249	Very stiff, brown and gray, LEAN CLAY - (CL)			5-8-12	SS2					
					5-11-12	SS3					
10	244				4-8-10	SS4					
15	239	Very stiff, brown and gray SILT - ML			3-8-9	SS5					
20	234	Very stiff to medium stiff, brown to brown and gray, LEAN CLAY - (CL)			5-10-13	SS6					
25	229				3-4-4	SS7					
					98	ST8					
30	224	Medium stiff, brown and gray, FAT CLAY - (CH)			2-2-4	SS9					64
35	219	Loose to very loose, gray to brown, fine SAND, trace silt - (SP-SM)			2-2-3	SS10					
40	214				1-0-1	SS11					
45	209	9.4 percent passing No. 200 sieve			3-4-5	SS12					
50	204	Loose to medium dense, brown, fine SAND - (SP) 3.7 percent passing No. 200 sieve			3-4-5	SS13					
55	199				4-4-9	SS14					
60	194	Medium stiff, brown, sandy, LEAN CLAY - (CL)			4-3-2	SS15					
65	189	Stiff, brown, LEAN CLAY - CL			3-4-9	SS16					
		Dense, brown and gray, SILTY SAND - SM			8-10-23	SS17					

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 30 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
 HAMMER TYPE Auto
 HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM	Checked by: DFB	App'vd. by: ASE
Date: 9/24/20	Date: 11/19/20	Date: 11/25/20



**Proposed Bridge over Route
 901 and UPRR
 Hwy. 49 Extension
 Craighead County, Arkansas**

LOG OF BORING: B-4

**Geotechnology Project No.
 J037334.01**

Surface Elevation: 254.391

Completion Date: 9/21/20

Datum: NAVD88

Station: 335+00.63

Offset: 21.13

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL | 10 20 30 40 50 | LL

DEPTH
IN FEET

ELEVATION
IN FEET

DESCRIPTION OF MATERIAL

GRAPHIC LOG

DRY UNIT WEIGHT (pcf)
SPT BLOW COUNTS
CORE RECOVERY/RQD

SAMPLES

Dense, brown and gray, SILTY SAND - SM
(continued)

75 — 179

Very stiff, gray, sandy SILT - ML
70.8 percent passing No. 200 sieve

8-10-13 SS18

80 — 174

Medium dense, tan and gray, SILTY SAND - (SM)
48.2 percent passing No. 200 sieve

6-10-6 SS19

85 — 169

Stiff, gray, LEAN CLAY - CL

4-4-6 SS20

90 — 164

Medium dense to loose, gray, CLAYEY SAND - (SC)

7-8-21 SS21

95 — 159

14.0 percent passing No. 200 sieve

2-3-3 SS22

100 — 154

Dense, gray, SILTY SAND - SM

20-22-20 SS24

105 — 149

110 — 144

Stiff, gray, LEAN CLAY - CL

2-4-6 SS25

Boring terminated at 110 feet.

115 — 139

120 — 134

125 — 129

130 — 124

135 — 119

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J037334.01.GPJ GTINC 0638301.GPJ 1/13/21

GROUNDWATER DATA

FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

AUGER 3 3/4" HOLLOW STEM WASHBORING FROM 30 FEET
BMF DRILLER TJB LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 92 %

REMARKS:

Drawn by: ASM	Checked by: DFB	App'vd. by: ASE
Date: 9/24/20	Date: 11/19/20	Date: 11/25/20



**Proposed Bridge over Route
901 and UPRR
Hwy. 49 Extension
Craighead County, Arkansas**

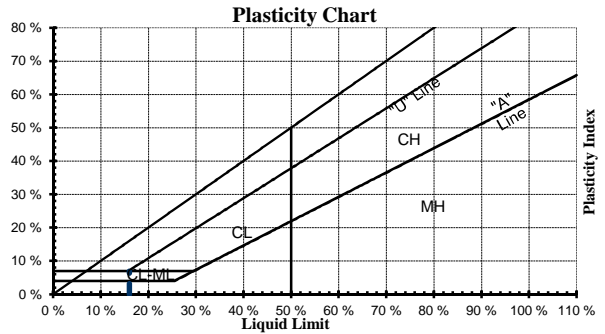
CONTINUATION OF
LOG OF BORING: B-4

Geotechnology Project No.
J037334.01

BORING LOG: TERMS AND SYMBOLS

LEGEND

CS	Continuous Sampler
GB	Grab Sample
NQ	NQ Rock Core
PST	Three-Inch Diameter Piston Tube Sample
SS	Split-Spoon Sample (Standard Penetration Test)
ST	Three-Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
PL	Plastic Limit (ASTM D4318)
LL	Liquid Limit (ASTM D4318)
SV	Shear Strength from Field Vane (ASTM D2573)
UU	Shear Strength from Unconsolidated-Undrained Triaxial Compression Test (ASTM D2850)
QU	Shear Strength from Unconfined Compression Test (ASTM D2166)



SOIL GRAIN SIZE

US STANDARD SIEVE

	12"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY	
		COARSE	FINE	COARSE	MEDIUM	FINE			
		300	76.2	19.1	4.76	2.00	0.42	0.074	0.005
SOIL GRAIN SIZE IN MILLIMETERS									

UNIFIED SOIL CLASSIFICATION SYSTEM

<i>Major Divisions</i>		<i>Symbol</i>	<i>Description</i>	
Coarse-Grained Soils (More than 50% Larger than No. 200 Sieve Size)	Gravel and Gravelly Soil	Clean Gravels Little or no Fines	GW Well-Graded Gravel, Gravel- Sand Mixture	
		Gravels with Appreciable Fines	GP Poorly-Graded Gravel, Gravel-Sand Mixture	
		Sand and Sandy Soils	Clean Sands Little or no Fines	GM Silty Gravel, Gravel-Sand-Silt Mixture
			Sands with Appreciable Fines	GC Clayey-Gravel, Gravel-Sand-Clay Mixture
	Fine-Grained Soils (More than 50% Smaller than No. 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	SW Well-Graded Sand, Gravelly Sand
				SP Poorly-Graded Sand, Gravelly Sand
				SM Silty Sand, Sand-Silt Mixture
		Silts and Clays	Liquid Limit Greater Than 50	SC Clayey-Sand, Sand-Clay Mixture
			ML Silt, Sandy Silt, Clayey Silt, Slight Plasticity	
			CL Lean Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity	
		MH Silt, High Plasticity		
		CH Fat Clay, High Plasticity		
		OH Organic Clay, Medium to High Plasticity		
Highly Organic Soils		PT	Peat, Humus, Swamp Soil	

STRENGTH OF COHESIVE SOILS

DENSITY OF GRANULAR SOILS

<i>Consistency</i>	<i>Undrained Shear Strength (tsf)</i>	<i>Unconfined Comp. Strength (tsf)</i>	<i>Descriptive Term</i>	<i>Approximate N₆₀-Value Range</i>
Very Soft	less than 0.125	less than 0.25	Very Loose	0 to 4
Soft	0.125 to 0.25	0.25 to 0.5	Loose	5 to 10
Medium Stiff	0.25 to 0.5	0.5 to 1.0	Medium Dense	11 to 30
Stiff	0.5 to 1.0	1.0 to 2.0	Dense	31 to 50
Very Stiff	1.0 to 2.0	2.0 to 3.0	Very Dense	>50
Hard	greater than 2.0	greater than 4.0		

N-Value (Blow Count) is the last two, 6-inch drive increments (i.e. 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on the grid plot and shown in the Unit Dry Weight/SPT column.

RELATIVE COMPOSITION

OTHER TERMS

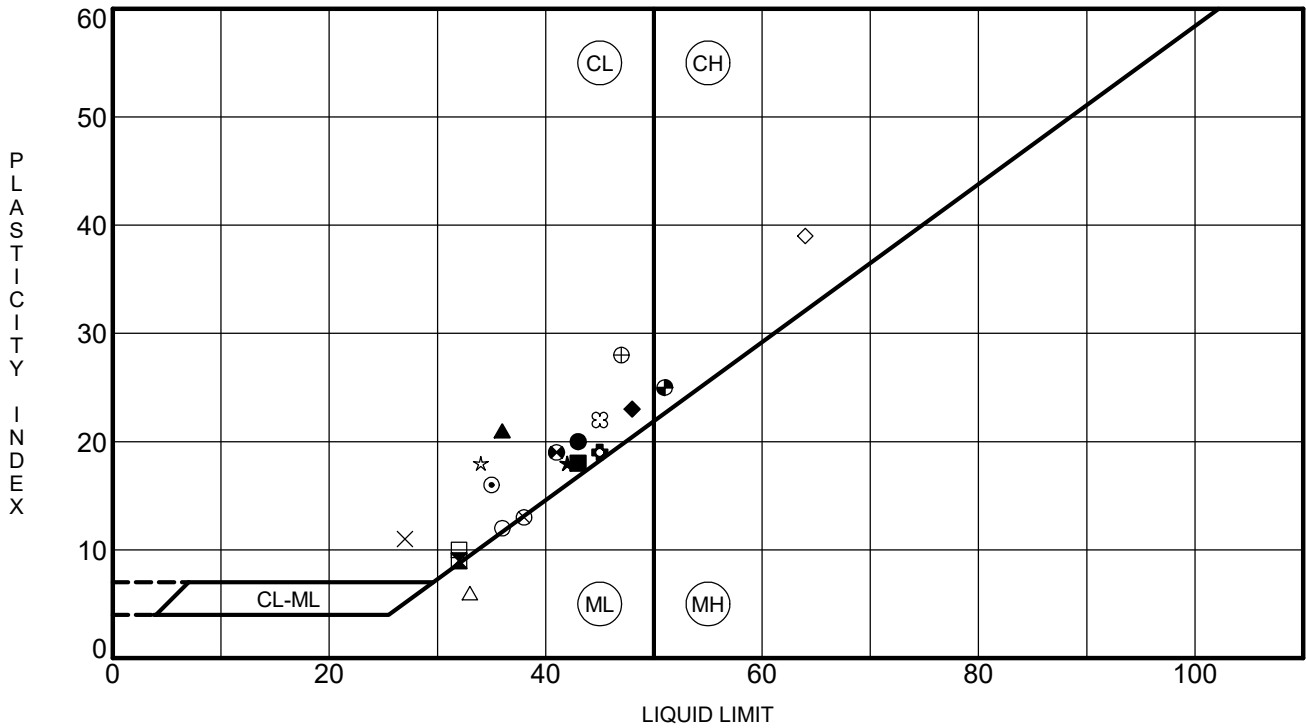
Trace	0 to 10%	Layer - Inclusion greater than 3 inches thick.
Little	10 to 20%	Seam - Inclusion 1/8-inch to 3 inches thick
Some	20 to 35%	Parting - Inclusion less than 1/8-inch thick
And	35 to 50%	Pocket - Inclusion of material that is smaller than sample diameter



Relative composition and Unified Soil Classification System (USCS) designations are based on visual descriptions and are approximate only. If laboratory tests were performed to classify the soil, the USCS designation is shown in parenthesis.



APPENDIX D
LABORATORY TEST DATA



Specimen Identification	LL	PL	PI	Fines	Classification	
● B-1	1.0	43	23	20	LEAN CLAY (CL), A-7-6	
⊠ B-1	8.0	32	23	9	LEAN CLAY (CL), A-4	
▲ B-1	23.0	36	15	21	97	LEAN CLAY (CL), A-6 (20)
★ B-1	28.5	42	24	18		LEAN CLAY (CL), A-7-6
⊙ B-2	10.0	35	19	16		LEAN CLAY (CL), A-6
⊕ B-2	30.0	45	26	19		LEAN CLAY (CL), A-7-6
○ B-2	33.5	36	24	12		LEAN CLAY (CL), A-6
△ B-2	40.0	33	27	6	85	SILT (ML), A-4 (5)
⊗ B-2	43.5	38	25	13		SILT (ML), A-6
⊕ B-3	8.5	47	19	28		LEAN CLAY (CL), A-7-6
□ B-3	25.0	32	22	10		LEAN CLAY (CL), A-4
⊕ B-3	30.0	41	22	19		LEAN CLAY (CL), A-7-6
⊕ B-3	35.0	51	26	25		FAT CLAY (CH), A-7-6
★ B-3	108.5	34	16	18		LEAN CLAY (CL), A-6
⊗ B-4	3.5	45	23	22		LEAN CLAY (CL), A-6
■ B-4	23.5	43	25	18		LEAN CLAY (CL), A-7-6
◆ B-4	25.0	48	25	23		LEAN CLAY (CL), A-7-6
◇ B-4	28.5	64	25	39		FAT CLAY (CH), A-7-6
× B-4	58.5	27	16	11		LEAN CLAY (CL), A-6

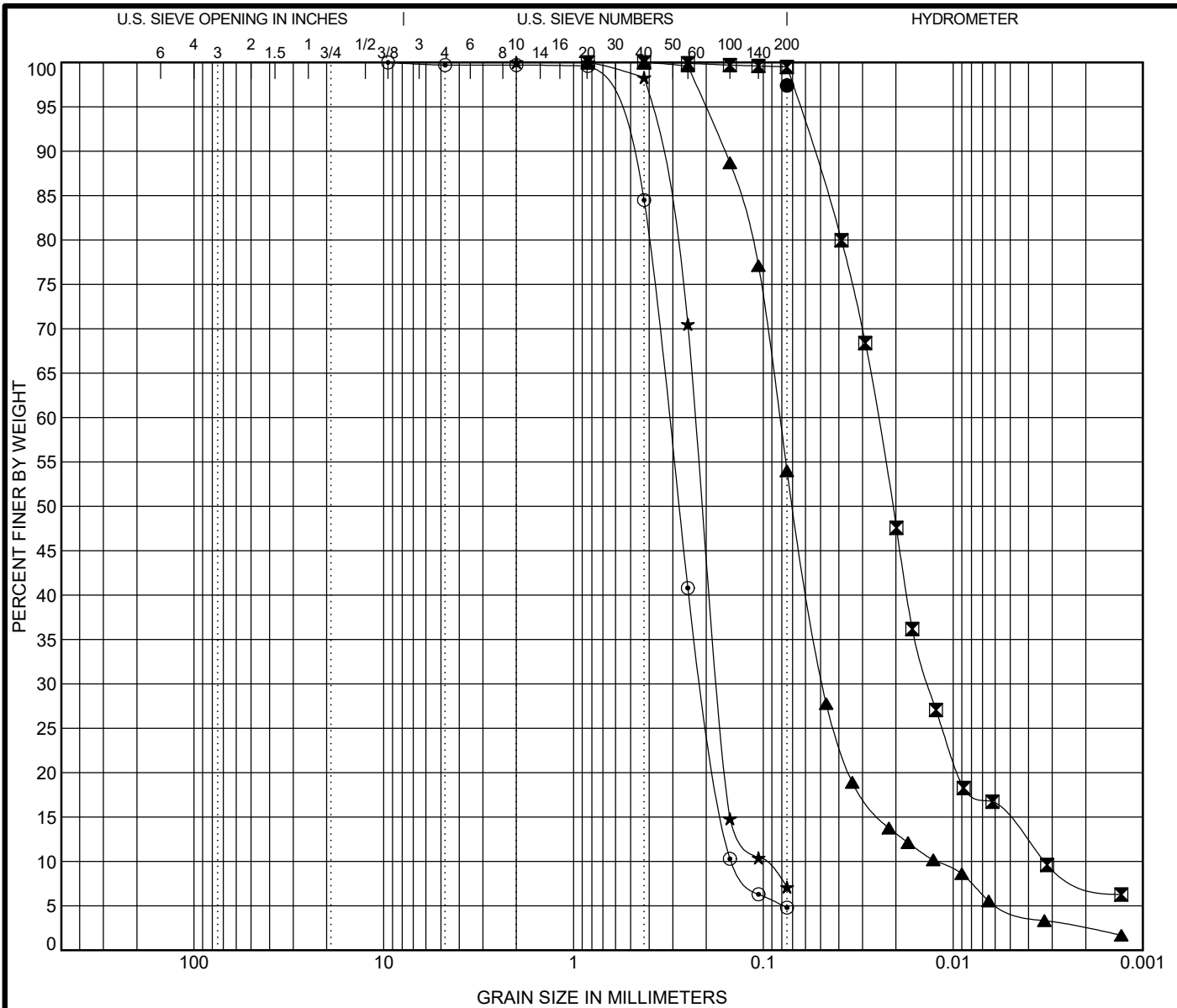
US ATTERBERG LIMITS J037334.01.GPJ US LAB.GDT 12/23/20



ATTERBERG LIMITS RESULTS

I-555 - Hwy 49 Bridge
over Route 901 and UPRR
Jonesboro, Arkansas

J037334.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

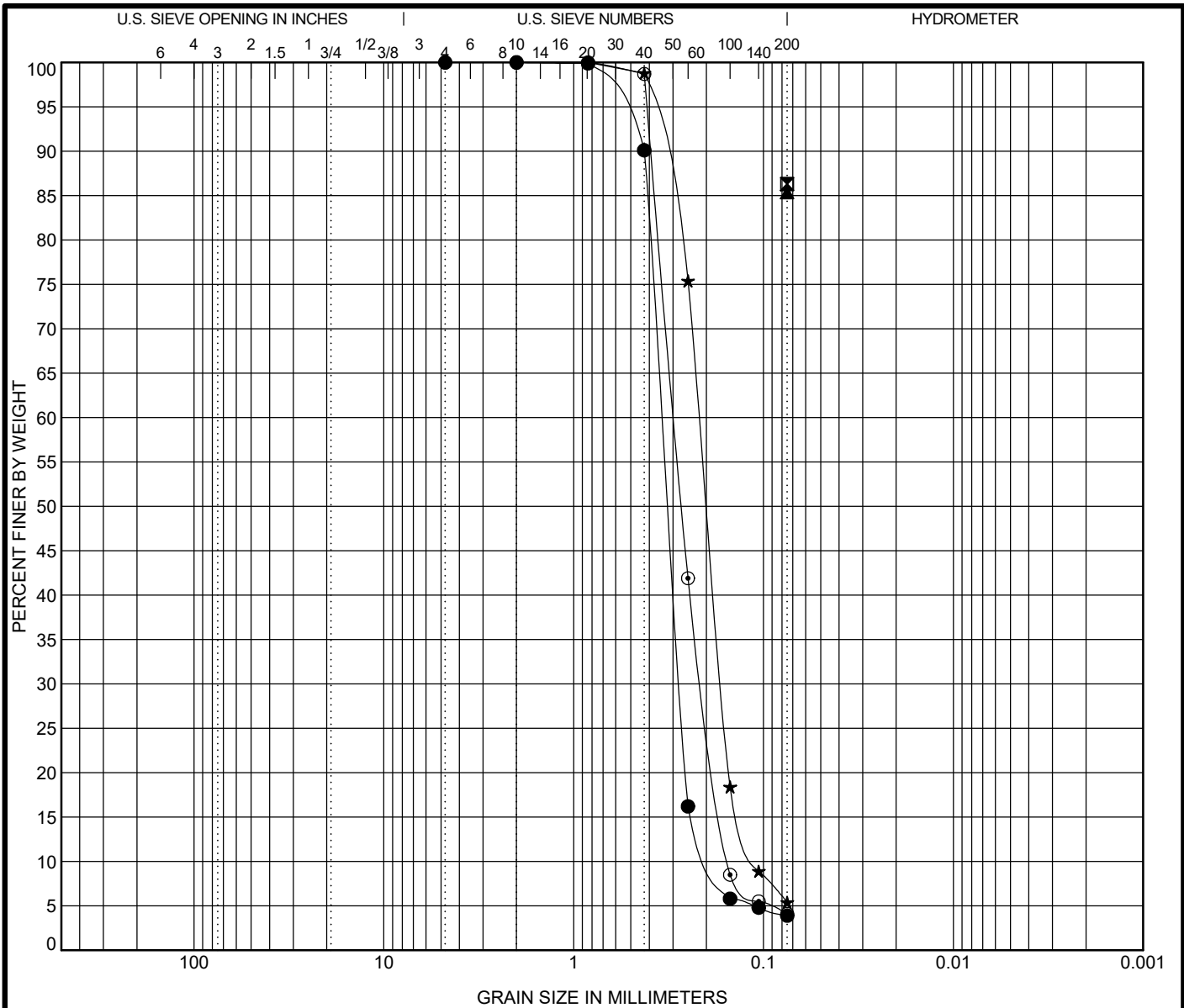
Specimen ID / Depth	Classification	LL	PL	PI	Cc	Cu		
● B-1 23.0	LEAN CLAY (CL), A-6 (20)	36	15	21				
☒ B-1 33.5	SILT (ML), A-4				2.20	7.51		
▲ B-1 38.5	SILT (ML), A-4				2.35	6.73		
★ B-1 48.5	POORLY GRADED SAND (SP-SM), A-3				1.29	2.23		
⊙ B-1 63.5	POORLY GRADED SAND (SP), A-3				0.94	2.16		
Specimen ID / Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1 23.0							97.4	
☒ B-1 33.5	0.84	0.025	0.013	0.003	0.0	0.5	85.1	14.4
▲ B-1 38.5	0.84	0.082	0.049	0.012	0.0	46.0	49.3	4.7
★ B-1 48.5	2	0.227	0.172	0.102	0.0	92.9	7.1	
⊙ B-1 63.5	9.5	0.316	0.209	0.146	0.3	94.9	4.8	

US GRAIN SIZE J037334.01.GPJ US LAB.GDT 11/19/20



GRAIN SIZE DISTRIBUTION

I-555 - Hwy 49 Bridge
over Route 901 and UPRR
Jonesboro, Arkansas
Geotechnology Project No. J037334.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

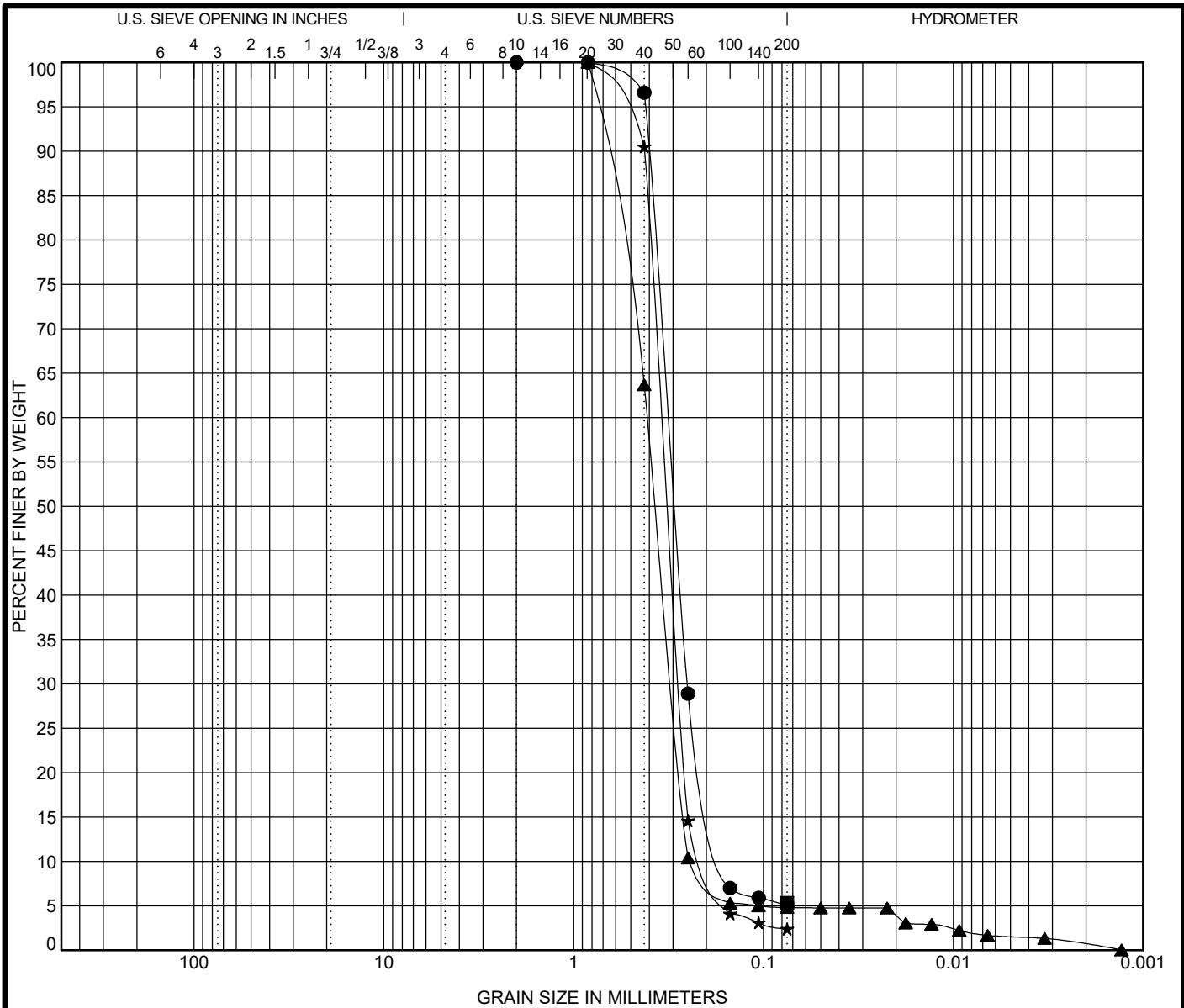
Specimen ID / Depth	Classification	LL	PL	PI	Cc	Cu		
● B-1 83.5	POORLY GRADED SAND (SP), A-3				1.21	1.86		
☒ B-2 38.5	LEAN CLAY (CL), A-6							
▲ B-2 40.0	SILT (ML), A-4 (5)	33	27	6				
★ B-2 48.5	POORLY GRADED SAND (SP-SM), A-3				1.15	1.97		
⊙ B-2 63.5	POORLY GRADED SAND (SP), A-3				0.96	1.93		
Specimen ID / Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1 83.5	4.75	0.342	0.276	0.184	0.0	96.1	3.9	
☒ B-2 38.5							86.3	
▲ B-2 40.0							85.3	
★ B-2 48.5	0.84	0.218	0.166	0.11	0.0	94.6	5.4	
⊙ B-2 63.5	2	0.296	0.208	0.153	0.0	95.9	4.1	

US GRAIN SIZE J037334.01.GPJ US LAB.GDT 11/19/20



GRAIN SIZE DISTRIBUTION

I-555 - Hwy 49 Bridge
over Route 901 and UPRR
Jonesboro, Arkansas
Geotechnology Project No. J037334.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

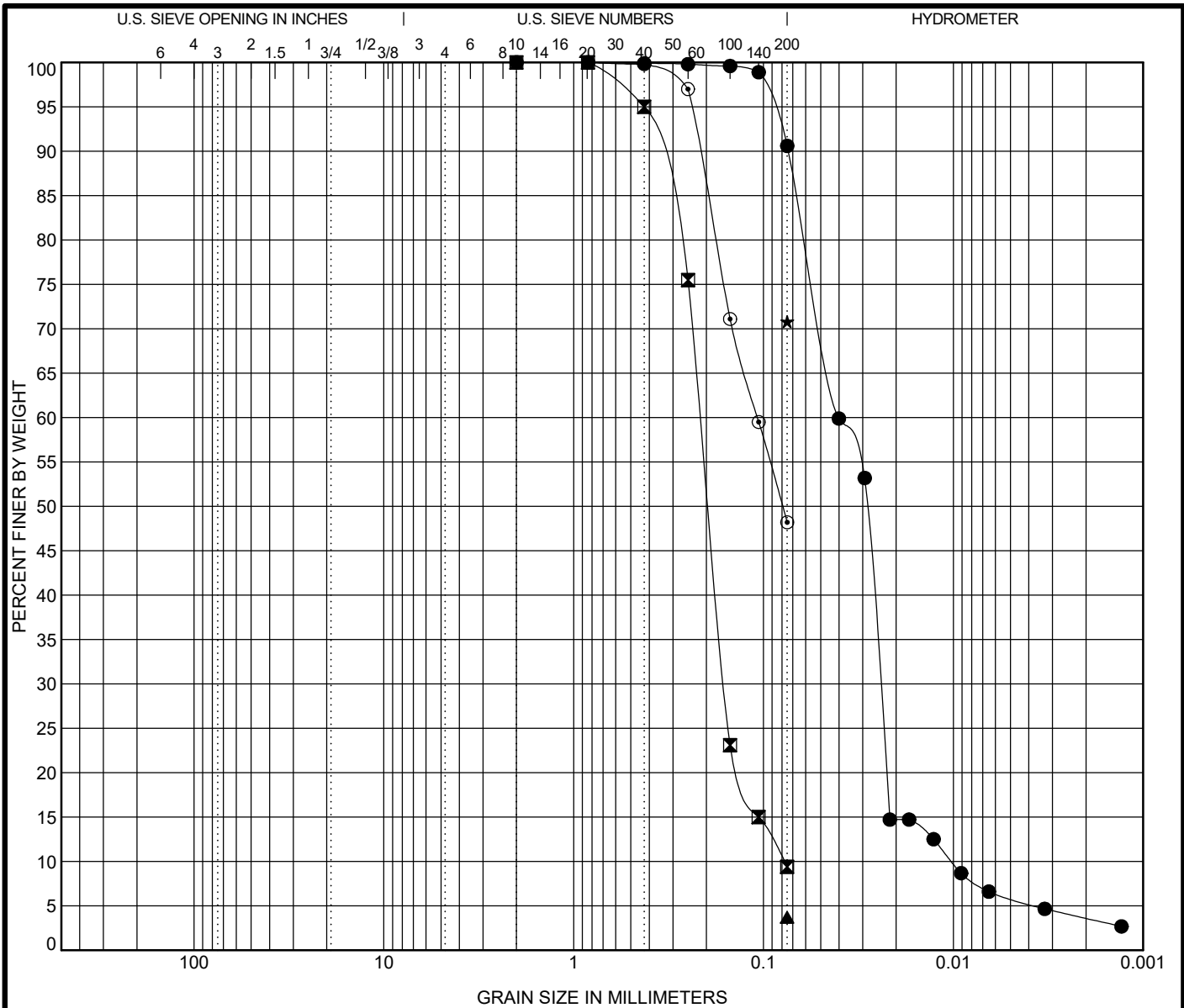
Specimen ID / Depth	Classification	LL	PL	PI	Cc	Cu		
● B-2 83.5	POORLY GRADED SAND (SP-SM), A-3				1.24	1.98		
■ B-3 38.5	POORLY GRADED SAND (SP-SM), A-3							
▲ B-3 48.5	POORLY GRADED SAND (SP), A-3				0.94	1.71		
★ B-3 68.5	POORLY GRADED SAND (SP), A-3				1.13	1.72		
◎ B-3 98.5	POORLY GRADED SAND (SP-SC), A-2-6							
Specimen ID / Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-2 83.5	2	0.319	0.252	0.161	0.0	95.0	5.0	
■ B-3 38.5							5.3	
▲ B-3 48.5	0.84	0.41	0.304	0.24	0.0	95.2	3.3	1.5
★ B-3 68.5	2	0.343	0.278	0.2	0.0	97.6	2.4	
◎ B-3 98.5							5.3	

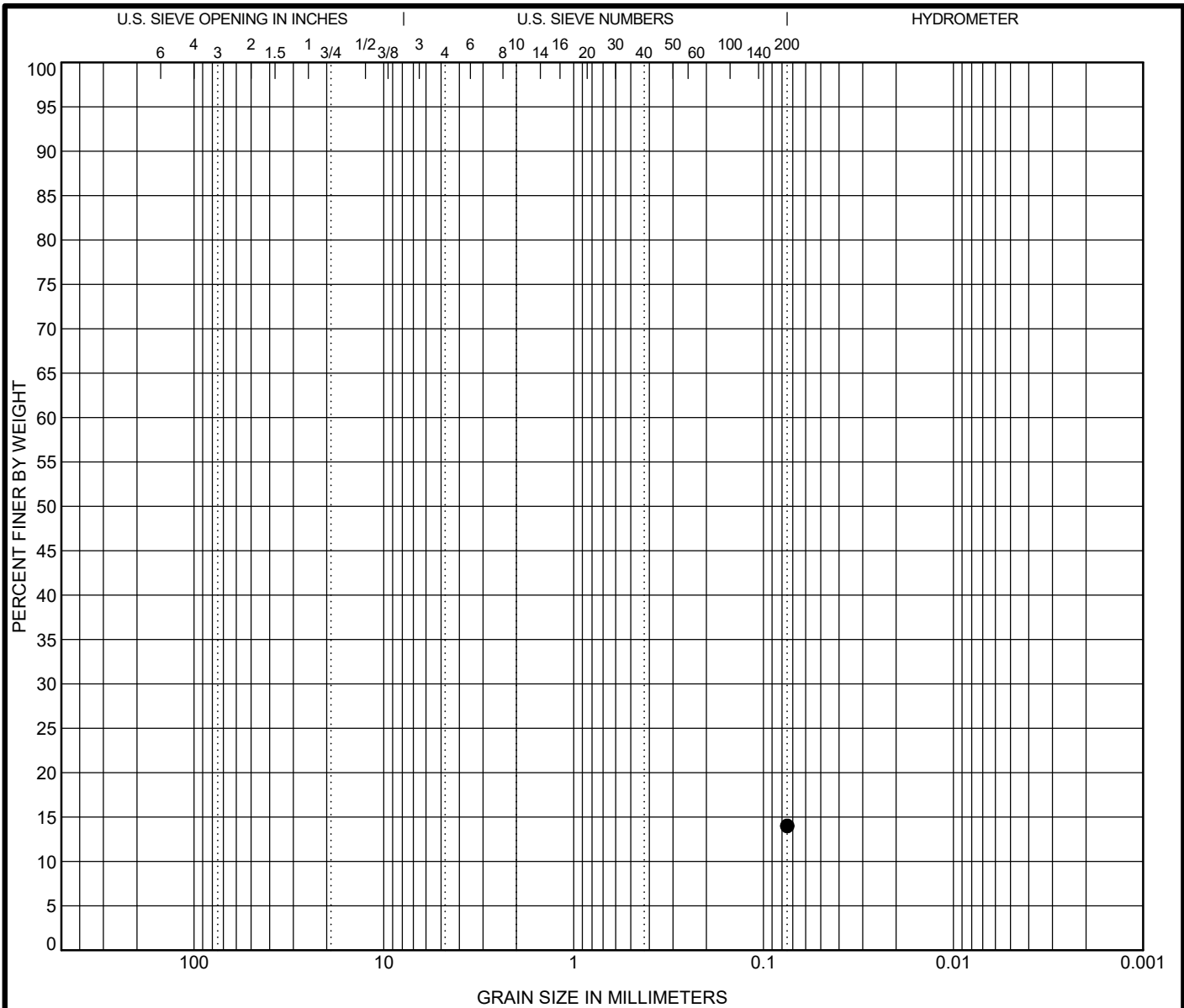
US GRAIN SIZE J037334.01.GPJ US LAB.GDT 11/19/20



GRAIN SIZE DISTRIBUTION

I-555 - Hwy 49 Bridge
over Route 901 and UPRR
Jonesboro, Arkansas
Geotechnology Project No. J037334.01





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen ID / Depth	Classification	LL	PL	PI	Cc	Cu
● B-4 93.5	CLAYEY SAND (SC), A-2-6					

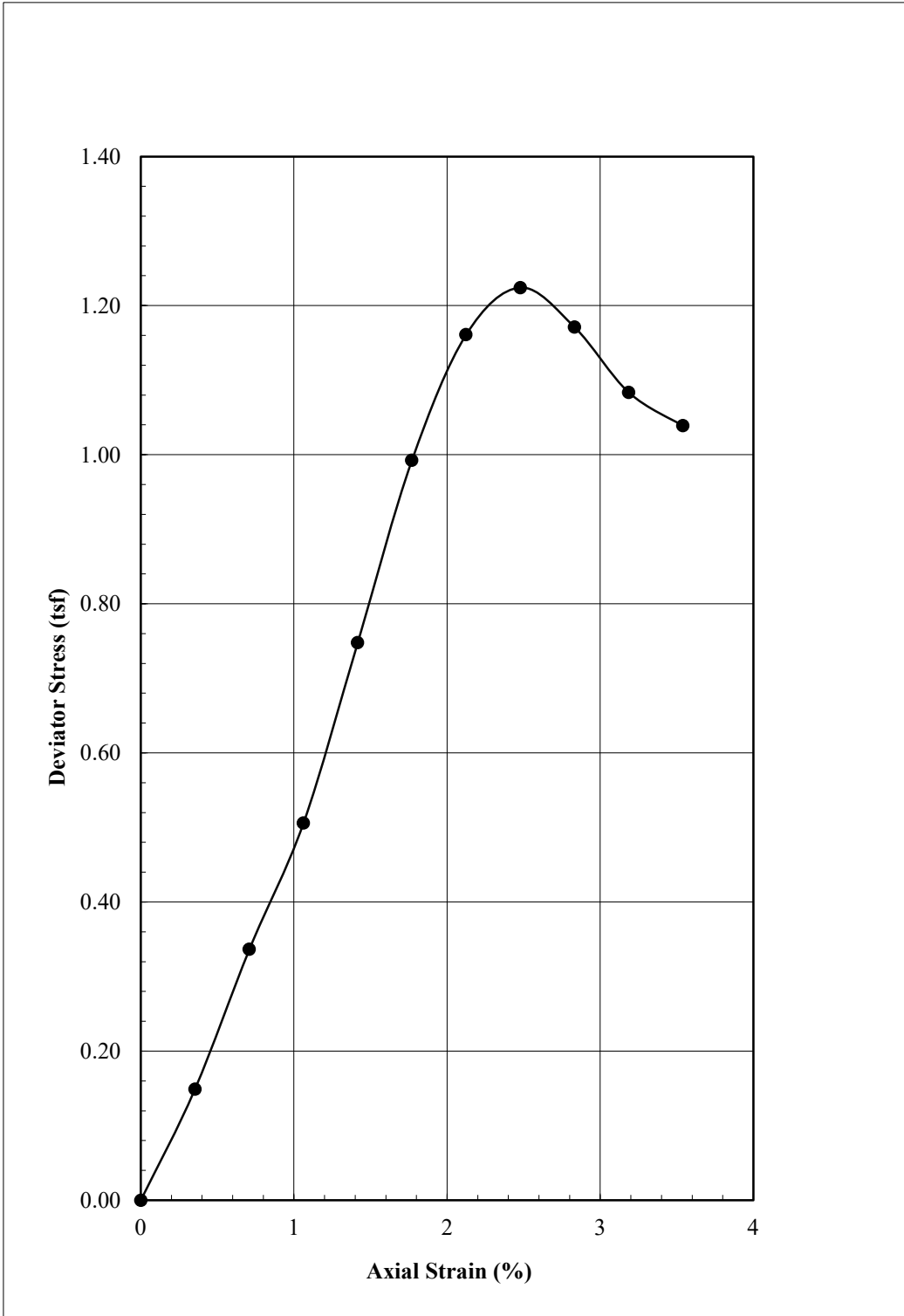
Specimen ID / Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-4 93.5							14.0	

US GRAIN SIZE J037334.01.GPJ US LAB.GDT 11/19/20



GRAIN SIZE DISTRIBUTION

I-555 - Hwy 49 Bridge
over Route 901 and UPRR
Jonesboro, Arkansas
Geotechnology Project No. J037334.01



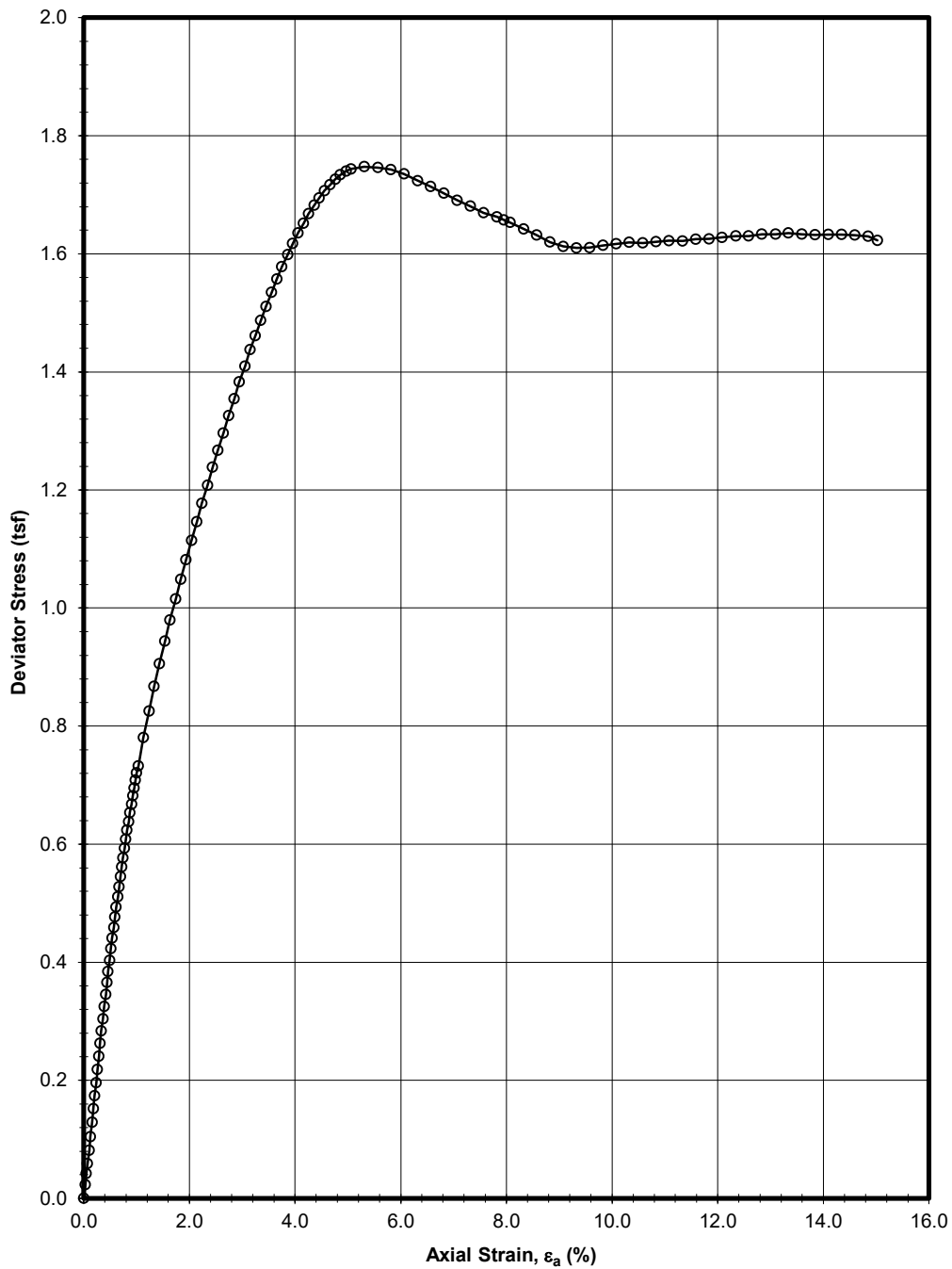
UNCONFINED COMPRESSION TEST

ASTM D 2166

Project No.: J037334.01

Boring: B-1

Sample: ST1 - Depth: 1 ft.



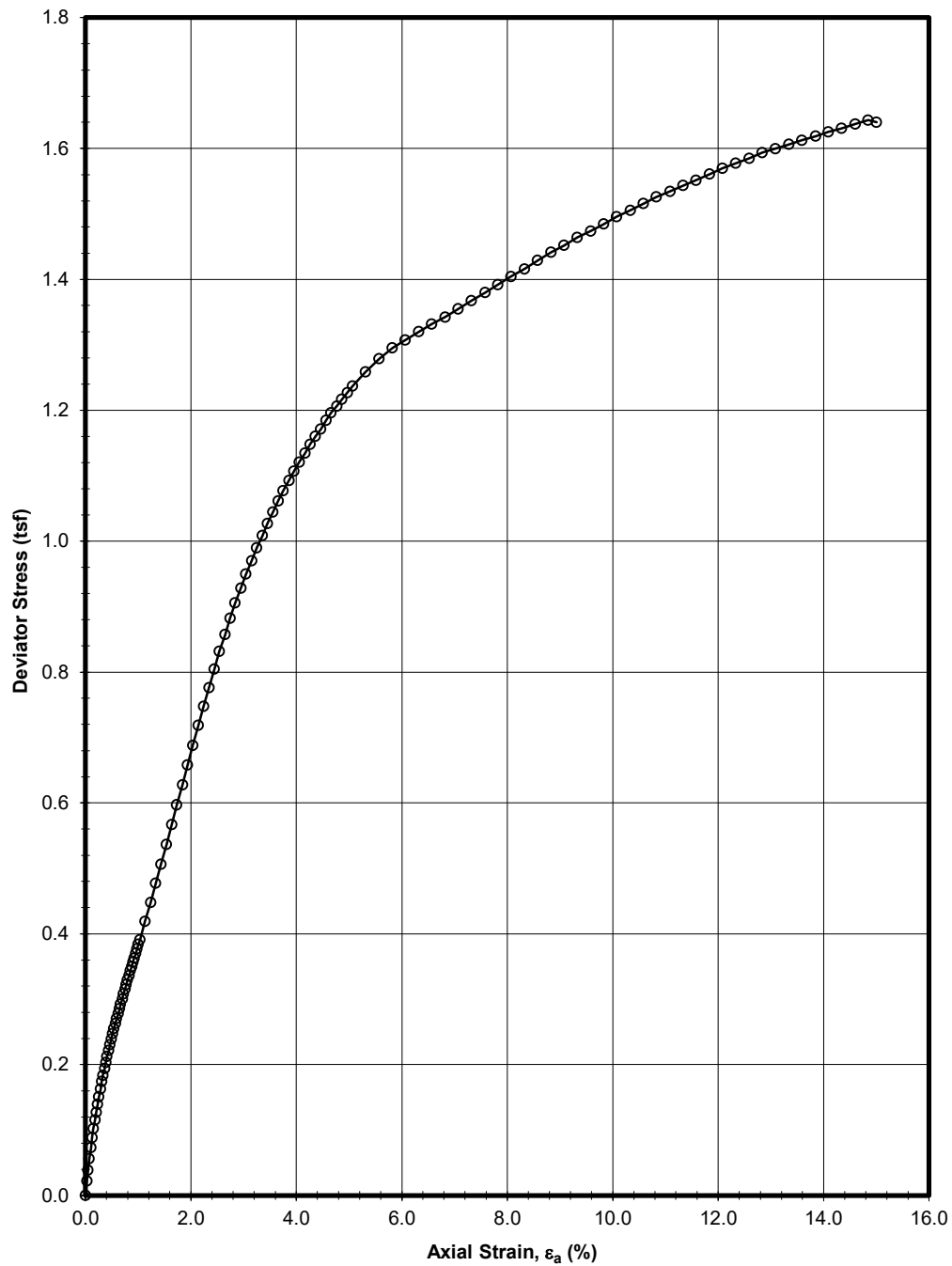
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850

Project No.: J037334.01

Boring: B-1

Sample: ST4 - Depth: 8 ft.



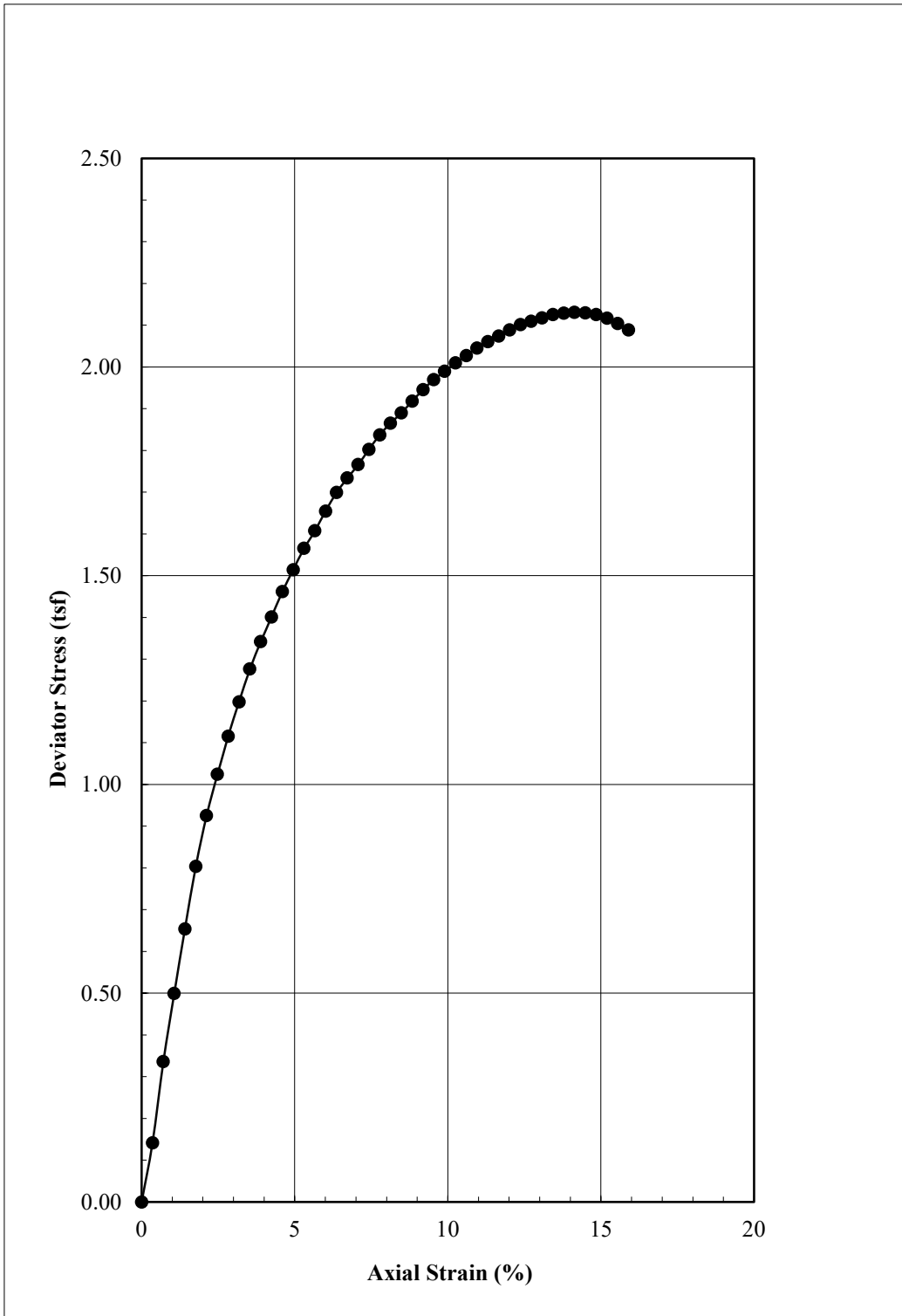
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850

Project No.: J037334.01

Boring: B-1

Sample: ST-7 - Depth: 23 ft.



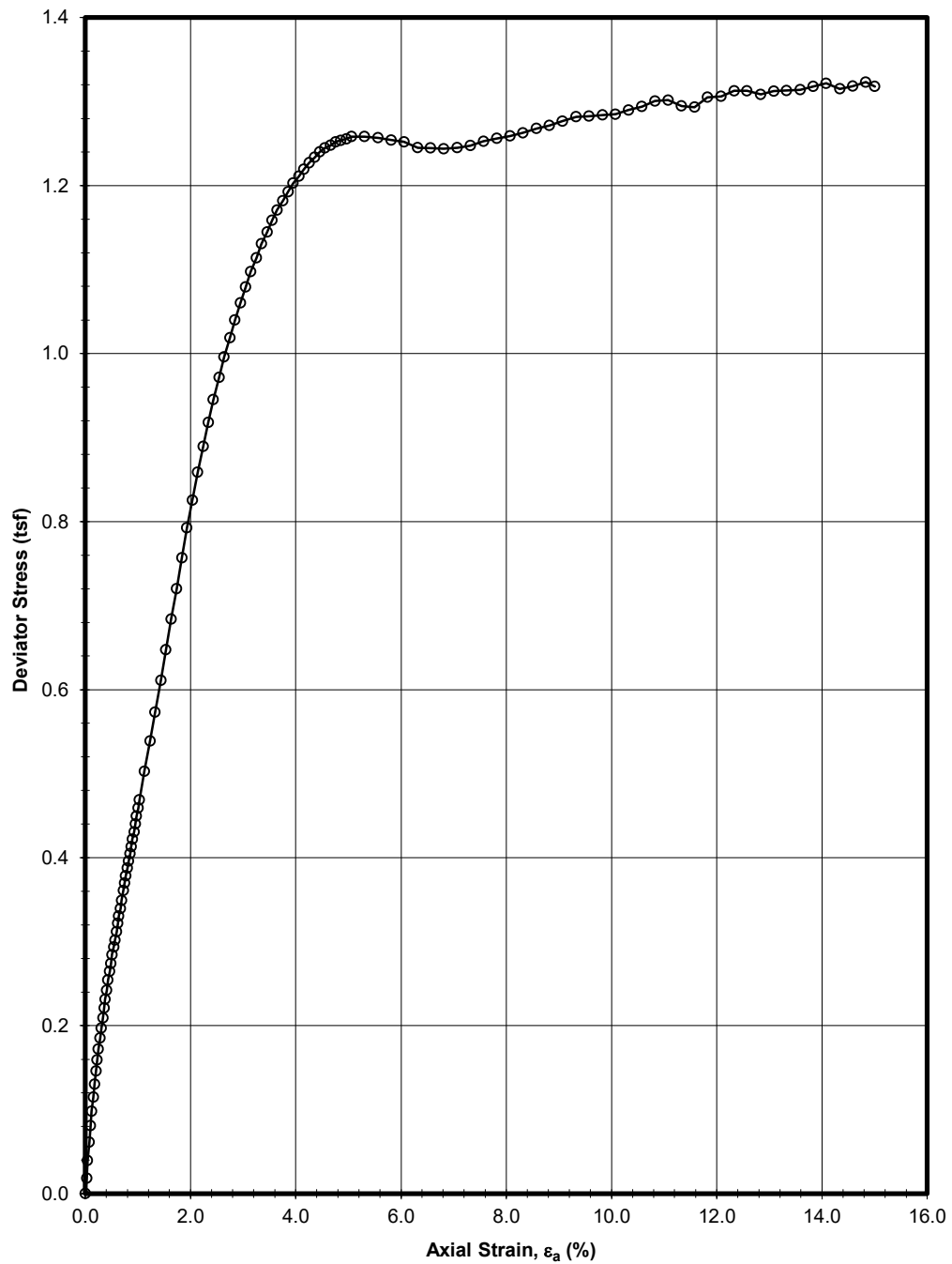
UNCONFINED COMPRESSION TEST

ASTM D 2166

Project No.: J037334.01

Boring: B-2

Sample: ST2 - Depth: 3 ft.



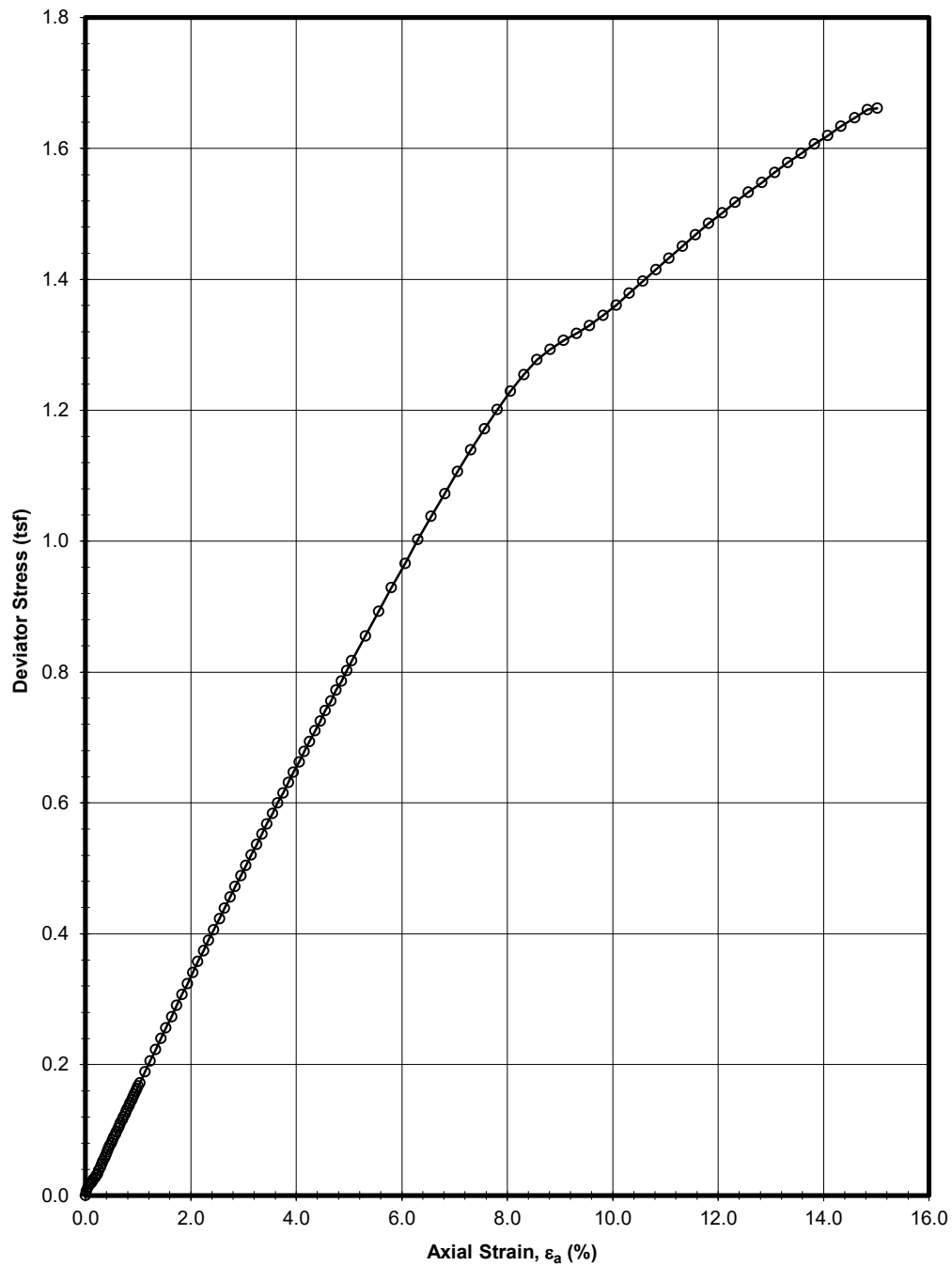
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850

Project No.: J037334.01

Boring: B-2

Sample: ST12 - Depth: 30 ft.



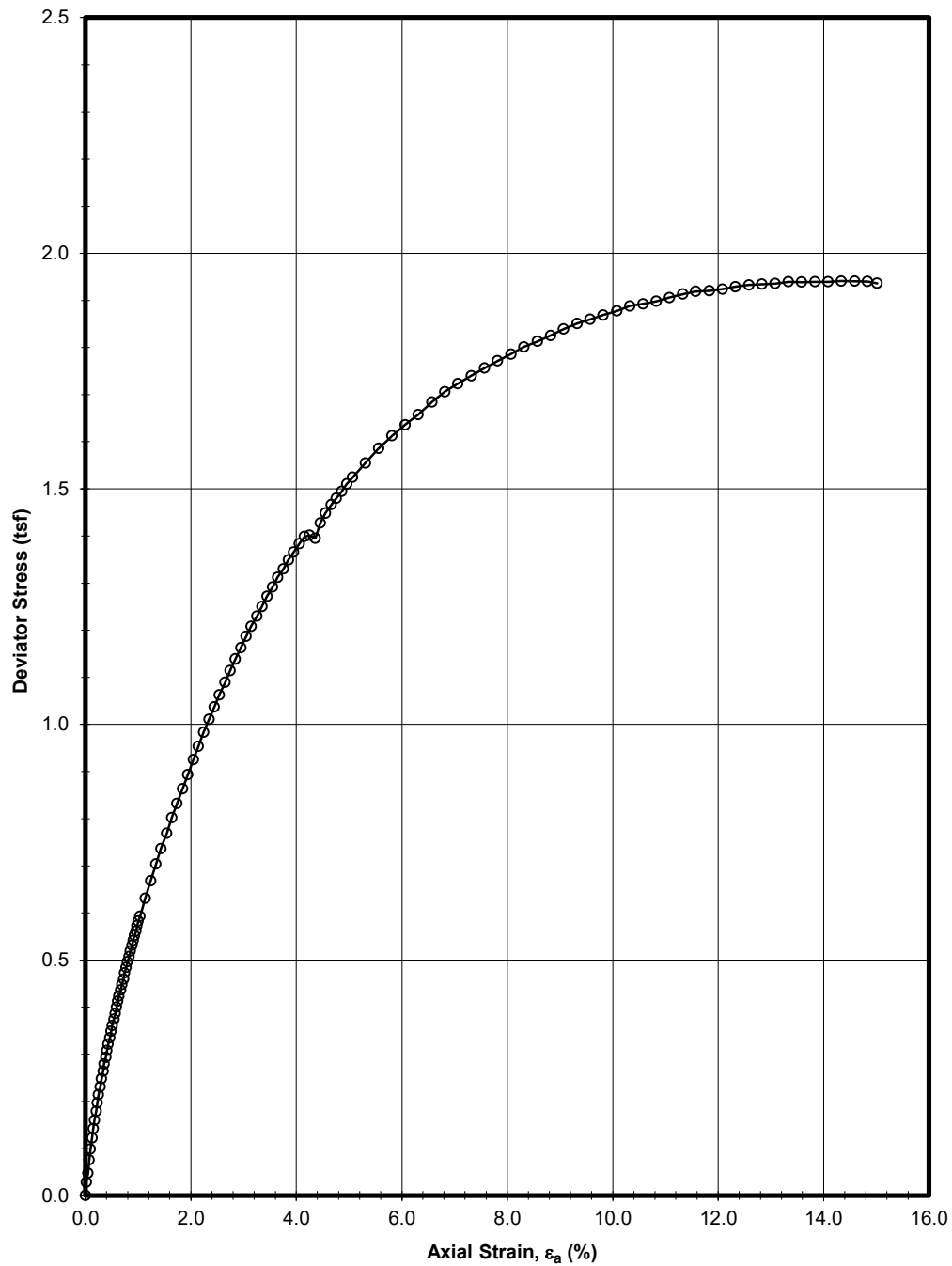
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850

Project No.: J037334.01

Boring: B-3

Sample: ST8 - Depth: 25 ft.



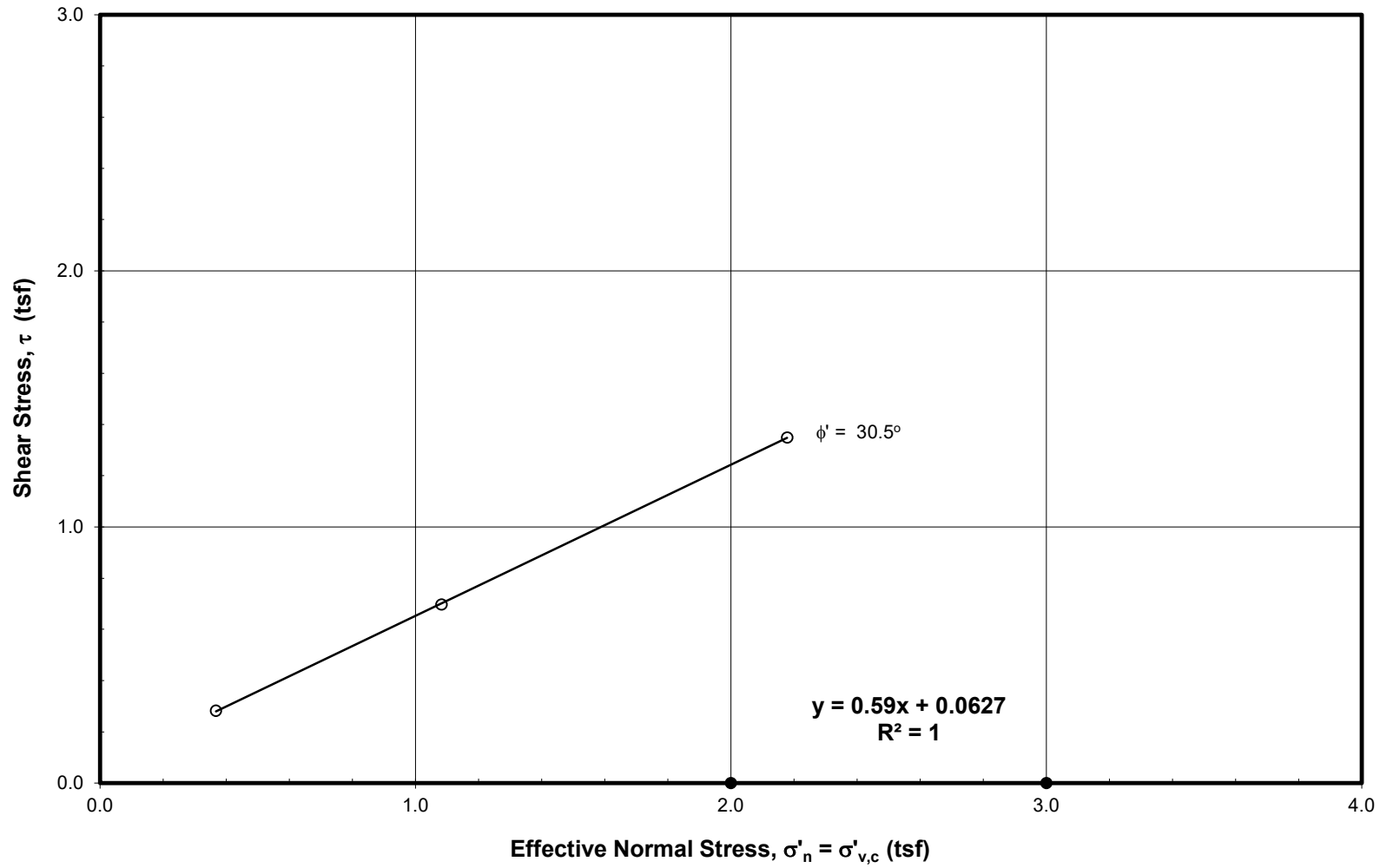
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850

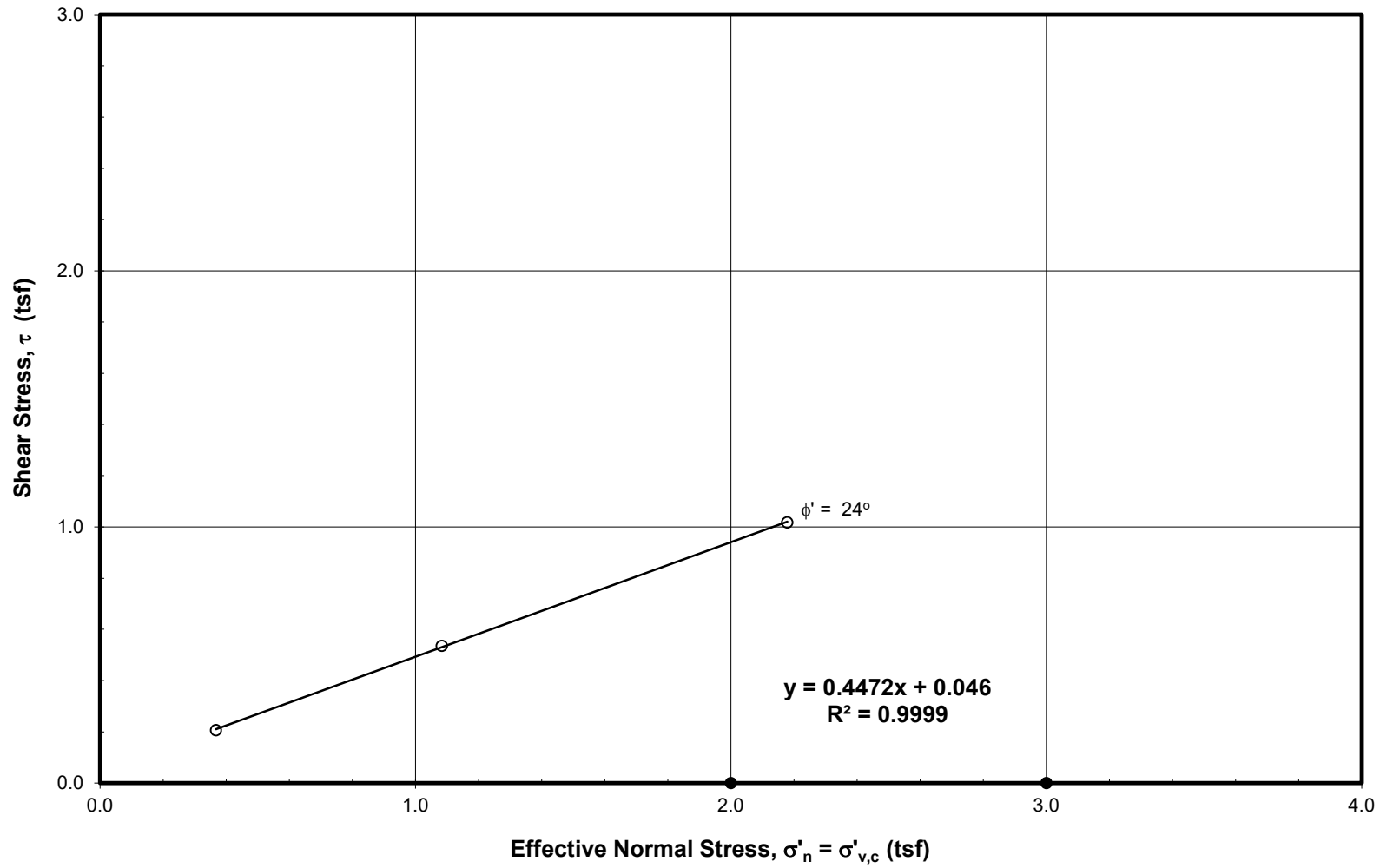
Project No.: J037334.01

Boring: B-4

Sample: ST-8 - Depth: 25 ft.



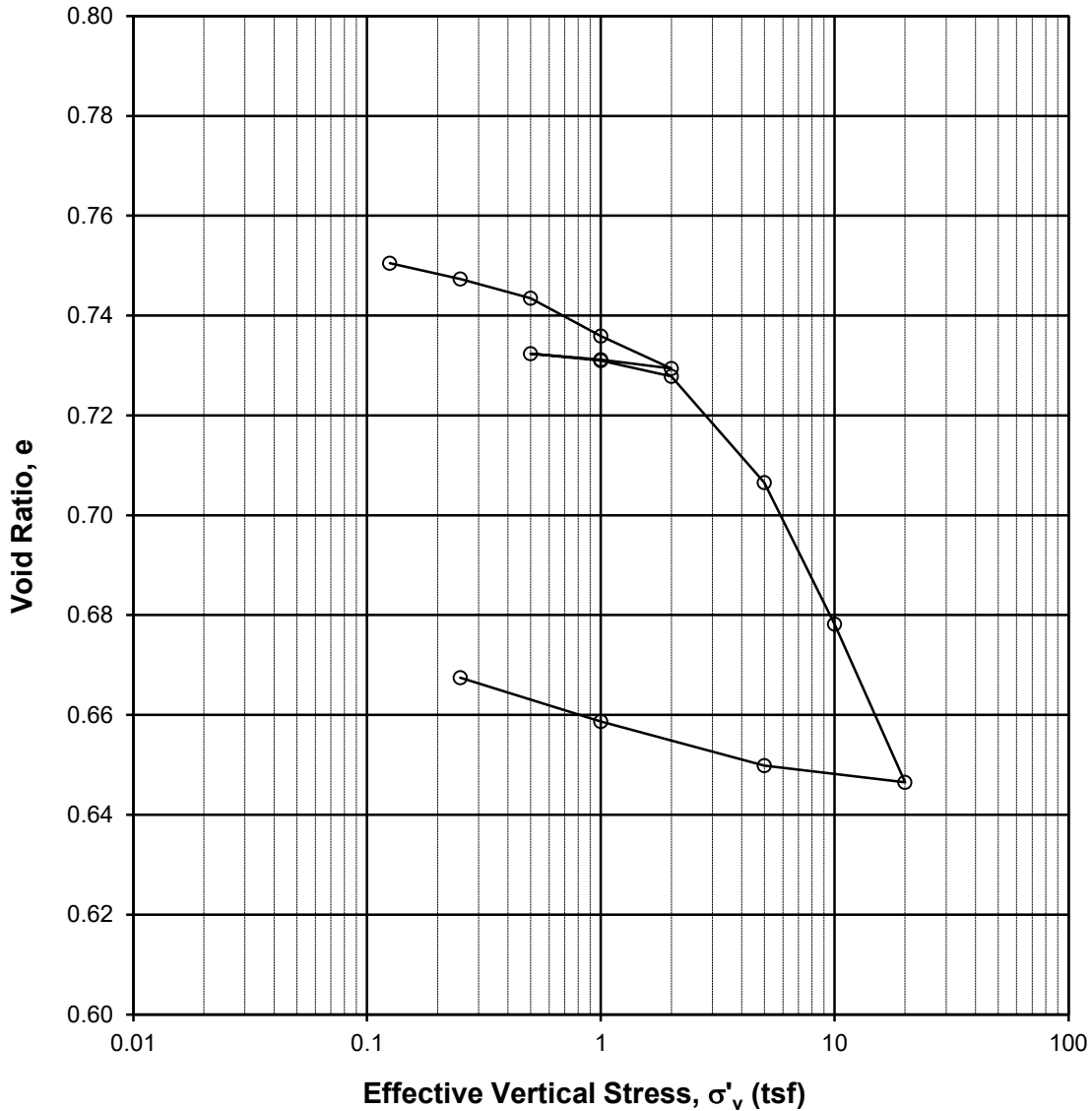
DRAINED DIRECT SHEAR TEST
ASTM D 3080
Boring: B-2 Sample: ST5 -Depth: 10.0ft



DRAINED DIRECT SHEAR TEST
ASTM D 3080
Boring: B-3 Sample: ST10 -Depth: 30ft

Liquid Limit= 43 Plastic Limit= 23 Plasticity Index = 20 USCS: CL

Compression Index, C_c = 0.11 Void Ratio, e_o = 0.75
 Recompression Index, C_r = 0.02 Preconsolidation Pressure = 3.0 tsf



1-D CONSOLIDATION TEST: INCREMENTAL

ASTM D 2435

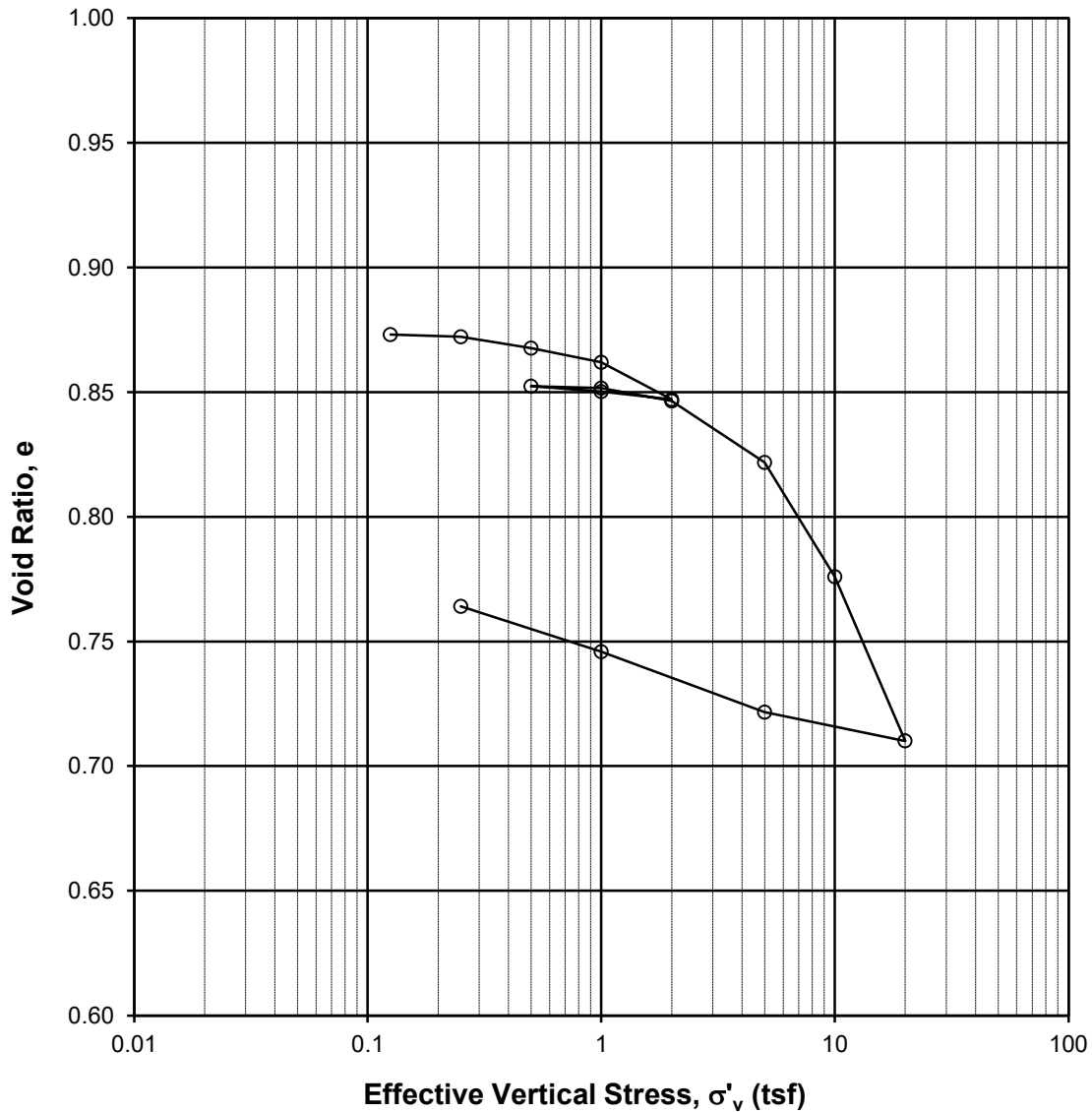
Project No.: J037334.01

Boring: B-1

Sample: ST4 - Depth: 8.0

Liquid Limit= 36 Plastic Limit= 15 Plasticity Index = 21 USCS: CL

Compression Index, C_c = 0.19 Void Ratio, e_o = 0.88
 Recompression Index, C_r = 0.03 Preconsolidation Pressure = 3.5 tsf



1-D CONSOLIDATION TEST: INCREMENTAL

ASTM D 2435

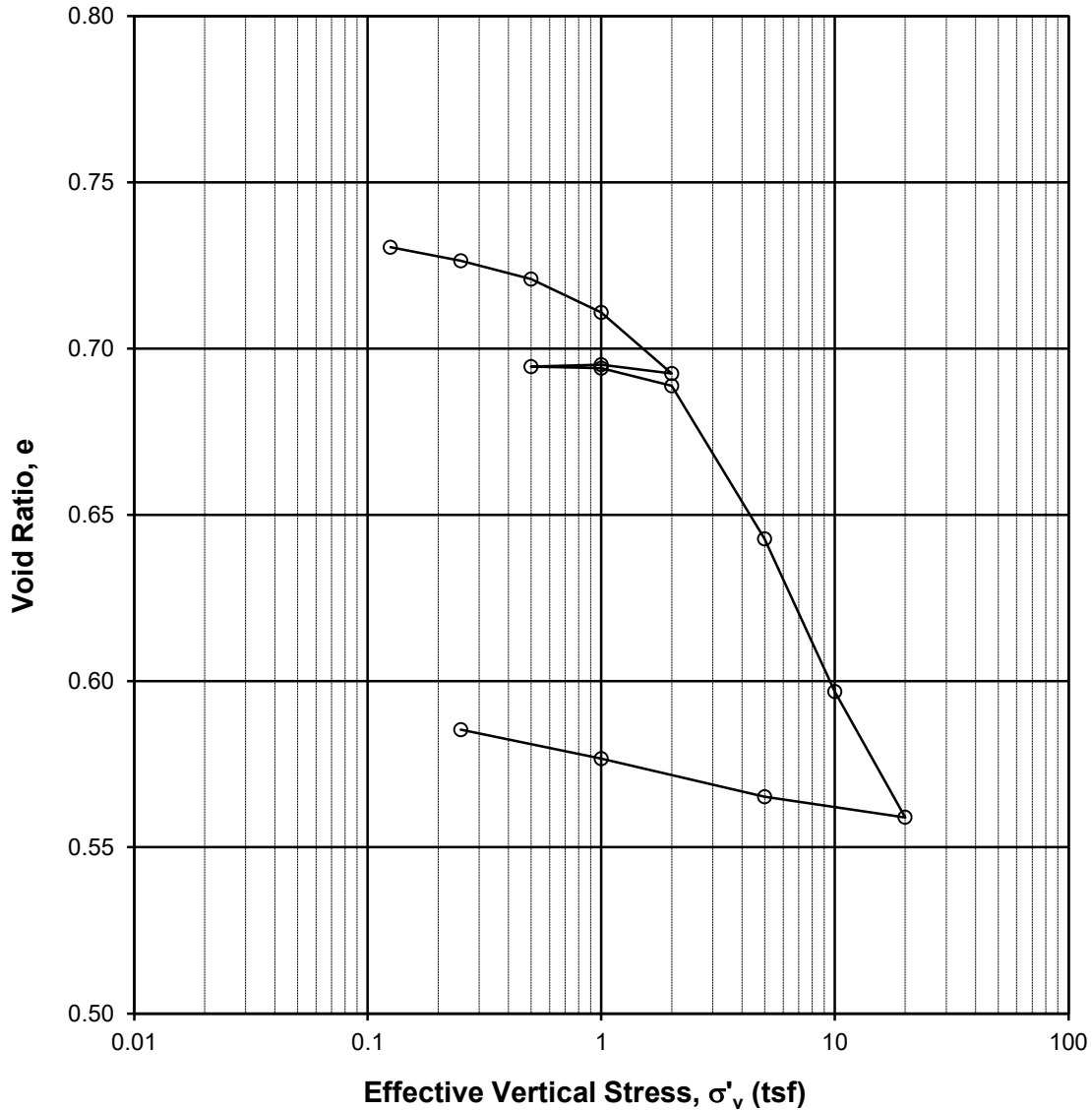
Project No.: J037334.01

Boring: B-1

Sample: ST7 - Depth: 23.0

Liquid Limit= 43 Plastic Limit= 25 Plasticity Index = 18 USCS: CL

Compression Index, C_c = 0.14 Void Ratio, e_o = 0.73
 Recompression Index, C_r = 0.02 Preconsolidation Pressure = 2.0 tsf



1-D CONSOLIDATION TEST: INCREMENTAL

ASTM D 2435

Project No.: J037334.01

Boring: B-4

Sample: ST-8 - Depth: 23.5

pH TESTS (ASTM D 4972 or AASHTO T-289)



DATE 11/12/2020	PROJECT NAME I-555	PROJECT NO. J037334.01
General Test Information: pH Meter: Humboldt Ph Testr H-4371 or _____ Distilled Water: required pH=5.5 to 7.5 Measured value: _____ Soil/Water Ratio: Typically 1/1 or 1/2, but 1/5 for lime stabilized soils		

Boring No.	Sample No.	Depth (ft)	Visual Identification (Color, Group Name & Symbol)	Soil : Water Ratio (g/g) or (g/mL)	pH of Solution (Meter/ Paper) ¹	Tare No. Air Drying	Jar Number	Remarks
B-2	ST5	10.00		1:1	7.90 ----- 19.5			

B-1	ST1	1.00		1:1	4.68 ----- 19.3			

B-2	ST2	3.00		1:1	4.45 ----- 19.3			

B-4	SS8	23.50		1:1	6.77 ----- 19.3			
B-1	ST7	23.00		1:1	7.09 ----- 19.2			

pH by Meter is Method A; pH by Paper is Method B

Tested By: CR
Date: 11/14/20

Calculated By: HP
Date: _____

Checked By: dfb
Date: 12/1/20

pH TESTS (ASTM D 4972 or AASHTO T-289)



DATE 11/12/2020	PROJECT NAME I-555	PROJECT NO. J037334.01
General Test Information: pH Meter: Humboldt Ph Testr H-4371 or _____ Distilled Water: required pH=5.5 to 7.5 Measured value: _____ Soil/Water Ratio: Typically 1/1 or 1/2, but 1/5 for lime stabilized soils		

Boring No.	Sample No.	Depth (ft)	Visual Identification (Color, Group Name & Symbol)	Soil : Water Ratio (g/g) or (g/mL)	pH of Solution (Meter/ Paper) ¹	Tare No. Air Drying	Jar Number	Remarks
B-2	ST12	30.00		1:1	7.22 ----- 21.2			

B-1	SS6	18.50		1:1	7.28 ----- 21.4			

B-2	ST7	15.00		1:1	6.38 ----- 20.6			

B-3	ST17	58.00		1:1	7.12 ----- 20.4			

pH by Meter is Method A; pH by Paper is Method B

Tested By: CR
Date: 11/30/20

Calculated By: HP
Date: 12/01/20

Checked By: DFB
Date: 12/02/20



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.:	J037334.01	November 30, 2020
Project Name:	I-555	Page 1 of 1
Boring Number:	B-1	
Sample ID:	ST1	
Depth (ft):	1.0	

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	6,500	0.57	3,705	13.5
#2	2,600	0.57	1,482	20.2
#3	2,100	0.57	1,197	26.6
#4	2,150	0.57	1,226	32.3

Minimum Soil Resistivity **1,197**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.: J037334.01
Project Name: I-555
Boring Number: B-1
Sample ID: SS6
Depth (ft): 18.5

December 1, 2020
Page 1 of 1

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	3,300	0.57	1,881	10.9
#2	1,900	0.57	1,083	17.6
#3	1,400	0.57	798	25.5
#4	1,500	0.57	855	30.8

Minimum Soil Resistivity **798**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.:	J037334.01	November 30, 2020
Project Name:	I-555	Page 1 of 1
Boring Number:	B-1	
Sample ID:	ST7	
Depth (ft):	23.0	

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	3,650	0.57	2,081	12.7
#2	2,170	0.57	1,237	19.4
#3	1,400	0.57	798	26.3
#4	1,550	0.57	884	33.8

Minimum Soil Resistivity 798



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.:	J037334.01	November 30, 2020
Project Name:	I-555	Page 1 of 1
Boring Number:	B-2	
Sample ID:	ST2	
Depth (ft):	3.0	

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	9,450	0.57	5,387	13.4
#2	4,700	0.57	2,679	20.4
#3	3,800	0.57	2,166	27.3
#4	4,200	0.57	2,394	31.9

Minimum Soil Resistivity **2,166**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.: J037334.01
Project Name: I-555
Boring Number: B-2
Sample ID: ST5
Depth (ft): 10.0

November 30, 2020
Page 1 of 1

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	3,100	0.57	1,767	11.7
#2	2,700	0.57	1,539	18.5
#3	2,350	0.57	1,340	25.3
#4	2,400	0.57	1,368	31.0

Minimum Soil Resistivity **1,340**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.: J037334.01
Project Name: I-555
Boring Number: B-2
Sample ID: ST7
Depth (ft): 15.0

December 1, 2020
Page 1 of 1

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	8,500	0.57	4,845	13.0
#2	3,100	0.57	1,767	19.6
#3	2,050	0.57	1,169	25.9
#4	2,200	0.57	1,254	32.8

Minimum Soil Resistivity **1,169**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.: J037334.01
Project Name: I-555
Boring Number: B-2
Sample ID: ST12
Depth (ft): 30.0

December 1, 2020
Page 1 of 1

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	5,000	0.57	2,850	19.0
#2	1,600	0.57	912	24.7
#3	1,250	0.57	713	31.7
#4	1,300	0.57	741	38.0

Minimum Soil Resistivity 713



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.:	J037334.01	December 1, 2020
Project Name:	I-555	Page 1 of 1
Boring Number:	B-3	
Sample ID:	ST17	
Depth (ft):	58.0	

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	5,000	0.57	2,850	10.2
#2	23,000	0.57	13,110	16.8

Minimum Soil Resistivity **2,850**



TEST REPORT

Prepared For:
Arkansas State Highway and Transportation Department
PO Box 2261
Little Rock, AR 72203

Project No.:	J037334.01	November 18, 2020
Project Name:	I-555	Page 1 of 1
Boring Number:	B-4	
Sample ID:	SS8	
Depth (ft):	23.5	

MINIMUM LABORATORY SOIL RESISTIVITY AASHTO T288

<u>Reading</u>	<u>Resistance Measurement</u>	<u>Soil Box Factor (cm)</u>	<u>Soil Resistivity (ohms-cm)</u>	<u>Moisture Content (%)</u>
#1	3,300	0.57	1,881	20.5
#2	1,800	0.57	1,026	28.0
#3	1,850	0.57	1,055	33.3

Minimum Soil Resistivity **1,026**



APPENDIX E
AASHTO AND USCS CLASSIFICATIONS






SUMMARY OF CLASSIFICATION TEST RESULTS
I-555 - Hwy. 94 Bridge over Route 901 and UPRR
Craighead County, Arkansas
ARDOT 100657

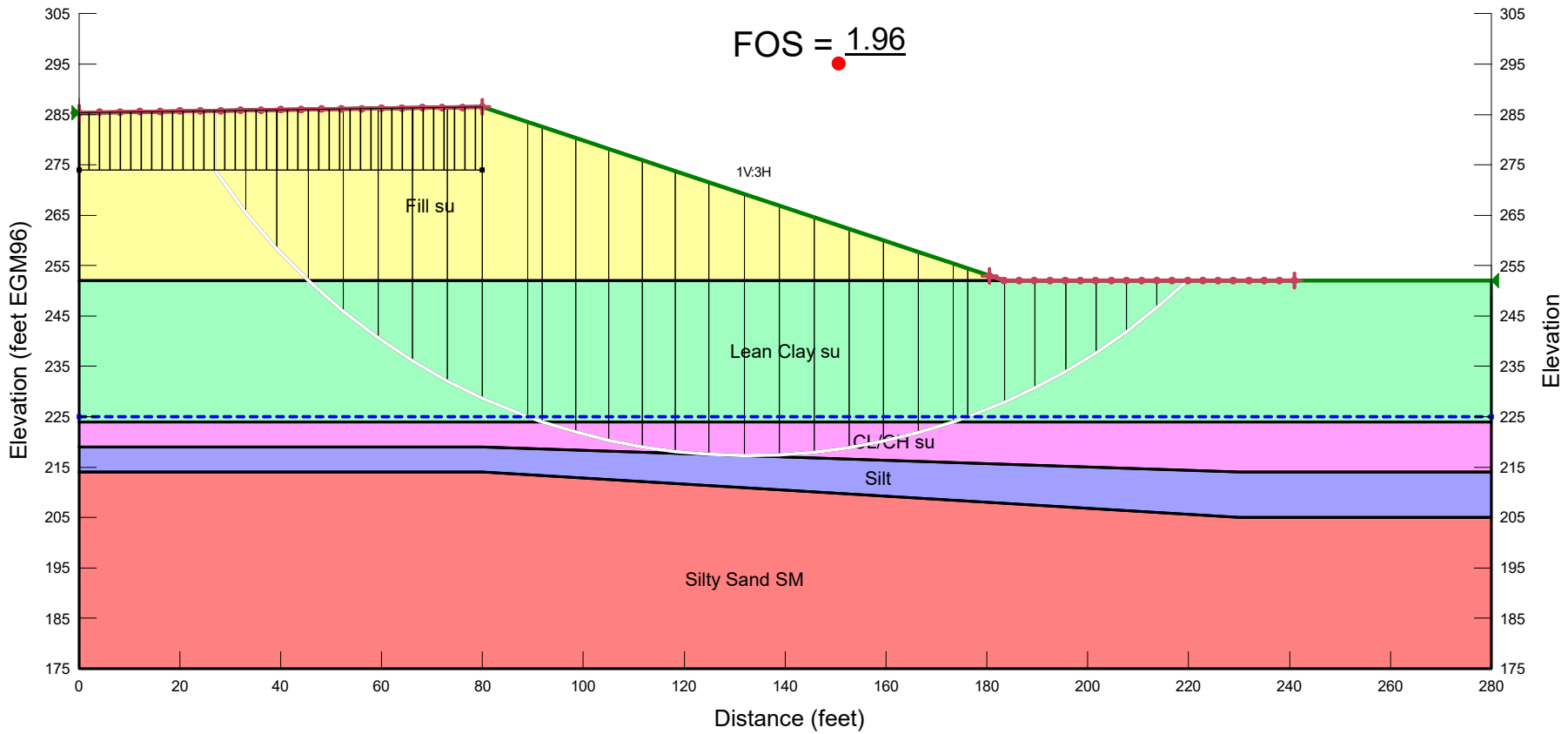
Boring No.	Depth	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Sieve Analysis								AASHTO CLASS.	USCS CLASS.
					2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
B-1	1.5	43	23	20									A-7-6	CL
B-1	8.0	32	23	9									A-4	CL
B-1	23.0	36	15	21								97.4	A-6 (20)	CL
B-1	28.5	42	24	18									A-7-6	CL
B-1	33.5									100.0	100.0	99.5	A-4	ML
B-1	38.5									100.0	100.0	54.0	A-4	ML
B-1	48.5									100.0	98.3	7.1	A-3	SP-SM
B-1	63.5									100.0	84.5	4.8	A-3	SP
B-1	83.5									100.0	90.1	3.9	A-3	SP
B-2	10.0	35	19	16									A-6	CL
B-2	30.0	45	26	19									A-7-6	CL
B-2	33.5	36	24	12									A-6	CL
B-2	38.5											86.3	A-6	CL
B-2	40.0	33	27	6								85.3	A-4 (5)	ML
B-2	43.5	38	25	13									A-6	ML
B-2	48.5									100.0	98.8	5.4	A-3	SP-SM
B-2	63.5									100.0	98.7	4.1	A-3	SP
B-2	83.5									100.0	96.6	5.0	A-3	SP-SM
B-3	8.5	47	19	28									A-7-6	CL
B-3	25.0	32	22	10									A-4	CL
B-3	30.0	41	22	19									A-7-6	CL
B-3	35.0	51	26	25									A-7-6	CH
B-3	38.5											5.3	A-3	SP-SM
B-3	48.5									100.0	63.7	4.8	A-3	SP
B-3	68.5									100.0	90.5	2.4	A-3	SP
B-3	98.5											5.3	A-2-6	SP-SC
B-3	108.5	34	16	18									A-6	CL
B-4	3.5	45	23	22									A-7-6	CL
B-4	23.5	43	25	18									A-7-6	CL
B-4	25.0	48	25	23									A-7-6	CL
B-4	28.5	64	25	39									A-7-6	CH
B-4	33.5									100.0	99.9	90.6	A-4	ML
B-4	43.5									100.0	95.0	9.4	A-3	SP-SM
B-4	48.5											3.7	A-3	SP
B-4	58.5	27	16	11									A-6	CL
B-4	73.5											70.8	A-4	ML
B-4	78.5									100.0	99.8	48.2	A-4	SM
B-4	93.5											14.0	A-2-6	SC



APPENDIX F
GLOBAL STABILITY ANALYSIS RESULTS

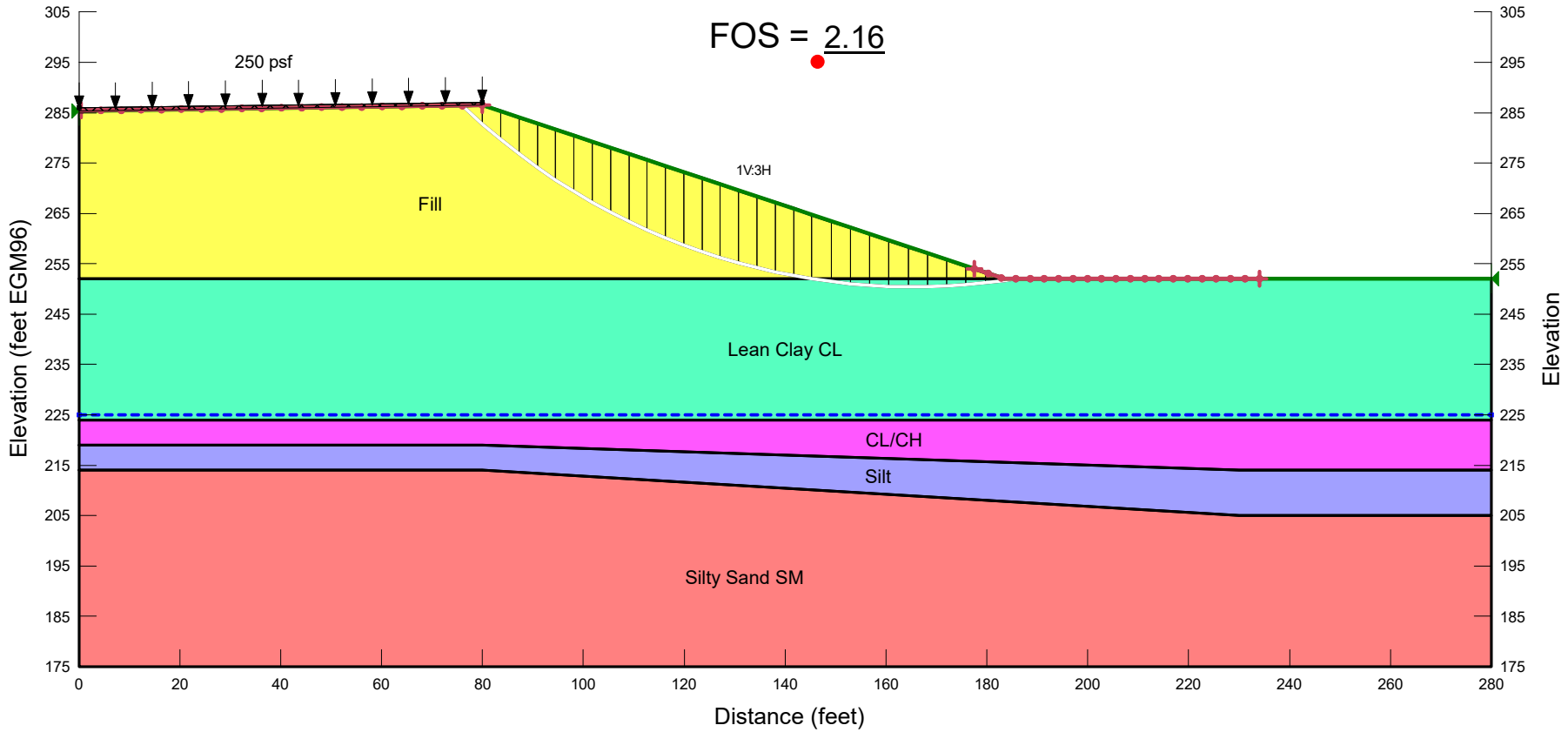
South Bridge Abutment
 Sta. 331+00
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Short-Term Analysis

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
	CL/CH su	Undrained (Phi=0)	120			800
	Fill su	Undrained (Phi=0)	125			1,750
	Lean Clay su	Undrained (Phi=0)	125			1,700
	Silt	Mohr-Coulomb	120	0	28	
	Silty Sand SM	Mohr-Coulomb	125	0	32	



South Bridge Abutment
 Sta. 331+00
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Long-Term Analysis

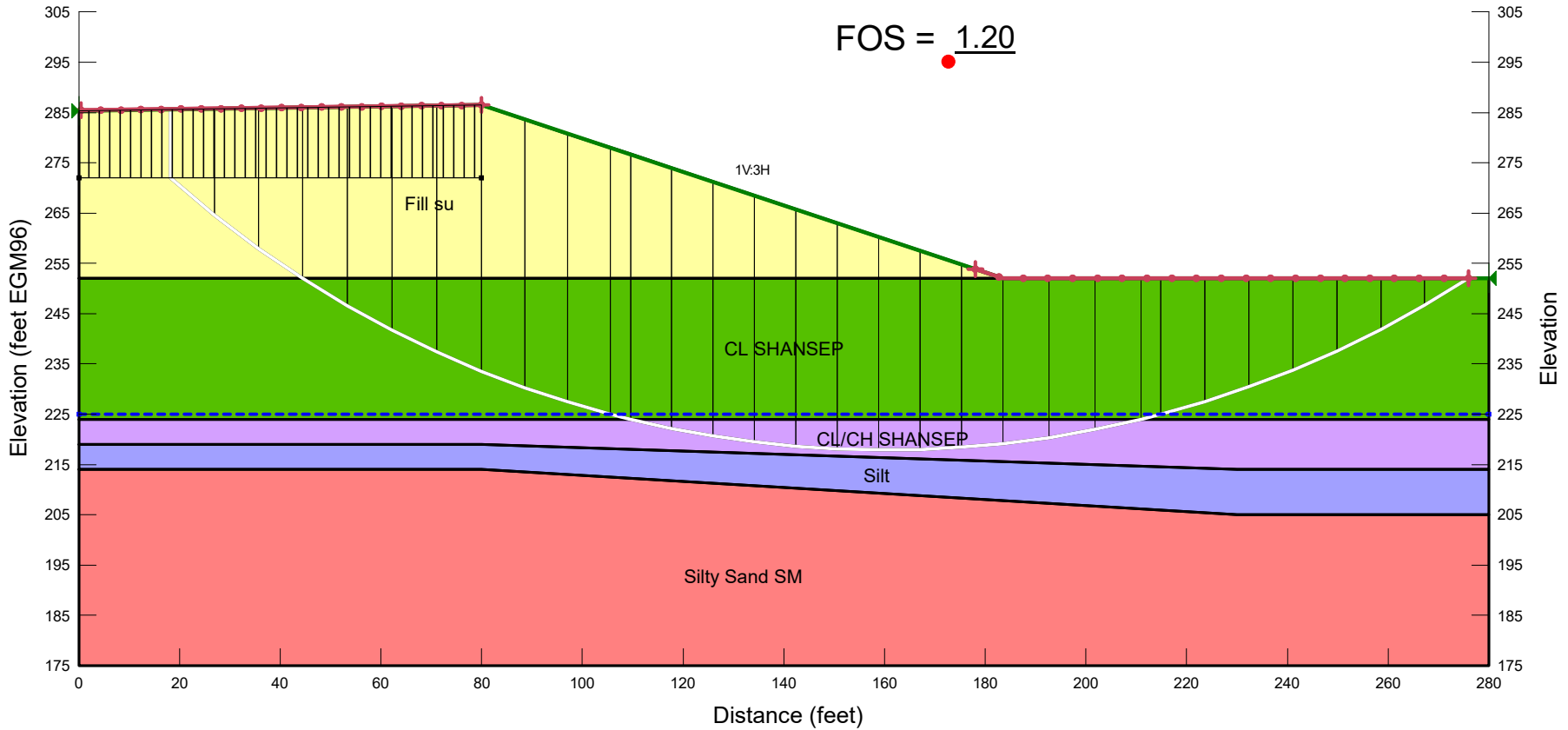
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	CL/CH	Mohr-Coulomb	120	0	24
Light Blue	Fill	Mohr-Coulomb	125	100	30
Light Green	Lean Clay CL	Mohr-Coulomb	125	50	30
Light Purple	Silt	Mohr-Coulomb	120	0	28
Light Red	Silty Sand SM	Mohr-Coulomb	125	0	32



South Bridge Abutment
 Sta. 331+00
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Seismic Analysis - ah=0.328g OCR

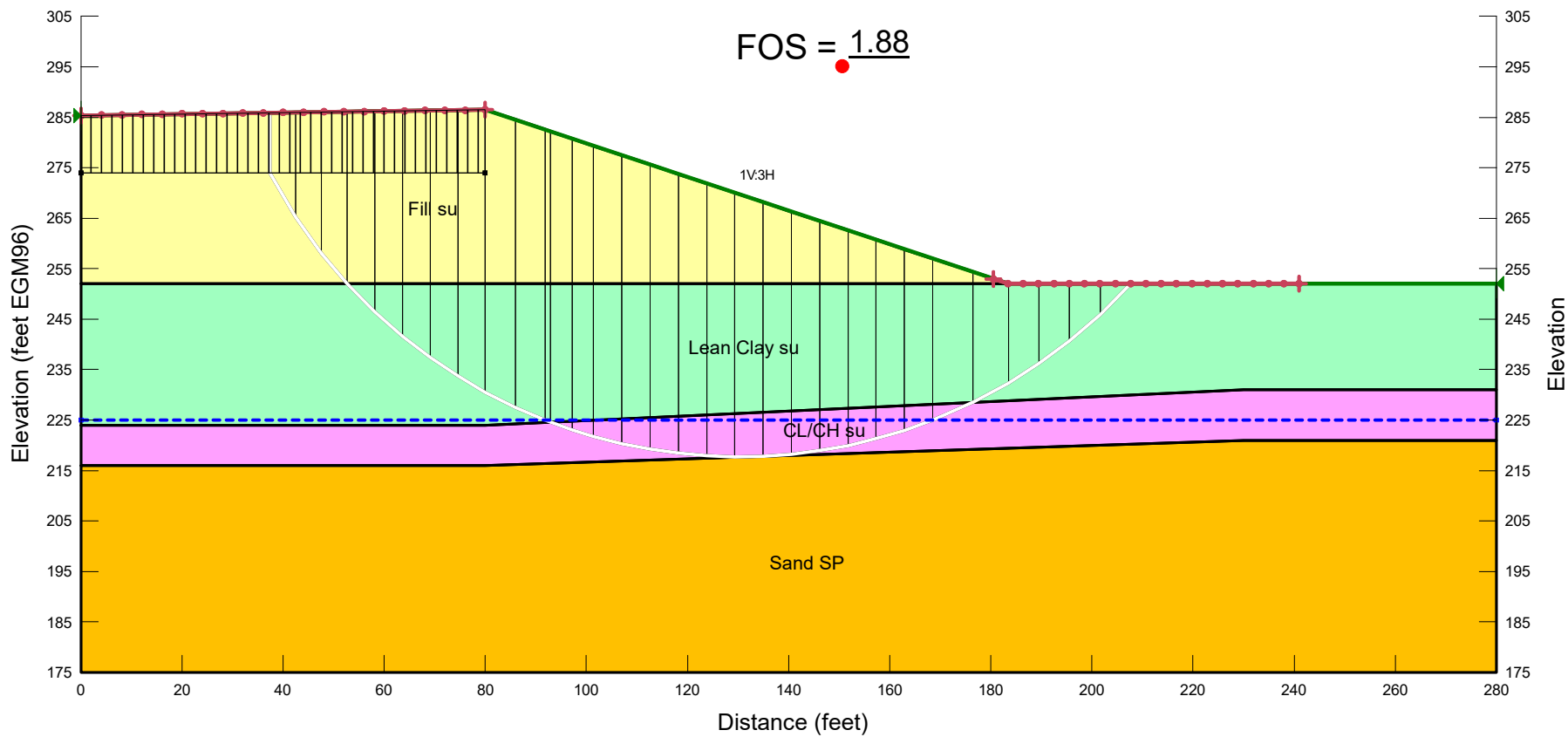
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	Minimum Strength (psf)	Non-constrained undrained strength ratio	SHANSEP function exponent	Overconsolidation Ratio Fn.
Green	CL SHANSEP	SHANSEP	125				1,700	0.3	0.8	OCR vs. Elevation
Purple	CL/CH SHANSEP	SHANSEP	120				800	0.3	0.8	OCR vs. Elevation
Yellow	Fill su	Undrained (Phi=0)	125			1,750				
Blue	Silt	Mohr-Coulomb	120	0	28					
Red	Silty Sand SM	Mohr-Coulomb	125	0	32					

FOS = 1.20



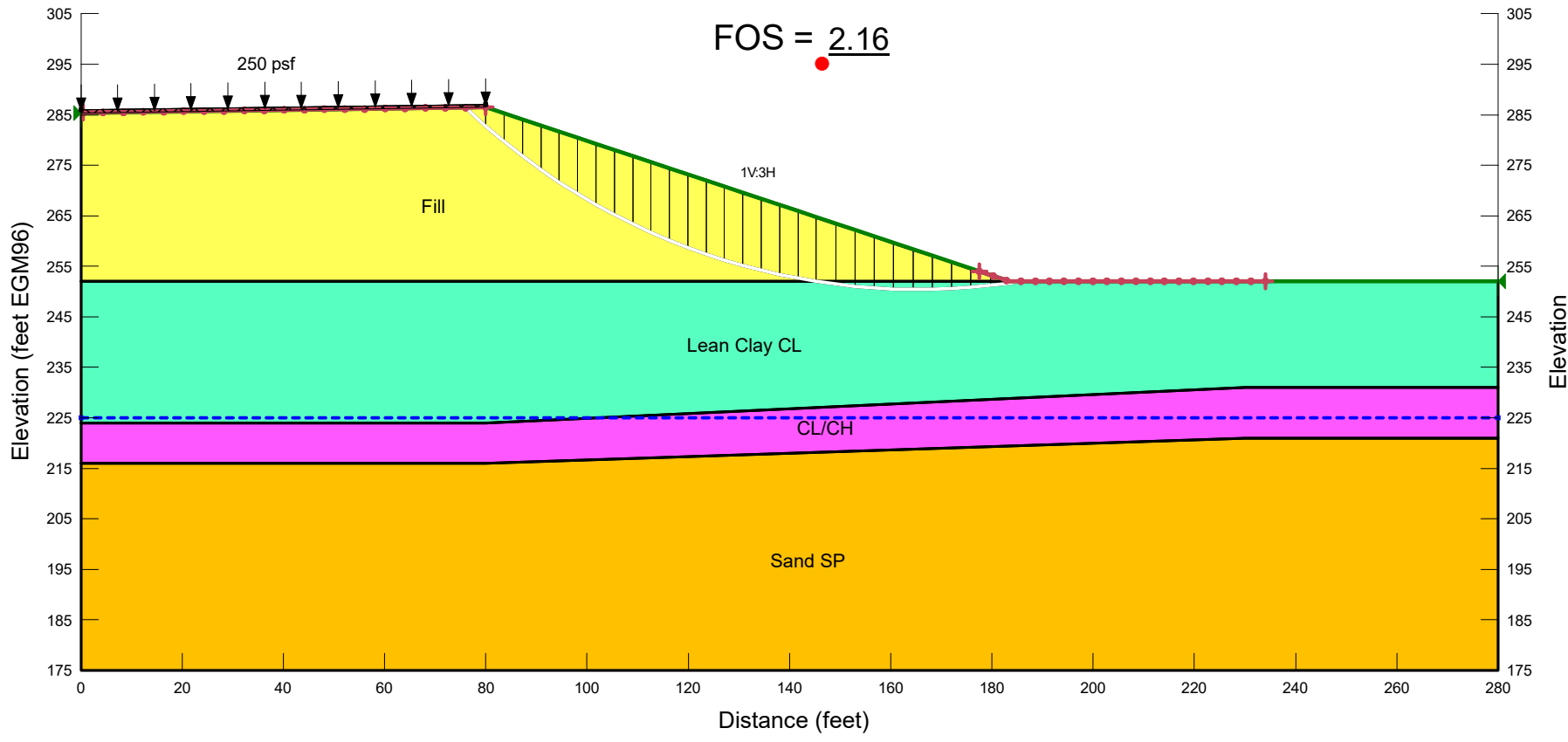
North Bridge Abutment Spill and Side Slopes
 Sta. 335+50
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Short-Term Analysis

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)
Light Purple	CL/CH su	Undrained (Phi=0)	120			800
Light Yellow	Fill su	Undrained (Phi=0)	125			1,750
Light Green	Lean Clay su	Undrained (Phi=0)	125			1,700
Orange	Sand SP	Mohr-Coulomb	125	0	34	



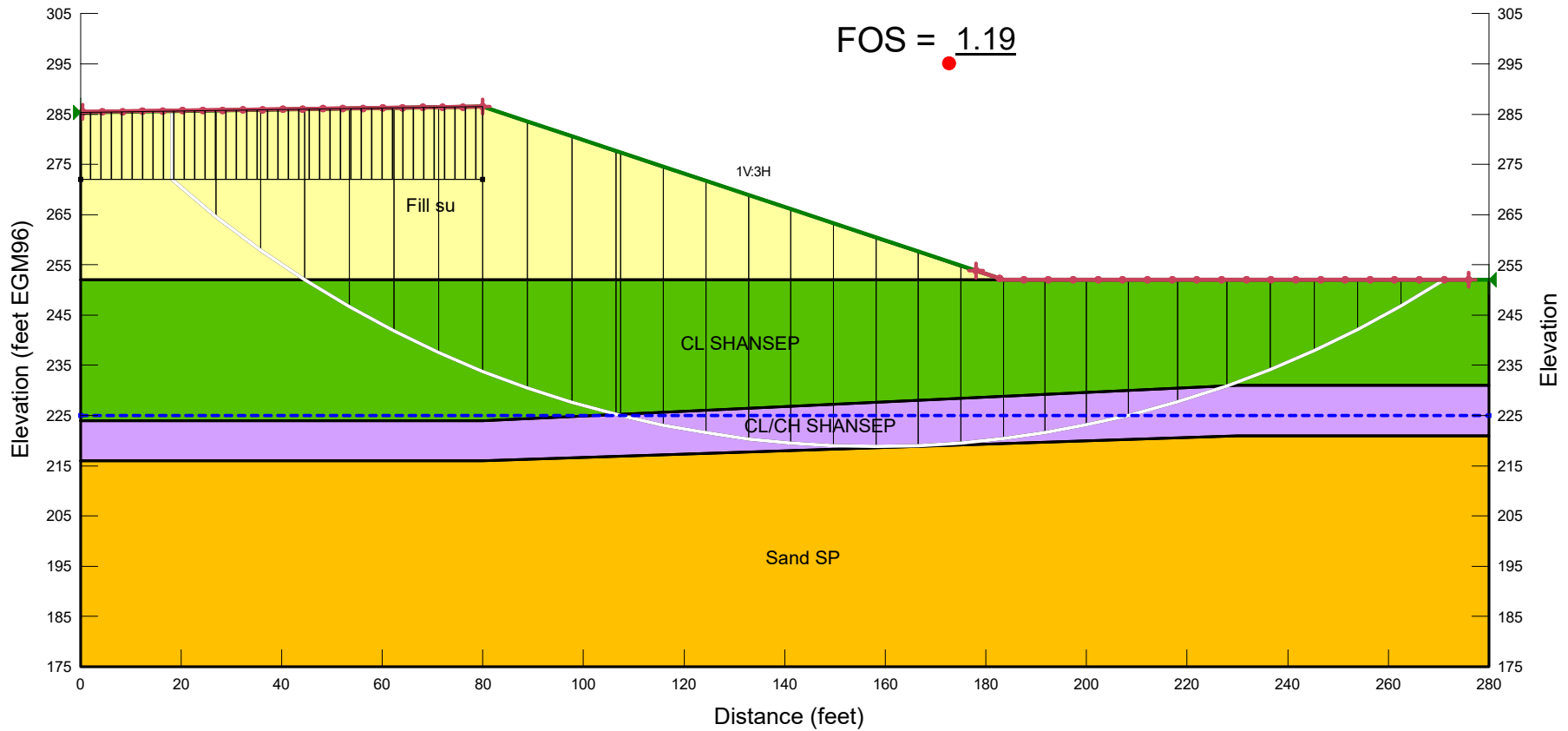
North Bridge Abutment Spill and Side Slopes
 Sta. 335+50
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Long-Term Analysis

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
Yellow	CL/CH	Mohr-Coulomb	120	0	24
Light Blue	Fill	Mohr-Coulomb	125	100	30
Light Green	Lean Clay CL	Mohr-Coulomb	125	50	30
Light Orange	Sand SP	Mohr-Coulomb	125	0	34



North Bridge Abutment Spill and Side Slopes
 Sta. 335+50
 I-555 - US49 Extension
 Craighead County
 ARDOT 100657
 Geotechnology Project Number J037334.01
 Global Stability - Spencer's Method
 Name: Seismic Analysis - ah=0.328g OCR

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Cohesion (psf)	Minimum Strength (psf)	Non-constrained undrained strength ratio	SHANSEP function exponent	Overconsolidation Ratio Fn.
Green	CL SHANSEP	SHANSEP	125				1,700	0.3	0.8	OCR vs. Elevation
Purple	CL/CH SHANSEP	SHANSEP	120				300	0.3	0.8	OCR vs. Elevation
Yellow	Fill su	Undrained (Phi=0)	125			1,750				
Orange	Sand SP	Mohr-Coulomb	125	0	34					





APPENDIX G
SOIL PARAMETERS FOR SYNTHETIC PROFILES

LPILE STATIC SOIL PARAMETERS										
ZONE	SOIL TYPES	APPROXIMATE DEPTH (ELEVATION)		WET UNIT WEIGHT (PCF)	SHEAR STRENGTH PARAMETERS				LATERAL LOAD PARAMETERS ^a	
		FROM	TO		UNDRAINED (SHORT TERM)		DRAINED (LONG TERM)		SOIL STRAIN, e_{50}	STATIC SOIL MODULUS (PCI) ^b
					COHESION (PSF)	Φ (DEGREE)	EFFECTIVE COHESION (PSF)	Φ' (DEGREE)		
1	Stiff, Lean Clay	254	224	125	1,500	--	--	30	0.007	300
2	Soft to Medium Stiff, Lean to Fat Clay	224	214	120	800	--	--	24	0.01	100
3	Soft Silt below Groundwater	214 ^c	204	120	300	--	--	26	0.02	20
4	Medium Dense, Silty Sand and Fine Sand	204	144	125	--	--	--	33	--	60
5	Stiff, Sandy Clay	194	164	125	1,000	--	--	30	0.01	200

^a parameters for lateral load analysis only

^b pounds per cubic inch

^c design groundwater El 214.

LPILE LIQUEFIED SOIL PARAMETERS								
ZONE	SOIL TYPES	APPROXIMATE DEPTH (ELEVATION)		SOIL MODEL	EFFECTIVE UNIT WEIGHT (PCF)	SHEAR STRENGTH PARAMETERS	LATERAL LOAD PARAMETERS ^a	
						UNDRAINED SHEAR STRENGTH (PSF)	SOIL STRAIN, e_{50}	SOIL MODULUS (PCI) ^b
1	Stiff, Lean Clay	254	224	Soft Clay	125	1,000	0.05	--
2	Soft to Medium Stiff, Lean to Fat Clay	224	214	Soft Clay	58	400	0.05	--
3	Soft Silt below Groundwater	214 ^c	204	Liquefied Sand or Soft Clay	58	500	0.05	20
4a	Medium Dense, Silty Sand and Fine Sand below Groundwater	204	174	Liquefied Sand or Soft Clay	63	600	0.05	20
4b		174	144	Liquefied Sand or Soft Clay	63	750	0.05	20
5	Stiff, Sandy Clay	194	164	Soft Clay	63	700	0.05	--

^a parameters for lateral load analysis only

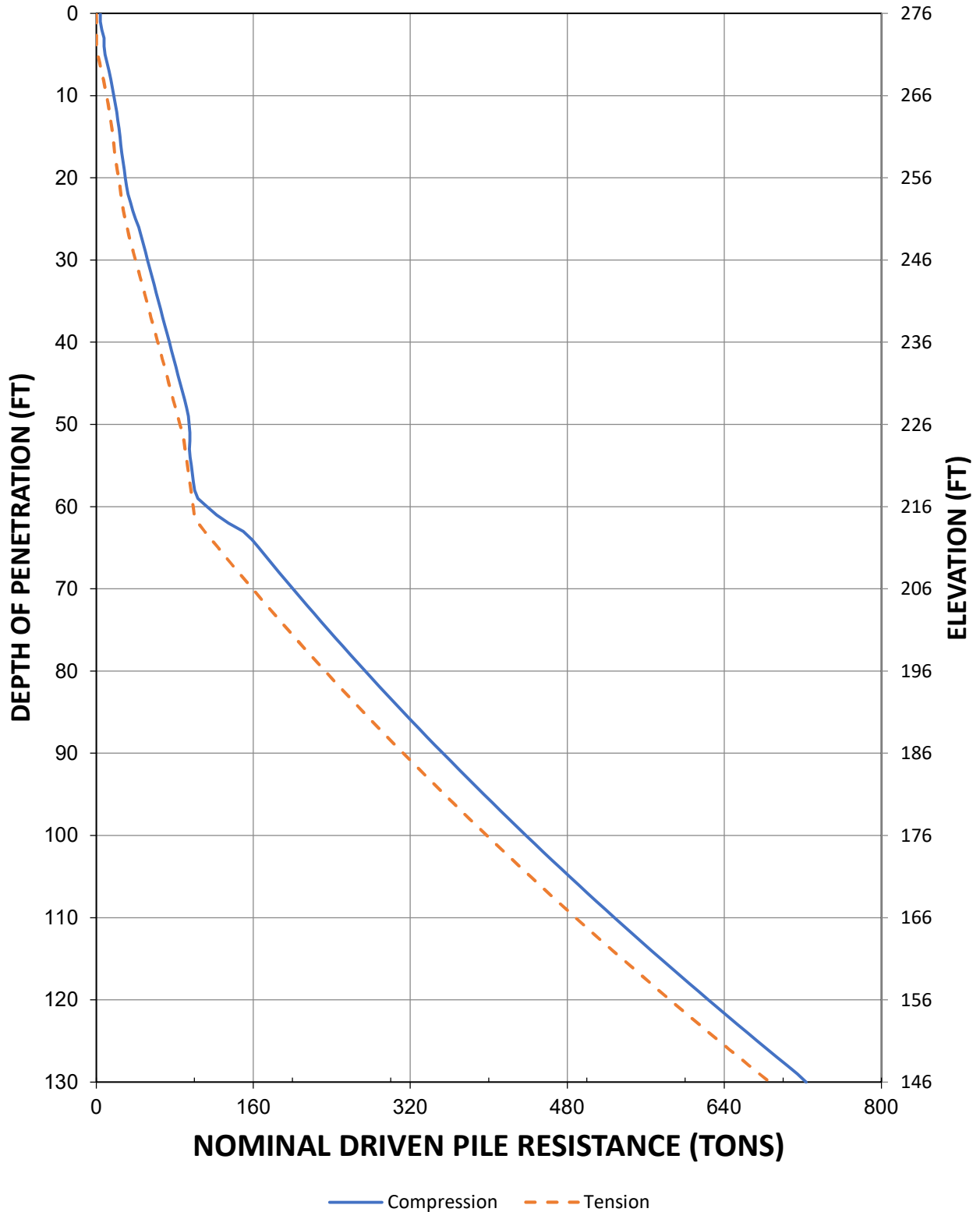
^b pounds per cubic inch

^c design groundwater El 214.

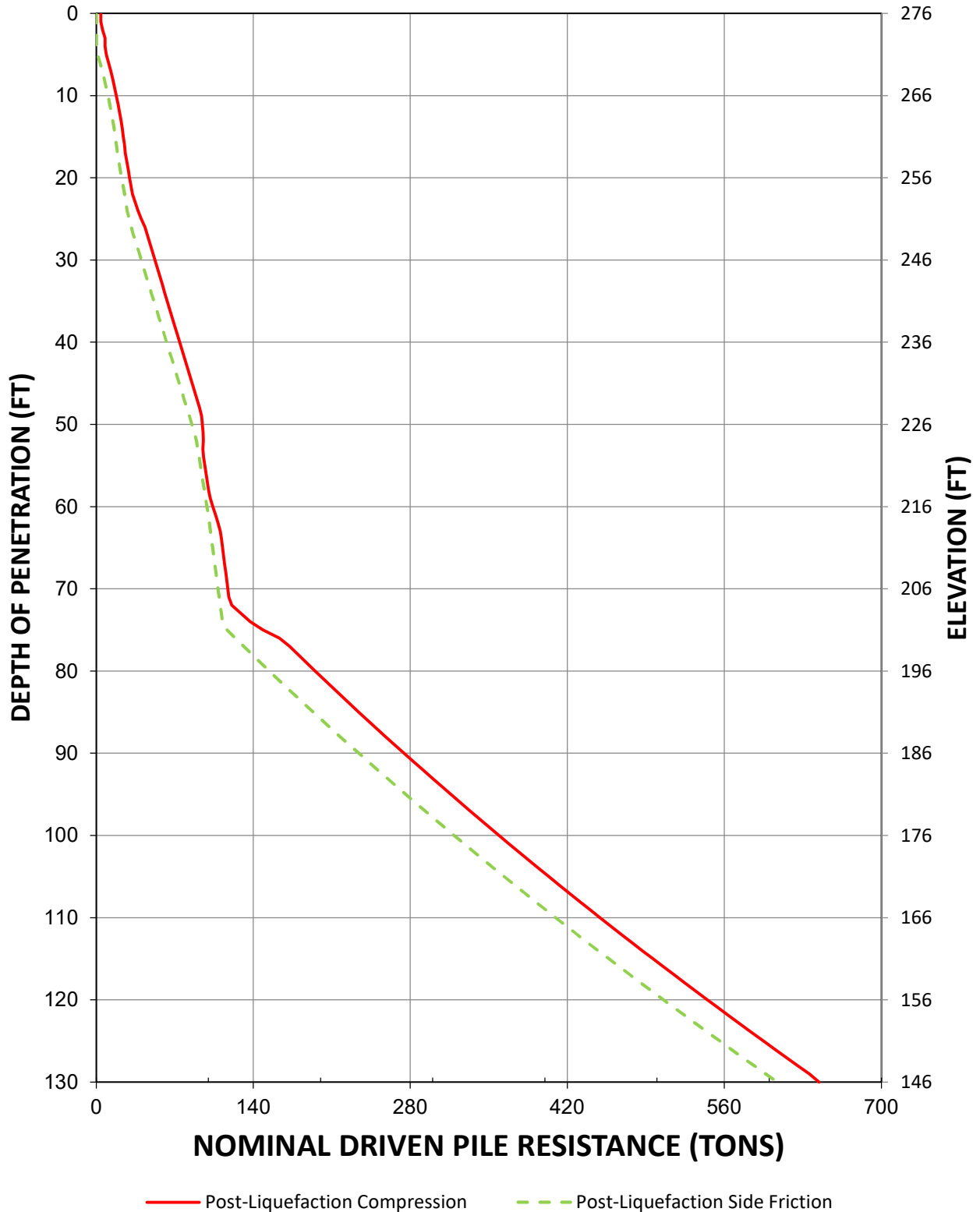


APPENDIX H
NOMINAL RESISTANCE CURVES FOR DRIVEN PILES

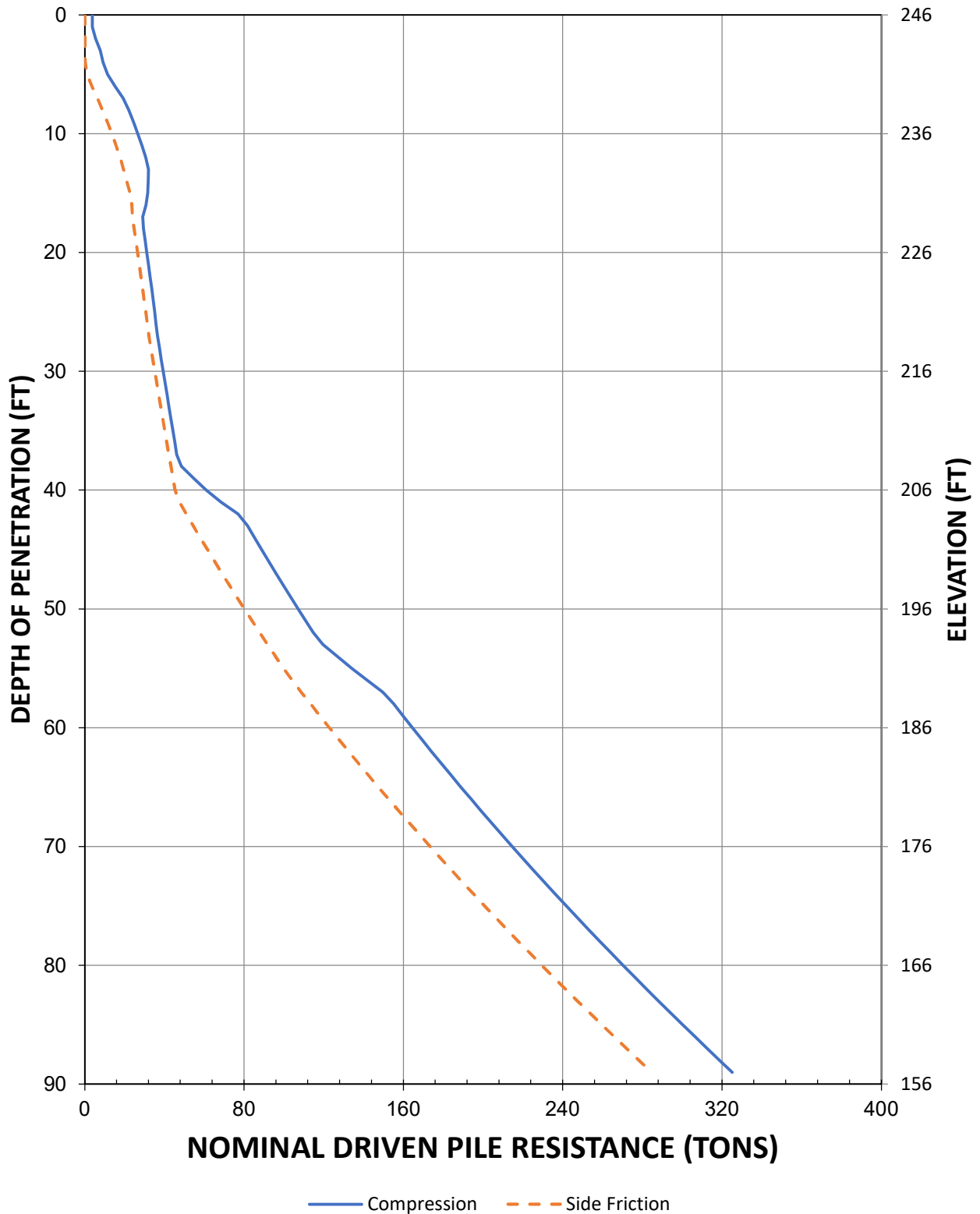
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Abutment - Boring B-1
18-Inch Closed-Ended Pipe Piles**



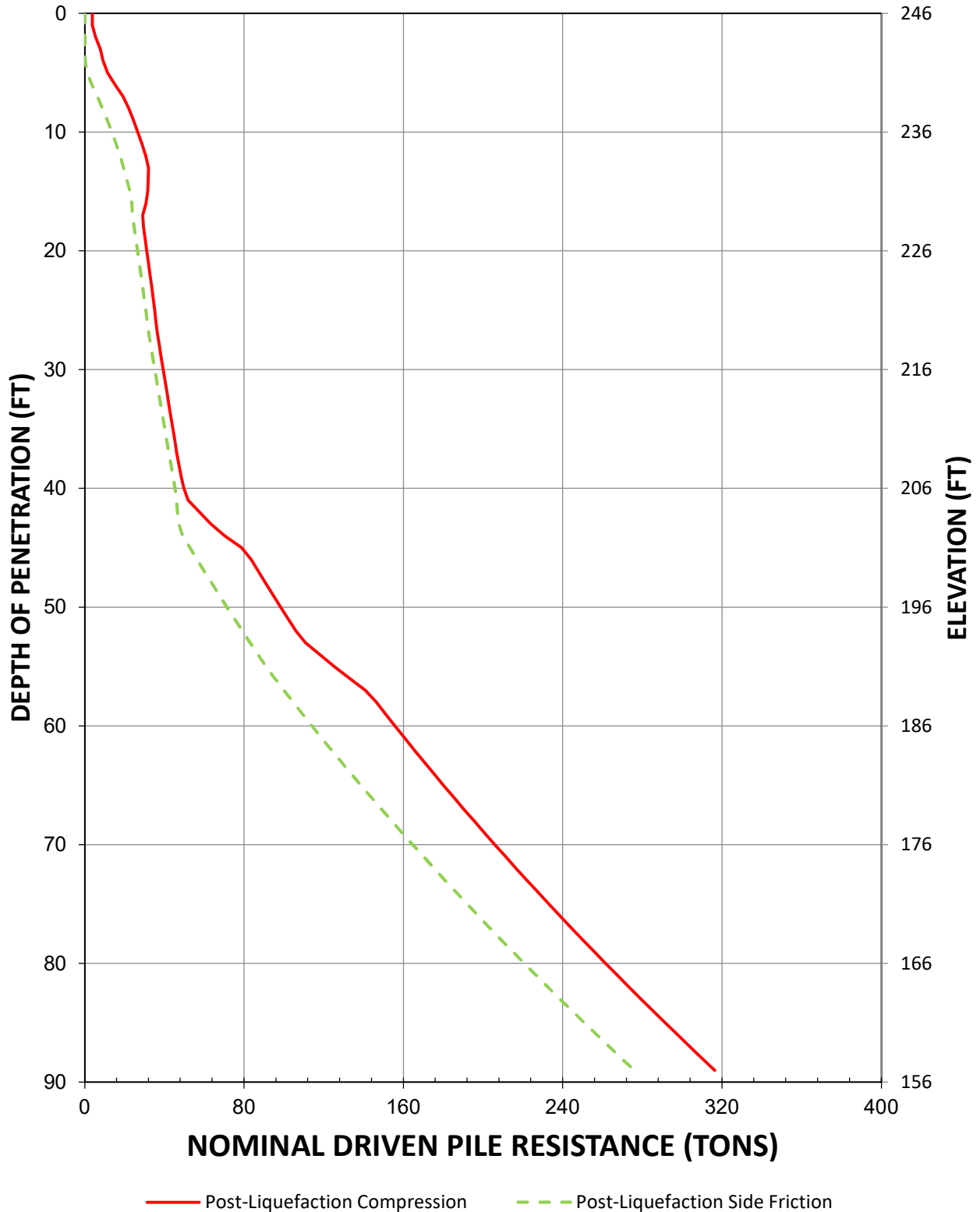
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Abutment - Boring B-1 Post-Liquefaction
18-Inch Closed-Ended Pipe Piles**



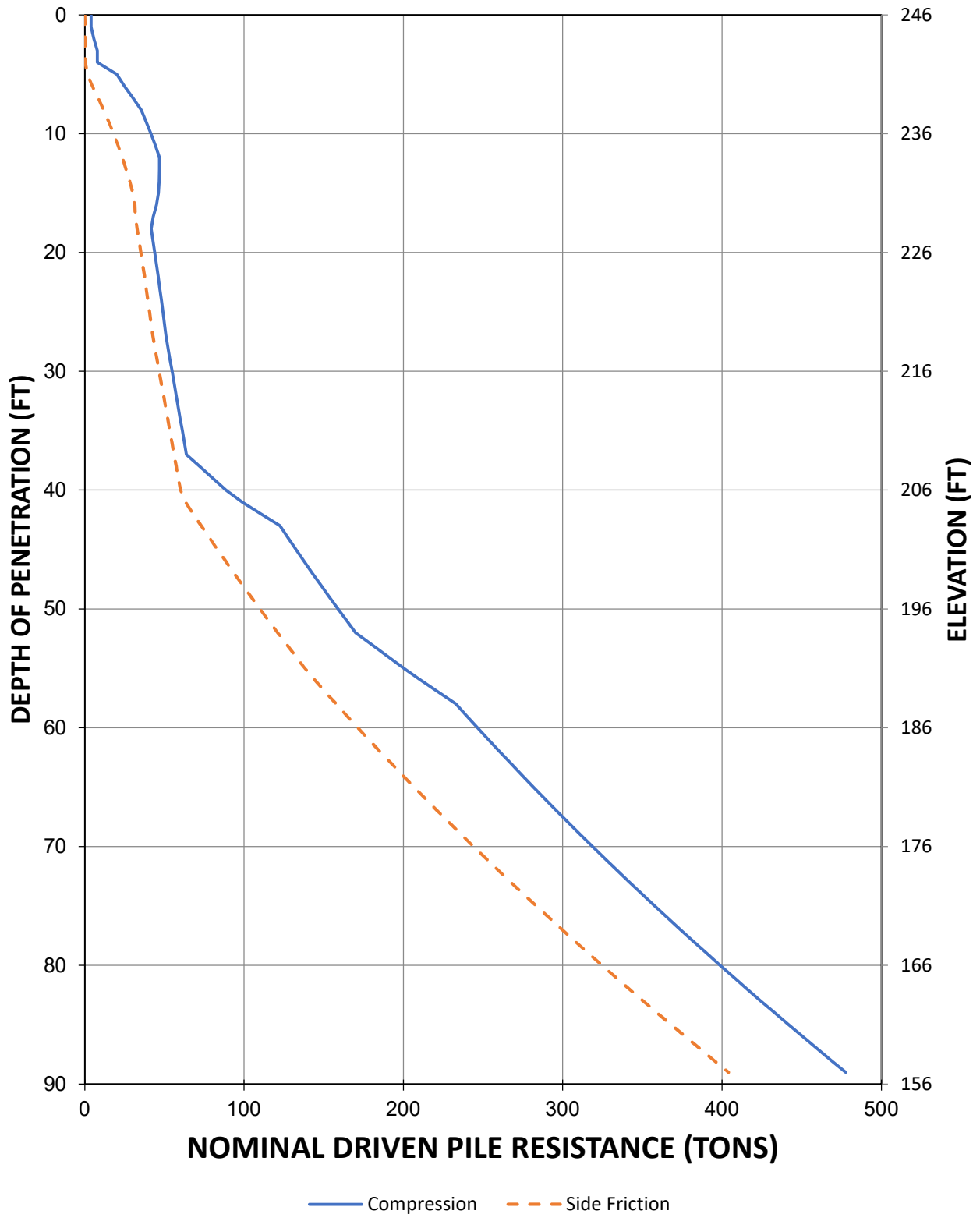
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Intermediate Bent - Boring B-2
18-Inch Closed-Ended Pipe Piles**



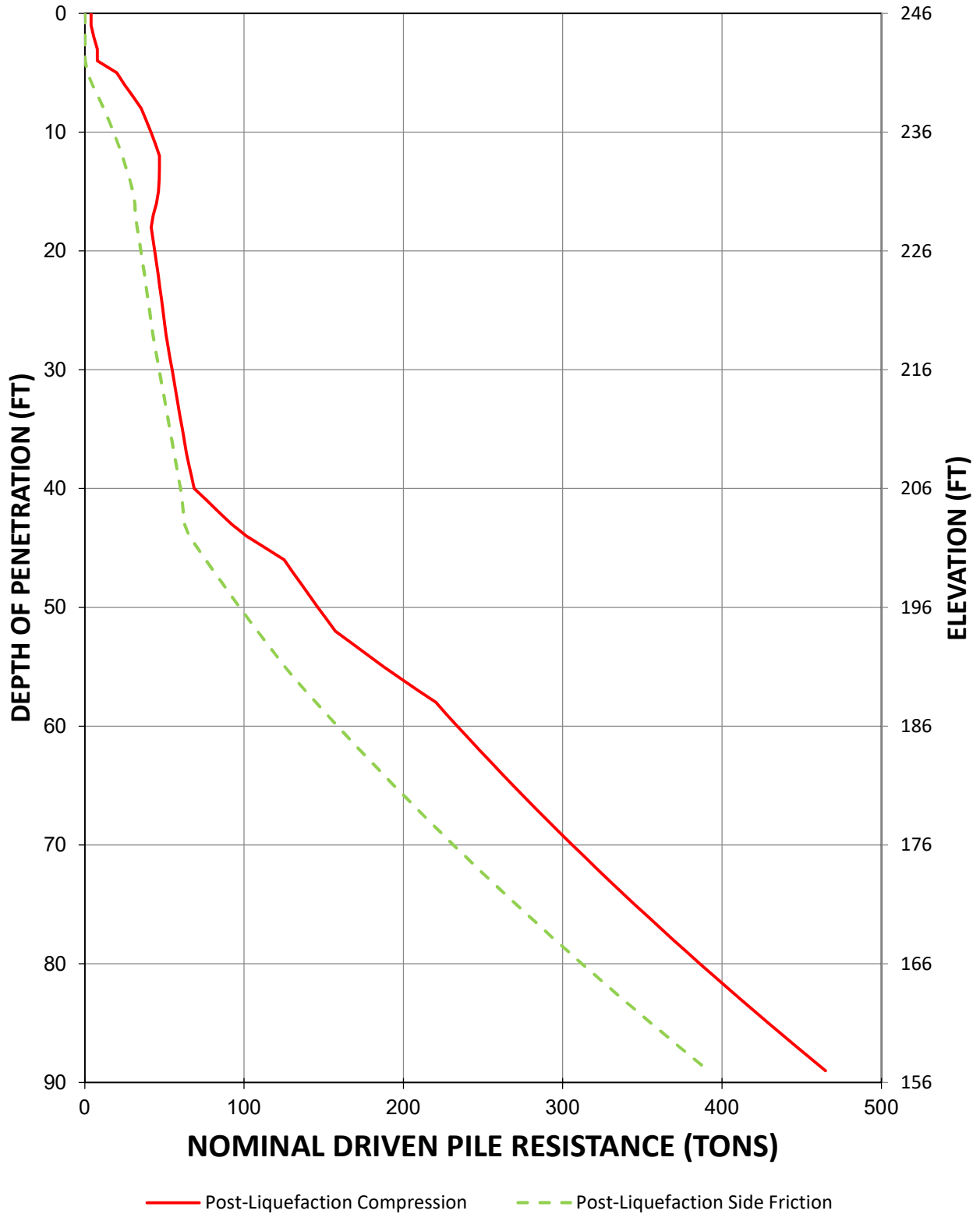
I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Intermediate Bent - Boring B-2 Post-Liquefaction
18-Inch Closed-Ended Pipe Piles



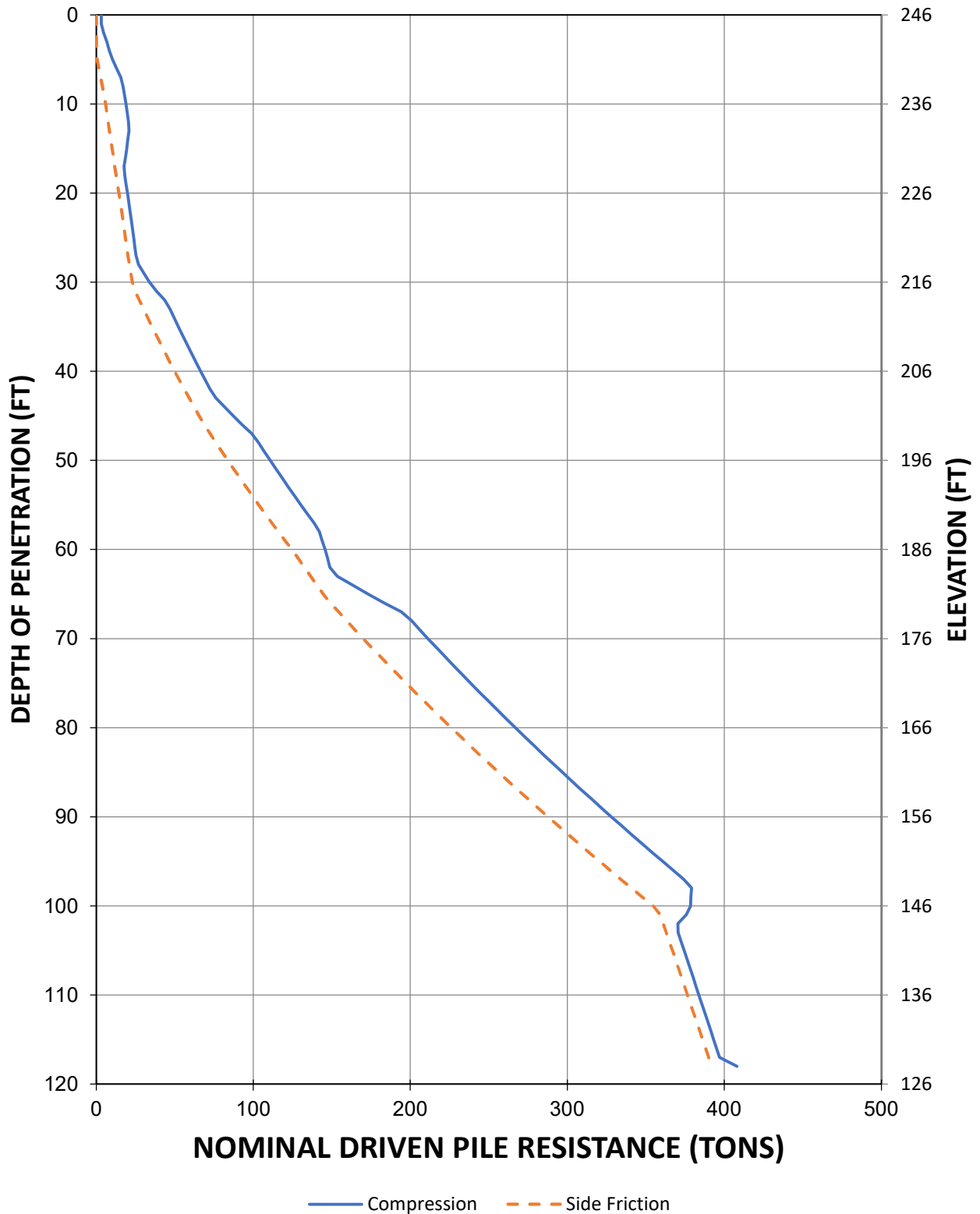
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Intermediate Bent - Boring B-2
24-Inch Closed-Ended Pipe Piles**



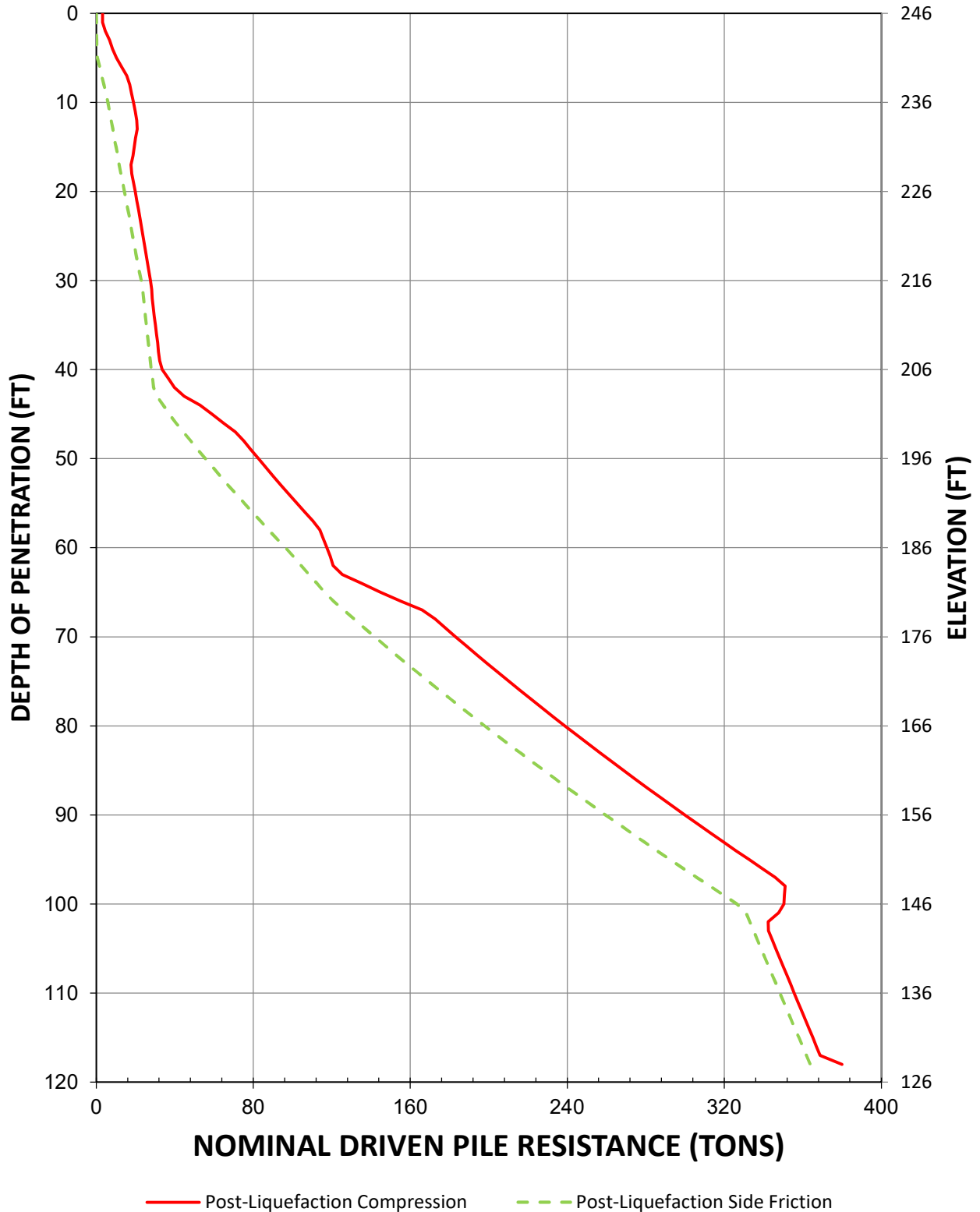
I-555 US49 Extension
Bridge over Rte 901 and UPRR
South Intermediate Bent - Boring B-2 Post-Liquefaction
24-Inch Closed-Ended Pipe Piles



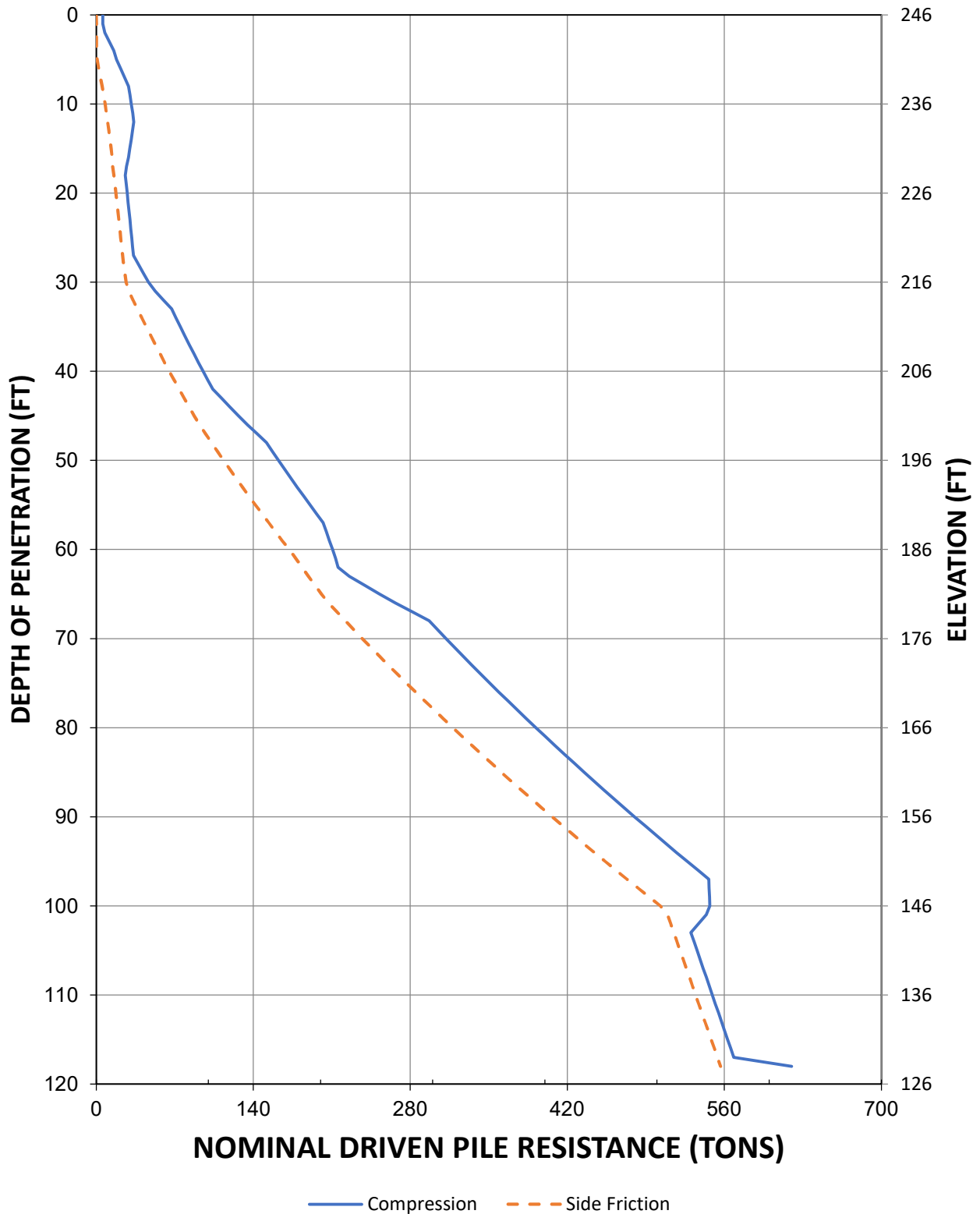
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Intermediate Bent - Boring B-3
18-Inch Closed-Ended Pipe Piles**



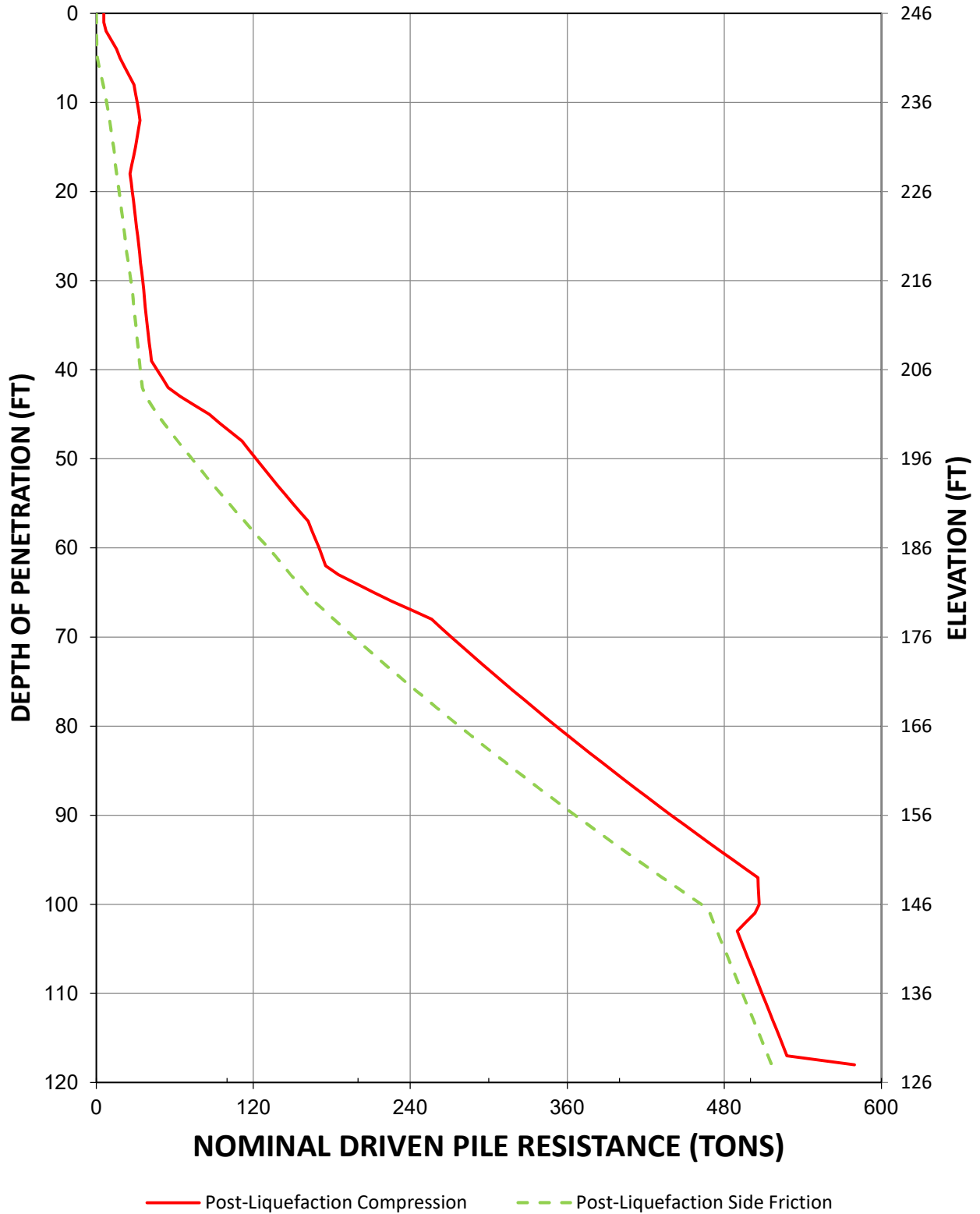
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Intermediate Bent - Boring B-3 Post-Liquefaction
18-Inch Closed-Ended Pipe Piles**



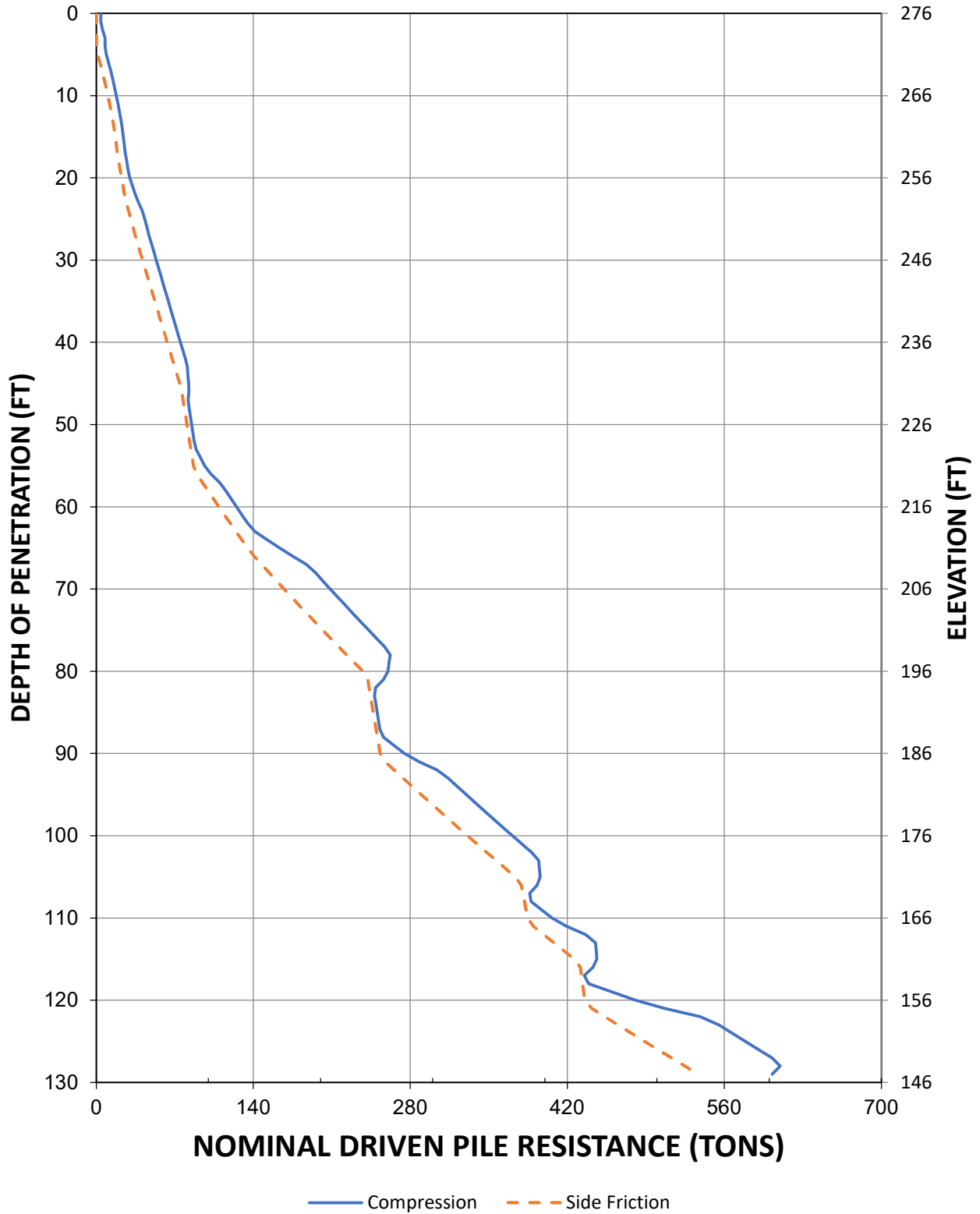
**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Intermediate Bent - Boring B-3
24-Inch Closed-Ended Pipe Piles**



**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Intermediate Bent - Boring B-3 Post-Liquefaction
24-Inch Closed-Ended Pipe Piles**



**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Abutment - Boring B-4
18-Inch Closed-Ended Pipe Piles**



**I-555 US49 Extension
Bridge over Rte 901 and UPRR
North Abutment - Boring B-4 Post-Liquefaction
18-Inch Closed-Ended Pipe Piles**

