ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 100824

FEDERAL AID PROJECT NO. NHPP-9227(80)

BNSF RAILROAD OVERPASS (HWY. 18) (JONESBORO) (S)

STATE HIGHWAY 18 **SECTION** 4

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.

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
FAX (501) 455-4137

April 7, 2018
Job No. 16-022

Bridgefarmer & Associates, Inc.
12801 North Central Expressway, Suite 400
Dallas, Texas 75243

Attn: Mr. Shahriar Azad, P.E.

RE: SUPPLEMENTAL RECOMMENDATIONS
WALLS JJ and KK – WATT STREET
ARDOT JOB 100824: HWY. 18 RAILROAD OVERPASS (JONESBORO) (S)
JONESBORO, CRAIGHEAD COUNTY, ARKANSAS

Mr. Azad,

Submitted herewith are supplemental recommendations for the retaining wall alternate planned for ARDOT Job 100824. Specifically, these recommendations are provided for the north end of the grade separation structure planned at Watt Street over the Burlington Northern Santa Fe (BNSF) railroad tracks. A simple slope was previously planned for the north bridge end and side slopes for the Watt Street Bridge. The design modification consists of replacing the side slopes with mechanically stabilized earth (MSE) retaining walls. Preliminary recommendations for these walls were provided on April 6, 2018.

The planned right of way modification and wall locations are shown on the drawing provided in Attachment 1. The alternative embankment design for the north end of the Watt Street grade separation includes two (2) walls: Wall JJ and Wall KK. Wall JJ has a total length of 433 ft with height varying from 8 to 31 feet. Wall KK has a height varying from 6 to 31 ft and a total length of 459 feet. Wall sections are shown on the drawings provided in Attachment 2. The relevant soil boring locations are also shown on these drawings.

Retaining Wall Bearing

Walls JJ and KK should bear on a foundation stratum of either the natural stiff silty clay, compacted SM-1 selected material (AHTD Standard Specifications Section 302, SM-1), rammed aggregate piers and silty clay, or an approved alternate. Bearing capacity recommendations are summarized below.

- For wall heights less than about 25 ft (Wall JJ, approximately Sta 5+40 to 8+00 and approximately Sta 9+06 to Sta 9+73 and Wall KK, approximately Sta 5+06 to 5+75 and approximately Sta 6+80 to 9+65):
    - Bear in stiff silty clay
    - Nominal bearing resistance (q_{ult}): 7700 lbs per sq ft
    - Nominal coefficient of sliding (tan δ): 0.33

- For wall heights between 25 ft and 31 ft (Wall JJ, approximately Sta 8+00 to Sta 9+06 and Wall KK, approximately Sta 5+75 to Sta 6+80):
    - Undercut bearing stratum at least 8 ft below plan subgrade elevation to stiff silty clay, backfill with SM-1 or approved alternate
    - Nominal bearing resistance (q_{ult}): 9000 lbs per sq ft
    - Nominal coefficient of sliding (tan δ): 0.35

      As an alternative to undercut, a rammed aggregate pier alternative may be considered where wall heights are greater than about 25 feet.
    - Rammed Aggregate Piers with an estimated 30 percent area ratio, 30-in. diameter and nominal length of 12 ft below the plan subgrade elevation
    - Nominal composite bearing resistance (q_{ult}): 14,000 lbs per sq ft
    - Nominal composite coefficient of sliding (tan δ): 0.40

A resistance factor (φ_b) of 0.65 is recommended for bearing. A resistance factor (φ_τ) of 1.0 is recommended for evaluation of sliding resistance. A summary of recommendations related to wall bearing and sliding resistance is provided in Attachment 3.

The suitability of the wall bearing strata must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend at least 10 ft outside the reinforced zone to the extent possible. At the wall ends (longitudinally), the undercut should extend beyond the reinforced zone a minimum distance determined by a 1-horizontal to 2-vertical (1H:2V) projection from the edge of the reinforced zone to the undercut bottom. Where existing structures limit the undercut extent, the undercut limits should be field verified and adjusted as needed.

For rammed aggregate piers, the Geopier™ system is recommended. Geopier™ design and construction is proprietary and provided by contractors licensed by Geopier Foundation Company, Inc. The recommendations regarding rammed aggregate piers above are offered for use in preliminary design. Detailed recommendations for rammed aggregate pier design can be provided by Geopier Foundation Company when specific design concepts, wall foundation loads, and site grading plans are available. The area stabilized by rammed aggregate piers should cover the complete footprint of the MSE wall reinforced zone and extend at least 10 ft outside the reinforced zone limits to the extent possible.

Retaining Wall Global Stability

Supplemental stability analyses were performed to verify the global (external) stability of the new MSE wall configurations. Fill, backfill, and natural soil properties were utilized as in prior analyses for Watt Street. Cohesive embankment fill was assumed as per the recommendations of the supplemental memorandum of April 12, 2017. Stability analyses have been performed using the computer program SLOPE/W 2007[1] and a Morgenstern-Price analysis. The results of the stability analyses are provided in Attachment 4. The results of these analyses

[1] Slope/W 2007; GEO-SLOPE International; March 2008.

indicate acceptable calculated minimum factors of safety for the end of construction and long term conditions. For the seismic condition, the calculated minimum factor of safety is 1.0.

Closing

The Engineer, Department, or a designated representative thereof should monitor all subgrade preparation, ground improvement, and foundation and embankment construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this submittal.

Attachment 1	Watt Street Site Plan
Attachment 2	Watt Street Wall Layouts
Attachment 3	Preliminary Recommendations for MSE Walls
Attachment 4	Stability Analysis Results

* * * * *

We hope that this supplemental information is helpful in final design. Please contact us should you have any questions regarding this supplemental information or if we may be of further service.

Sincerely,

GRUBBS, HOSKYN, BARTON & WYATT, INC.

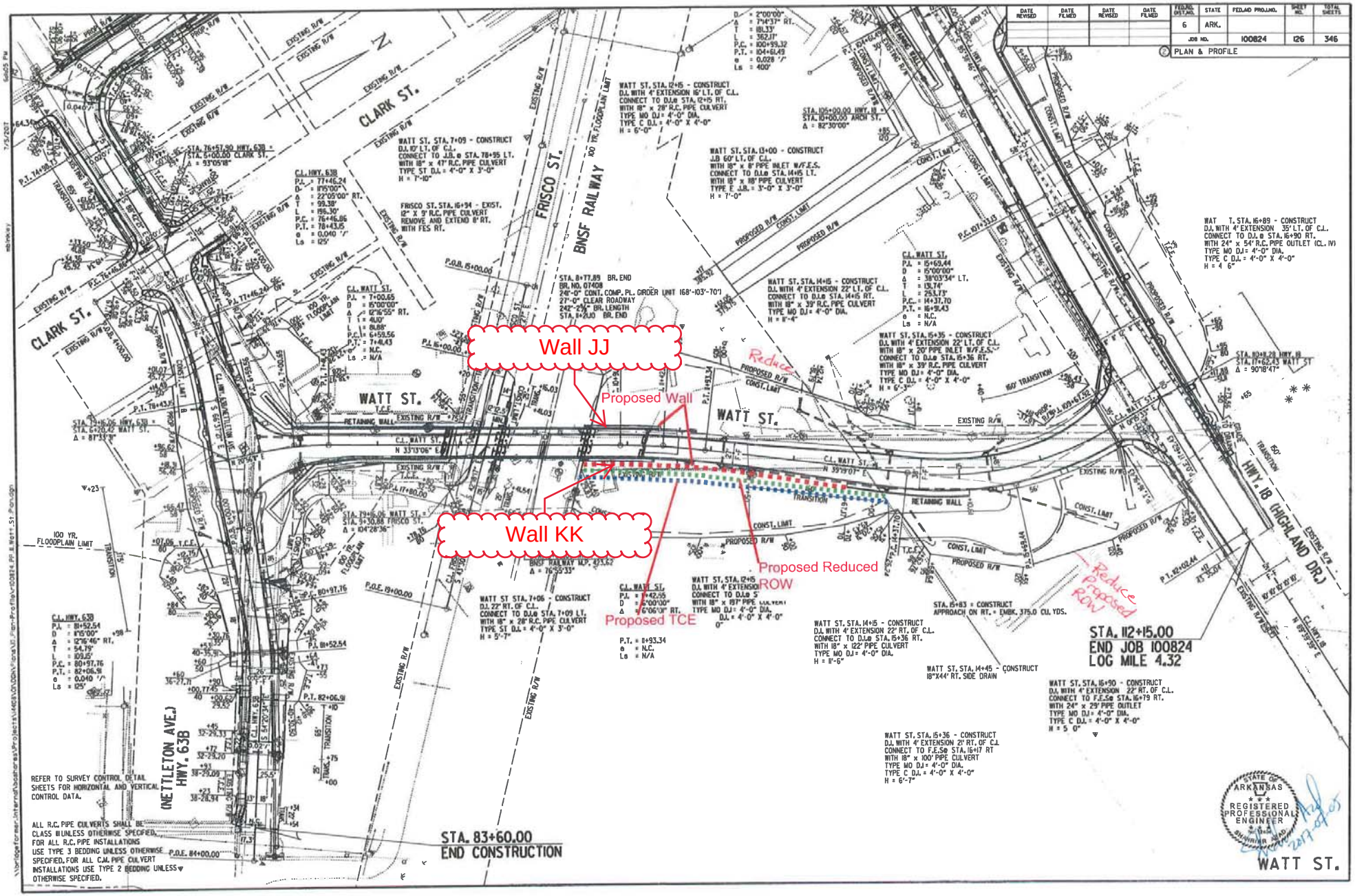
STATE OF ARKANSAS REGISTERED PROFESSIONAL ENGINEER No. 7791 MARK E. WYATT

Mark E. Wyatt, P.E.
President

MEW:jw

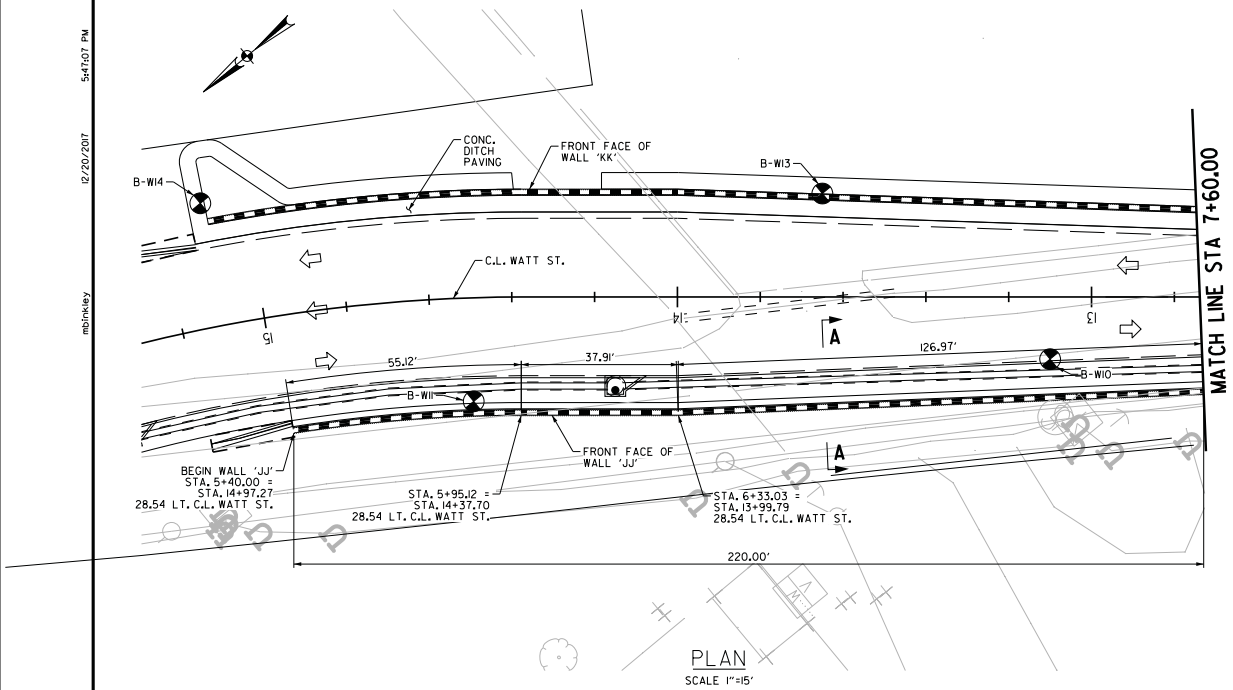
Copies Submitted: Bridgefarmer & Associates, Inc.
Attn: Mr. Shahriar Azad, P.E. (1+email)
Attn: Mr. Stephen Smiley, P.E. (1-email)

ATTACHMENT 1


Wall JJ
Proposed Wall
Wall KK
Proposed Reduced ROW
Proposed TCE
Reduce Proposed ROW
CLARK ST.
WATT ST.
FRISCO ST.
BNSF RAILWAY
HWY. 63B (NETTLETON AVE.)
HWY. 18 (HIGHLAND DR.)
STA. 112+15.00
END JOB 100824
LOG MILE 4.32
STA. 83+60.00
END CONSTRUCTION
PLAN & PROFILE
REFER TO SURVEY CONTROL DETAIL SHEETS FOR HORIZONTAL AND VERTICAL CONTROL DATA.
ALL R.C. PIPE CULVERTS SHALL BE CLASS III UNLESS OTHERWISE SPECIFIED. FOR ALL R.C. PIPE INSTALLATIONS USE TYPE 3 BEDDING UNLESS OTHERWISE SPECIFIED. FOR ALL C.M. PIPE CULVERT INSTALLATIONS USE TYPE 2 BEDDING UNLESS OTHERWISE SPECIFIED.
STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER

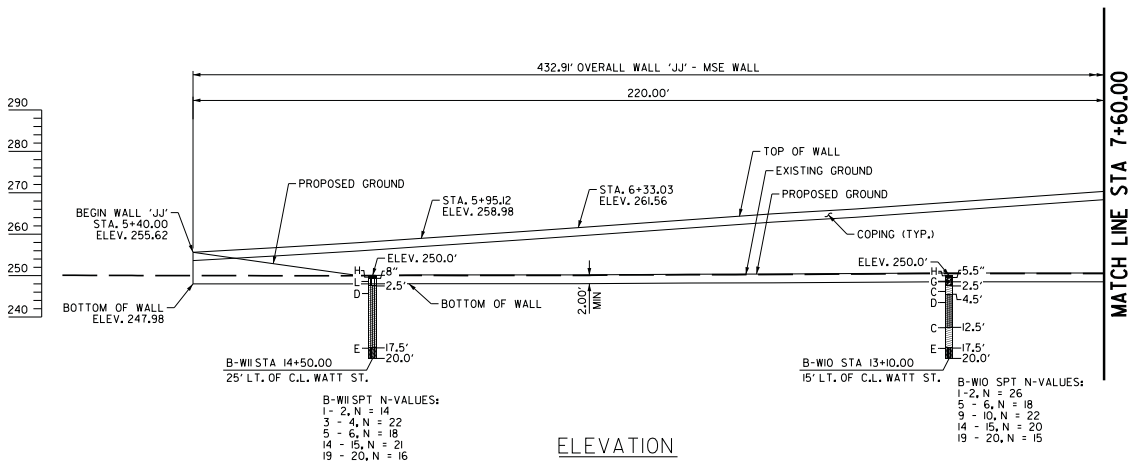
ATTACHMENT 2

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		100824	245	346
				①		P&P RET. WALL 'JJ'		59589



PLAN

SCALE 1"=15'



B-W11 SPT N-VALUES:
1 - 2, N = 14
3 - 4, N = 22
5 - 6, N = 18
14 - 15, N = 21
19 - 20, N = 16

B-W10 SPT N-VALUES:
1-2, N = 26
5 - 6, N = 18
9 - 10, N = 22
14 - 15, N = 20
19 - 20, N = 15

ELEVATION

SCALE 1"=15'

* BENTLEY HORIZONTAL ALIGNMENT REVIEW
* Alignment name: WJJ
* Alignment description:
* Alignment style: Default
* Input Factor: 1.00000000

		STATION	NORTHING	EASTING
Element: Circular				
P.C. (	8044)	5+00.00	544062.7854	1712958.0898
P.I. (	)	5+47.85	544019.0410	1712938.7058
C.C. (	8023)		544205.9697	1712634.9627
P.T. (	WJJ-1)	5+95.12	543982.0252	1712908.3886
Radius:		353.43		
Delta:		15°25'10.0" Right		
Degree of Curvature(Arc):		16°12'40.8"		
Length:		95.12		
Tangent:		47.85		
Chord:		94.83		
Middle Ordinate:		3.19		
External:		3.22		
Tangent Direction:		S 23°53'56.8" W		
Radial Direction:		N 66°06'03.2" W		
Chord Direction:		S 31°36'31.8" W		
Radial Direction:		N 50°40'53.2" W		
Tangent Direction:		S 39°19'06.8" W		
Element: Linear				
P.T. (	WJJ-1)	5+95.12	543982.0252	1712908.3886
P.I. (	WJJHXX002)	6+33.03	543952.6961	1712884.3672
Tangential Direction:		S 39°19'06.8" W		
Tangential Length:		37.91		
Element: Linear				
P.I. (	WJJHXX002)	6+33.03	543952.6961	1712884.3672
P.I. (	WJJHXX003)	7+83.15	543832.8490	1712793.9642
Tangential Direction:		S 37°01'40.6" W		
Tangential Length:		150.12		
Element: Linear				
P.I. (	WJJHXX003)	7+83.15	543832.8490	1712793.9642
P.C. (	WJJ-2)	8+39.60	543789.1750	1712758.1939
Tangential Direction:		S 39°19'06.8" W		
Tangential Length:		56.45		
Element: Circular				
P.C. (	WJJ-2)	8+39.60	543789.1750	1712758.1939
P.I. (	)	8+91.68	543748.8803	1712725.1912
C.C. (	8045)		543169.8183	1713514.3999
P.T. (	8046)	9+43.67	543705.3066	1712696.6575
Radius:		977.47		
Delta:		6°06'01.0" Left		
Degree of Curvature(Arc):		5°51'41.9"		
Length:		104.07		
Tangent:		52.08		
Chord:		104.02		
Middle Ordinate:		1.38		
External:		1.39		
Tangent Direction:		S 39°19'06.8" W		
Radial Direction:		N 50°40'53.2" W		
Chord Direction:		S 36°16'06.3" W		
Radial Direction:		N 56°46'54.2" W		
Tangent Direction:		S 33°13'05.8" W		
Element: Linear				
P.T. (	8046)	9+43.67	543705.3066	1712696.6575
P.O.E. (	WJJHXX004)	9+87.29	543668.8175	1712672.7631
Tangential Direction:		S 33°13'05.8" W		
Tangential Length:		43.62		

BORING LEGEND:

A - Portland cement concrete
B - Firm to stiff silty clay (fill)
C - Soft to stiff clay
D - Soft to very stiff silty clay
E - Firm to stiff clayey silt
F - Crushed stone base
G - Aggregate base
H - Asphalt concrete
I - Stiff clay (fill)
J - Stiff fine sandy clay (fill)
K - Firm to stiff fine sandy clay
L - Medium dense silt
M - Medium dense silty fine sand (fill)
N - Medium dense clayey fine sand
O - Loose to Medium dense clayey fine sand with fine to coarse gravel
P - Medium dense to dense fine sandy silt
Q - Medium dense to dense silty fine sand
R - Medium dense to dense fine to coarse sand
S - Medium dense to dense clayey fine to coarse sand with some fine to coarse gravel (fill)

NOTES:

1. CONTROL POINT STATIONS AND OFFSETS ARE MEARSURED TO THE OUTSIDE TOP CORNER OF COPING.
2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
4. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
5. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB 100824 "RETAINING WALLS."
6. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
8. ALL EXPOSED WALL CONCRETE ELEMENTS VISIBLE BEYOND COPINGS SHALL HAVE "ASHLAR STONE" FORMLINER PRODUCED FINISH PATTERN WITH 3/4" NOMINAL DEPTH OF RELIEF.

EXHIBIT
PRELIMINARY FOR REVIEW ONLY
SHAHRIAR AZAD, P.E. 12404
DECEMBER-2017

SHEET 1 OF 2
LAYOUT OF RETAINING WALL 'JJ'

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (S)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

ARKANSAS STATE HIGHWAY COMMISSION

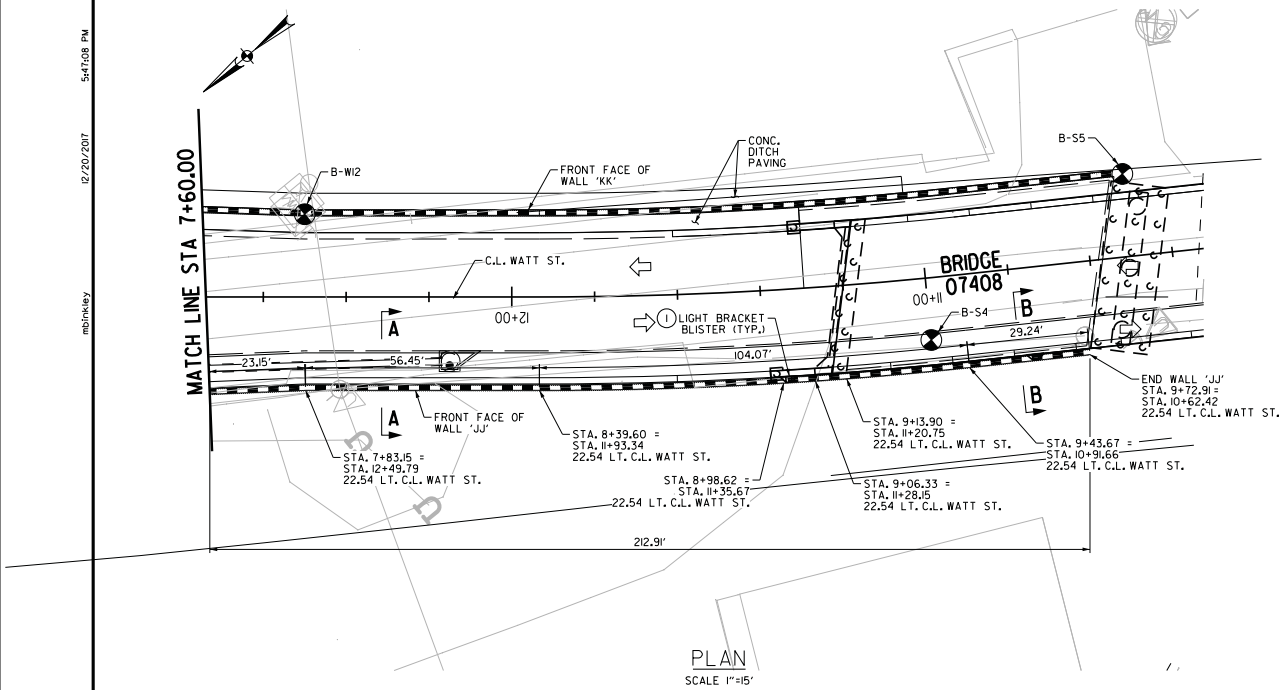
LITTLE ROCK, ARK.

DRAWN BY:	DCD	DATE:	6/2/2016	FILENAME:	r100824_p&p_JJ.01
CHECKED BY:	SA	DATE:	6/6/2016	SCALE:	1" = 15'
DESIGNED BY:	DCD	DATE:	5/3/2016		

DRAWING NO. 59589

S:\14408\ON\DGN\Plans\14_Walls\r100824_p&p_JJ_01.dgn mbrinkley 12/20/2017 5:47:07 PM

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		100824	245	346
				①	P&P RET. WALL 'JJ'			59589



PLAN

SCALE 1"=15'

RETAINING WALL 'JJ'

STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
5+40.00	255.62	255.62	247.98
5+65.00	257.04	252.09	247.97
5+90.00	258.63	250.08	248.00
6+15.00	260.31	250.14	248.02
6+40.00	262.05	250.20	248.08
6+65.00	263.83	250.34	248.22
6+90.00	265.48	250.43	248.31
7+15.00	267.13	250.58	248.46
7+40.00	268.89	250.61	248.49
7+65.00	270.66	250.59	248.47
7+90.00	272.52	250.63	248.51
8+15.00	274.41	250.88	248.76
8+40.00	276.17	250.86	248.74
8+65.00	277.87	251.01	248.89
8+90.00	279.56	251.16	249.04
9+15.00	273.86	251.56	249.44
9+40.00	264.63	252.11	249.99
9+65.00	255.40	252.54	250.42
9+72.91	252.48	252.48	250.36

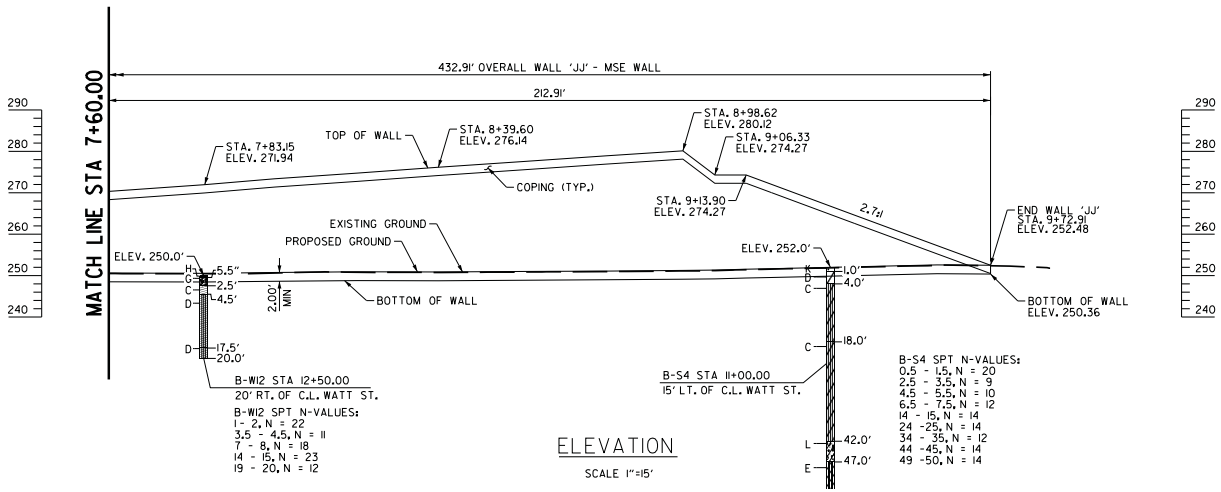
① FOR "LIGHT BRACKET BLISTER DETAILS" SEE BRIDGE PLAN, DWG NO. 59563

NOTES:

1. CONTROL POINT STATIONS AND OFFSETS ARE MEARSURED TO THE OUTSIDE TOP CORNER OF COPING.
2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
4. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
5. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB 100824 "RETAINING WALLS."
6. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
8. ALL EXPOSED WALL CONCRETE ELEMENTS VISIBLE BEYOND COPINGS SHALL HAVE "ASHLAR STONE" FORMLINER PRODUCED FINISH PATTERN WITH 3/4" NOMINAL DEPTH OF RELIEF.

BORING LEGEND:

A - Portland cement concrete
B - Firm to stiff silty clay (fill)
C - Soft to stiff clay
D - Soft to very stiff silty clay
E - Firm to stiff clayey silt
F - Crushed stone base
G - Aggregate base
H - Asphalt concrete
I - Stiff clay (fill)
J - Stiff fine sandy clay (fill)
K - Firm to stiff fine sandy clay
L - Medium dense silt
M - Medium dense silty fine sand (fill)
N - Medium dense clayey fine sand
O - Loose to Medium dense clayey fine sand with fine to coarse gravel
P - Medium dense to dense fine sandy silt
Q - Medium dense to dense silty fine sand
R - Medium dense to dense fine to coarse sand
S - Medium dense to dense clayey fine to coarse sand with some fine to coarse gravel (fill)



ELEVATION

SCALE 1"=15'

EXHIBIT
PRELIMINARY FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
DECEMBER-2017

SHEET 2 OF 2
LAYOUT OF RETAINING WALL 'JJ'

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (S)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

ARKANSAS STATE HIGHWAY COMMISSION

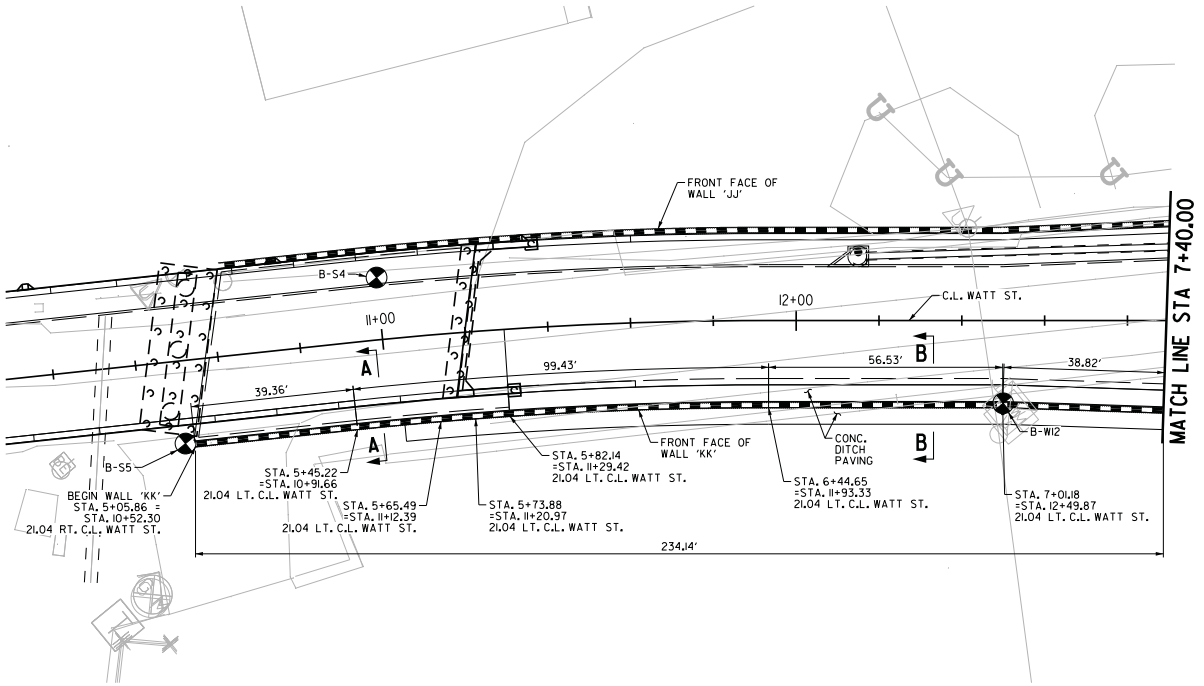
LITTLE ROCK, ARK.

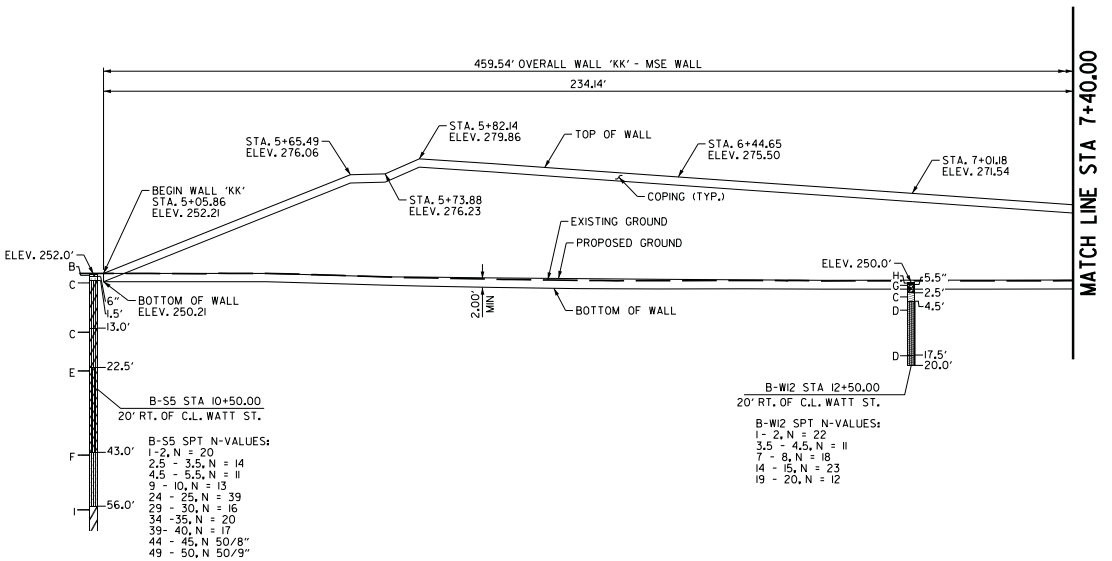
DRAWN BY: DCD DATE: 6/2/2016
CHECKED BY: SA DATE: 6/6/2016
DESIGNED BY: DCD DATE: 5/3/2016
FILENAME: r100824_p&p_JJ.02
SCALE: 1" = 15'

DRAWING NO. 59589

12/20/2017 5:47:08 PM mbinkley S:\14408\ON\DGN\Plans\14_Walls\r100824_p&p_JJ.02.dgn

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		100824	244	346
				①		P&P RET. WALL 'KK'		59588





B-S5 SPT N-VALUES:
1 -2, N = 20
2.5 - 3.5, N = 14
4.5 - 5.5, N = 11
9 - 10, N = 13
24 - 25, N = 39
29 - 30, N = 16
34 -35, N = 20
39- 40, N = 17
44 - 45, N 50/8"
49 - 50, N 50/9"

B-WI2 SPT N-VALUES:
1 - 2, N = 22
3.5 - 4.5, N = 11
7 - 8, N = 18
14 - 15, N = 23
19 - 20, N = 12

```
* BENTLEY HORIZONTAL ALIGNMENT REVIEW
*
* Alignment name: WKK
* Alignment description:
* Alignment style: Default
* Input Factor: 1.00000000
*
```

		STATION	NORTHING	EASTING
Element: Linear				
P.O.B. (	WKKHXX001)	5+00.00	543643.5990	1712708.3456
P.C. (	WKK-1)	5+45.22	543681.4303	1712733.1189
Tangential Direction:		N 33°13'05.8" E		
Tangential Length:		45.22		
Element: Circular				
P.C. (	WKK-1)	5+45.22	543681.4303	1712733.1189
P.I. (	)	5+94.98	543723.0612	1712760.3804
C.C. (	8045)		543169.8183	1713514.3999
P.T. (	8047)	6+44.65	543761.5592	1712791.9115
Radius:		933.89		
Delta:		6°06'01.0" Right		
Degree of Curvature(Arc):		6°08'06.7"		
Length:		99.43		
Tangent:		49.76		
Chord:		99.38		
Middle Ordinate:		1.32		
External:		1.32		
Tangent Direction:		N 33°13'05.8" E		
Radial Direction:		S 56°46'54.2" E		
Chord Direction:		N 36°16'06.3" E		
Radial Direction:		S 50°40'53.2" E		
Tangent Direction:		N 39°19'06.8" E		
Element: Linear				
P.T. (	8047)	6+44.65	543761.5592	1712791.9115
P.I. (	WKKHXX002)	7+01.18	543805.2926	1712827.7305
Tangential Direction:		N 39°19'06.8" E		
Tangential Length:		56.53		
Element: Linear				
P.I. (	WKKHXX002)	7+01.18	543805.2926	1712827.7305
P.I. (	WKKHXX003)	8+51.26	543918.1696	1712926.6434
Tangential Direction:		N 41°13'39.8" E		
Tangential Length:		150.08		
Element: Linear				
P.I. (	WKKHXX003)	8+51.26	543918.1696	1712926.6434
P.C. (	WKK-2)	8+89.10	543947.4394	1712950.6163
Tangential Direction:		N 39°19'06.8" E		
Tangential Length:		37.83		
Element: Circular				
P.C. (	WKK-2)	8+89.10	543947.4394	1712950.6163
P.I. (	)	10+26.57	544053.7949	1713037.7247
C.C. (	8023)		544205.9697	1712634.9627
P.T. (	8048)	11+54.30	544191.1795	1713042.7081
Radius:		408.01		
Delta:		37°14'28.2" Left		
Degree of Curvature(Arc):		14°02'33.4"		
Length:		265.20		
Tangent:		137.47		
Chord:		260.56		
Middle Ordinate:		21.36		
External:		22.54		
Tangent Direction:		N 39°19'06.8" E		
Radial Direction:		S 50°40'53.2" E		
Chord Direction:		N 20°41'52.7" E		
Radial Direction:		S 87°55'21.4" E		
Tangent Direction:		N 2°04'38.6" E		

BORING LEGEND:

A - Portland cement concrete
B - Firm to stiff silty clay (fill)
C - Soft to stiff clay
D - Soft to very stiff silty clay
E - Firm to stiff clayey silt
F - Crushed stone base
G - Aggregate base
H - Asphalt concrete
I - Stiff clay (fill)
J - Stiff fine sandy clay (fill)
K - Firm to stiff fine sandy clay
L - Medium dense silt
M - Medium dense silty fine sand (fill)
N - Medium dense clayey fine sand
O - Loose to Medium dense clayey fine sand with fine to coarse gravel
P - Medium dense to dense fine sandy silt
Q - Medium dense to dense silty fine sand
R - Medium dense to dense fine to coarse sand
S - Medium dense to dense clayey fine to coarse sand with some fine to coarse gravel(fill)

NOTES:

1. CONTROL POINT STATIONS AND OFFSETS ARE MEARSURED TO THE OUTSIDE TOP CORNER OF COPING.
2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
4. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
5. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB 100824 "RETAINING WALLS."
6. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
8. ALL EXPOSED WALL CONCRETE ELEMENTS VISIBLE BEYOND COPINGS SHALL HAVE "ASHLAR STONE" FORMLINER PRODUCED FINISH PATTERN WITH 3/4" NOMINAL DEPTH OF RELIEF.

EXHIBIT

PRELIMINARY
FOR REVIEW ONLY

SHAHRIAR AZAD, P.E. 12404

DECEMBER-2017

SHEET 1 OF 2
LAYOUT OF RETAINING WALL 'KK'

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (S)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

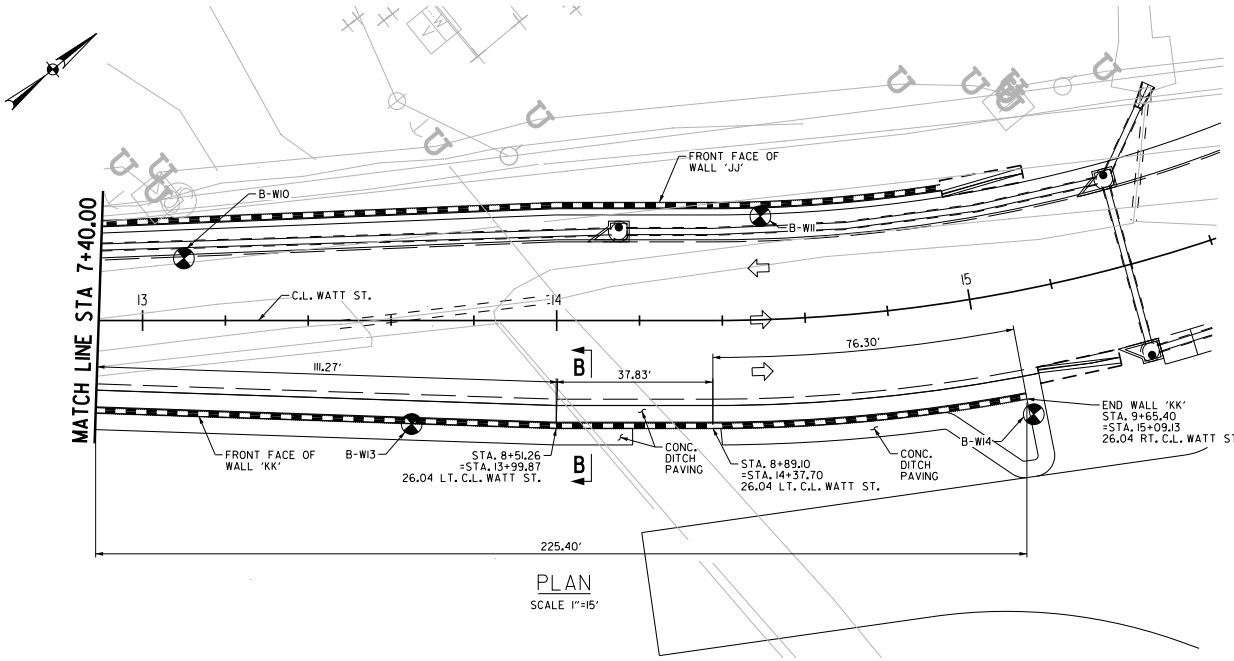
ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

DRAWN BY:	DCD	DATE:	6/2/2016	FILENAME:	r100824_p&p_kk.01
CHECKED BY:	SA	DATE:	6/6/2016	SCALE:	1" = 15'
DESIGNED BY:	DCD	DATE:	5/3/2016		

DRAWING NO. 59588

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		100824	244	346
				①	P&P RET. WALL 'KK'			59588



PLAN

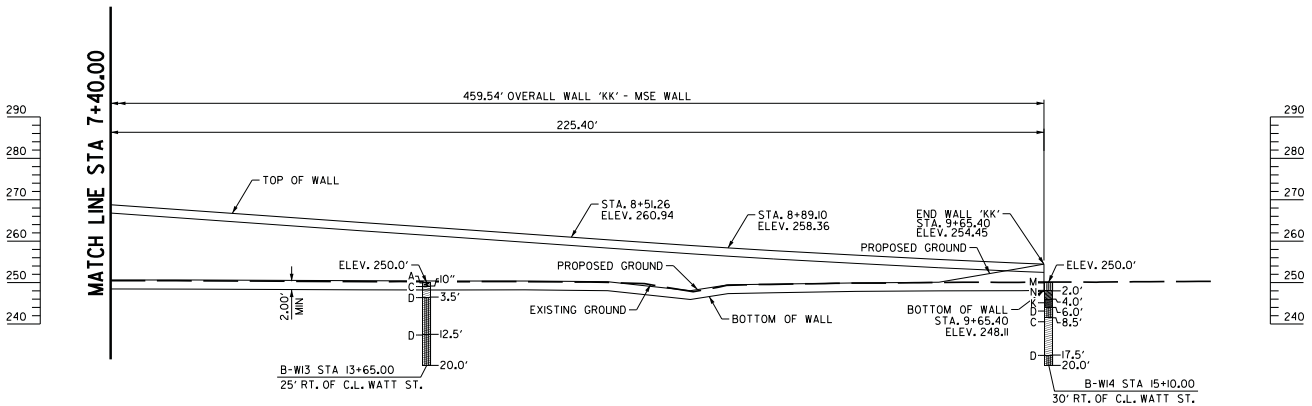
SCALE 1"=15'

RETAINING WALL 'KK'

STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
5+05.86	252.21	252.21	250.21
5+30.86	262.21	252.20	250.20
5+55.86	272.21	251.90	249.90
5+80.86	279.30	251.34	249.19
6+05.86	278.27	251.08	248.74
6+30.86	276.48	250.86	248.50
6+55.86	274.71	250.69	248.47
6+80.86	272.96	250.54	248.40
7+05.86	271.21	250.58	248.42
7+30.86	269.44	250.61	248.44
7+55.86	267.67	250.64	248.43
7+80.86	265.91	250.55	248.33
8+05.86	264.15	250.43	248.23
8+30.86	262.38	250.38	248.22
8+55.86	260.62	250.26	248.09
8+80.86	258.89	248.17	246.05
9+05.86	257.39	249.72	247.65
9+30.86	256.06	250.01	247.94
9+55.86	254.87	252.81	248.05
9+65.40	254.45	254.45	248.11

NOTES:

1. CONTROL POINT STATIONS AND OFFSETS ARE MEARSURED TO THE OUTSIDE TOP CORNER OF COPING.
2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
4. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
5. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB 100824 "RETAINING WALLS."
6. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
8. ALL EXPOSED WALL CONCRETE ELEMENTS VISIBLE BEYOND COPINGS SHALL HAVE "ASHLAR STONE" FORMLINER PRODUCED FINISH PATTERN WITH 3/4" NOMINAL DEPTH OF RELIEF.



B-WI3 SPT N-VALUES:
1 - 2, N = 14
2.5 - 3.5, N = 8
4.5 - 5.5, N = 19
6.5 - 7.5, N = 18
9.5 - 10.5, N = 10
14 - 15, N = 22
19 - 20, N = 20

B-WI4 SPT N-VALUES:
0.5 - 1.5, N = 11
2.5 - 3.5, N = 13
4.5 - 5.5, N = 14
6.5 - 7.5, N = 17
9.5 - 10.5, N = 11
14 - 15, N = 25
19 - 20, N = 4

ELEVATION

SCALE 1"=15'

BORING LEGEND:

A - Portland cement concrete
B - Firm to stiff silty clay (fill)
C - Soft to stiff clay
D - Soft to very stiff silty clay
E - Firm to stiff clayey silt
F - Crushed stone base
G - Aggregate base
H - Asphalt concrete
I - Stiff clay (fill)
J - Stiff fine sandy clay (fill)
K - Firm to stiff fine sandy clay
L - Medium dense silt
M - Medium dense silty fine sand (fill)
N - Medium dense clayey fine sand
O - Loose to Medium dense clayey fine sand with fine to coarse gravel
P - Medium dense to dense fine sandy silt
Q - Medium dense to dense silty fine sand
R - Medium dense to dense fine to coarse sand
S - Medium dense to dense clayey fine to coarse sand with some fine to coarse gravel(fill)

EXHIBIT
PRELIMINARY FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
DECEMBER-2017

SHEET 2 OF 2
LAYOUT OF RETAINING WALL 'KK'

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (S)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

DRAWN BY: DCD DATE: 6/2/2016
CHECKED BY: SA DATE: 6/6/2016
DESIGNED BY: DCD DATE: 5/3/2016

FILENAME: r100824_p&p_kk_01
SCALE: 1" = 15'

DRAWING NO. 59588

S:\14408\ON\DGN\Plans\14_Rwalls\r100824_p&p_kk_02.dgn 12/20/2017 5:47:13 PM mbrinkley

ATTACHMENT 3

Summary of Preliminary Recommendations for MSE Walls

PROJECT: ArDOT Job No. 100824 – BNSF Railroad Overpass - Watt Street, North Bridge End
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

Wall	Wall Station	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft below plan subgrade	Bearing Stratum	Nominal Sliding Resistance (tan δ)	Comments
Wall JJ	Sta 5+40 to Sta 7+25	185	8 to 25	W11, W10	7.7	0.7H ≥ 8	2	Stiff silty clay	0.33	
Wall JJ	Sta 7+25 to Sta 8+00	75	8 to 25	W10, W12	7.7	0.7H ≥ 8	4	Stiff silty clay	0.33	
Wall JJ	Sta 8+00 to Sta 9+06	106	25 to 31	W12, S4	9.0	0.7H	8	SM-1 backfill	0.35	Undercut for bearing, backfill undercut with SM-1 or approved alternate.
Wall JJ	Sta 8+00 to Sta 9+06	106	25 to 31	W12, S4	14.0	0.7H	Rammed Aggregate Pier (RAP) Alternative	RAP/silty clay	0.40	Rammed Aggregate Piers @ 30% Area Ratio, 30-in. dia., L = 12 ft
Wall JJ	Sta 9+06 to Sta 9+73	67	tapers from 25	S4	7.7	0.7H ≥ 8	minimal	Stiff silty clay	0.33	
Wall KK	Sta 5+06 to Sta 5+75	69	tapers up to 25	S5	7.7	0.7H ≥ 8	minimal	Stiff silty clay	0.33	
Wall KK	Sta 5+75 to Sta 6+80	105	25 to 31	S5, W12	9.0	0.7H	8	SM-1 backfill	0.35	Undercut for bearing, backfill undercut with SM-1 or approved alternate.
Wall KK	Sta 5+75 to Sta 6+80	105	25 to 31	S5, W12	14.0	0.7H	Rammed Aggregate Pier (RAP) Alternative	RAP/silty clay	0.40	Rammed Aggregate Piers @ 30% Area Ratio, 30-in. dia., L = 12 ft
Wall KK	Sta 6+80 to Sta 9+65	285	25 to 6	W13, W14	7.7	0.7H ≥ 8	2	Stiff silty clay	0.33	

Notes: 1. Strap length is an estimate only. The Designer must select the length for use in final design.
2. The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. Undercuts required to develop suitable bearing should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), crushed stone base (AHTD SS 303, Class 7), or an approved alternate.
4. Undercuts should extend at least 10 ft outside the reinforced zone to the extent possible.
5. Criteria above provided for information only. Final design to be developed by Others.

ATTACHMENT 4

Summary of Preliminary Recommendations for MSE Walls

PROJECT: ArDOT Job No. 100824 – BNSF Railroad Overpass - Watt Street, North Bridge End
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

Wall	Wall Station	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft below plan subgrade	Bearing Stratum	Nominal Sliding Resistance (tan δ)	Comments
Wall JJ	Sta 5+40 to Sta 7+25	185	8 to 25	W11, W10	7.7	0.7H ≥ 8	2	Stiff silty clay	0.33	
Wall JJ	Sta 7+25 to Sta 8+00	75	8 to 25	W10, W12	7.7	0.7H ≥ 8	4	Stiff silty clay	0.33	
Wall JJ	Sta 8+00 to Sta 9+06	106	25 to 31	W12, S4	9.0	0.7H	8	SM-1 backfill	0.35	Undercut for bearing, backfill undercut with SM-1 or approved alternate.
Wall JJ	Sta 8+00 to Sta 9+06	106	25 to 31	W12, S4	14.0	0.7H	RAP Alternative	RAP/silty clay	0.40	Rammed Aggregate Piers @ 30% Area Ratio, 30 in. dia., L = 12 ft
Wall JJ	Sta 9+06 to Sta 9+73	67	tapers from 25	S4	7.7	0.7H ≥ 8	minimal	Stiff silty clay	0.33	
Wall KK	Sta 5+06 to Sta 5+75	69	tapers up to 25	S5	7.7	0.7H ≥ 8	minimal	Stiff silty clay	0.33	
Wall KK	Sta 5+75 to Sta 6+80	105	25 to 31	S5, W12	9.0	0.7H	8	SM-1 backfill	0.35	Undercut for bearing, backfill undercut with SM-1 or approved alternate.
Wall KK	Sta 5+75 to Sta 6+80	105	25 to 31	S5, W12	14.0	0.7H	RAP Alternative	RAP/silty clay	0.40	Rammed Aggregate Piers @ 30% Area Ratio, 30 in. dia., L = 12 ft
Wall KK	Sta 6+80 to Sta 9+65	285	25 to 6	W13, W14	7.7	0.7H ≥ 8	2	Stiff silty clay	0.33	

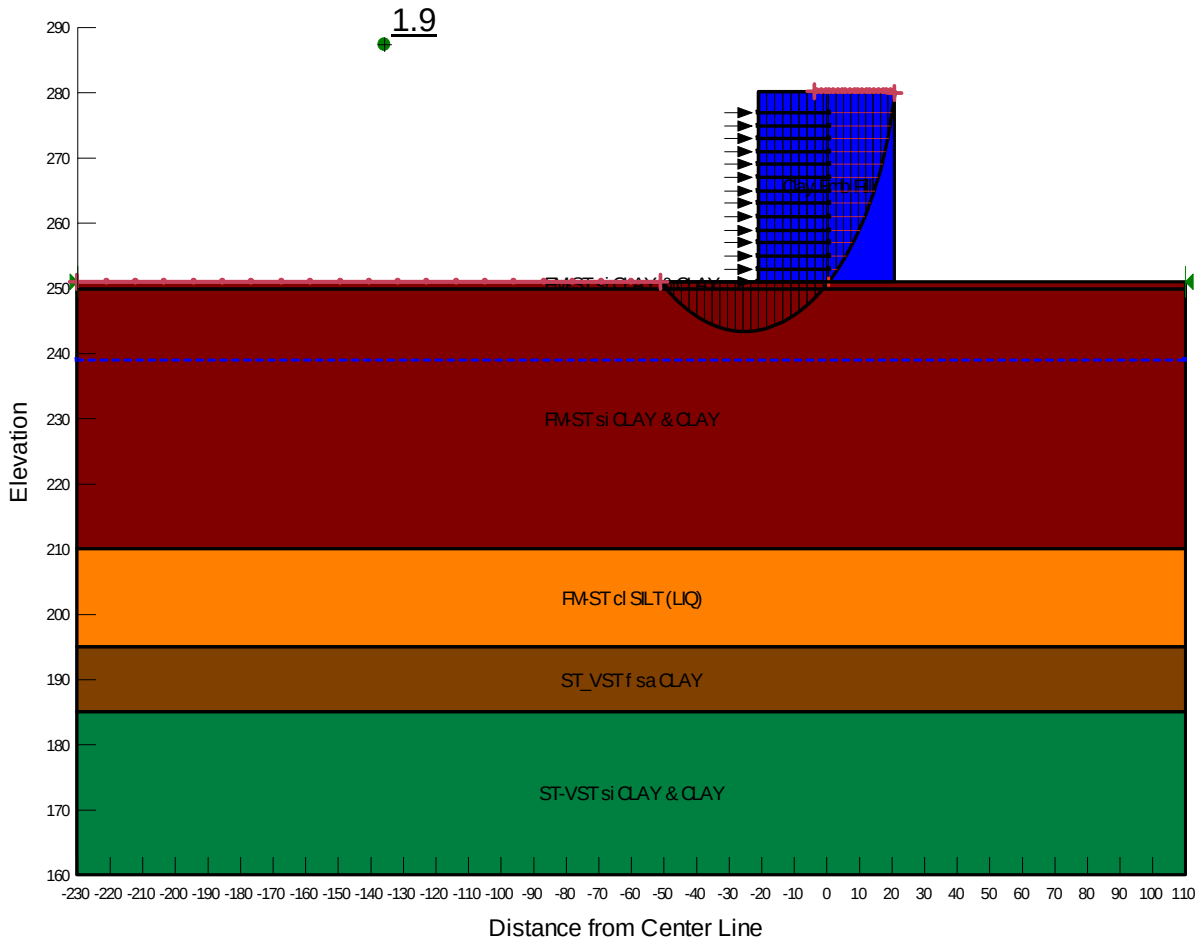
Notes: 1. Strap length is an estimate only. The Designer must select the length for use in final design.
2. The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. Undercuts required to develop suitable bearing should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), crushed stone base (AHTD SS 303, Class 7), or an approved alternate.
4. Undercuts should extend at least 10 ft outside the reinforced zone to the extent possible.
5. Criteria above provided for information only. Final design to be developed by Others.

Summary of Stability Analysis Results
Cross Section @ Sta 11+28
16-022 - Watt Street over BNSF Railroad, Wall JJ & KK
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

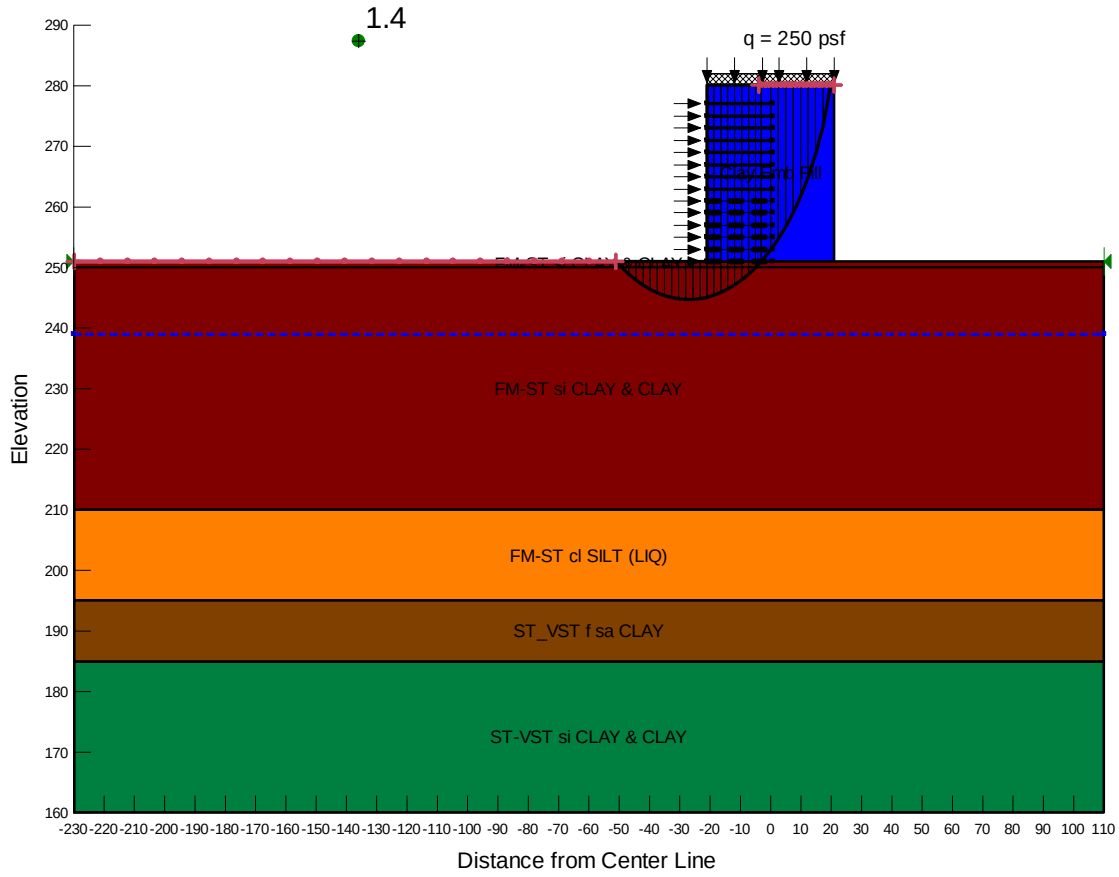
Station	Design Loading Condition	Calculated Minimum Factor of Safety
11+29	End of Construction	1.9
	Long Term	1.4
	Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

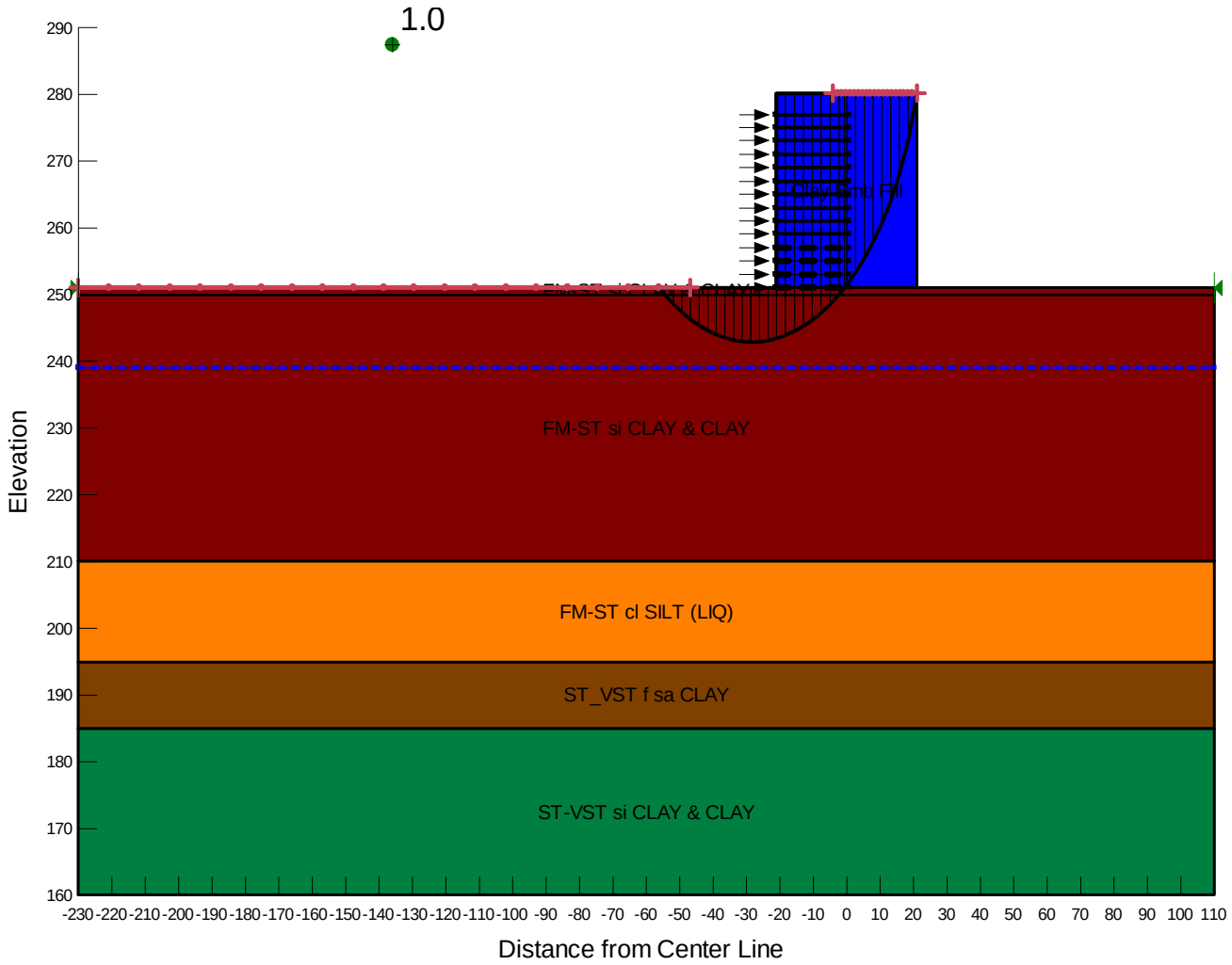
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Existing Fill / Embankment Fill	120	750	200	20
Firm to stiff silty clay and clay	120	1500	200	25
Firm to stiff clayey silt (liquefiable)	120	---	---	32
Stiff to very stiff fine sandy clay	125	2000	500	20
Stiff to very stiff silty clay and clay	120	2250	200	24



Results of Stability Analyses – End of Construction Condition
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
FAX (501) 455-4137

December 22, 2016
Job No. 16-022

Bridgefarmer & Associates, Inc.
12801 North Central Expressway, Suite 400
Dallas, Texas 75243

Attn: Mr. Shahriar Azad, P.E.

GEOTECHNICAL INVESTIGATION
AHTD JOB 100824: HWY. 18 RAILROAD OVERPASS (JONESBORO) (S)
JONESBORO, CRAIGHEAD COUNTY, ARKANSAS

INTRODUCTION

Submitted herewith are the results of the geotechnical investigation performed for the new railroad grade separations over the Burlington Northern Santa Fe (BNSF) railroad tracks in Jonesboro, Craighead County, Arkansas. This geotechnical investigation has been performed in accordance with the Bridgefarmer & Associates, Inc. Subconsultant Agreement of April 6, 2015. This revised report includes considerations of review comments provided by the Engineer (Bridgefarmer & Associates, Inc.) and the Department (AHTD). The report providing recommendations for pavement subgrade support was submitted on May 13, 2016. Interim results of the geotechnical investigation, along with design recommendations for seismic conditions and foundations have been provided throughout the course of this project.

The project consists of railroad grade separations over the Burlington Northern Santa Fe (BNSF) railroad tracks on Highway 18, a principal arterial that is part of the Arkansas Primary Highway Network (APHN) and the National Highway System (NHS). The Highway 18 structure will be a continuous composite plate girder unit with two (2) spans and a total length of about 257 feet. The bridge ends will utilize mechanically stabilized earth (MSE) walls at the bridge ends and longitudinally to transition grades. The project will also include a grade separation structure over Watt Street. The Watt Street grade separation will be a three-span structure with a total length of approximately 243 feet. MSE walls are planned at the south end of the bridge and

a simple slope will be utilized at the north end of the Watt Street Bridge. The bridge foundation loads are expected to be moderate to heavy.

The purposes of this phase of the geotechnical investigation were to explore subsurface conditions in the bridge alignments and at the approach embankments. The data developed through the field and laboratory studies were utilized to develop recommendations to guide design and construction of foundations, embankments, and earthwork. These purposes were achieved by a multi-phased study that has included:

- Drilling sample borings to evaluate subsurface conditions and to obtain samples for laboratory testing.
- Performing laboratory tests to establish pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations and conclusions for seismic site class, seismic design category/seismic performance zone, foundation design, MSE wall preliminary design, embankment configurations, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridges and approaches has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the bridge locations and in the wall alignments were evaluated by drilling 27 sample borings to 20- to 170-ft depth. The site vicinity is shown on Plate 1 of Attachment 1. The approximate boring locations are shown on the Plans of Borings, Plates 2 through 5 of Attachment 1. The subsurface exploration program is summarized on Plate 6 of Attachment 1. A key to the terms and symbols used on the logs is provided as Plate 7 of Attachment 1.

The specific site vicinity, approximate boring locations, and borings logs for the Hwy 18 and Watt Street grade separations and walls are shown in Attachments 2, 3, and 4, respectively. The logs of the roadway borings (designated as "R") are provided in Attachment 5 for supplemental information. The results of pavement cores are also summarized in Attachment 5. The centerline station and offset of the boring locations and the inferred ground surface elevation are noted on the logs. The approximate boring surface elevation was inferred from the

topographic information provided by the Engineer. It must be recognized that the elevations shown are approximate and actual elevations may vary.

To aid in visualizing subsurface conditions at the grade separation locations, generalized subsurface profiles are presented in Attachment 2 for Hwy 18 and Attachment 3 for Watt Street. The stratigraphy illustrated by the profiles has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profiles should be anticipated.

The borings performed for this project facet were drilled with truck-mounted Mobile B-53 and SIMCO 2800 rotary-drilling rigs using a combination of dry-auger and rotary-wash drilling methods. Soil samples were typically obtained using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb safety hammer or automatic hammer dropped 30 in. as per Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Selected undisturbed samples of cohesive soils were obtained using a 3-in.-diameter thin-walled tube hydraulically advanced into the soil. Undrained shear strength of the cohesive soils was estimated in the field using a calibrated hand penetrometer. Estimated shear strength values are plotted on the log forms, in tons per sq ft, as circles enclosing an "x".

All samples were removed from sampling tools in the field, examined, and visually classified by a field geologist or geotechnical technician. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

Borings were advanced using dry-auger procedures to the extent possible to facilitate groundwater observations. Observations regarding groundwater are noted in the lower portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining final water level readings. Where borings were drilled in pavements, the pavement was patched.

LABORATORY TESTING

To evaluate pertinent physical and engineering characteristics of the foundation and subgrade soils, laboratory tests consisting of natural water content determinations, classification tests, and shear strength measurements were performed on selected representative samples. The laboratory testing program performed for the project alignment included the following.

- Soil water content (AASHTO T-265)
- Liquid limit, plastic limit, and plasticity index (AASHTO T-89 and T-90)
- Grain size analyses (AASHTO T-88)
- Unconsolidated-Undrained Triaxial Compression Tests (AASHTO T-296)
- One-Dimensional Consolidation Properties of Soils Using Incremental Loading (AASHTO T-216)

Natural water content determinations were performed to develop information on *in-situ* soil water content. Water content results are plotted on the log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

Atterberg (liquid and plastic) limit determinations and sieve analyses were performed on selected representative soil samples to evaluate soil plasticity and to verify field classification. The Atterberg limits of the soil samples are plotted on the logs as plus signs connected with a dashed line. The percentage by weight of soil passing the No. 200 sieve is noted in the "- No. 200%" column on the far right side of the log forms. A summary of classification test results and classification by the Unified Soil Classification System and AASHTO classification system is presented on Plates 1 through 10 of Attachment 6.

Soil shear strength was estimated in the field using hand penetrometer and/or SPT results. Laboratory soil strength testing included unconsolidated-undrained triaxial compression tests. Undrained shear strength (cohesion) determined from the results of the compression tests is plotted at the appropriate depth, in tons per sq ft, as an open triangle. Unit dry weight and natural water content were also determined as a part of each strength test and are also reported on the logs.

The laboratory testing program also included one-dimensional consolidation tests. In this test, an undisturbed soil sample was placed in a cell, inundated with water, and incrementally loaded. The deflection was measured with time until vertical movement had essentially stopped. At that point, another load increment was applied. After the completion of all loading cycles, the load was removed incrementally and rebound was measured. The consolidation test results are presented graphically on Plates 11 and 12 in Attachment 6.

GENERAL SITE AND SUBSURFACE CONDITIONS

Site Conditions

The site vicinity is shown on Plate 1 of Attachment 1 and in more detail for each bridge in Attachments 2 and 3. Highway 18 is a four-lane major arterial roadway, crossing the existing BNSF railroad tracks on a slight skew, but generally oriented east-west. This area is primarily commercial development, but with some residential areas on the north. The terrain is generally flat at this location. Surface drainage is facilitated by ditches along the road sides.

The Watt Street grade separation is also located in primarily urban, commercial area. Watt Street is a two-lane, minor arterial roadway with an asphalt concrete pavement section and ditches on the roadside. The terrain is flat and surface drainage is considered poor to fair.

Site Geology

The project alignment is located in the Mississippi Embayment Physiographic Province. The site vicinity is the mapped exposure of Quaternary Terrace Deposits and Pleistocene Silt and Sand. These are flood-plain deposits comprised primarily of unconsolidated sand and silt with lenses of clay and gravel. Specifically, the site is located on Crowley's Ridge. This is an erosional remnant of 40- to 50-million-year-old sedimentary rock in the upper Mississippi River Embayment. Crowley's Ridge was formed late in the Pleistocene Epoch as the river, filled with glacial meltwater, shifted course and broadened its floodplain by eroding the Tertiary rock forming its banks. The gravel deposits of Crowley's Ridge can be thick and typically lie over Tertiary sediments at varying depths. Bedrock (Paleozoic rock) in this vicinity is reported to be about 1400 ft deep.

Seismic Conditions

In light of the results of the borings and the surface geology at the Hwy 18 and Watt Street grade separation locations, a Site Class D (stiff soil profile) is considered fitting for each bridge with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014[1].

Based on the bridge locations, the 1.0-sec period spectral acceleration coefficient for

---

[1] AASHTO LRFD Bridge Design Specifications, 7th Edition; AASHTO; 2014.

Class D soil (S_1) for the Hwy 18 Bridge is 0.32. The site coefficient for 1.0-sec period spectral acceleration (Fv) adjusted for Site Class D is 1.76. Accordingly, the calculated design 1.0-sec period spectral acceleration coefficient (S_{D1}) value is 0.563 for the bridge site. Table 3.10.6-1[2] indicates that a Seismic Performance Zone 4 is fitting for the bridge site.

The 2014 edition of the AASHTO Guide Specifications indicates that the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) for the bridge location is predicted to be 0.67. For a Site Class D, the Site Coefficient for the PGA, F_{PGA} is determined to be 1.0. Consequently, a design PGA (A_s) value of 0.67 is considered appropriate for the Hwy 18 Bridge location.

Liquefaction analyses were performed to evaluate the liquefaction potential of the subsurface soils. The analyses were performed utilizing the methodology and procedures proposed by Idriss and Boulanger[3] in 2008. A design PGA (A_s) value of 0.67, as per the site-specific seismic analysis, and an earthquake Moment Magnitude (M_w) of 7.2 were utilized. Liquefaction analyses were performed for each boring performed in the grade separation alignments.

The results of the liquefaction analyses are provided in Attachment 7 as plots of calculated factors of safety against liquefaction potential. The potentially liquefiable zones are indicated on the generalized subsurface profiles, provided in Attachments 2 and 3.

Subsurface Conditions

Based on the results of the borings drilled for the grade separation project, the surface soil stratum is locally on-site fill. This represents localized fill placed during prior site grading operations. The on-site fill zones are relatively thin.

The natural soils consist of interbedded units of silty clay, clay, fine sandy clay, and clayey silt with subordinate units of fine sandy silt, silty fine sand, and sand. Relatively weak zones are locally present at shallow depth in the cohesive and slightly cohesive soils (i.e., silty clay and clayey silt) with moderate to high compressibility and low shear strength. At depth, the cohesive soils predominantly exhibit moderate shear strength and low to moderate compressibility.

---

2 AASHTO LRFD Bridge Design Specifications, 3.10 Earthquake Effects, AASHTO; 2014.

3 "Soil Liquefaction during Earthquakes." Earthquake Engineering Research Institute, MNO-12, Idriss and Boulanger, 2008.

Granular soil units of medium dense to very dense fine sandy silt, silty fine sand, and sand are predominant at depth. The deeper granular soil units exhibit high relative density and low compressibility.

Groundwater Conditions

Groundwater observations are shown on the boring logs (see Attachments 2 through 5). Groundwater levels will vary with seasonal precipitation, surface infiltration, and stream levels of nearby surface water features. Shallow perched water could be present locally, particularly in existing utility trenches and within on-site fill.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new grade separation structures must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling and liquefaction of the underlying strata should not exceed tolerable limits for the structure. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

In light of the results of the borings and the anticipated moderate to heavy bridge foundation loads, we recommend deep foundation systems comprised of piling be utilized to support the foundation loads at the abutments and interior bents of the new bridges. Recommendations for piling are discussed in the following report sections.

Piling

Axial Pile Capacities. We recommend the bridge foundation loads be supported on deep foundation systems comprised of steel shell piles. We understand that 18- or 24-in.-diameter steel shell piles are preliminarily planned. All steel shell piles will be filled with concrete after initial driving. Shear rings, shear studs, or other equivalents may be considered on the inside walls of the steel shells to enhance bonding between the concrete and the steel shells.

Nominal (ultimate) single pile capacity curves are provided for the planned 18- and 24-in.-diameter steel shell piles in Attachments 8 and 9 for the Hwy 18 and Watt Street grade separations, respectively. Nominal (ultimate) axial pile capacities have been developed using static pile capacity formulae, the results of the borings, and the plan pile cap bottom elevations

shown on the preliminary bridge layout drawings. Soil shear strength was reduced in liquefiable zones. In addition, downdrag loads from embankment settlement and liquefaction were considered.

Based on AASHTO LRFD geotechnical design procedures, an effective resistance factor (φ_{stat}) of 0.45 is recommended for evaluation of factored compression capacity. For evaluation of factored uplift capacities, a resistance factor (φ_{up}) of 0.35 is recommended. These resistance factors are based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, resistance factors of 1.0 and 0.8 are recommended for evaluating compression and uplift capacities, respectively. Post-construction settlement of piles installed to the recommended factored capacities should be less than 1.0 inch. Downdrag loads due to long-term embankment settlement and seismic settlement have been considered in developing the nominal pile capacity curves.

The steel shell piles are expected to be installed through the localized dense to very dense fine sandy silt and silty fine sand units. Jetting may be utilized to facilitate pile penetration to the plan pile tip elevation. Jetting is typically effective in granular soils. Final driving and any re-strikes should be performed using an impact hammer. It is anticipated that jetting will be required to install piling to the plan tip elevation at Bent 1 of the Watt Street grade separation. The pile capacity curves for Bent 1 provided in Attachment 8 have been developed based on the anticipated use of jetting.

Summaries of the estimated pile tip elevations and recommended minimum hammer energy are provided in Attachments 8 and 9. The recommended tip elevations were developed based on the axial loads provided by the Engineer and the nominal pile capacity curves. The recommended hammer energy was developed based on the results of driveability analyses as discussed in the following report section.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile diameters may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) diameters.

Battered piles can be utilized to resist lateral loads. The axial capacity of battered piles may be taken as equivalent to that of a vertical pile with the same tip elevation and embedment. Special driving equipment is typically required where pile batter exceeds about 1-horizontal to 4-vertical.

WEAP Driveability Analyses. To evaluate suitable driving equipment, driveability analyses have been performed for representative bents utilizing wave equation analysis of piles (WEAP) and the computer program GRLWEAP 2010[4]. To develop information on driveability, steel shell piles at representative bridge bents were selected for 18- and 24-in.-diameter piles. A yield strength (f_y) of 50 kips per sq in. was assumed for the steel shell piles.

Various open-ended hammers were utilized for the driveability analyses of all pile sizes. Hammer and pile cushion information was based on manufacturer-recommended values. Graphical results of the drivability analyses are provided in Attachments 10 and 11.

Piling Construction. In light of the uncertainties in subsurface conditions and the construction process, we recommend that test piles be installed at all bridge locations prior to final selection of production pile lengths. One (1) test pile should be installed at an abutment and at least one (1) test pile should be performed at an interior bent for each bridge. In general, test piles should have a length at least 10 ft longer than that anticipated for production piles.

Piles should be installed in compliance with AHTD Standard Specifications Section 805. Jetting is expected to be required for pile installation at Bent 1 of the Watt Street grade separation. Pile points are recommended at the pile tips to facilitate pile penetration.

Where jetting is to be utilized, containment of jetted materials must be provided unless approved by environmental agencies or other authorities. However, the final 5 ft of pile penetration must be achieved by impact hammers. Where jetting is used to facilitate pile penetration, the jetting pressure and flow rate through jet pipes will directly affect jetting effort. Excess flow and pressure can result in poor controllability and poor alignment of the pile being installed and/or misalignment and compromising of the adjacent piles. Too low water flow or pressure could make the jetting technique ineffective. The Contractor should have demonstrable experience in installing steel shell piles of similar sizes in subsurface conditions similar to those at this site. The Contractor must have appropriate equipment with sufficient jetting pressure / flow rate and adequate hammer energy to install piles to the plan tip elevation.

---

[4] GRLWEAP 2010; Pile Dynamics, Inc.

Safe bearing capacity of test piles and production piles should be determined by AHTD Standard Specifications Section 805.09, Method B. Driving records should be available for review by the Engineer or Department during pile installation.

Conventional Cantilevered Retaining Walls

We understand that some conventional cantilevered reinforced concrete walls will be utilized to transition grades at certain locations throughout the project area. The 90% drawings indicate four (4) conventional cantilevered walls on the alignment. Each wall varies in length and height, with the sum total length of all the planned conventional cantilevered walls estimated to be about 249 ft with a maximum wall height of 8 feet.

We recommend Select Granular Fill (AASHTO M 43, #57 stone), be utilized for all conventional cantilevered wall backfill. The cantilevered retaining walls will be free to rotate about the base. Consequently, active earth pressure will be mobilized against the concrete walls. The select granular fill should extend behind walls in a zone defined by a 1-horizontal to 1-vertical (1H:1V) configuration from the back of the wall footing.

Recommendations regarding lateral earth pressures for the concrete walls are summarized below for fully-drained and undrained conditions.

- Select Granular Fill (AASHTO M 43, #57 stone)
    - Total unit weight (γ): 115 lbs per cu ft
    - Angle of internal friction (φ) for clean crushed stone backfill: 35°
    - Equivalent fluid pressure (fully drained): 35 lbs per sq ft per ft depth
    - Equivalent fluid pressure (undrained, i.e., with no provision for internal drainage): 80 lbs per sq ft per ft depth.

To reduce the potential for soil loss due to infiltration into crushed stone backfill void spaces, the backfill should be completely encapsulated by a geotextile filter fabric. A geotextile complying with AHTD Standard Specifications Section 625, Type 2 is recommended. To facilitate drainage of perched water from wall backfill, a perimeter drain consisting of a continuous, perforated PVC pipe should be provided behind these concrete retaining walls. Water should be discharged from backfill by a system of regularly-spaced, functioning weep holes.

Wingwall and Abutment Wall Lateral Earth Pressures

It is expected that wingwalls and abutment walls, where present, will be backfilled with unclassified borrow or select material. Recommendations regarding lateral earth pressures for wingwalls and abutments are summarized below.

- Total unit weight (γ) for unclassified backfill: 130 lbs per cu ft
- Angle of internal friction (ϕ) for unclassified backfill: 20°
- Equivalent fluid pressure for unclassified backfill:
  - Active condition for walls that are free to rotate, backfilled with unclassified borrow, and fully drained: 65 lbs per sq ft per ft depth.
  - Active condition for walls that are free to rotate, backfilled with unclassified borrow, and with no provision for internal drainage: 96 lbs per sq ft per ft depth.
- Angle of internal friction (ϕ) for SM-1 backfill: 32°
- Total unit weight (γ) for SM-1: 125 lbs per cu ft
- Equivalent fluid pressure for SM-1 backfill:
  - Active condition for walls that are free to rotate, backfilled with SM-1 or clean granular backfill, and fully drained: 40 lbs per sq ft per ft depth.
  - Active condition for walls that are free to rotate, backfilled with SM-1 or clean granular backfill, and with no provision for internal drainage: 85 lbs per sq ft per ft depth.
- Nominal/ultimate sliding resistance:
  - Interaction friction angle (δ) for concrete on stable bearing stratum: 19°.
  - Interaction friction factor (tan δ) for concrete on stable bearing stratum: 0.34.
  - A resistance factor (φ) for sliding resistance: 0.8

To utilize the lower earth pressure values of the "drained" condition, positive and continuous drainage from behind walls must be provided. This may include a clean, free draining crushed stone, gravel, or granular soil zone or a geosynthetic drainage board approved by the Engineer. Drainage zones should be fully isolated from all fine-grained soils by a suitable geotextile complying with AHTD Standard Specifications Subsection 625.02, Type 2. Water should be discharged from backfill by a system of regularly-spaced, functioning weep holes or a drain pipe.

Approach Embankments

General. Fill embankments will be utilized at all bridge abutments. MSE walls will be utilized at the Hwy 18 bridge ends and the south bridge end of the Watt Street grade separation.

We understand that a nominal 3-horizontal to 1-vertical (3H:1V) configurations will be utilized for both the end and side slopes at the Watt Street north bridge end.

Geosynthetics (uniaxial geogrid) will be utilized to reinforce all embankments. Stability analyses have been performed to evaluate and verify stability of the proposed embankment sections with respect to shear strength of geogrid-reinforced embankment fill and compaction pile-improved embankment foundation soils.

Selected material (AHTD Standard Specifications Section 302, SM-1) is recommended for all retained fill where approach embankments utilize MSE walls. This includes both ends of the Hwy 18 Bridge and the south end of the Watt Street Bridge. Unclassified fill has been assumed for stability analyses of the embankment at the Watt Street north bridge end. To model the lower strength boundary of unclassified embankment fill placed for new embankments, a cohesion value of 750 lbs per sq ft and an internal friction angle (ϕ) of 0° were assumed. The *in-situ* soil properties have been modeled for use in stability analyses based on the results of the laboratory testing program and our experience with similar soils.

Stability analyses have been performed using the computer program SLOPE/W 2007[5] and a Morgenstern-Price analysis. These analyses included global stability for all walls and the end and side slopes at the north bridge end of the Watt Street grade separation. The loading conditions evaluated for the approach embankments included the following.

- End of construction condition with total stresses and normal stream pool.
- Long term condition with effective stresses.
- Seismic condition with effective stresses. As per FHWA guidelines[6] and assuming an embankment reinforced with geogrid, the analyses for the seismic condition have utilized a horizontal acceleration coefficient (k_h) value of one-half of the peak ground acceleration value, i.e., 0.34.

As noted, geosynthetic (uniaxial geogrid) internal reinforcement was considered as incorporated into the new embankment modelling and stability analyses. For the purposes of the analyses, the internal reinforcement was assumed to be structural geogrids with a Long Term Design Strength (LTSD) of 1600 lbs/foot. The geogrid reinforcement was assumed to be spaced at 2-ft vertical intervals, starting from the subgrade surface and continuing to within 2 ft of the

---

5 Slope/W 2007; GEO-SLOPE International; March 2008.

6 Design and Construction of Mechanistically Stabilized Earth Walls and Reinforced Soil Slopes – Volume II, Publication No. FHWA-NHI-10-025, FHWA, November 2009, Page 8-10.

final grade. Laterally, the reinforcement in the new embankments has been assumed to extend from one side of the slope face to the opposite slope face. Geogrid reinforcement is considered to be warranted for all embankment heights in the approaches.

Results of the stability analyses performed on various embankment sections for each structure are provided in Attachments 11, 12, and 13 for Hwy 18, Watt Street, and Wall DD, respectively. Global stability analyses for the conventional cantilevered concrete retaining walls was deemed unnecessary due to the relatively short wall heights as well as the layout of these walls. The results of the analyses indicated suitable stability for all cases analyzed.

It should be noted that some undercut will be required for wall stability, as well as for MSE bearing in some locations. Information on undercuts is discussed in the report section on retaining walls.

Embankment Settlement. Maximum embankment heights on the order of 25 to 39 ft are anticipated. Given the predominance of cohesive soils in the embankment foundations, some consolidation settlement will occur.

Based on the results of the borings and the anticipated maximum embankment height, total settlement of the natural foundation soils below the embankment is estimated to be on the order of 2 inches. Settlement of selected material (SM-1) fill in the embankments with MSE walls is expected to be minimal and to occur during construction. Settlement of embankment fill in the compacted embankment on the north end of the Watt Street grade separation is expected to be about 2 to 3 in. with 40 to 60 percent of the settlement occurring during construction.

We recommend that embankment fill be placed as early in the construction sequence as possible to limit post-construction settlement after foundation construction. It is expected that piling will be installed though casing at the bridge ends with MSE walls. This is expected to reduce downdrag loads on piles associated with embankment settlement.

Bearing and Sliding Stability – Retaining Walls

General Considerations for Bearing. As noted, MSE walls are planned at both bridge ends of the Hwy 18 grade separation (Walls AA and BB) and the south end of the Watt Street grade separation (Wall CC). In addition, an MSE retaining wall is planned on Watt Street (Wall DD). Also mentioned above, four (4) new conventional cantilever concrete walls are included within the scope of this project (Walls EE, FF, GG, and HH). Bearing capacity and sliding resistance of new retaining walls has been analyzed. A summary of recommendations related to wall bearing

Extended minimum to match the depth of undercut.

and sliding resistance is provided in Attachment 14. Considerations of bearing and global stability for Walls GG and HH were not addressed since the maximum wall height of these walls is less than 4 feet. Specific design of MSE retaining walls will be performed by Others on behalf of the Contractor. All final wall design should be reviewed by the Engineer or Department.

The suitability of the wall bearing strata must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend at least 10 ft outside the reinforced zone to the extent possible. At the wall ends (longitudinally), the undercut ~~should extend~~ beyond the reinforced zone a minimum distance determined by a 1-horizontal to 2-vertical (1H:2V) projection from the edge of the reinforced zone to the undercut bottom. Where existing structures limit the undercut extent, the undercut limits should be field verified and adjusted as needed.

We recommend that undercut backfill consist of crushed stone aggregate base (AHTD Standard Specifications Section 303, Class 7) or an approved alternate. A minimum 2 ft embedment is recommended for all MSE Walls. Deeper embedment will be required for walls higher than 20 feet. A resistance factor (φ_b) of 0.65 is recommended for bearing. A resistance factor (φ_τ) of 1.0 is recommended for evaluation of sliding resistance.

Rammed Aggregate Piers. Bearing capacity of the on-site soils is not adequate for Wall BB from about Sta 5+75 to Sta 10+00. Due to the depth of the weak and highly-compressible soil zones and the wall height, the effectiveness of undercutting will be limited as an effective method to improve bearing capacity and limit settlement. In addition to the condition at Wall BB, relatively deep undercuts will be warranted for Wall AA from about Sta 4+75 to Sta 7+50 and Wall CC at Sta 4+40 to 5+75. Consequently, a rammed aggregate pier alternative is recommended for this area as an alternative to deep undercut. Compared to the undercut and backfill alternative, using rammed aggregate piers also has the advantage of a reduced foundation soil treatment area, improved global stability, and reduced influence on existing structures.

To limit weak surface zones between the tops of rammed aggregate pier elements, a load transfer platform is recommended below the MSE wall reinforced zone and over the tops of rammed aggregate piers. The concept for the load transfer platform, as well as an example Special Provision regarding a stabilization geotextile for use in the platform, is provided in Attachment 15.

Asked by the Department to eliminate on 2017-03-27 meeting. Initially this example was provided by the Department.

The Geopier™ system is a foundation system of rammed aggregate piers. Rammed aggregate pier elements are typically constructed by drilling 30-in.-diameter holes from the MSE wall subgrade elevation and ramming thin lifts of well-graded aggregate within the holes to form very stiff, high-density aggregate piers. The wall foundation soils would be reinforced by installing rammed aggregate pier elements. The first lift of compacted aggregate backfill forms a bulb below the bottoms of the piers, thereby prestressing and prestraining the soils to an approximate depth equal to one (1) pier diameter. Subsequent lifts are typically about 12-in. thick. Ramming is performed with a high-energy beveled tamper that densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in the surrounding soil and further stiffens the stabilized composite soil mass. The result of rammed aggregate pier installation is a strengthening and stiffening of foundation soils.

Geopier™ design and construction is proprietary and provided by contractors licensed by Geopier Foundation Company, Inc. Detailed recommendations can be provided by Geopier Foundation Company when specific design concepts, wall foundation loads, and site grading plans are available. Preliminary recommendations for rammed aggregate piers are provided on the preliminary wall recommendations summary in Attachment 14. As noted, the area stabilized by rammed aggregate piers should cover the complete footprint of the MSE wall reinforced zone.

Global Stability of Retaining Walls. Stability analyses were performed to verify the global stability of the embankments utilizing retaining walls. The results of these analyses are provided in Attachments 11, 12, and 13.

Site Grading and Subgrade Preparation Considerations

Site grading and subgrade preparation should include necessary clearing and grubbing of trees and underbrush and stripping the organic-containing surface soils in work areas. Where fill depths in excess of 3 ft are planned, stumps may be left after close cutting trees to grade, as per AHTD criteria. Otherwise, the tree stumps must be completely excavated and stumpholes properly backfilled. The depth of stripping will be variable, with deeper stripping depths in the low-lying, poorly drained, and/or wooded areas, and less stripping required in the higher-terrain areas. In general, the stripping depth is estimated to be about 6 in. for open, unwooded areas, but may be 18 to 24 in. or more in wooded areas. The zone of organic surface soils must be

completely stripped in the embankment footprints. Demolition of existing pavements and some structures is also anticipated.

Following demolition, stripping and grubbing, and prior to fill placement or otherwise continuing with subgrade preparation, the extent of weak and unsuitable soils should be determined. Proof-rolling is recommended to evaluate subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Based on the results of the borings, some undercuts will be required at the bridge abutments. Anticipated undercut depths are summarized on the table provided in Attachment 14. It should be noted that the estimated undercut depths are below existing grade and are based on the results of the borings. Required as-built depth of undercut will vary with seasonal site conditions and final grading plans. As-built undercut requirements must be field verified by the Engineer or Department.

Undercuts for embankments may be backfilled with suitable embankment fill. Should excavations or deeper undercuts encounter shallow water or seepage, or if areas of seepage or seasonal springs are encountered during the work, backfill should consist of select granular fill (AASHTO M 43, #57 stone), stone backfill (AHTD Standard Specifications, Section 207), or clean aggregate (AHTD Standard Specifications Subsections 403.01 and 403.02 Class 3 mineral aggregate) extending up to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be fully encapsulated with a filter fabric complying with AHTD Standard Specifications Subsection 625.02, Type 2.

Subgrade preparation and mass undercuts should extend at least 10 ft beyond the embankment toes to the extent possible. Subgrade preparation in roadway areas should extend at least 3 ft outside pavement shoulder edges to the extent possible. Existing drainage features should be completely mucked out and all loose and/or organic soils removed prior to fill placement.

We recommend that retained fill of embankments with MSE walls consist of SM-1 selected material. Fill and backfill may consist of unclassified borrow free of organics and other

deleterious materials as per AHTD Standard Specifications Subsection 210.06. Granular soils must be protected from erosion with a minimum 24-in.-thick armor of clayey soil with a PI in the range of 5 to 18. We recommend that all conventional cantilevered walls be backfilled with Select Granular Fill (AASHTO M 43, #57 stone) or an approved alternate. All fill in the MSE reinforced zone must comply with the Designer's specifications and should be approved by the Engineer or Department.

Subgrade preparation should comply with AHTD Standard Specifications Section 212. Embankments should be constructed in accordance with AHTD criteria (AHTD Standard Specifications, Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Where fill is placed against existing slopes, short vertical cuts should be "notched" in the existing slope face to facilitate bonding of horizontal fill lifts. The in-place density and water content should be determined for each lift of backfill and fill and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the project to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the embankments and bridge work is completed. Subgrade soils that become saturated by ponding water or runoff should be excavated to undisturbed soils. The embankment subgrade should be evaluated by the Engineer during subgrade preparation.

Groundwater was encountered at 13 to 25 ft at the time of the field studies in February to June 2016. Nevertheless, shallow perched groundwater could be encountered in shallow excavations. Seepage into shallow excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage into excavations becomes a problem, backfill should consist of (AASHTO M 43, #57 stone), stone backfill (AHTD Standard Specifications Section 207), or clean aggregate (AHTD Standard Specifications Subsections 403.01 and 403.02 Class 3 mineral aggregate) to an elevation above the inflow of seepage. In areas of seepage infiltration,

the granular fill should be fully encapsulated with a filter fabric complying with AHTD Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge.

Piling

Piles should be installed in compliance with AHTD Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Driving records should be available for review by the Engineer or Department during pile installation. Compatible driving equipment should be utilized based on the results of drivability analyses performed by the Department. Blow counts on steel piles should be limited to about 20 blows per inch. As-built pile capacities should be evaluated by use of wave equation analysis of piles (WEAP) in accordance of AHTD Standard Specifications, Section 805.09, Method B.

The Piling Contractor should have demonstrable experience in installing steel shell piles of similar sizes in subsurface conditions similar to those at this site. The Contractor should have appropriate equipment with sufficient jetting pressure/flow rate and adequate hammer energy to install piles to the plan tip elevation.

CLOSURE

The Engineer, Department, or a designated representative thereof should monitor site preparation, grading work, ground improvements, and all foundation and embankment construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this submittal.

Attachment 1	Site Vicinity Map, Plans of Borings Subsurface Exploration, Key to Terms and Symbols
Attachment 2	Hwy 18 Grade Separation Boring Logs
Attachment 3	Watt Street Grade Separation Boring Logs
Attachment 4	Wall Boring Logs
Attachment 5	Roadway Boring Logs
Attachment 6	Laboratory Test Results
Attachment 7	Results of Liquefaction Analyses
Attachment 8	Hwy 18 - Nominal Single Pile Capacity Curves
Attachment 9	Watt Street - Nominal Single Pile Capacity Curves
Attachment 10	Driveability Analyses Results
Attachment 11	Stability Analyses Results – Hwy 18 Grade Separation
Attachment 12	Stability Analyses Results – Watt Street Grade Separation
Attachment 13	Stability Analyses Results – Wall DD
Attachment 14	Summary of Preliminary Wall Recommendations
Attachment 15	Concept for Load Transfer Platform

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance during final design or construction, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, INC.

Dillon G. Goins, P.E.
Project Engineer

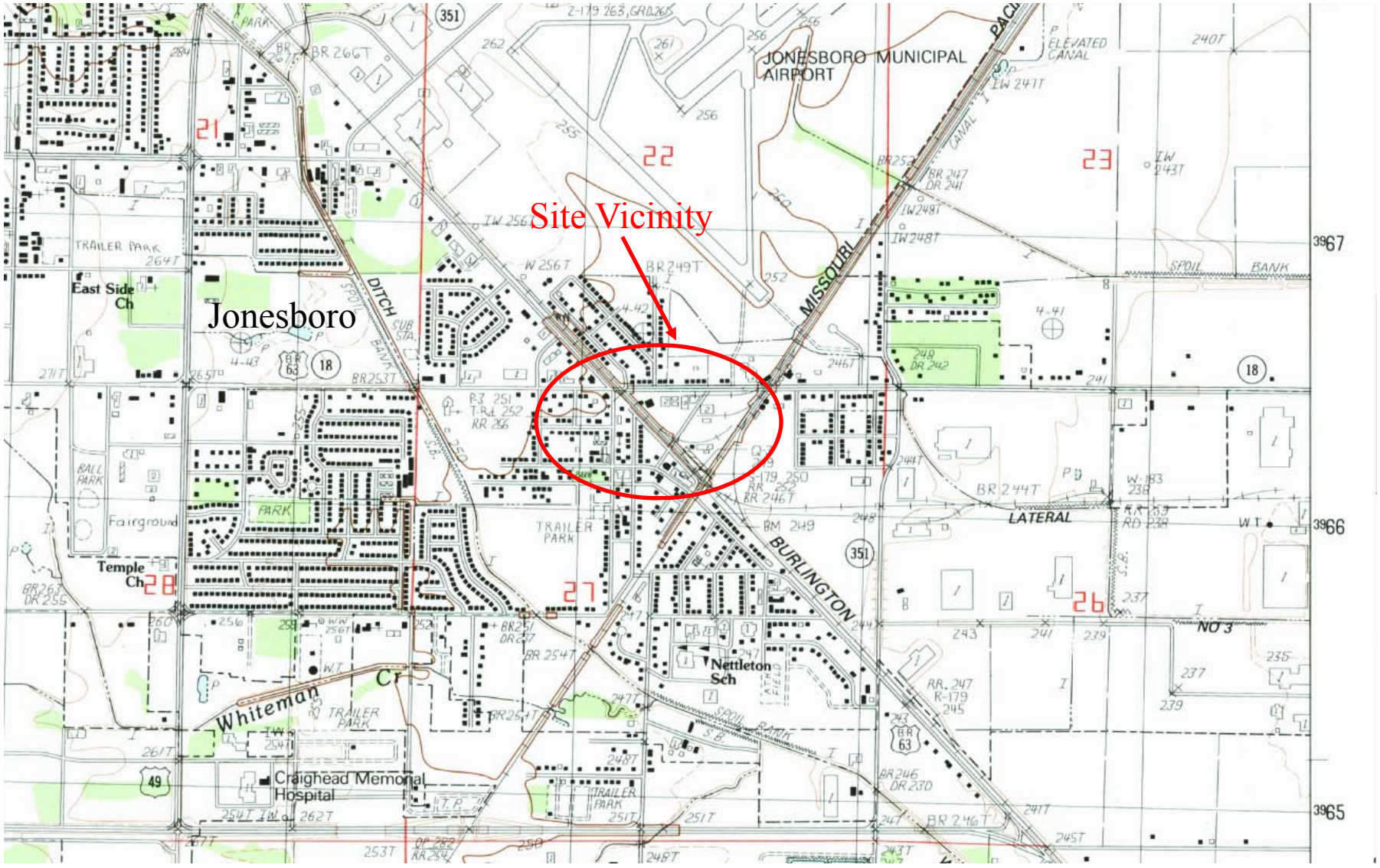
Mark E. Wyatt, P.E.
President

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

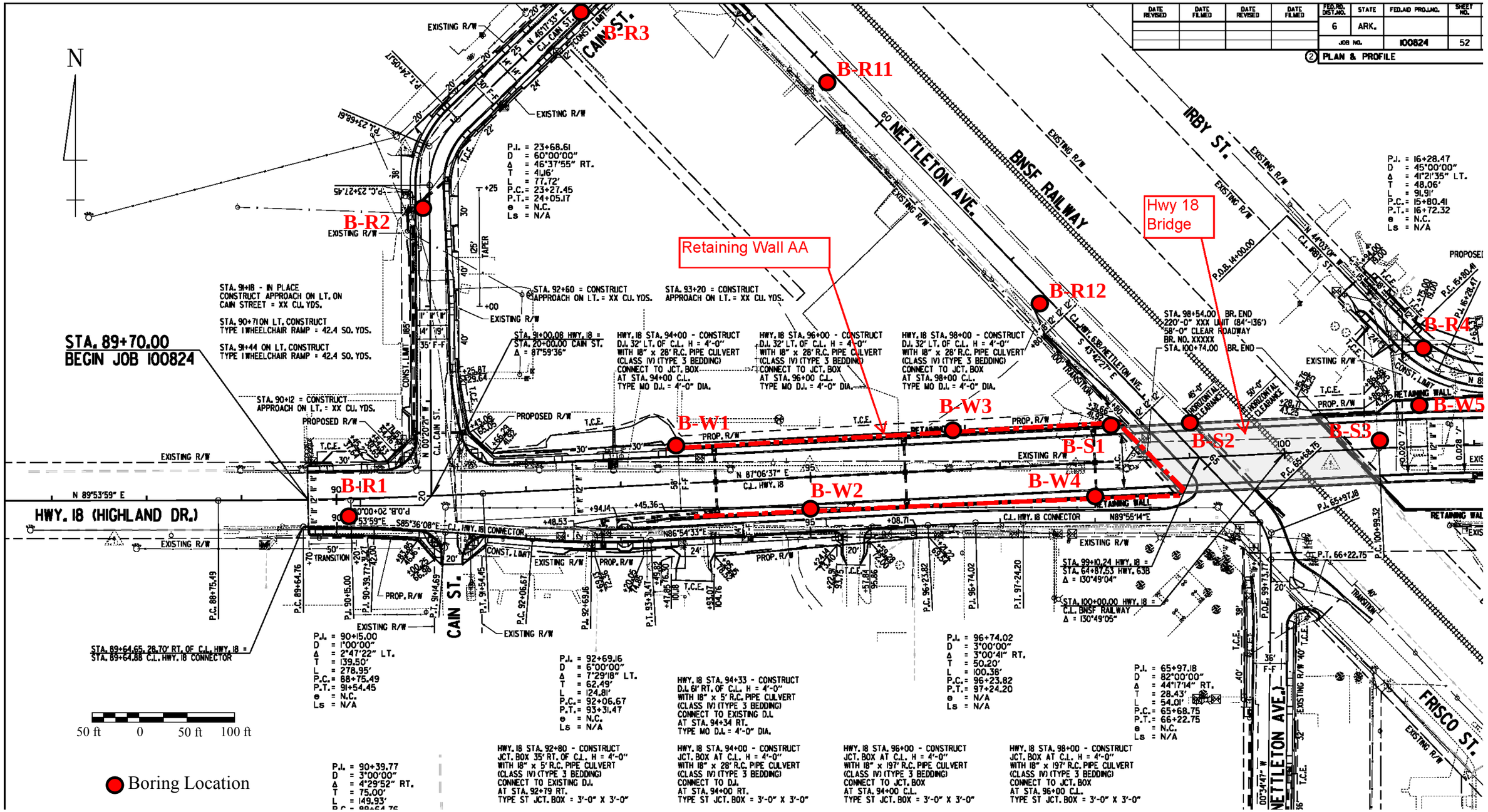
DGG/MEW:jw

Copies Submitted: Bridgefarmer & Associates, Inc.
Attn: Mr. Shahriar Azad, P.E. (1+electronic)
Attn: Mr. Stephen Smiley, P.E. (1-electronic)

ATTACHMENT 1



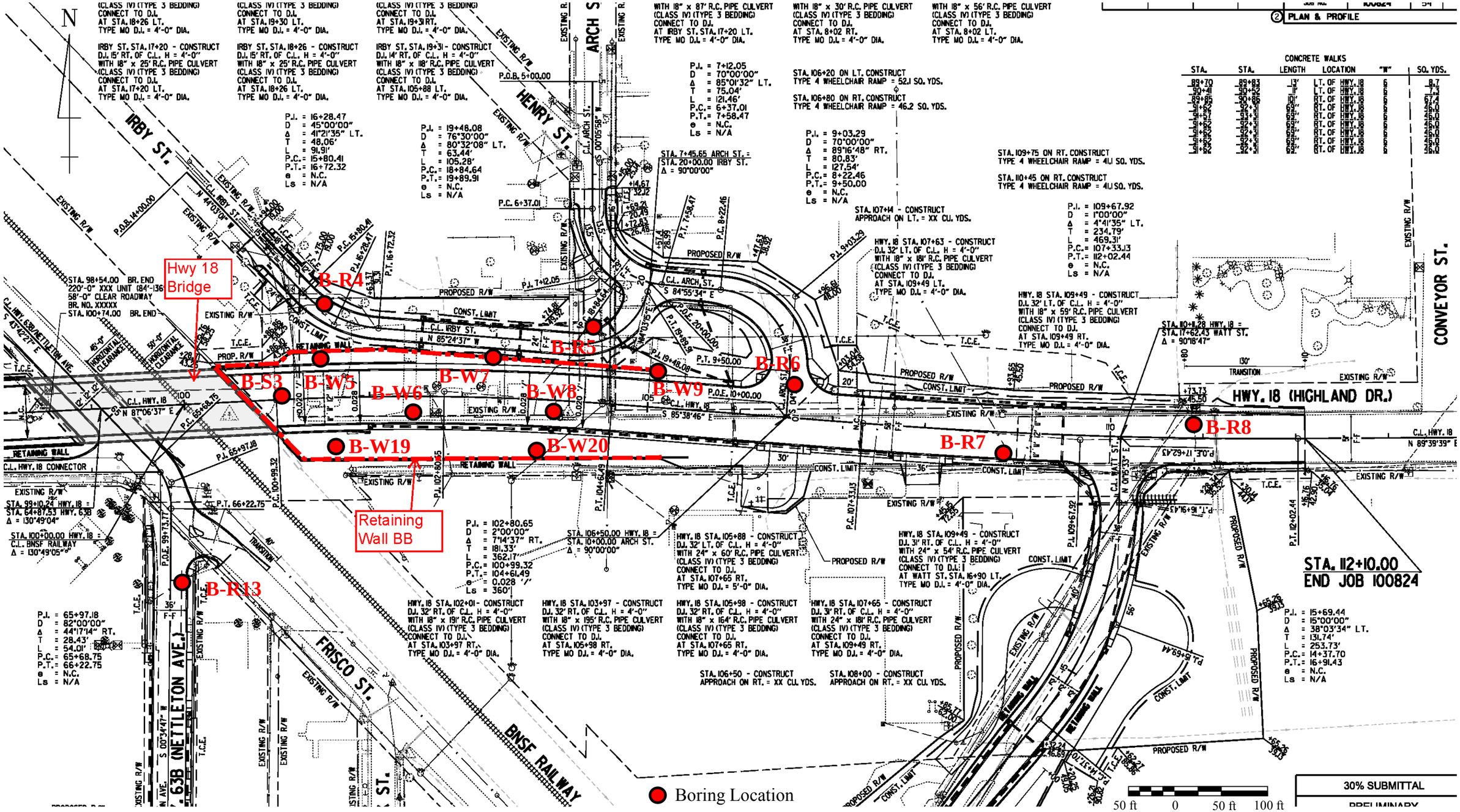
Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**Site Vicinity Map** **AHTD Job No. 100824 –BNSF Railroad Overpass** **Jonesboro, Craighead County, Arkansas**	**Job No. 16-022**	**Plate 1**



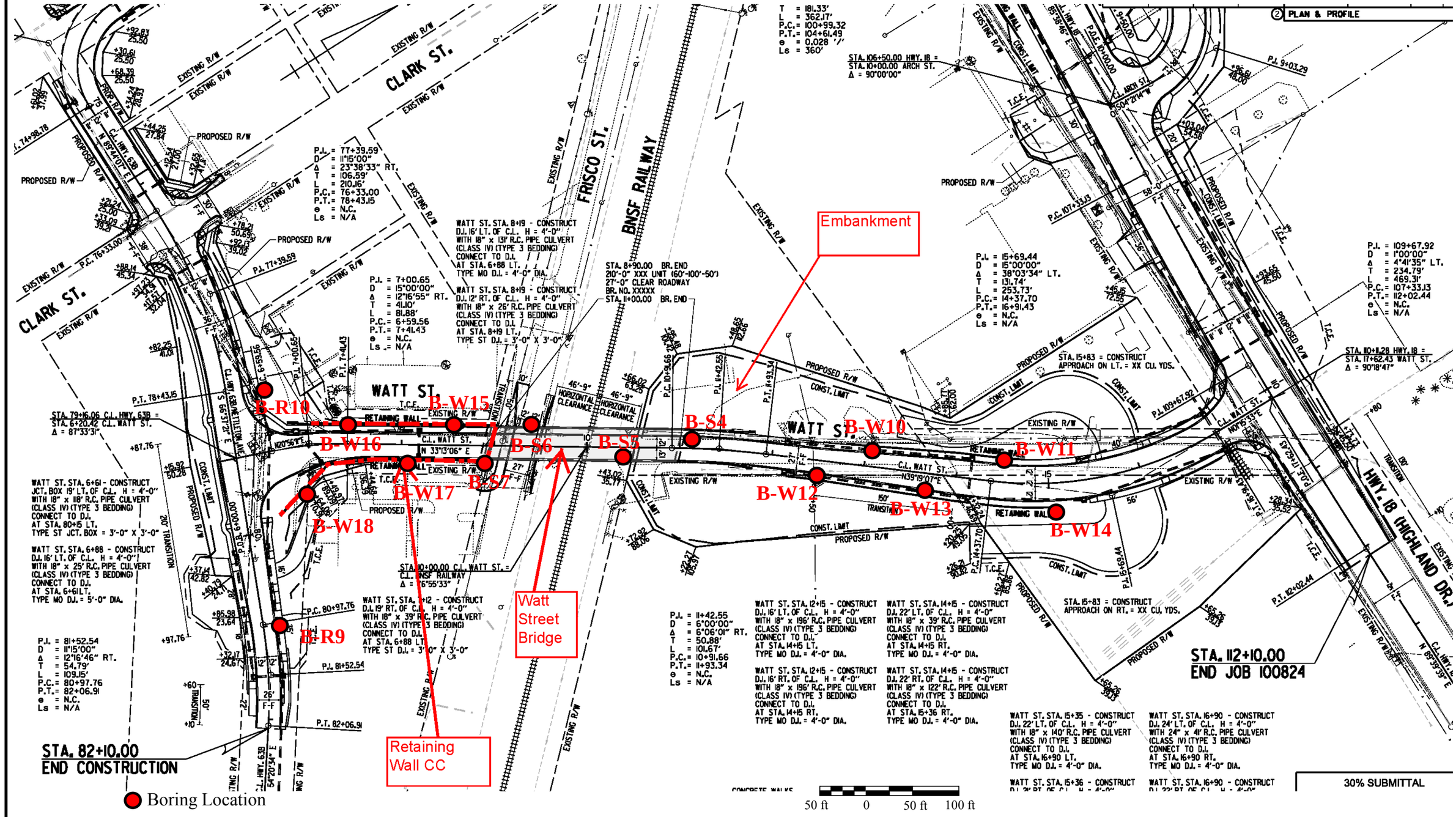
DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.
				6	ARK.		
				JOB NO.	100824		52

② PLAN & PROFILE

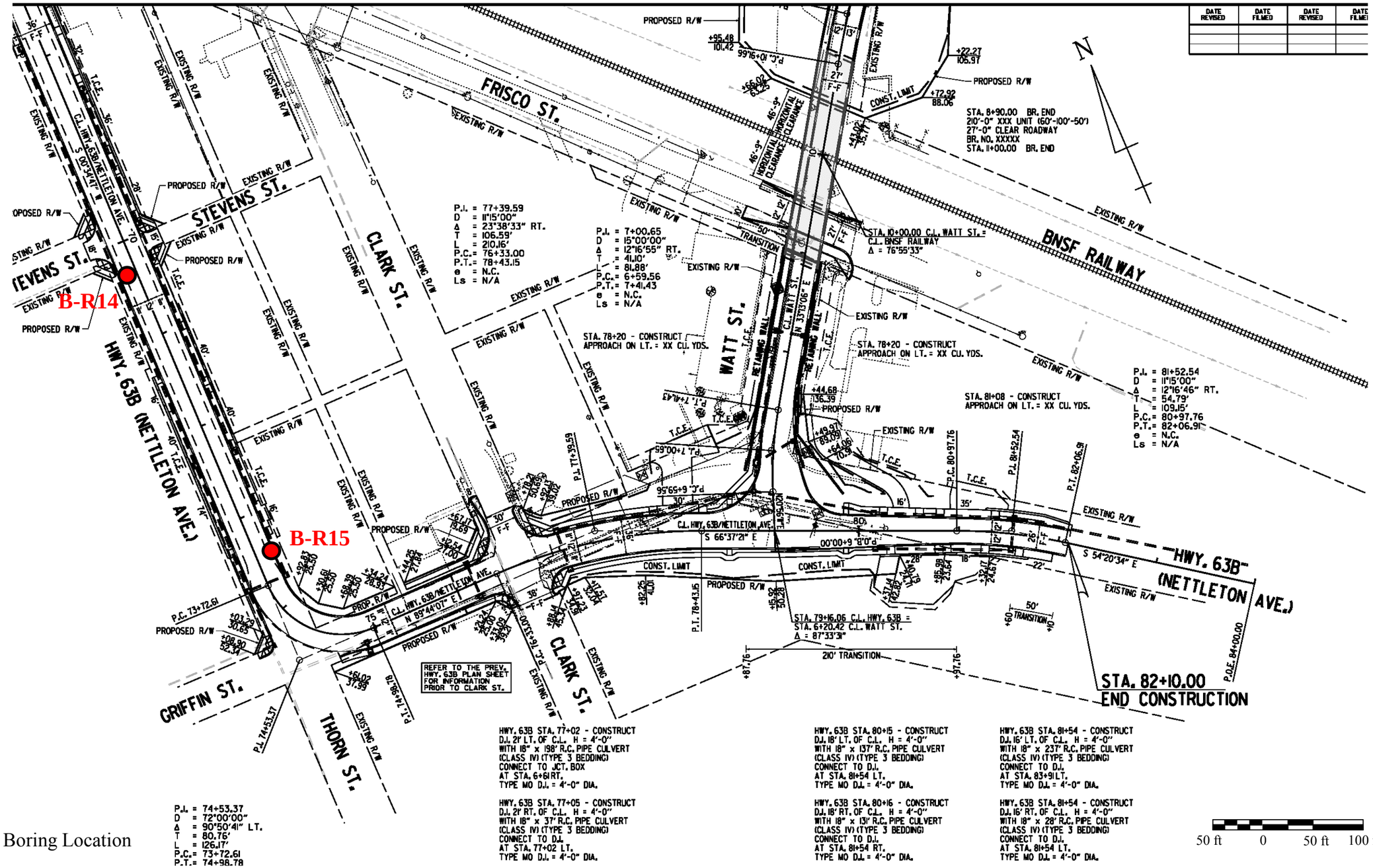
Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN of BORINGS** **AHTD Job No. 100824 – BNSF RR Overpass (HWY 18) (JONESBORO)(PE)** **Jonesboro, Craighead County, Arkansas**	**Scale: As Shown** **Date: August 2016**	**Job No. 16-022**	**PLATE 2**



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN of BORINGS** **AHTD Job No. 100824 – BNSF RR Overpass (HWY 18) (JONESBORO)(PE)** **Jonesboro, Craighead County, Arkansas**	**Scale: As Shown** **Date: August 2016**	**Job No. 16-022**	**PLATE 3**



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN of BORINGS** **AHTD Job No. 100824 – BNSF RR Overpass (HWY 18) (JONESBORO)(PE)** **Jonesboro, Craighead County, Arkansas**	**Scale: As Shown** **Date: August 2016**	**Job No. 16-022**	**PLATE 4**



DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

PLAN of BORINGS
AHTD Job No. 100824 – BNSF RR Overpass (HWY 18) (JONESBORO)(PE)
Jonesboro, Craighead County, Arkansas

Scale: As Shown

Date: August 2016

Job No. 16-022

PLATE 5

SUBSURFACE EXPLORATION SUMMARY

PROJECT: AHTD Job 100824 -BNSF Railroad Overpass
LOCATION: Jonesboro, AR
GHBW JOB No.: 16-022

Boring No.	CL Station	Offset from CL, ft		Approx Surface El, ft	Boring Completion Depth, ft
S1	98+25	35	LT	253	150
S2	99+10	35	LT	253	100
S3	101+05	5	LT	253	170
S4	11+00	15	LT	252	149
S5	10+50	20	RT	252	159
S6	9+40	20	LT	251	150
S7	8+90	20	RT	250	100
W1	93+60	35	LT	255	20
W2	95+00	30	RT	255	20
W3	96+50	40	LT	254	20
W4	98+00	35	RT	254	20
W5	101+50	45	LT	252	20
W6	102+45	20	RT	253	20
W7	103+40	40	LT	252	20
W8	104+00	15	RT	251	20
W9	105+10	40	LT	252	20
W10	13+10	15	LT	250	20
W11	14+50	25	LT	250	20
W12	12+50	20	RT	250	20
W13	13+65	25	RT	250	20
W14	15+10	30	RT	250	20
W15	8+55	25	LT	250	20
W16	7+35	25	LT	250	20
W17	8+00	20	RT	250	20
W18	6+95	50	RT	251	20
W19	101+65	50	RT	252	20
W20	103+70	55	RT	252	20

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

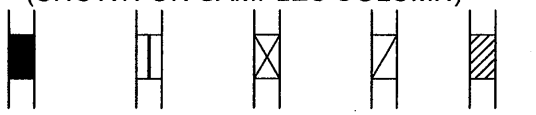
(SHOWN IN SYMBOLS COLUMN)

Gravel Sand Silt Clay

Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



Shelby Tube | Rock Core | Split Spoon | No Recovery | Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

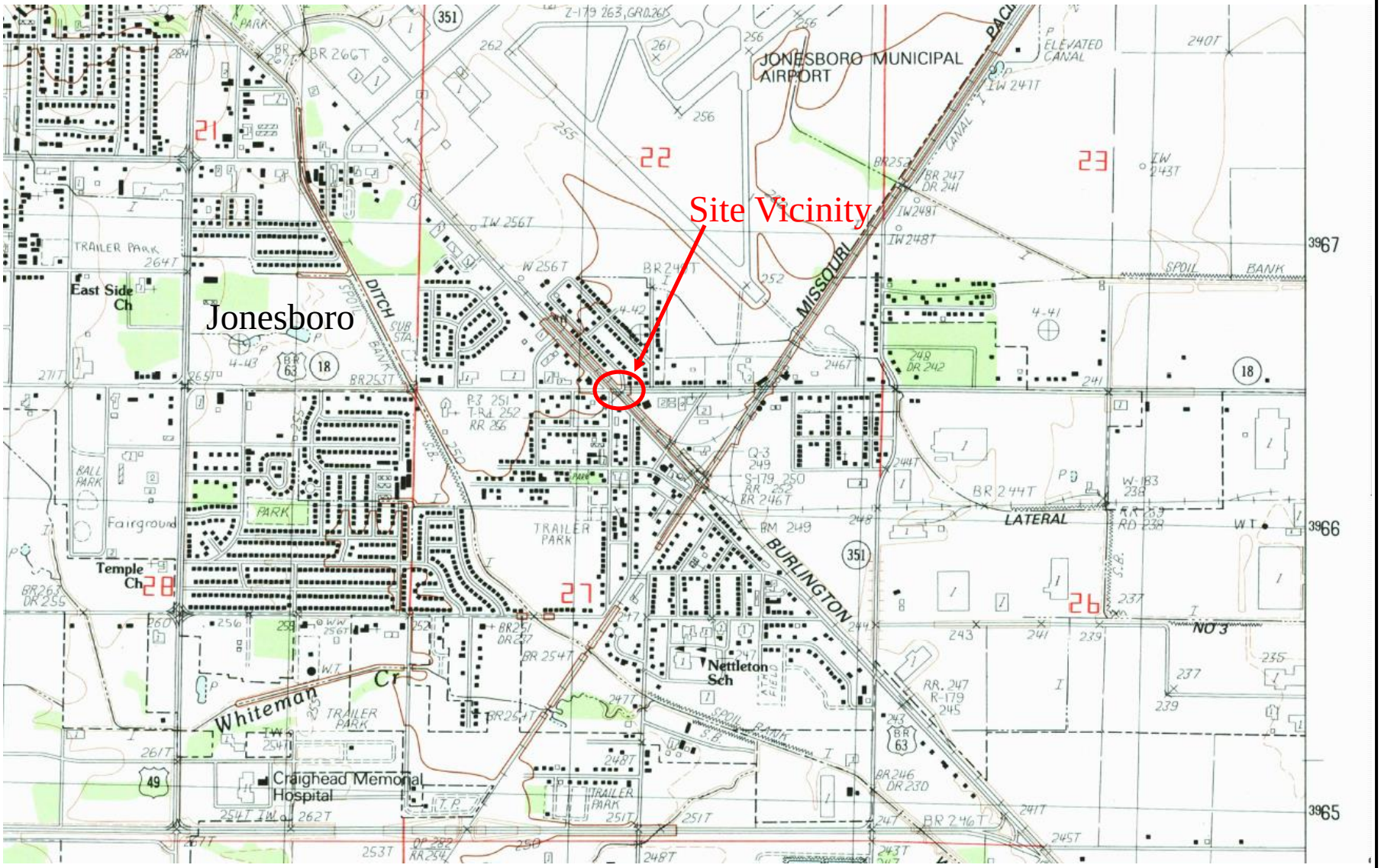
TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

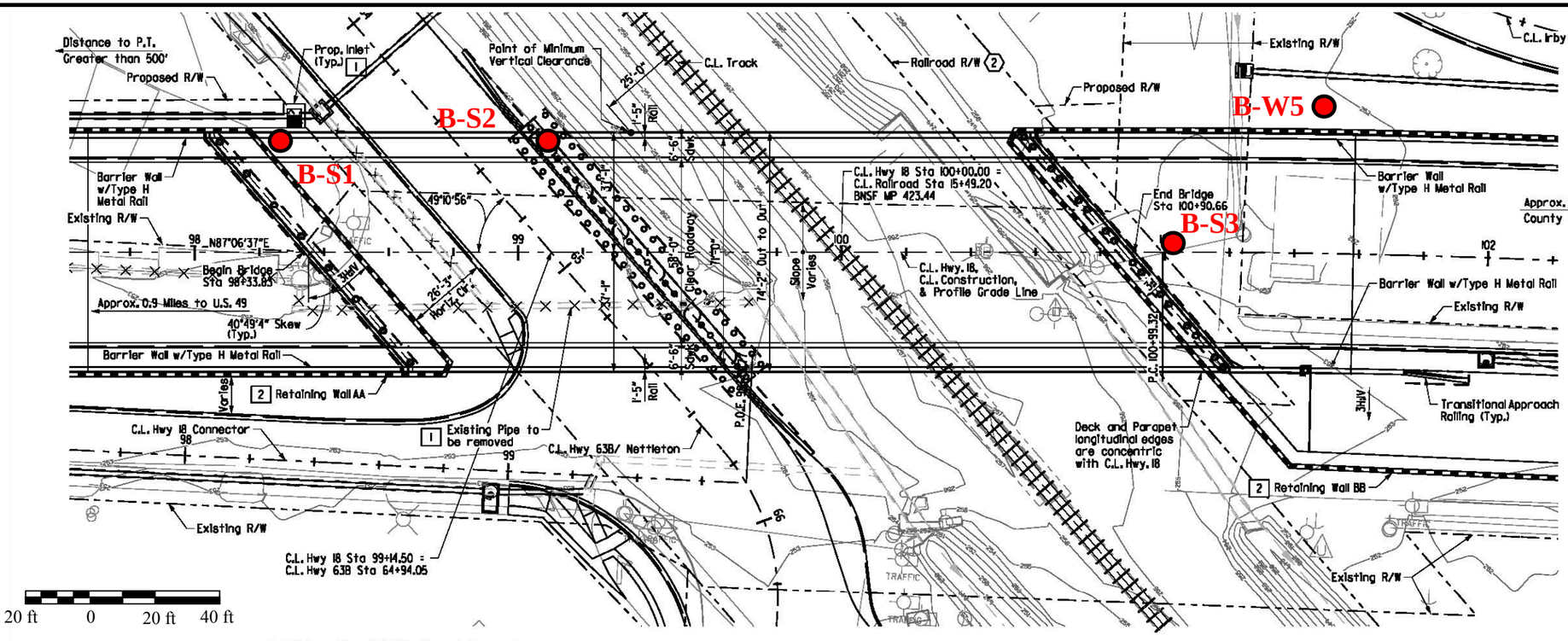
Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 6-30-10

ATTACHMENT 2



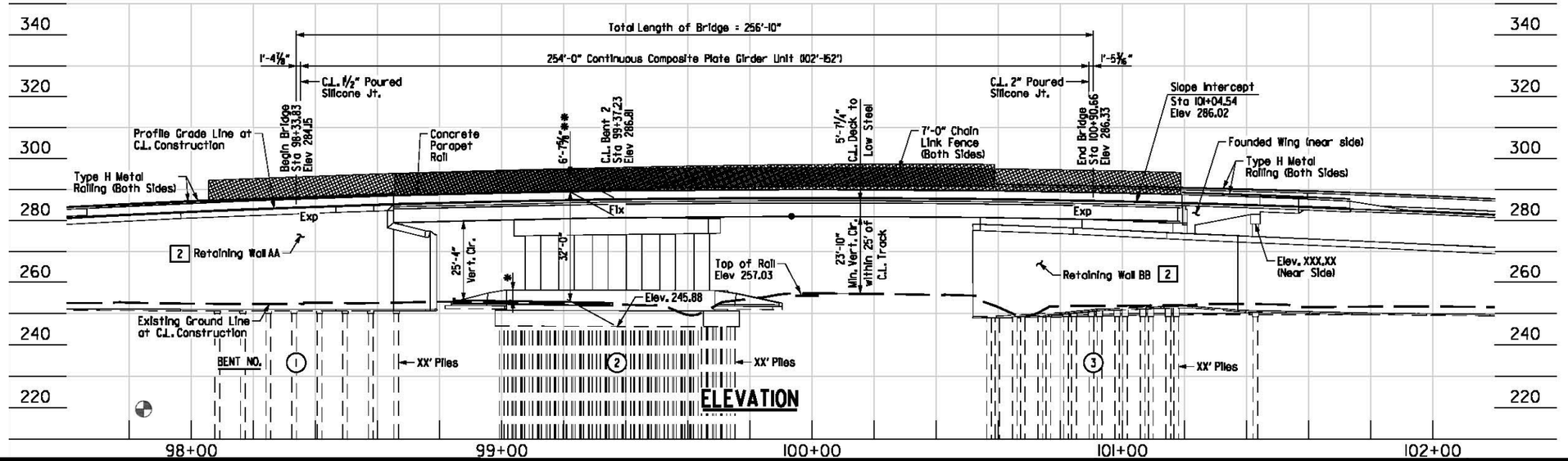
Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**Site Vicinity Map** **AHTD Job No. 100824 - Hwy 18 over BNSF Railroad** **Jonesboro, Craighead County, Arkansas**	**Job No. 16-022**	**Plate 1**

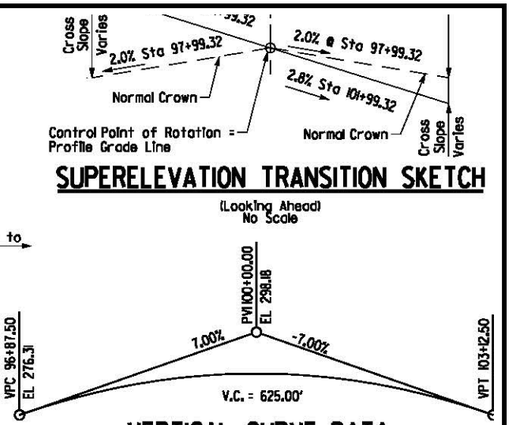


Boring Location

* 54" from Top of Wall to Top of Pavement
** Top of Deck @ C.L. Bent @ C.L. Construction to Low Side Top of Cap

PLAN





VERTICAL CURVE DATA

(Along Profile Grade)

NOTES:

1. C.L. Construction and respective PGL is coincident with C.L. Hwy. 18.
2. All longitudinal edges of deck and approaches are concentric to C.L. Hwy. 18 unless noted otherwise.
3. All Bents are parallel to each other.
4. See Project Bridge General Notes Dwg. No. XXXX2

1 See Roadway Plans

2 See Retaining Wall Plans

(1) BNSF Railroad R/W map segment 1001 Craighead County

(2) The plat of Irby resubdivision, recorded in the Craighead County circuit clerks office plat book J page 52 and plat book A page 152.

DETAIL DRAWINGS:	DRAWING NO.:
End Bents	
Intermediate Bent	
254' Cont. Comp. Plate Girder Unit	
Silicone Joints	
Elastomeric Bearings	
Type Special Approach Slabs (1-2)	
Concrete Barrier Wall	
Type H Metal Bridge Railing	
Transitional Approach Railing	
Concrete Filled Steel Shell Piles	55021
Concrete Riprap	55002

GEOTECHNICAL INFORMATION PENDING

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

LAYOUT OF HWY. 18 BRIDGE OVER BNSF RAILROAD

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (PE)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY:	AKH	DATE:	MAR2016	FILENAME:	FileName
CHECKED BY:	JH	DATE:	MAR2016	SCALE:	1" = 20'
DESIGNED BY:	KH	DATE:	MAR2016		

BRIDGE NO. XXXXX DRAWING NO. XXXXX

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

PLAN of BORINGS
AHTD Job No. 100824 – Hwy 18 over BNSF Railroad
Jonesboro, Craighead County, Arkansas

Scale: As Shown

Date: August 2016

Job No. 16-022

PLATE 2

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S1

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 98+25, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 253±				
			Firm to stiff reddish brown fine sandy clay w/some fine to coarse gravel, moist - firm below 2 ft	10 8			
5			Loose gray and reddish brown clayey fine sand w/fine to coarse gravel and occasional fine sandy clay pockets	4 4			27
10				4			
15			Stiff gray clayey silt w/occasional fine sandy silt pockets	16			99
20			Stiff tan and olive gray silty clay w/some silt pockets	20			99
25			Stiff tan and olive gray silty clay - water at 25 ft	13	99		99
30							
35			- slightly sandy below 33 ft				
40				13			
45			Stiff tan and gray clayey silt, slightly sandy	16			
50			Stiff reddish tan and gray silty clay w/some silt seams and layers and occasional fine sand partings	16			

COMPLETION DEPTH: 150.0 ft
DATE: 6-7-16

DEPTH TO WATER IN BORING: 25 ft

DATE: 6/7/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S1

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 98+25, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
60			- slightly sandy below 58 ft	17			88
65			Stiff tan and reddish brown silty clay w/occasional silty clay pockets				
70				16			98
75			Dense reddish tan and gray fine sandy silt, slightly clayey w/ferrous stains				
80				50/9"			60
85			Stiff to very stiff reddish tan and gray silty clay w/occasional silt pockets and seams and ferrous nodules and stains				
90				24			97
95							
100			- with some clay pockets below 98 ft	26			99
105			Medium dense gray fine sandy silt w/interbedded clay pockets				
				28			53

COMPLETION DEPTH: 150.0 ft
DATE: 6-7-16

DEPTH TO WATER IN BORING: 25 ft

DATE: 6/7/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S1

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 98+25, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
115							
120			- with occasional organic inclusions and more clay pockets below 118 ft	34			
125			Dense gray silty fine sand w/occasional silty clay pockets and organic inclusions				
130				39			
135			- medium dense, tan and gray at 133 ft				
140			- with occasional fine gravel below 140 ft	16		-NON-PLASTIC-	46
145			Dense tan and reddish tan fine to coarse sand, slightly silty w/trace fine gravel				
150				40			14
155							
160							

COMPLETION DEPTH: 150.0 ft
DATE: 6-7-16

DEPTH TO WATER IN BORING: 25 ft

DATE: 6/7/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S2

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 99+10, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 253±				
			10 inches: Asphalt Concrete				
			6 inches: Aggregate Base				
			Soft brown, tan and gray silty clay w/some silty clay pockets and seams (fill)	6			88
5				4			97
			Soft reddish tan and brownish gray silty clay w/some ferrous stains and nodules		103		99
10			- very stiff below 7 ft	17			99
			Stiff tan and brownish gray silty clay w/some silt pockets and seams and some ferrous stains and nodules				95
15							
			- moist below 18 ft				
20							
			Stiff reddish tan clayey silt w/some silty clay pockets and seams	14			
25							
			- reddish tan and grayish brown below 28 ft	11			100
30							
			- with occasional clay pockets and ferrous stains and nodules below 33 ft	19			
35							
				18			
40							
			Dense tan and gray fine sandy silt, slightly clayey	50/10"			60
45							
			Stiff gray and tan silty clay w/occasional fine sandy clay pockets	19			64
50							

COMPLETION DEPTH: 100.0 ft
DATE: 3-4-16

DEPTH TO WATER IN BORING: 15 ft

DATE: 3/4/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S2

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 99+10, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
60				23			
65			Stiff reddish tan and gray silty clay w/clay pockets and ferrous stains and nodules				
70				19			90
75							
80			- more clay pockets below 78 ft	18			
85			Dense tan and reddish tan fine to coarse sand, slightly silty w/some fine to coarse gravel and occasional clay pockets				
90				50/10"			7
95							
100			- with silty clay seams and layers below 98 ft	50/9"			
105							

COMPLETION DEPTH: 100.0 ft
DATE: 3-4-16

DEPTH TO WATER IN BORING: 15 ft

DATE: 3/4/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S3

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 101+05, 5 ft Lt

SURF. EL: 253±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	5 inches: Asphalt Concrete	35		
	Dense reddish brown clayey fine to medium sand w/some fine to coarse gravel (fill)	22		
5	Stiff reddish tan and gray clay, slightly silty w/some ferrous stains and nodules		102	99
		14		
	- with occasional silt pockets and clay pockets below 6 ft			98
10	Stiff reddish tan and gray clay w/some silt pockets and seams an ferrous stains and nodules			
15	- firm to stiff at 14 - 15 ft	10		
	- water at 17.5 ft			
	- firm at 18 to 23 ft		90	99
20				
25	- stiff, slightly silty with a little fine to coarse gravel below 23 ft	15		
	Firm to stiff tan and gray silty clay w/some clay pockets and ferrous stains and nodules		94	98
30	- stiff below 32 ft			
35		14		
40		14		
45		15		
	Stiff gray silty clay, slightly sandy w/occasional organic stains			
50		24		
55				
	- very stiff below 58 ft	31		85

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70

COMPLETION DEPTH: 170.0 ft
DATE: 6-8-16

DEPTH TO WATER IN BORING: 17.5 ft

DATE: 6/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S3

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 101+05, 5 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
65			Very stiff tan and gray silty clay				
70				30			97
75							
80			- more silty below 78 ft	25			
85							
90			- very stiff to hard below 88 ft	50/7"			96
95							
100				50/8"			
			Stiff tan silty clay, slightly sandy				
105							
110				17			89
115			Medium dense gray fine sandy silt				
				16			53

COMPLETION DEPTH: 170.0 ft
DATE: 6-8-16

DEPTH TO WATER IN BORING: 17.5 ft

DATE: 6/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S3

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 101+05, 5 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
125			Dense gray silty fine sand w/ occasional clay pockets				
130				38			
135			Dense tan fine to medium sand				
140				36			10
145			- with trace fine gravel below 145 ft				
150				40			
155			Dense to very dense tan and brownish yellow fine to coarse sand w/ fine to coarse gravel, slightly silty				
160				50/7"			11
165			- dense below 165 ft				
170				37			
175							

COMPLETION DEPTH: 170.0 ft
DATE: 6-8-16

DEPTH TO WATER IN BORING: 17.5 ft

DATE: 6/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W5

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

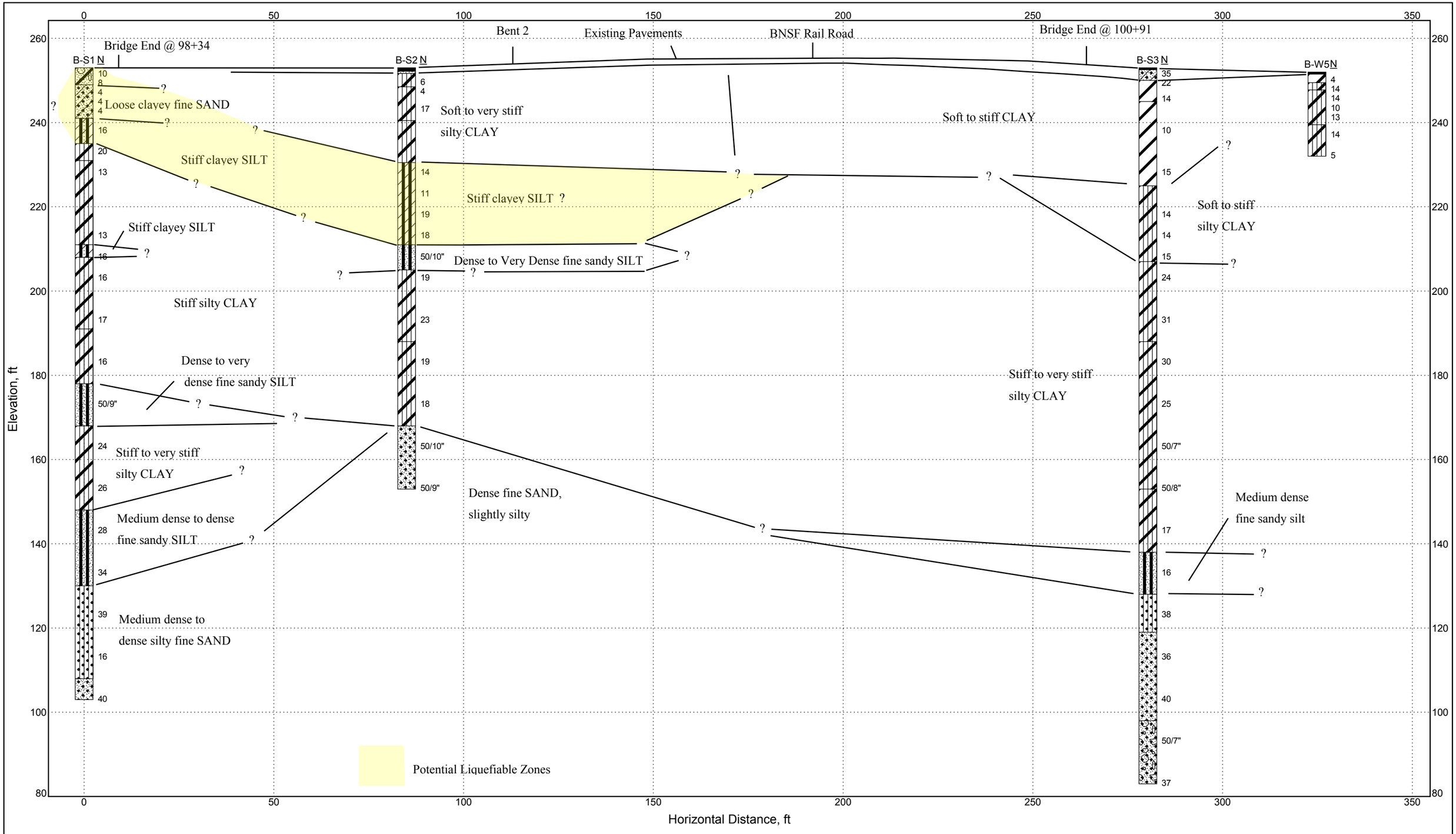
LOCATION: Approx Sta 101+50, 45 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			6 inches: Asphalt Concrete				
			Soft tan and olive gray clay w/organic stains	4			99
			Stiff tan and gray silty clay	14			
5			Stiff reddish tan, gray and tan silty clay w/clay pockets and ferrous stains and nodules	14			97
			- firm to stiff at 6.5 to 8.5 ft	10			98
			- stiff below 8.5 ft	13			
10							
			Stiff gray, tan and reddish tan silty clay w/occasional silt pockets and organic stains	14			96
15							
			- soft, gray and reddish tan below 17.5 ft				
			- water at 19 ft	5			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016



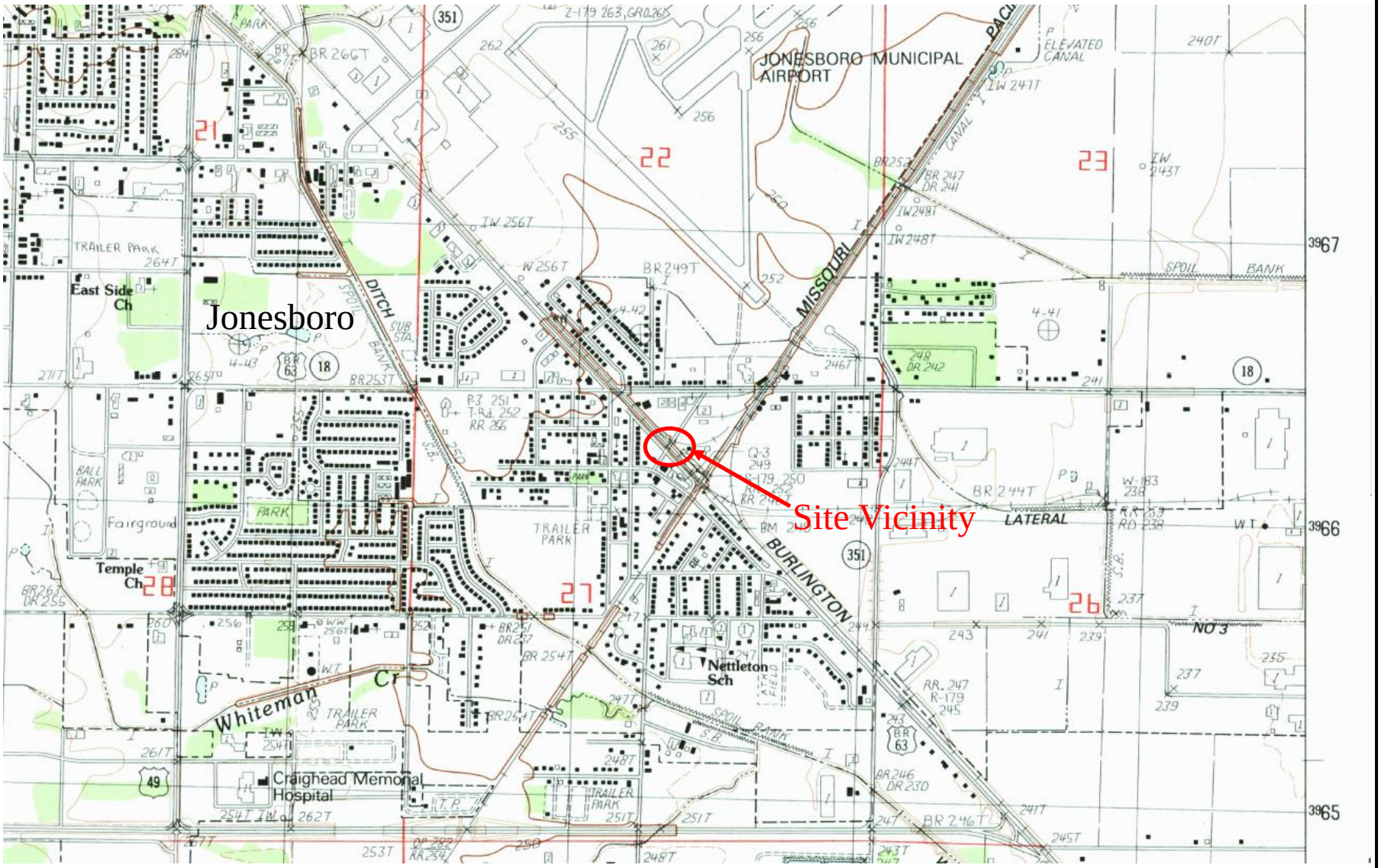
Grubbs, Hoskyn,
Barton & Wyatt, Inc.

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

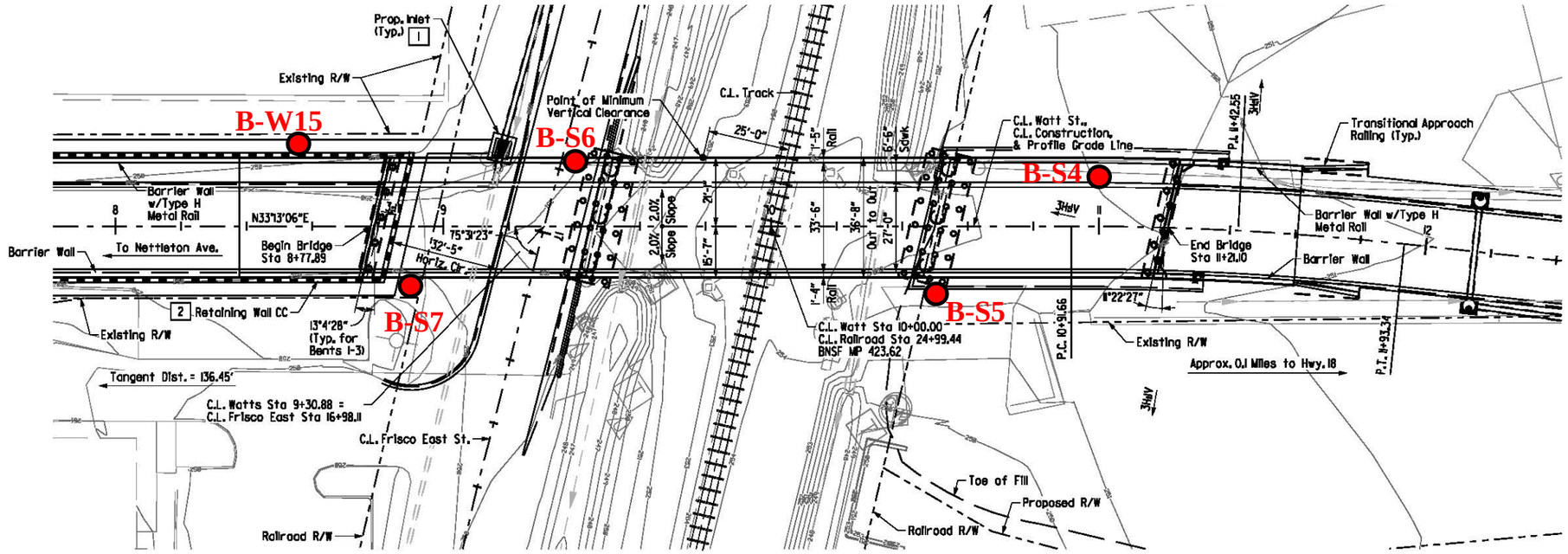
Scale: As Shown

Generalized Subsurface Profile
100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas
Project Number: 16-022

ATTACHMENT 3



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**Site Vicinity Map** **AHTD Job No. 100824 – Watt St over BNSF Railroad** **Jonesboro, Craighead County, Arkansas**	**Job No. 16-022**	**Plate 1**



PLAN

* 54" from Top of Wall to Top of Pavement

** Top of Deck @ C.L. Bent @ C.L. Construction to Low Side Top of Cap

4. See Project Bridge General Notes Dwg. No. XXXXZ

1 See Roadway Plans

2 See Retaining Wall Plans

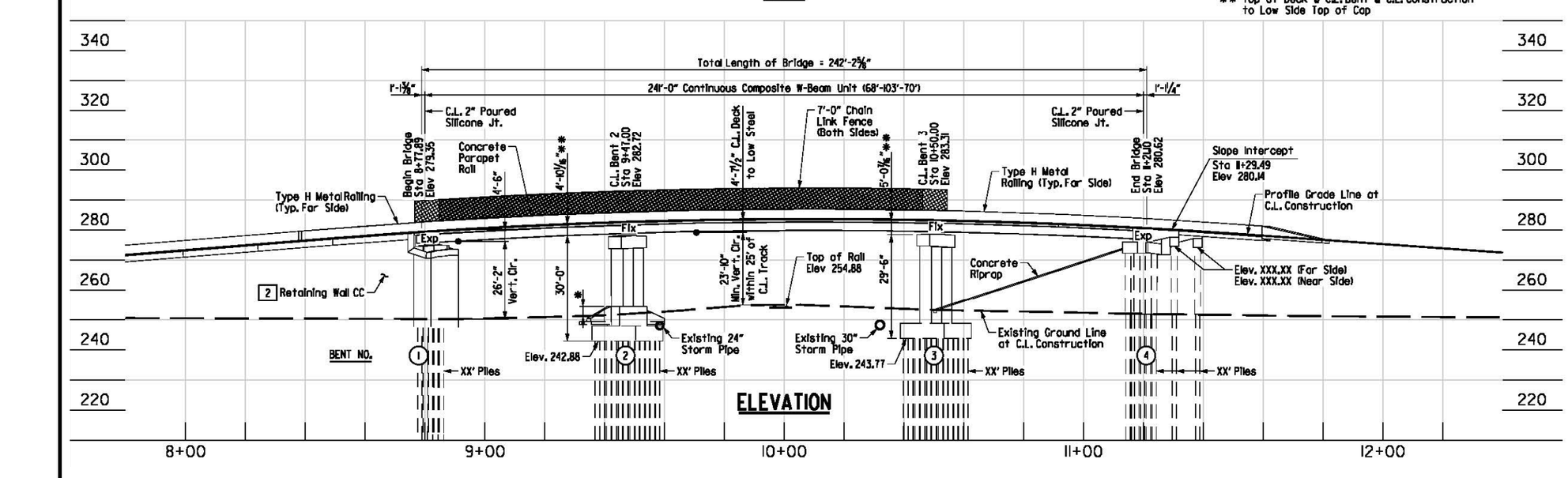
DETAIL DRAWINGS:	DRAWING NO.:
End Bents	
Intermediate Bents	
24I' Cont. Comp. Plate Girder Unit	
Silicone Joints	
Elastomeric Bearings	
Type Special Approach Slabs (3-4)	
Concrete Barrier Wall	
Type H Metal Bridge Railing	
Transitional Approach Railing	
Concrete Filled Steel Shell Piles	55021
Concrete Riprap	55002

Horizontal Curve C.L. Watts St.

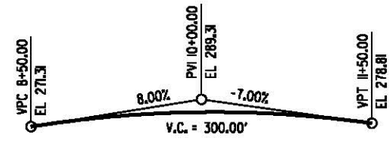
PI Sta	= 7+00.65
Delta	= 15°0'0"
Degree	= 12°16'55"
Tangent	= 41.10'
Length	= 81.88'
Radius	= 381.97'
PC Sta	= 6+59.56
PT Sta	= 7+41.43
PC Brg	= N 20°56'8"E
PT Brg	= N 33°13'06"E

Horizontal Curve C.L. Watts St.

PI Sta	= 11+42.55
Delta	= 6°0'0"
Degree	= 6°06'01"
Tangent	= 50.88'
Length	= 101.67'
Radius	= 954.93'
PC Sta	= 10+91.66
PT Sta	= 11+93.34
PC Brg	= N 33°13'06"E
PT Brg	= N 39°19'07"E



ELEVATION



VERTICAL CURVE DATA
(Along Profile Grade)

GEOTECHNICAL INFORMATION PENDING

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

LAYOUT OF WATT ST. BRIDGE OVER BNSF RAILROAD

BNSF RAILROAD OVERPASS (HWY 18) (JONESBORO) (PE)
CRAIGHEAD COUNTY
ROUTE 18 SECTION 4

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY:	AKH	DATE:	MAR2016	FILENAME:	FileName
CHECKED BY:	JH	DATE:	MAR2016	SCALE:	1" = 20'
DESIGNED BY:	KH	DATE:	MAR2016		

BRIDGE NO. XXXXX

DRAWING NO. XXXXX

● Boring Location

20 ft 0 20 ft 40 ft

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

PLAN of BORINGS
AHTD Job No. 100824 – Watt St over BNSF Railroad
Jonesboro, Craighead County, Arkansas

Scale: As Shown

Date: August 2016

Job No. 16-022

PLATE 2

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W12

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger LOCATION: Approx Sta 12+50, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			5.5 inches: Asphalt Concrete				
			Medium dense reddish brown clayey fine to coarse gravel (Aggregate Base)	22			
			Stiff brown and gray clay w/ferrous stains	11			98
5			Stiff tan and gray silty clay w/clay pockets and silt pockets and ferrous stains	18			
10					104		99
			- with fewer clay pockets below 13 ft	23			
15							
			Stiff gray and tan silty clay w/silt seams and layers - water at 17.8 ft	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-22-16

DEPTH TO WATER IN BORING: 17.8 ft

DATE: 3/22/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S4

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 11+00, 15 ft Lt

SURF. EL: 252±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	12 inches: Crushed Stone	20		
	Firm tan and reddish tan clay, slightly silty w/some silt pockets and ferrous stains and nodules	9		97
5	Firm to stiff reddish tan and gray silty clay w/occasional silt pockets and ferrous stains	10		
	- stiff below 6 ft	12		
10			105	99
	- water at 13 ft			
15	- slightly sandy with some silt pockets and seams and more ferrous stains and nodules below 13 ft	14		
20	Stiff tan, gray and reddish tan silty clay w/occasional silt pockets and ferrous stains and nodules		94	93
25	- with occasional organic stains below 24 ft	14		
30	- firm, tan and brownish gray below 28 ft		96	99
35	- stiff below 33 ft	12		
40	- slightly sandy below 38 ft			
45	Medium dense gray, tan and reddish brown clayey fine sand w/occasional silt pockets and clay pockets and fine to coarse gravel and ferrous stains and nodules, moist	14		33
50	Stiff reddish tan and gray clayey silt w/some ferrous stains	14		52

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

COMPLETION DEPTH: 149.0 ft
DATE: 6-9-16

DEPTH TO WATER IN BORING: 13 ft

DATE: 6/9/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S4

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 11+00, 15 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
60			Stiff gray and reddish brown fine sandy clay w/occasional fine sand partings and ferrous stains and nodules		115		53
65							
70			Stiff reddish tan, gray and reddish brown silty clay w/some silt pockets and seams and ferrous stain and nodules	12			97
75							
80			Stiff gray and reddish tan silty clay, sandy w/occasional fine sand pockets and silt pockets and ferrous stains and nodules	13			
85							
90				18			80
95			Stiff gray and reddish tan silty clay w/some silt pockets and seams				
100				22			
105			- very stiff below 105 ft				
				29			99

COMPLETION DEPTH: 149.0 ft
DATE: 6-9-16

DEPTH TO WATER IN BORING: 13 ft

DATE: 6/9/2016

LGBNEW 16-022_WATT ST BRIDGE.GPJ 8-17-16

PLATE 5

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S4

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 11+00, 15 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
115			Medium dense dark gray fine sandy silt w/occasional clay pockets				
120				26			74
125							
130				17			65
135			- with occasional silty clay seams and layers below 135 ft				
			- silty clay layer at 138 -139 ft				93
140			Dense gray and tan fine to coarse sand w/fine to coarse gravel, slightly silty	50			10
145							
			- dense to very dense below 148 ft	50/3"			
150							
155							
160							

COMPLETION DEPTH: 149.0 ft
DATE: 6-9-16

DEPTH TO WATER IN BORING: 13 ft

DATE: 6/9/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S5

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 10+50, 20 ft Rt

SURF. EL: 252±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			6 inches: Portland Cement Concrete	20			
			12 inches: Aggregate Base	14			
5			Stiff reddish tan and gray silty clay w/occasional silt pockets and some ferrous stains and nodules	11			
			- very stiff at 6 to 8 ft		105		98
10			- stiff, with clay pockets below 8 ft	13			
15			Very stiff tan and reddish tan silty clay w/some ferrous stains and nodules and occasional calcareous precipitants		102		95
20			- stiff with occasional clay pockets below 18 ft		103		98
25			Stiff gray, tan and reddish tan clayey silt w/occasional ferrous stains and nodules	39			95
30			- stiff, more clayey w/occasional silty clay pockets below 28 ft	16			
35			- reddish tan and tan below 33 ft	20			97
40				17			98
45			Dense to very dense tan and gray silty fine sand w/occasional organic inclusions	50/8"			
50			- with occasional clay pockets and a little fine gravel below 48 ft	50/9"			

COMPLETION DEPTH: 159.0 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 17 ft

DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S5

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 10+50, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
60			Stiff reddish tan, tan and gray fine sandy clay, silty w/occasional silt pockets and clay pockets	19			69
65							
70			- more clay pockets below 48 ft	24			
75			Stiff reddish tan fine sandy clay				
80				14			72
85			Stiff reddish tan silty clay w/occasional clay pockets				
90				16			
95			Very stiff reddish tan, gray and tan clay w/occasional silty clay pockets				
100				41			
105			Very stiff tan and gray fine sandy clay				
				28			

COMPLETION DEPTH: 159.0 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 17 ft

DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S5

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 10+50, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
			- stiff below 110 ft				
115							
120				14			50
125			Dense tan and gray silty fine sand w/occasional fine sandy clay pockets and seams				
130				30			25
135							
			- silty clay layer at 138-139 ft				84
140			Dense to very dense yellowish red tan and gray fine to medium sand, slightly silty	50/10"			11
145			Dense to very dense yellowish red fine to coarse sand w/some fine to coarse gravel, slightly silty				
				50/6"			
150							
155							
				50/5"			8
160							

COMPLETION DEPTH: 159.0 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 17 ft

DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S6

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 9+40, 20 ft Lt

SURF. EL: 251±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	6 inches: Asphalt Concrete			
	6 inches: Aggregate Base	10		
	Stiff gray and reddish brown fine sandy clay w/fine to coarse gravel (fill)	9		
5	Firm gray clay, slightly silty			
	Stiff tan and gray clay w/ferrous stains and nodules	12		
10	- very stiff with occasional silt pockets below 8 ft		100	99
15	- with more clay pockets and some silt pockets below 13 ft			
20	Firm gray and reddish tan clayey silt w/occasional silty clay pockets and ferrous stains and nodules, moist		90	89
	- water at 18 ft			
25	- firm to stiff at 23 to 28 ft	10		
30	- stiff, reddish tan and tan below 28 ft	16		
35	Stiff reddish tan and tan silty clay w/some silt seams and layers		102	96
40	- soft, tan and gray below 38 ft	6		
45	- firm below 43 ft	8		
50	Very stiff gray and reddish tan fine sandy clay w/ferrous stains and nodules	35		74

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

COMPLETION DEPTH: 149.6 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S6

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 9+40, 20 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
60			- with clayey silt pockets and seams below 58 ft	35			
65			Stiff tan and gray fine sandy clay w/ferrous stains and nodules				
70				20			65
75							
80			Dense tan and gray fine sandy silt	36		-NON-PLASTIC-	64
85							
90			Very stiff gray and reddish tan silty clay w/occasional silt partings	39			
95							
100				36			
105			- with little fine sand below 105 ft				
				26			81

COMPLETION DEPTH: 149.6 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 18 ft
DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S6

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 9+40, 20 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
115			Stiff tan and gray fine sandy clay w/fine sand pockets and seams				
120				22			
125			Dense to very dense tan fine to medium sand, slightly silty				
130				50/7"			11
135			Dense to very dense reddish tan fine to coarse sand w/some fine to coarse gravel and occasional clay pockets				
140				50/4"			12
145			- reddish tan and tan below 145 ft				
150				50/7"			
155							
160							

COMPLETION DEPTH: 149.6 ft
DATE: 6-10-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 6/10/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S7

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 8+90, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			10 inches: Asphalt Concrete	24			
			8 inches: Aggregate Base				
			Firm tan and gray clay w/some silty clay pockets and occasional organics	9			
5			Stiff tan and gray silty clay w/occasional clay pockets and silt pockets and ferrous stains and nodules		98		98
10			- firm at 6 to 8 ft - stiff below 8 ft	14			
15			- reddish brown, gray and tan below 13 ft	13			
20			Stiff reddish tan and tan clayey silt w/occasional silty clay pockets and trace fine to coarse gravel and ferrous stains and nodules - water at 18 ft				99
25				14			
30				13			
35			- more clayey below 33 ft	16			
40			- with occasional calcareous inclusions below 38 ft	14			
45			Dense to very dense gray and tan silty fine sand w/occasional clayey silt pockets	50/7"			50
50			- with some silt seams and layers below 48 ft	50/10"			
			Very stiff gray and tan silty clay				

COMPLETION DEPTH: 100.0 ft
DATE: 3-2-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 3/2/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S7

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 8+90, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			(continued)				
60			w/occasional clay pockets and some silt pockets and seams and fine sand partings	26			64
65							
70			- with some fine sandy clay pockets below 68 ft	25			
75			Dense to very dense tan fine sandy silt w/occasional clayey silt pockets and some organic stains				
80				50/6"		-NON-PLASTIC-	53
85			Very stiff tan and gray clayey silt, sandy w/occasional silty clay pockets				
90				50/9"			55
95							
100				50/7"			
105							

COMPLETION DEPTH: 100.0 ft
DATE: 3-2-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 3/2/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W15

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

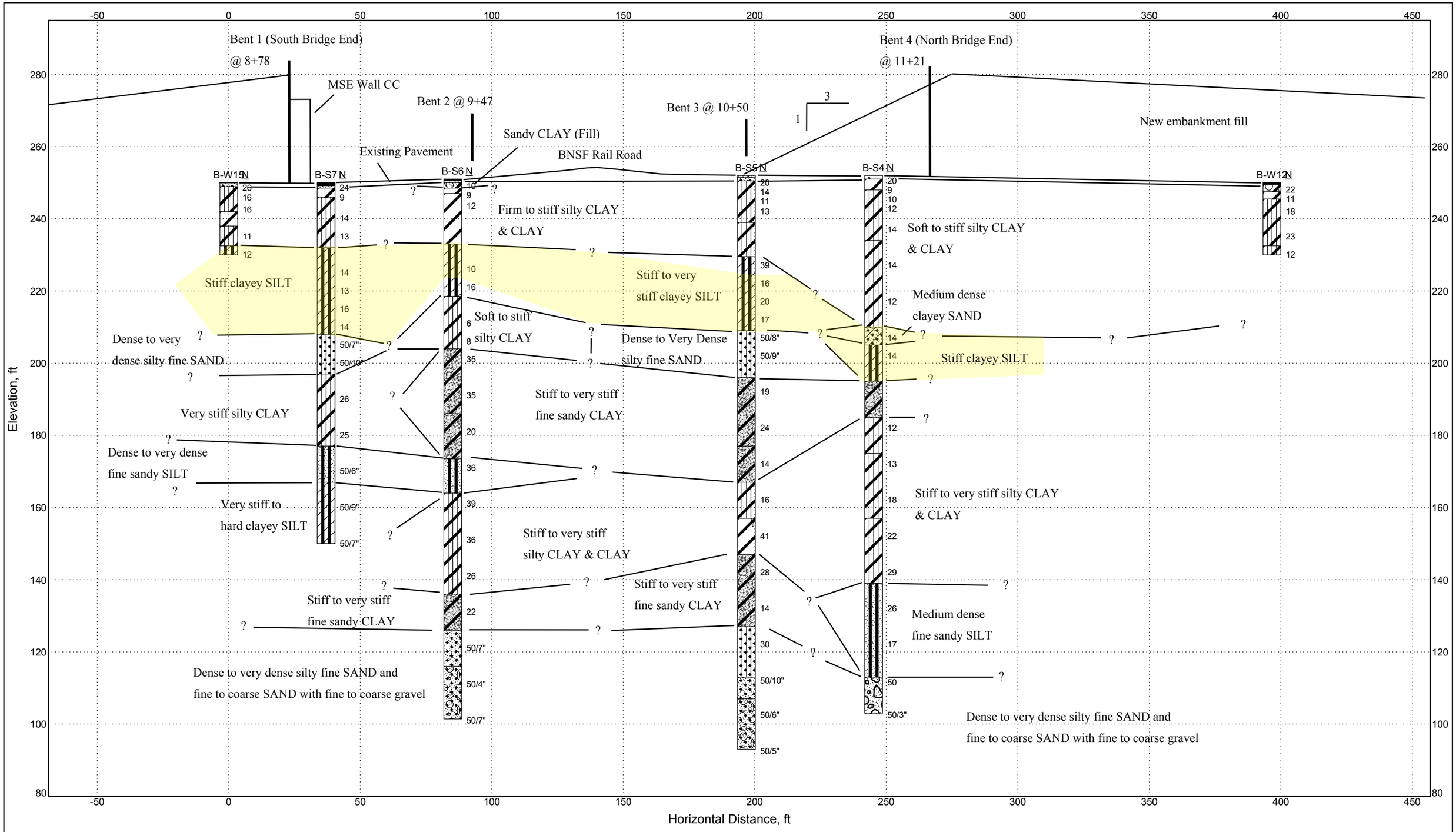
LOCATION: Approx Sta 8+55, 25 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			1 inch: Asphalt Concrete 12 inches: Aggregate Base	26			
			Stiff to very stiff tan and gray silty clay w/occasional clay pockets - with occasional silt pockets below 2 ft	16			
5					104		97
			- stiff below 6 ft	16			
			Very stiff tan and gray clay		104	1.51	99
10							
			Stiff gray and tan silty clay w/clayey silt seams and layers and occasional ferrous stains and nodules	11			
15							
			Stiff gray and tan clayey silt w/occasional silty clay pockets and ferrous stains and nodules - water at 18 ft	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-1-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 3/1/2016



Grubbs, Hoskyn,
Barton & Wyatt, Inc.

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

Scale: As Shown

Generalized Subsurface Profile
100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas
Project Number: 16-022

ATTACHMENT 4

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W1

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 93+60, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 255±				
			6 inches: Portland Cement Concrete				
			Firm gray, tan and brown silty clay w/clay pockets and occasional silt pockets (fill)	7			
			Stiff gray and tan clay w/occasional silt partings and some ferrous stains	14			
5			Stiff to very stiff tan and gray silty clay		104		97
			- stiff, with some silt pockets below 6 ft	17			
			- with numerous ferrous stains and nodules below 8 ft	14			
10							
			Very stiff reddish tan, tan and gray silty clay w/clay pockets and ferrous stains and nodules and occasional calcareous inclusions		104	1.63	96
15							
			Stiff gray and reddish tan clayey silt, calcareous w/occasional ferrous stains and nodules	21			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W2

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 95+00, 30 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 255±				
			Stiff brown and gray silty clay w/silt pockets and seams and ferrous stains and nodules	11			
			Very stiff tan and gray silty clay w/occasional clay pockets and silt partings and ferrous stains	31			97
5			- more silty with numerous ferrous stains and nodules below 4 ft	27			
					103		99
			- stiff below 8 ft				
10				22			
			- with occasional silt pockets below 13 ft				
15				16			
			Firm gray, tan and reddish tan clayey silt w/some silty clay pockets and seams and occasional ferrous stains and nodules				
20			- water at 19 ft	7			
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W3

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 96+50, 40 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			6 inches: Crushed Stone Base				
			Dense reddish brown clayey fine to coarse sand w/fine to coarse gravel	36			
			Firm tan and bluish gray clay w/some ferrous stains	8			99
5			Stiff tan and gray silty clay w/clay pockets and seams and ferrous stains and nodules	24			
			- with more clay below 6 ft	12			
10					104		98
			Very stiff tan and gray silty clay w/clayey silt pockets and seams	31			98
15							
			Stiff gray, tan and reddish tan silty clay w/clayey silt pockets and seams and occasional calcareous inclusions	14			
20			- water at 19 ft				
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W4

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 98+00, 35 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			12 inches: Asphalt Concrete				
			Stiff reddish brown and gray clay, slightly silty w/a little fine gravel and some silty clay pockets (possible fill)	15			
			Stiff tan and brown clay, slightly silty w/occasional silt pockets and ferrous stains and nodules	18			98
5			- gray, tan and reddish tan with silty clay pockets below 5 ft	15			
			Stiff tan and gray silty clay	16			98
10			- with some clay pockets and seams below 10 ft	14			
			Stiff gray clayey silt w/occasional ferrous stains	22			99
15							
			Stiff tan and gray silty clay w/some clay pockets nd seams and occasional clayey silt seams	13			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-29-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W5

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 101+50, 45 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			6 inches: Asphalt Concrete				
			Soft tan and olive gray clay w/organic stains	4			99
			Stiff tan and gray silty clay	14			
5			Stiff reddish tan, gray and tan silty clay w/clay pockets and ferrous stains and nodules	14			97
			- firm to stiff at 6.5 to 8.5 ft	10			98
			- stiff below 8.5 ft	13			
10							
			Stiff gray, tan and reddish tan silty clay w/occasional silt pockets and organic stains	14			96
15							
			- soft, gray and reddish tan below 17.5 ft				
			- water at 19 ft	5			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W6

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 102+45, 20 ft Rt

SURF. EL: 253±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
	3.5 inches: Portland Cement Concrete				
	Stiff dark brown fine sandy clay w/occasional clay pockets and some fine gravel (fill)	15			
	Firm to stiff gray, tan and brown clay, slightly silty w/occasional silt pockets and ferrous stains and nodules	10			
5	Stiff to very stiff tan and gray silty clay w/occasional silt pockets and clay pockets and ferrous stains and nodules		103		98
	- firm below 4 ft	8			
	- very stiff at 8 to 13 ft		106	2.01	
10					
	- stiff, more silty below 13 ft	16			
15					
	Stiff reddish tan and gray clayey silt w/some ferrous stains and nodules				
	- water at 18 ft				
20					
25					

COMPLETION DEPTH: 20.0 ft
DATE: 2-29-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 2/29/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W7

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 103+40, 40 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			Firm dark brown fine sandy clay w/occasional organics	8			
			Very stiff tan and gray silty clay w/occasional silt pockets and ferrous stains and nodules	42			
5			- stiff below 4 ft		100		97
				14			
10			- with occasional clay pockets below 8 ft				
			- more silty below 13 ft	14			
15							
			Stiff reddish tan and tan clayey silt w/occasional silty clay pockets and ferrous stains and nodules - water at 18 ft	12			99
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 2-29-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 2/29/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W8

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 104+00, 15 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 251±				
			Soft dark brown clay w/occasional organics	5			
			Firm gray, tan and reddish tan clay w/occasional silt pockets and trace fine sand partings	7			98
5			Stiff gray and reddish tan silty clay w/some ferrous stains and nodules	12			
			- firm with occasional silt pockets below 6 ft	8			98
10			Soft gray and reddish tan silty clay w/clay pockets and some ferrous stains and nodules	6			95
15			Stiff gray, tan and reddish tan silty clay w/occasional silt pockets and ferrous stains and nodules	15			95
20			Firm reddish tan and gray clayey silt w/some ferrous stains and nodules	9			99
25							

COMPLETION DEPTH: 20.0 ft
DATE: 2-26-16

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W9

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 105+10, 40 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			2 inches: Asphalt Concrete				
			4 inches: Aggregate Base	10			
			Firm to stiff grayish brown silty clay w/occasional fine sand pockets and a little fine to coarse gravel (fill)	10			97
			Firm to stiff tan and gray clay w/occasional decayed organics and ferrous stains and nodules				
5			Stiff reddish tan and gray silty clay w/occasional silt pockets and ferrous stains and nodules	13			
			- with some organic stains below 6 ft	11			97
			- firm to stiff with more silt pockets at 8 to 13 ft	10			
10							
			- stiff, tan and reddish tan with trace fine gravel below 13 ft	11			
15							
			Firm reddish tan and gray clayey silt w/occasional organic stains	8			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 2-26-16

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W10

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 13+10, 15 ft Lt

SURF. EL: 250±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	5.5 inches: Asphalt Concrete			
	Medium dense reddish brown clayey fine to coarse gravel w/some asphalt concrete debris (Aggregate Base)	26		
	Stiff tan and gray clay, slightly silty w/occasional silty clay pockets and some ferrous stains			97
5	Stiff reddish tan and gray silty clay w/clay pockets and occasional silt pockets and ferrous stains and nodules	18		
			101	98
	- less silty below 8 ft			
10		22		99
	Stiff reddish tan and gray clay w/occasional silty clay pockets			
15		20		97
	Stiff tan and gray clayey silt w/ferrous stains and nodules - water at 18 ft			
20		15		
25				

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

COMPLETION DEPTH: 20.0 ft
DATE: 3-22-16

DEPTH TO WATER IN BORING: 18 ft
DATE: 3/22/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W11

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 14+50, 25 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			8 inches: Asphalt Concrete				
			Medium dense gray silt, slightly clayey	14			
			Stiff tan and gray silty clay w/clay pockets and seams and some ferrous stains and nodules	22			
5			- with more clay below 5 ft	18			97
					96		98
10							
			- with some silt pockets below 13 ft				
				21			
15			- water at 14.7 ft				
			Stiff tan and reddish tan clayey silt w/some silt pockets and seams and occasional clay pockets	16			99
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-22-16

DEPTH TO WATER IN BORING: 14.7 ft

DATE: 3/22/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W12

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 12+50, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			5.5 inches: Asphalt Concrete				
			Medium dense reddish brown clayey fine to coarse gravel (Aggregate Base)	22			
			Stiff brown and gray clay w/ferrous stains	11			98
5			Stiff tan and gray silty clay w/clay pockets and silt pockets and ferrous stains	18			
10					104		99
			- with fewer clay pockets below 13 ft	23			
15							
			Stiff gray and tan silty clay w/silt seams and layers - water at 17.8 ft	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-22-16

DEPTH TO WATER IN BORING: 17.8 ft

DATE: 3/22/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W13

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 13+65, 25 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			10 inches: Portland Cement Concrete				
			Stiff reddish tan and gray clay w/some ferrous stains and nodules	14			
			- firm below 2.5 ft	8			97
			Stiff reddish tan and gray silty clay w/occasional ferrous stains and nodules	19			99
5			- with some clay pockets below 6 ft	18			
			- firm to stiff below 9 ft	10			99
10							
			Stiff reddish tan and gray silty clay w/occasional silt pockets and ferrous stains and nodules	22			
15							
			- with occasional clay pockets and fine sand partings below 18 ft	20			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-3-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/3/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W14

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 15+10, 30 ft Rt

SURF. EL: 250±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Medium dense reddish tan silty fine sand, slightly clayey w/a little fine to coarse gravel (fill)	11			
			Medium dense reddish tan clayey fine sand, silty w/some clay pockets and a little fine to coarse gravel below 2 ft	13			26
5			Stiff gray fine sandy clay	14			86
			Stiff reddish tan and gray silty clay w/clay pockets and ferrous stains and nodules	17			96
10			Stiff tan and gray clay, slightly silty w/silty clay pockets and seams and some ferrous stains and nodules	11			
15			- very stiff with more silty clay pockets and some silt pockets below 13 ft	25			
			- water at 17 ft				
20			Very soft to soft reddish tan silty clay w/clayey silt seams and layers	4			
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-30-16

DEPTH TO WATER IN BORING: 17 ft

DATE: 3/30/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W15

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 8+55, 25 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			1 inch: Asphalt Concrete 12 inches: Aggregate Base	26			
			Stiff to very stiff tan and gray silty clay w/occasional clay pockets - with occasional silt pockets below 2 ft	16			
5					104		97
			- stiff below 6 ft	16			
			Very stiff tan and gray clay		104	1.51	99
10							
			Stiff gray and tan silty clay w/clayey silt seams and layers and occasional ferrous stains and nodules	11			
15							
			Stiff gray and tan clayey silt w/occasional silty clay pockets and ferrous stains and nodules - water at 18 ft	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-1-16

DEPTH TO WATER IN BORING: 18 ft

DATE: 3/1/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W16

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 7+35, 25 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			6 inches: Asphalt Concrete				
			12 inches: Aggregate Base				
			Stiff tan and gray clay w/ferrous stains and nodules	15			
				16			98
5				18			
			Stiff reddish tan and gray silty clay w/occasional organic inclusions and ferrous stains and nodules	17			99
			- with some silt pockets below 8 ft				
10				18			
			Medium dense brownish gray silt, slightly clayey w/occasional silty clay pockets	20			98
15			- water at 16 ft				
				24			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-3-16

DEPTH TO WATER IN BORING: 16 ft

DATE: 3/3/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W17

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 8+00, 20 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			8 inches: Asphalt Concrete				
			4 inches: Aggregate base				
			Stiff tan and gray clay		95		98
5			- very stiff with occasional silt pockets below 4 ft		99		98
			Stiff tan and brownish gray silty clay w/some silt pockets and ferrous stains and nodules	13			
10					104		97
			Stiff tan, gray and reddish tan clayey silt w/some silt pockets and seams and ferrous stains and nodules	17			
15			- water at 16 ft				
				14			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-8-16

DEPTH TO WATER IN BORING: 16 ft

DATE: 3/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W18

100824 - Watt St over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 6+95, 50 ft Rt

SURF. EL: 251±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	4 inches: Portland Cement Concrete			
	3 inches: Reddish brown clayey fine sand w/fine to coarse gravel (aggregate Base)	10		
	Firm to stiff tan and bluish gray clay, slightly silty	7		98
	- firm, with occasional silt pockets below 2 ft			
5	Stiff tan and gray silty clay w/occasional clay pockets	15		
		11		
10		12		
	- with occasional silty clay pockets and calcareous nodules below 13 ft	25		97
15				
	Stiff gray, tan and reddish tan clayey silt	11		
20				
25				

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

COMPLETION DEPTH: 20.0 ft
DATE: 3-31-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/31/2016

LGBNEW 16-022_WATT ST BRIDGE.GPJ 8-17-16

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W19

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 101+65, 50 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			14 inches: Asphalt Concrete				
			Stiff tan, reddish tan and gray silty clay, slightly sandy w/some clay pockets and ferrous stains and nodules (fill)	13			
			Stiff tan and gray silty clay w/clay pockets and ferrous stains and nodules	22			
5				13			98
			Stiff to very stiff gray and tan silty clay w/clay pockets and some silt pockets and seams				99
			- very stiff at 9 to 11 ft				
10				27			
			- stiff below 11 ft				
				22			97
15							
			Stiff tan clayey silt w/some silty clay pockets and occasional calcareous nodules				
			- water at 19 ft	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-30-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/30/2016

LGBNEW 16-022_HWY 18 BRIDGE.GPJ 8-17-16

PLATE 19

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W20

100824 - Hwy 18 over BNSF Railroad
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 103+70, 55 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			16 inches: Asphalt Concrete				
			Stiff tan and olive gray clay, slightly silty	11			99
			Stiff tan and gray silty clay w/clay pockets and ferrous stains and nodules	21			
5			- tan and bluish gray below 5 ft	17			98
			- reddish tan, tan and gray below 7 ft	17			
10					102		98
			- more silty below 13 ft	16			
15							
			Stiff gray, tan and reddish tan clayey silt w/occasional silty clay pockets, moist	12			
20							
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-30-16

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/30/2016

ATTACHMENT 5

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R1

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 90+10, 10 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			10 inches: Asphalt Concrete				
			Reddish brown clayey fine to coarse sand w/fine to coarse gravel (Aggregate Base)				12
			Stiff gray silty clay w/some clay pockets and a little fine gravel (fill)	12			86
			Very stiff tan and gray clay w/some silty clay seams and occasional silt pockets				97
5			Very stiff gray and tan silty clay w/occasional clay pockets and silt pockets and ferrous stains and nodules	26			98
			- stiff below 7 ft	20			
			- more clay pockets below 8 ft				
10				13			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R2

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger LOCATION: Approx Sta 23+00, 10 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			5 inches: Asphalt Concrete				
			Soft tan and gray silty clay w/some ferrous stains and nodules	5			98
			- firm to stiff below 2 ft				
5			Stiff tan and gray silty clay w/occasional clay pockets	19			98
			- with more clay pockets and some silt pockets below 7 ft	15			
10				17			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-16-16

DEPTH TO WATER IN BORING: Dry
DATE: 3/16/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R3

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 25+75, 10 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 255±				
			10 inches: Asphalt Concrete				
			Firm brown, gray and tan silty clay w/occasional clay pockets	8			99
			- stiff, less silty below 4 ft				100
5				17			
				13			
10				16			
15							

COMPLETION DEPTH: 10.5 ft
DATE: 3-16-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/16/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R4

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 101+60, 100 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 252±				
			Reddish brown clayey fine sand w/a little fine to coarse gravel (fill)				19
			Soft tan and brownish gray clay w/occasional silty clay pockets and ferrous stains and nodules	5			
			- firm below 2 ft	8			98
5			Stiff reddish tan and gray silty clay w/occasional clay pockets and silt pockets	12			
			- very stiff below 6 ft				
10				42			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-29-16

DEPTH TO WATER IN BORING: Dry

DATE: 2/29/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R5

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 104+50, 80 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			10 inches: Asphalt Concrete				
			Stiff tan and gray silty clay w/occasional clay pockets and some ferrous stains and nodules	20			97
			- very stiff at 2 - 4 ft				
				26			
			- stiff below 4 ft				
5				17			
				15			98
			- with occasional silt pockets below 8 ft				
				16			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R6

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 106+60, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			Soft reddish tan, tan and brown fine sandy clay w/silt pockets and occasional organics	6			78
			Very soft tan, gray and grayish brown silty clay w/occasional silt pockets	3			99
5			Stiff tan and gray silty clay w/clay pockets				98
			- with more clay pockets below 7 ft	17			
			- with some silt pockets and seams below 8 ft	13			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-30-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/30/2016

LGBNEW 16-022_NEW ROADWAY.GPJ 8-17-16

PLATE 6

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R7

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 108+85, 25 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			16 inches: Asphalt Concrete				
			Medium dense grayish brown, brown and gray silty fine sand w/occasional clay pockets (fill)	16		-NON-PLASTIC-	26
5			Stiff tan and brownish gray silty clay - with occasional organics from 4 ft to 5 ft	13			97
			- with ferrous stains below 6 ft	14			
			- with occasional clay pockets below 8 ft	14			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-8-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R8

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 110+90, 15 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 251±				
			17 inches: Asphalt Concrete				
			Stiff gray silty clay w/occasional silt pockets	11			98
			Stiff tan and gray clay w/occasional silty clay pockets				99
5				14			
				16			
10				11			
15							

COMPLETION DEPTH: 10.5 ft
DATE: 3-29-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R9

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 81+00, 10 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			16 inches: Asphalt Concrete				
			Firm to stiff gray silty clay w/some clay pockets	10			98
			Stiff tan and gray clay w/some silty clay pockets and occasional silt pockets and ferrous stains				96
5			Stiff gray and tan silty clay w/clay pockets and seams and occasional silt pockets	16			98
			Stiff tan and gray clay, slightly silty w/silty clay pockets	16			
			- with some silt pockets below 8 ft				
10				16			
15							

COMPLETION DEPTH: 10.5 ft
DATE: 3-22-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/22/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R10

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 78+40, 35 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 251±				
			8.5 inches: Asphalt Concrete 5.5 inches: Portland cement treated base				
			Soft tan and brownish gray clay	5			99
5			Stiff tan and brownish gray silty clay w/occasional silt pockets and ferrous stains and nodules	12			
				15			
10							
15							

COMPLETION DEPTH: 9.0 ft
DATE: 3-8-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/8/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R11

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 59+30, 15 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			12 inches: Asphalt Concrete				
			7 inches: Portland cement treated base				
			Stiff brown and gray clay w/occasional silty clay pockets and trace fine gravel (fill)	13			96
5			Stiff gray and reddish tan silty clay w/occasional silt pockets and ferrous stains and nodules - more silty below 6 ft	15			
10				14			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-7-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/7/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R12

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 62+60, 15 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			11.5 inches: Asphalt Concrete 4.5 inches Portland Cement treated base 7 inches: crushed stone base				
			Firm to stiff brown, reddish tan and gray clay w/occasional silty clay pockets and trace fine gravel (fill)	10		WC	89
5			Stiff gray and reddish tan silty clay w/occasional silt pockets and ferrous stains and nodules	24		WC	98
			- tan and brownish gray below 6 ft	15		WC	
10				13		WC	
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-7-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/7/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R13

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 67+15, 12 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 254±				
			10 inches: Asphalt Concrete				
			Medium dense reddish brown clayey fine to medium sand w/some fine to coarse gravel (Aggregate Base)	21			7
			Stiff tan and gray silty clay w/ferrous stains and nodules and clay pockets	16			
5				13			99
			Stiff reddish tan and gray clay, slightly silty w/occasional silt pockets	16			
10				16			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R14

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 70+30, 10 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			10.5 inches: Asphalt Concrete				
			2.5 inches: Portland Cement treated base				
			Stiff reddish tan and gray clay w/occasional silt pockets and ferrous stains and nodules		98		98
5				19			
			Stiff gray and tan silty clay w/some ferrous stains and nodules	13			
			- with occasional fine sandy clay pockets and trace fine gravel below 8 ft	15			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-8-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/8/2016

LGBNEW 16-022_NEW ROADWAY.GPJ 8-17-16

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R15

100824 - BNSF Railroad Overpass
Jonesboro, Arkansas

TYPE: Auger

LOCATION: Approx Sta 73+40, 15 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 250±				
			12 inches: Asphalt Concrete				
			5.5 inches: Portland Cement treated base				
			Firm reddish tan and gray silty clay w/some silt pockets and ferrous stains and nodules		97		99
5			Stiff tan and brownish gray fine sandy clay w/occasional silt pockets and occasional calcareous nodules				
			Stiff reddish tan and gray silty clay, slightly sandy w/occasional silt pockets and ferrous stains and nodules	16			
			- more silty below 8 ft	11			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-8-16

DEPTH TO WATER IN BORING: Dry

DATE: 3/8/2016

SUMMARY of PAVEMENT CORE RESULTS

PROJECT: AHTD Job No. 100824 -BNSF Railroad Overpass
LOCATION: Jonesboro, Craighead County, Arkansas
GHBW JOB No.: 16-022

Core No.	Approx Sta	Approx Offset From Construction CL, ft	Approx Surface EL, ft	Directional lane	Total ACHM, in.	Base/Subbase, in.	Subgrade
R2	23+00	10 LT	254±	Southbound - Outer wheel path	5	NA	Soft tan and gray silty clay w/ some ferrous stains and nodules
R3	25+75	10 RT	255±	Northbound - Outer wheel path	10	NA	Firm brown, gray and tan silty clay w/ occasional clay pockets
R7	108+85	25 RT	250±	Eastbound - Outer wheel path	16	NA	Medium dense grayish brown, brown and gray silty fine sand w/ occassional clay pockets
R10	78+40	35 LT	251±	Eastbound - Outer wheel path	8.5	5.5 in. Portland cement treated base	Soft tan and brownish gray clay
R11	59+30	15 RT	254±	Southbound - Outer wheel path	12	7 in. Portland cement treated base	Stiff brown and gray clay w/ occasional silty clay pockets and trace fine gravel
R12	62+60	15 RT	254±	Southbound - Outer wheel path	11.5	4.5 in. Portland cement treated base, 7 in. crushed stone base	Firm to stiff brown, reddish tan and gray clay w/ occasional silty clay pockets and trace fine gravel
R13	67+15	12 LT	254±	Northbound - Outer wheel path	10	18 in. aggregate base	Stiff tan and gray silty clay w/ ferrous stains and nodules and clay pockets
R14	70+30	10 RT	250±	Southbound - Outer wheel path	10.5	2.5 in. Portland cement treated base	Stiff reddish tan and gray clay w/ occasional silt pockets and ferrous stains and nodules
R15	73+40	15 LT	250±	Southbound - Outer wheel path	12	5.5 in. Portland cement treated base	Firm reddish tan and gray silty clay w/ some silt pockets and ferrous stains and nodules

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
CONSULTING ENGINEERS

SUMMARY of PAVEMENT CORE RESULTS

PROJECT: AHTD Job No. 100824 -BNSF Railroad Overpass
LOCATION: Jonesboro, Craighead County, Arkansas
GHBW JOB No.: 16-022

Core No.	Approx Sta	Approx Offset From Construction CL, ft	Approx Surface EL, ft	Directional lane	Total ACHM, in.	Base/Subbase, in.	Subgrade
W10	13+10	15 LT	250±	Southbound - Outer wheel path	5.5	22 in. aggregate base	Stiff tan and gray clay, slightly silty w/ occasional silty clay pockets and some ferrous stains
W11	14+50	25 LT	250±	Southbound - Outer wheel path	8	NA	Medium dense gray silt, slightly clayey
W12	12+50	20 RT	250±	Northbound - Outer wheel path	5.5	24 in. aggregate base	Stiff brown and gray clay w/ ferrous stains
W17	8+00	20 RT	250±	Northbound - Outer wheel path	8	4 in. aggregate base	Stiff tan and gray clay

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
CONSULTING ENGINEERS

ATTACHMENT 6

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S1	6.5-7.5	18	33	24	9	100	100	89	72	53	42	32	27	GM	A-2-4
S1	14-15	23	27	22	5	---	---	---	---	---	---	---	99	CL-ML	A-4
S1	19-20	34	31	23	8	---	---	---	---	---	---	---	99	ML	A-4
S1	29.5-30	26	32	22	10	---	---	---	---	---	---	---	99	CL	A-4
S1	44.5-45	23	30	23	7	---	---	---	---	---	---	---	99	CL-ML	A-4
S1	59-60	22	35	17	18	---	---	---	---	---	---	---	88	CL	A-6
S1	69-70	30	31	23	8	---	---	---	---	---	---	---	97	CL	A-4
S1	79-80	14	16	15	1	---	---	---	---	---	---	---	60	ML	A-4
S1	89-90	23	31	20	11	---	---	---	---	---	---	---	97	CL	A-6
S1	99-100	25	37	16	21	---	---	---	---	---	---	---	99	CL	A-6
S1	109-110	23	---	---	---	---	---	---	---	---	---	---	52	ML	A-4
S1	139-140	24	---Non Plastic---			---	---	---	---	---	---	---	46	SM	A-4
S1	149-150	20	---	---	---	100	100	100	97	96	95	74	14	SM	A-2-4
S2	2.5-3.5	26	45	17	28	---	---	---	---	---	---	---	88	CL	A-7-6
S2	4.5-5.5	26	49	18	31	---	---	---	---	---	---	---	97	CL	A-7-6
S2	7-7.5	21	41	17	24	---	---	---	---	---	---	---	99	CL	A-7-6
S2	9-10	23	49	17	32	---	---	---	---	---	---	---	99	CL	A-7-6
S2	14.5-15	24	27	21	6	---	---	---	---	---	---	---	95	CL-ML	A-4
S2	29-30	29	28	24	4	---	---	---	---	---	---	---	100	ML	A-4
S2	44-45	19	18	15	3	---	---	---	---	---	---	---	60	ML	A-4
S2	49-50	19	24	14	10	---	---	---	---	---	---	---	64	CL	A-4

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S2	69-70	26	37	18	19	---	---	---	---	---	---	---	90	CL	A-6
S2	89-90	13	---	---	---	100	93	84	78	67	56	24	7	SW-SM	A-1-b
S3	5-5.5	22	48	20	28	---	---	---	---	---	---	---	99	CL	A-7-6
S3	9.5-10	24	51	17	34	100	100	100	100	100	99	99	98	CH	A-7-6
S3	19.5-20	35	50	23	27	---	---	---	---	---	---	---	99	CH	A-7-6
S3	29.5-30	29	44	21	23	---	---	---	---	---	---	---	98	CL	A-7-6
S3	89-90	23	28	18	10	---	---	---	---	---	---	---	96	CL	A-4
S3	109-110	20	30	17	13	---	---	---	---	---	---	---	89	CL	A-6
S3	119-120	26	20	19	1	---	---	---	---	---	---	---	53	ML	A-4
S3	139-140	25	---	---	---	100	100	100	100	100	100	94	10	SP-SM	A-3
S3	158.5-159	14	---	---	---	100	100	100	88	78	65	33	11	SW-SM	A-1-b
S4	2.5-3.5	26	60	18	42	---	---	---	---	---	---	---	97	CH	A-7-6
S4	9.5-10	21	46	15	31	100	100	100	100	100	100	100	100	CL	A-7-6
S4	19.5-20	27	34	23	11	100	100	100	100	100	99	97	96	CL	A-6
S4	29.5-30	29	32	23	9	---	---	---	---	---	---	---	99	CL	A-4
S4	44-45	19	25	13	12	---	---	---	---	---	---	---	33	SC	A-2-6
S4	49-50	17	24	19	5	---	---	---	---	---	---	---	52	CL-ML	A-4
S4	59.5-60	17	24	12	12	---	---	---	---	---	---	---	53	CL	A-6
S4	69-70	30	34	22	12	---	---	---	---	---	---	---	97	CL	A-6
S4	89-90	21	26	18	8	---	---	---	---	---	---	---	80	CL	A-4

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S4	109-110	24	43	19	24	---	---	---	---	---	---	---	99	CL	A-7-6
S4	119-120	21	---	---	---	---	---	---	---	---	---	---	74	ML	A-4
S4	129-130	20	21	18	3	---	---	---	---	---	---	---	65	ML	A-4
S4	138.5-139	23	32	18	14	100	100	100	100	100	99	98	93	CL	A-6
S4	139-140	12	---	---	---	100	100	96	77	65	55	31	10	SP-SM	A-1-b
S5	7-7.5	20	37	18	19	---	---	---	---	---	---	---	98	CL	A-6
S5	14.5-15	23	41	20	21	---	---	---	---	---	---	---	95	CL	A-7-6
S5	19.5-20	23	42	18	24	100	100	100	100	100	100	98	97	CL	A-7-6
S5	24-25	25	30	24	6	---	---	---	---	---	---	---	95	ML	A-4
S5	34-35	26	27	21	6	---	---	---	---	---	---	---	97	CL-ML	A-4
S5	39-40	26	28	21	7	---	---	---	---	---	---	---	98	CL-ML	A-4
S5	59-60	17	21	14	7	---	---	---	---	---	---	---	69	CL-ML	A-4
S5	79-80	23	26	16	10	---	---	---	---	---	---	---	72	CL	A-4
S5	119-120	24	20	16	4	---	---	---	---	---	---	---	50	ML-CL	A-4
S5	129-130	23	---	---	---	---	---	---	---	---	---	---	25	SM	A-2-4
S5	138.5-139	24	27	17	10	---	---	---	---	---	---	---	84	CL	A-4
S5	139-139.8	20	---	---	---	100	100	100	100	99	99	94	11	SP-SM	A-3
S5	158.5-159	11	---	---	---	100	95	91	77	60	45	26	8	SP-SM	A-1-b
S6	9.5-10	22	52	17	35	---	---	---	---	---	---	---	99	CH	A-7-6
S6	19.5-20	32	32	24	8	---	---	---	---	---	---	---	89	ML	A-4

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S6	34-35	23	29	20	9	---	---	---	---	---	---	---	96	CL	A-4
S6	49-50	19	29	17	12	---	---	---	---	---	---	---	74	CL	A-6
S6	59-60	22	34	16	18	---	---	---	---	---	---	---	---	CL	A-6
S6	69-70	27	32	21	11	---	---	---	---	---	---	---	65	CL	A-6
S6	79-80	18	---Non Plastic---			---	---	---	---	---	---	---	64	ML	A-4
S6	89-90	23	43	18	25	---	---	---	---	---	---	---	---	CL	A-7-6
S6	109-110	19	28	15	13	---	---	---	---	---	---	---	81	CL	A-6
S6	129-129.6	23	---	---	---	---	---	---	---	---	---	---	11	SP-SM	A-2-4
S6	139-139.3	14	---	---	---	100	100	97	85	76	70	44	12	SP-SM	A-1-b
S7	7-7.5	26	41	20	21	---	---	---	---	---	---	---	98	CL	A-7-6
S7	19.5-20	27	28	23	5	100	100	100	100	100	100	99	99	ML	A-4
S7	34-35	23	30	22	8	---	---	---	---	---	---	---	---	CL	A-4
S7	44-45	22	---	---	---	---	---	---	---	---	---	---	50	SM	A-4
S7	59-60	19	25	15	10	---	---	---	---	---	---	---	64	CL	A-4
S7	79-80	16	---Non Plastic---			---	---	---	---	---	---	---	53	ML	A-4
S7	89-90	15	19	14	5	---	---	---	---	---	---	---	55	CL-ML	A-4
W1	5.5-6	20	40	18	22	---	---	---	---	---	---	---	98	CL	A-6
W1	14-14.5	21	41	18	23	---	---	---	---	---	---	---	96	CL	A-7-6

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
W2	2.5-3.5	19	45	20	25	---	---	---	---	---	---	---	97	CL	A-7-6
W2	7-7.5	17	38	17	21	---	---	---	---	---	---	---	99	CL	A-6
W3	2.5-3.5	25	59	18	41	---	---	---	---	---	---	---	99	CH	A-7-6
W3	9.5-10	21	39	17	22	---	---	---	---	---	---	---	98	CL	A-6
W3	14-15	22	31	22	9	---	---	---	---	---	---	---	98	CL	A-4
W4	3.5-4.5	23	51	19	32	---	---	---	---	---	---	---	98	CH	A-7-6
W4	7.5-8.5	22	42	17	25	---	---	---	---	---	---	---	98	CL	A-7-6
W4	14-15	23	29	23	6	---	---	---	---	---	---	---	99	ML	A-4
W5	1-2	29	56	18	38	---	---	---	---	---	---	---	99	CH	A-7-6
W5	5-6	21	39	17	22	---	---	---	---	---	---	---	97	CL	A-6
W5	7-8	21	39	18	21	---	---	---	---	---	---	---	98	CL	A-6
W5	14-15	24	32	22	10	---	---	---	---	---	---	---	96	CL	A-4
W6	5-5.5	22	44	20	24	---	---	---	---	---	---	---	99	CL	A-7-6
W7	5-5.5	22	41	18	23	---	---	---	---	---	---	---	97	CL	A-7-6
W7	19-20	34	30	24	6	---	---	---	---	---	---	---	99	ML	A-4

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
W8	2.5-3.5	26	54	18	36	---	---	---	---	---	---	---	98	CH	A-7-6
W8	6.5-7.5	23	37	19	18	---	---	---	---	---	---	---	98	CL	A-6
W8	9-10	23	46	15	31	---	---	---	---	---	---	---	95	CL	A-7-6
W8	14-15	22	37	20	17	---	---	---	---	---	---	---	95	CL	A-6
W8	19-20	29	31	25	6	---	---	---	---	---	---	---	99	ML	A-4
W9	1-2	25	30	20	10	---	---	---	---	---	---	---	---	CL	A-4
W9	2.5-3.5	27	59	18	41	---	---	---	---	---	---	---	97	CH	A-7-6
W9	6.5-7.5	22	42	18	24	---	---	---	---	---	---	---	97	CL	A-7-6
W10	3-3.5	24	52	20	32	---	---	---	---	---	---	---	97	CH	A-7-6
W10	7.5-8	23	39	18	21	---	---	---	---	---	---	---	98	CL	A-6
W10	9-10	24	45	17	28	---	---	---	---	---	---	---	99	CL	A-7-6
W10	14-15	23	50	20	30	---	---	---	---	---	---	---	97	CH	A-7-6
W11	5-6	21	43	19	24	---	---	---	---	---	---	---	97	CL	A-7-6
W11	9.5-10	23	44	17	27	---	---	---	---	---	---	---	98	CL	A-7-6
W11	19-20	26	30	23	7	---	---	---	---	---	---	---	99	CL-ML	A-4
W12	3-4	25	57	18	39	---	---	---	---	---	---	---	98	CH	A-7-6
W12	5-5.5	25	46	19	27	---	---	---	---	---	---	---	---	CL	A-7-6

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
W12	9.5-10	23	41	17	24	---	---	---	---	---	---	---	99	CL	A-7-6
W13	2.5-3.5	27	54	19	35	---	---	---	---	---	---	---	97	CH	A-7-6
W13	4.5-5.5	25	40	19	21	---	---	---	---	---	---	---	99	CL	A-6
W13	9-10	24	42	16	26	---	---	---	---	---	---	---	99	CL	A-7-6
W14	2.5-3.5	13	21	11	10	---	---	---	---	---	---	---	26	SC	A-2-4
W14	4.5-5.5	22	32	17	15	---	---	---	---	---	---	---	86	CL	A-6
W14	6.5-7.5	21	37	17	20	---	---	---	---	---	---	---	96	CL	A-6
W15	5-5.5	20	38	17	21	---	---	---	---	---	---	---	98	CL	A-6
W15	9.5-10	22	54	17	37	---	---	---	---	---	---	---	99	CH	A-7-6
W16	2.5-3.5	26	51	21	30	---	---	---	---	---	---	---	98	CH	A-7-6
W16	6.5-7.5	23	41	20	21	---	---	---	---	---	---	---	99	CL	A-7-6
W16	14-15	25	26	24	2	---	---	---	---	---	---	---	98	ML	A-4
W17	3-3.5	27	64	19	45	---	---	---	---	---	---	---	98	CH	A-7-6
W17	5-5.5	25	57	18	39	---	---	---	---	---	---	---	98	CH	A-7-6
W17	9.5-10	21	42	16	26	---	---	---	---	---	---	---	97	CL	A-7-6

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
W18	2.5-3.5	28	50	18	32	---	---	---	---	---	---	---	98	CH	A-7-6
W18	14-15	23	48	19	29	---	---	---	---	---	---	---	97	CL	A-7-6
W19	3.5-4.5	22	41	19	22	---	---	---	---	---	---	---	98	CL	A-7-6
W19	5.5-6.5	21	38	18	20	---	---	---	---	---	---	---	99	CL	A-6
W19	14-15	21	38	19	19	---	---	---	---	---	---	---	97	CL	A-6
W20	1.5-2.5	24	49	16	33	---	---	---	---	---	---	---	99	CL	A-7-6
W20	5.5-6.5	21	40	18	22	---	---	---	---	---	---	---	98	CL	A-6
W20	10-10.5	21	40	18	22	---	---	---	---	---	---	---	98	CL	A-6
R1	0.8-1.3	7	---	---	---	---	---	---	---	---	---	---	12	GC	A-2-4
R1	1.3-2.3	19	35	19	16	---	---	---	---	---	---	---	86	CL	A-6
R1	3-4	25	53	20	33	---	---	---	---	---	---	---	97	CH	A-7-6
R1	5-6	21	37	18	19	---	---	---	---	---	---	---	98	CL	A-6
R2	1.3-2.3	26	40	17	23	---	---	---	---	---	---	---	99	CL	A-6
R2	5-6	22	47	19	28	---	---	---	---	---	---	---	98	CL	A-7-6
R3	1.8-2.8	24	36	18	18	---	---	---	---	---	---	---	99	CL	A-2-4
R3	4-4.5	29	45	16	29	---	---	---	---	---	---	---	100	CL	A-7-6

SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R4	0.5-1.5	11	---	---	---	---	---	---	---	---	---	---	19	SC	A-2-4
R4	2.5-3.5	26	51	18	33	---	---	---	---	---	---	---	98	CH	A-7-6
R5	1.3-2.3	22	45	18	27	---	---	---	---	---	---	---	97	CL	A-7-6
R5	7-8	22	40	18	22	---	---	---	---	---	---	---	98	CL	A-6
R6	0.5-1.5	21	29	19	10	---	---	---	---	---	---	---	78	CL	A-4
R6	2.5-3.5	24	41	16	25	---	---	---	---	---	---	---	99	CL	A-7-6
R6	5-5.5	21	44	19	25	---	---	---	---	---	---	---	98	CL	A-7-6
R7	2.5-3.5	12	---Non Plastic---			---	---	---	---	---	---	---	26	SM	A-2-4
R7	4.5-5.5	23	39	18	21	---	---	---	---	---	---	---	97	CL	A-6
R8	1.8-2.8	26	38	19	19	---	---	---	---	---	---	---	93	CL	A-6
R8	4-4.5	21	50	18	32	---	---	---	---	---	---	---	99	CH	A-7-6
R9	1.8-2.8	26	41	19	22	---	---	---	---	---	---	---	98	CL	A-7-6
R9	3.5-4	24	55	18	37	---	---	---	---	---	---	---	96	CH	A-7-6
R9	5.5-6.5	22	48	19	29	---	---	---	---	---	---	---	98	CL	A-7-6

SUMMARY OF CLASSIFICATION TEST RESULTS

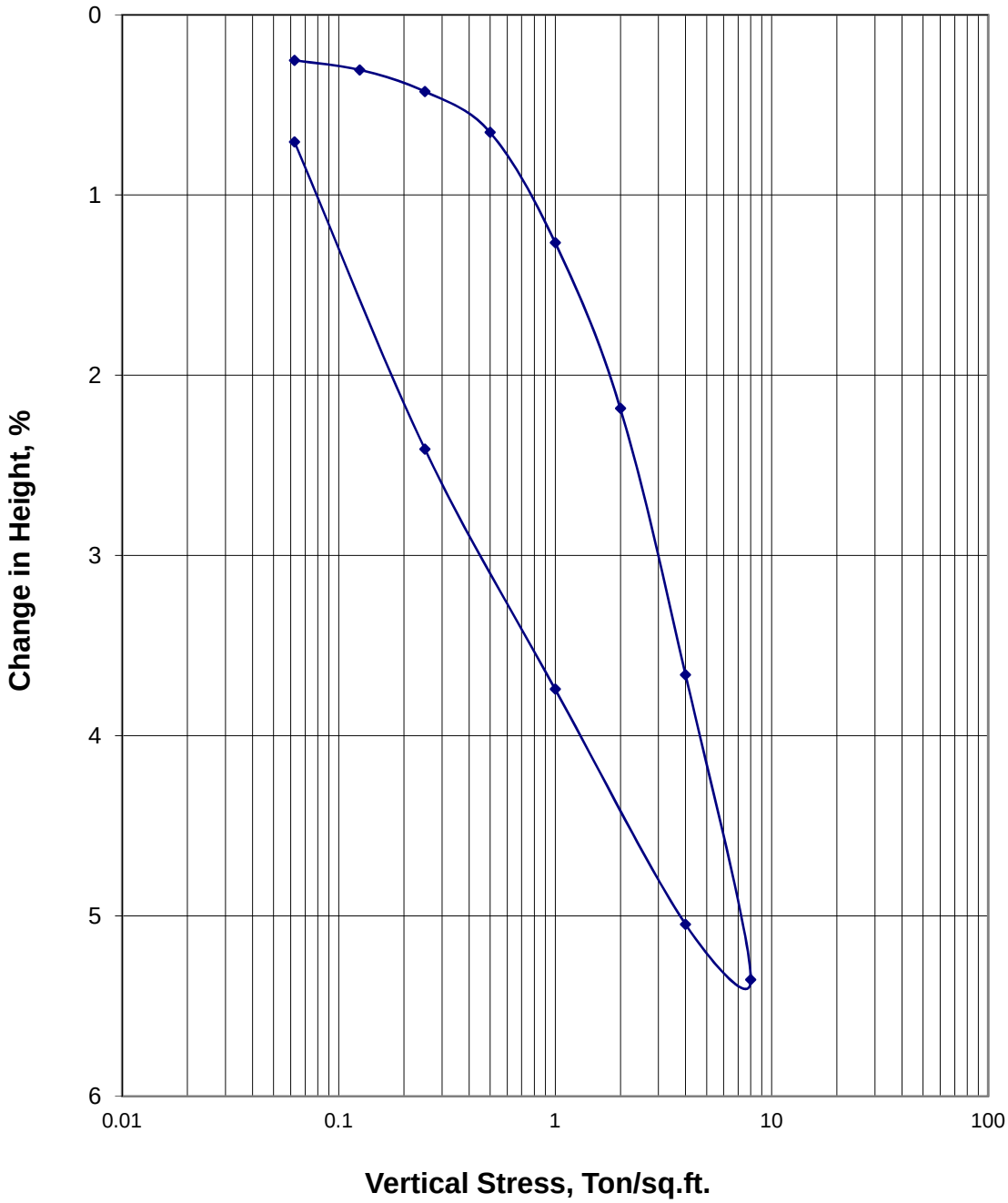
PROJECT: AHTD Job No. 100824 – Hwy 18 Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R10	1.7-2.7	29	52	18	34	---	---	---	---	---	---	---	99	CH	A-7-6
R11	2.5-3.5	25	51	18	33	---	---	---	---	---	---	---	97	CH	A-7-6
R12	2.5-3.5	24	57	18	39	---	---	---	---	---	---	---	89	CH	A-7-6
R12	4.5-5.5	22	44	20	24	---	---	---	---	---	---	---	98	CL	A-7-6
R13	1.4-2.4	5	22	13	9	---	---	---	---	---	---	---	7	SP-SM	A-2-4
R13	5-6	21	42	18	24	---	---	---	---	---	---	---	99	CL	A-7-6
R14	2.5-3	27	58	19	39	---	---	---	---	---	---	---	98	CH	A-7-6
R15	2.5-3	28	39	19	20	---	---	---	---	---	---	---	99	CL	A-6

CONSOLIDATION TEST RESULTS
(AASHTO T216)

Job No.: **16-022**
Boring: S4
Depth: 9-10 ft
Description: Reddish tan and gray silty clay
USCS = CL
AASHTO=A-7-6

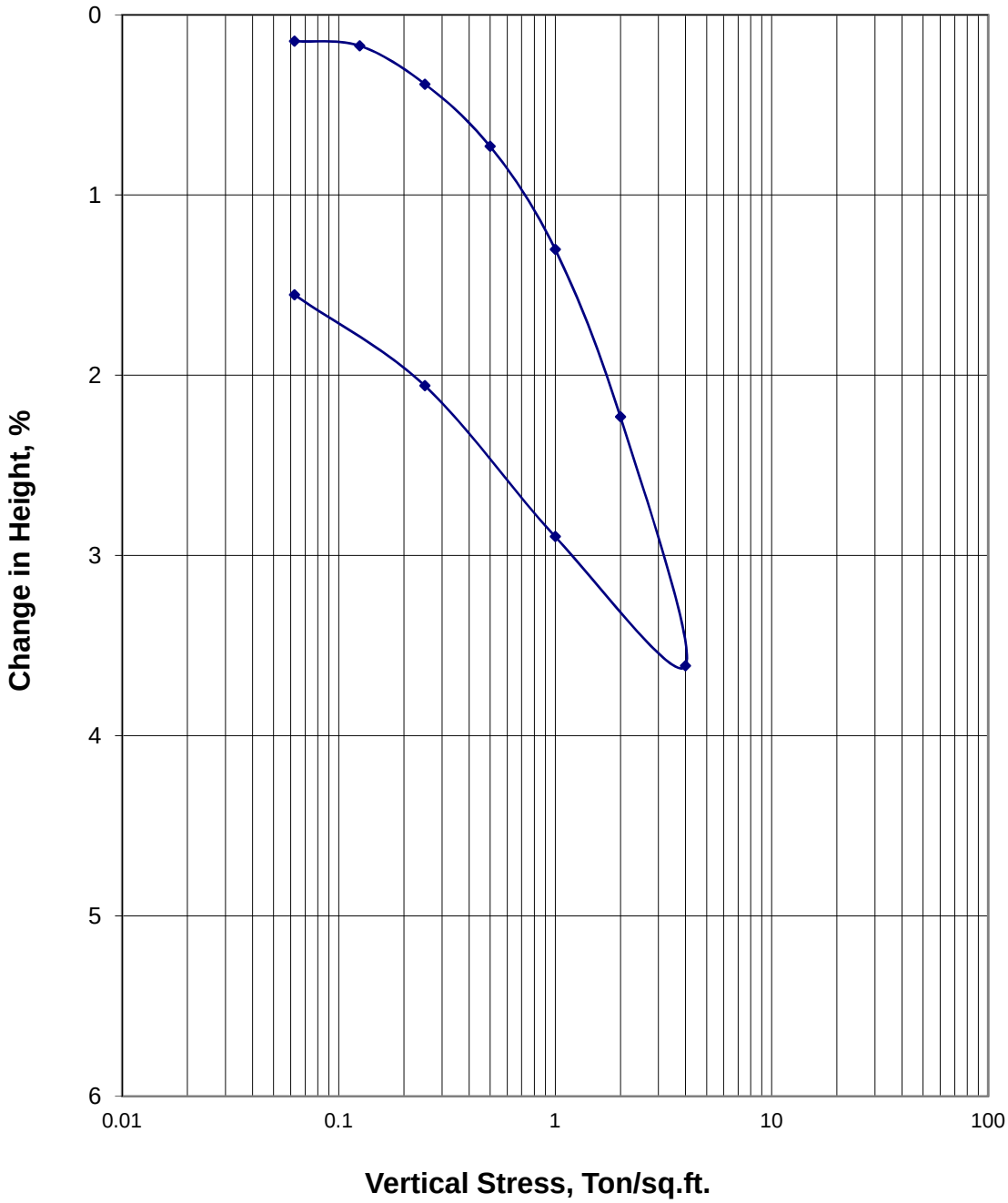
Unit Dry Weight: 104.6pcf
Initial Water Content: 21.3%
Final Water Content: 23.5%
Liquid Limit: 46
Plastic Limit: 15
Plasticity Index: 31
Minus #200: 100%



CONSOLIDATION TEST RESULTS
(AASTO T216)

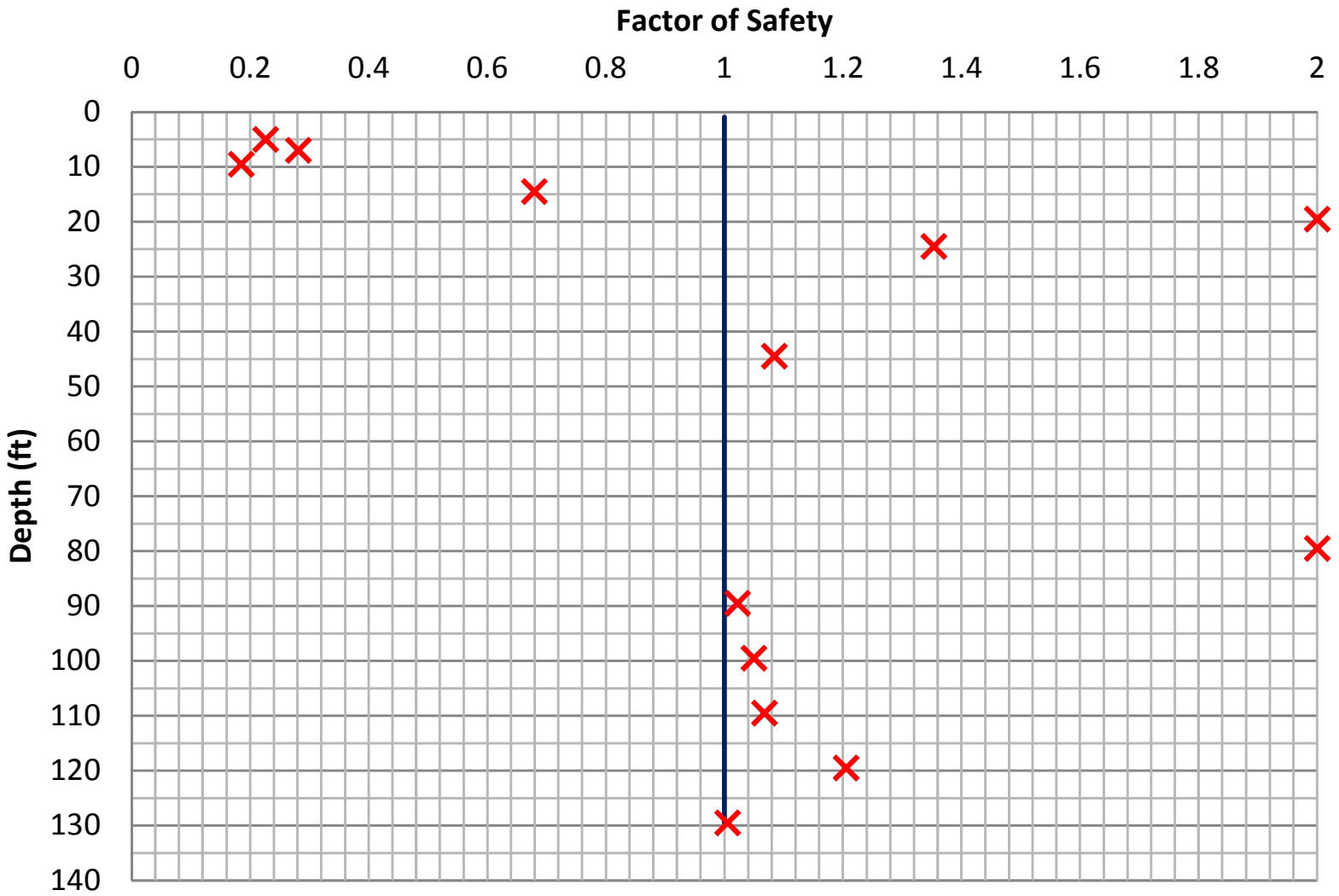
Job No.: **16-022**
Boring: S5
Depth: 19.5-20 ft
Description: Tan and reddish tan silty clay w/ occasional clay pockets
USCS = CL
AASHTO=A-7-6

Unit Dry Weight: 102.6pcf
Initial Water Content: 23.3%
Final Water Content: 23.7%
Liquid Limit: 42
Plastic Limit: 18
Plasticity Index: 24
Minus #200: 97%

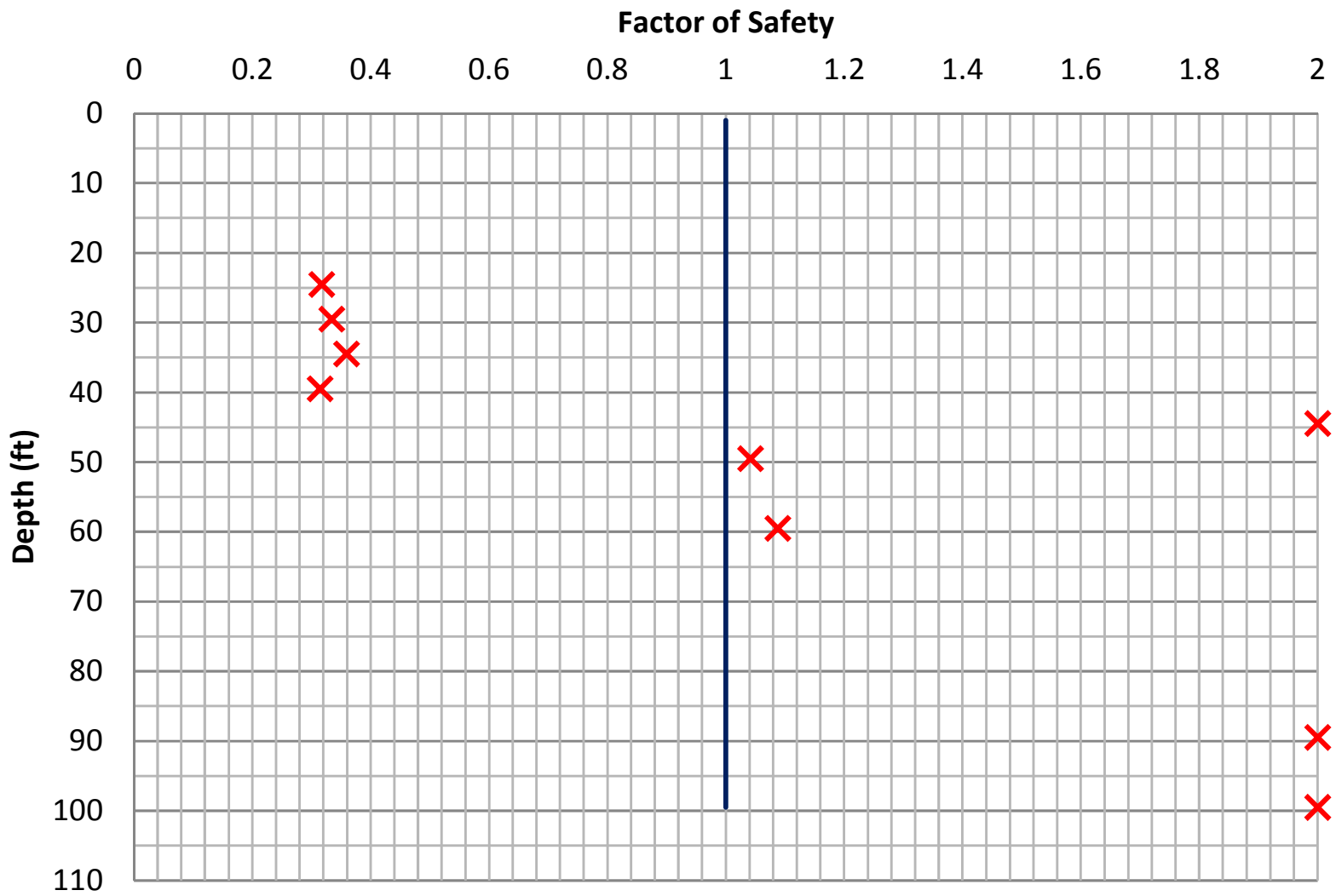


ATTACHMENT 7

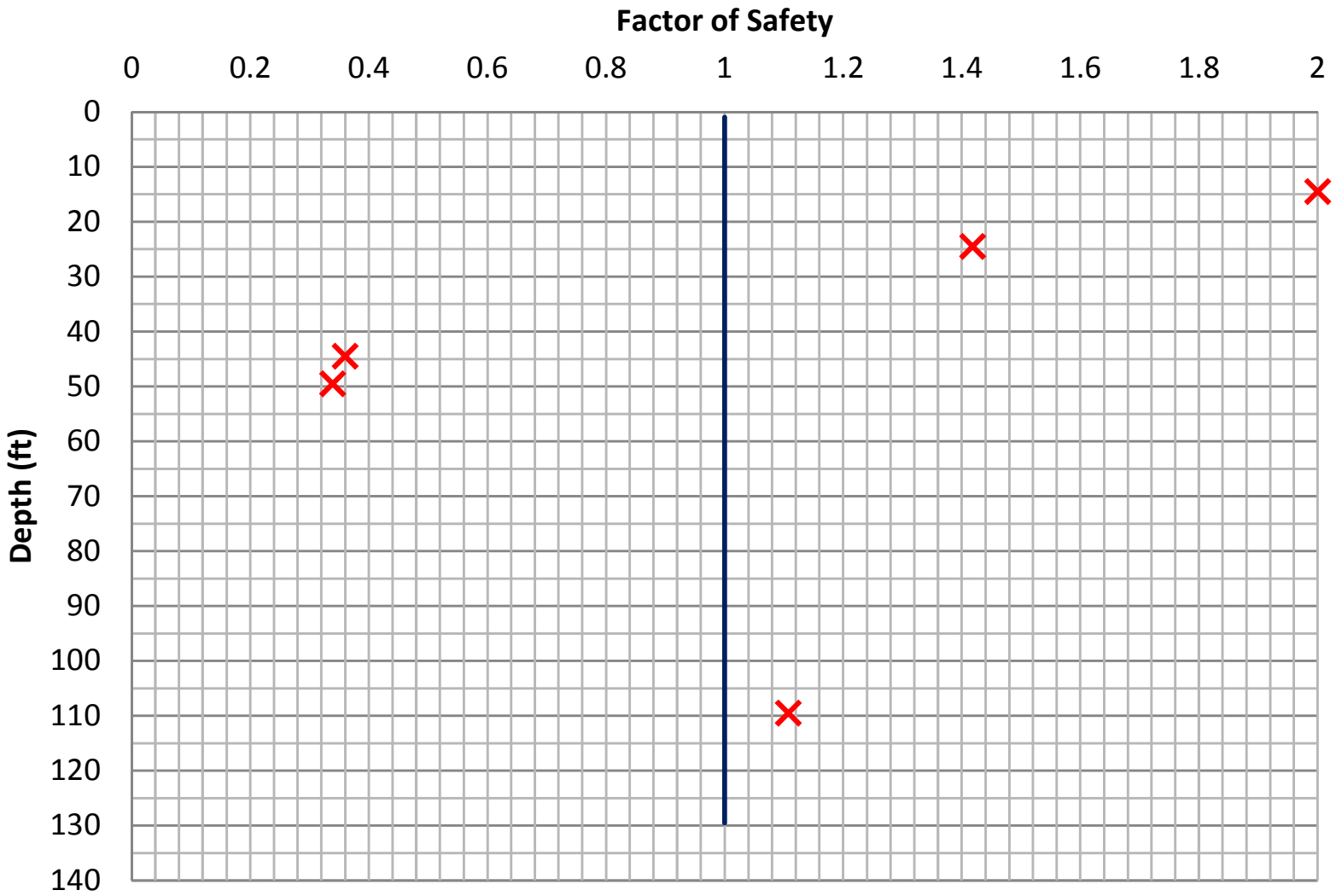
Results of Liquefaction Analyses - HWY 18 over BNSF Railroad
Station 98+25, 35 ft Left (Boring S1)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas



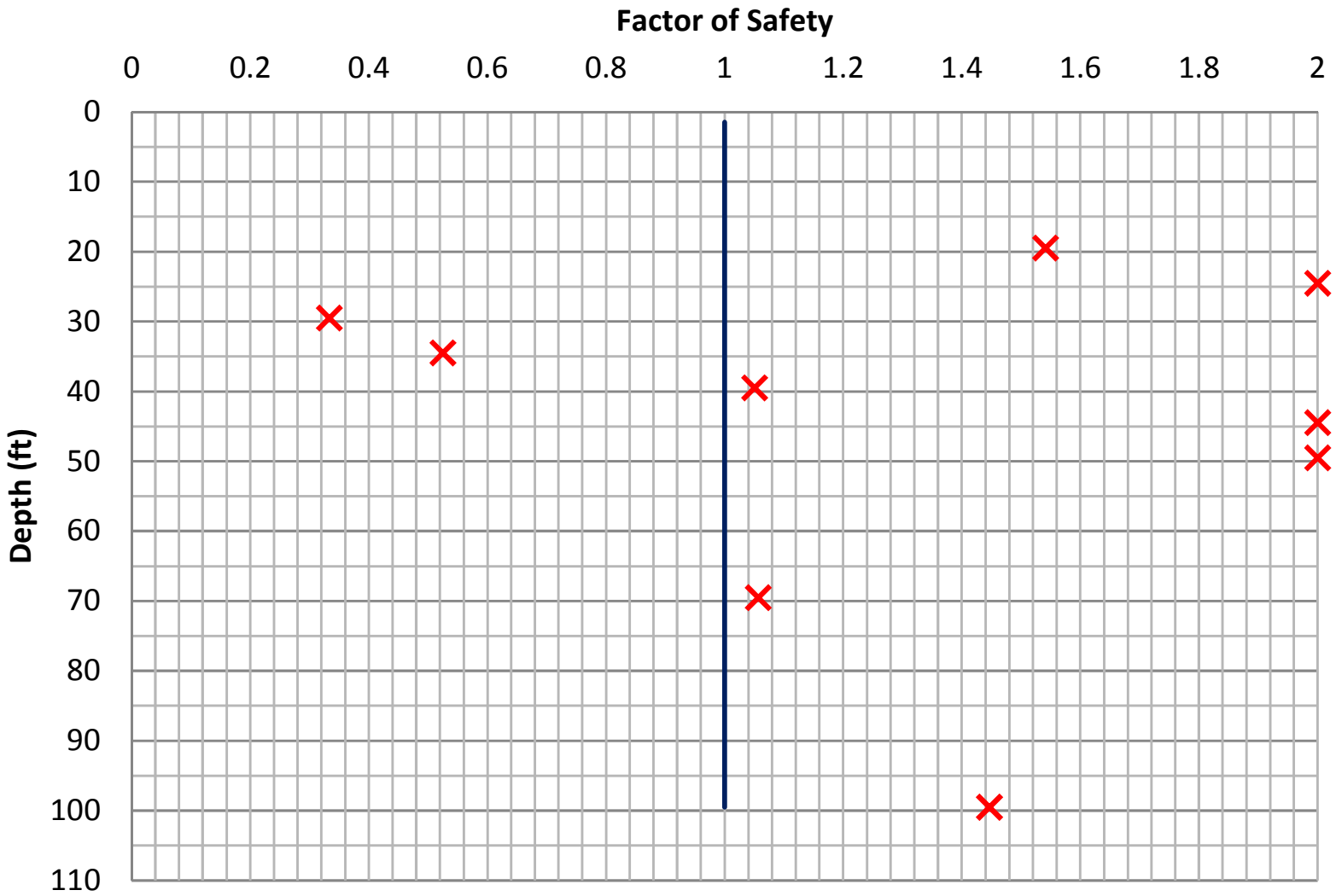
Results of Liquefaction Analyses - HWY 18 over BNSF Railroad
Station 99+10, 35 ft Left (Boring S2)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas



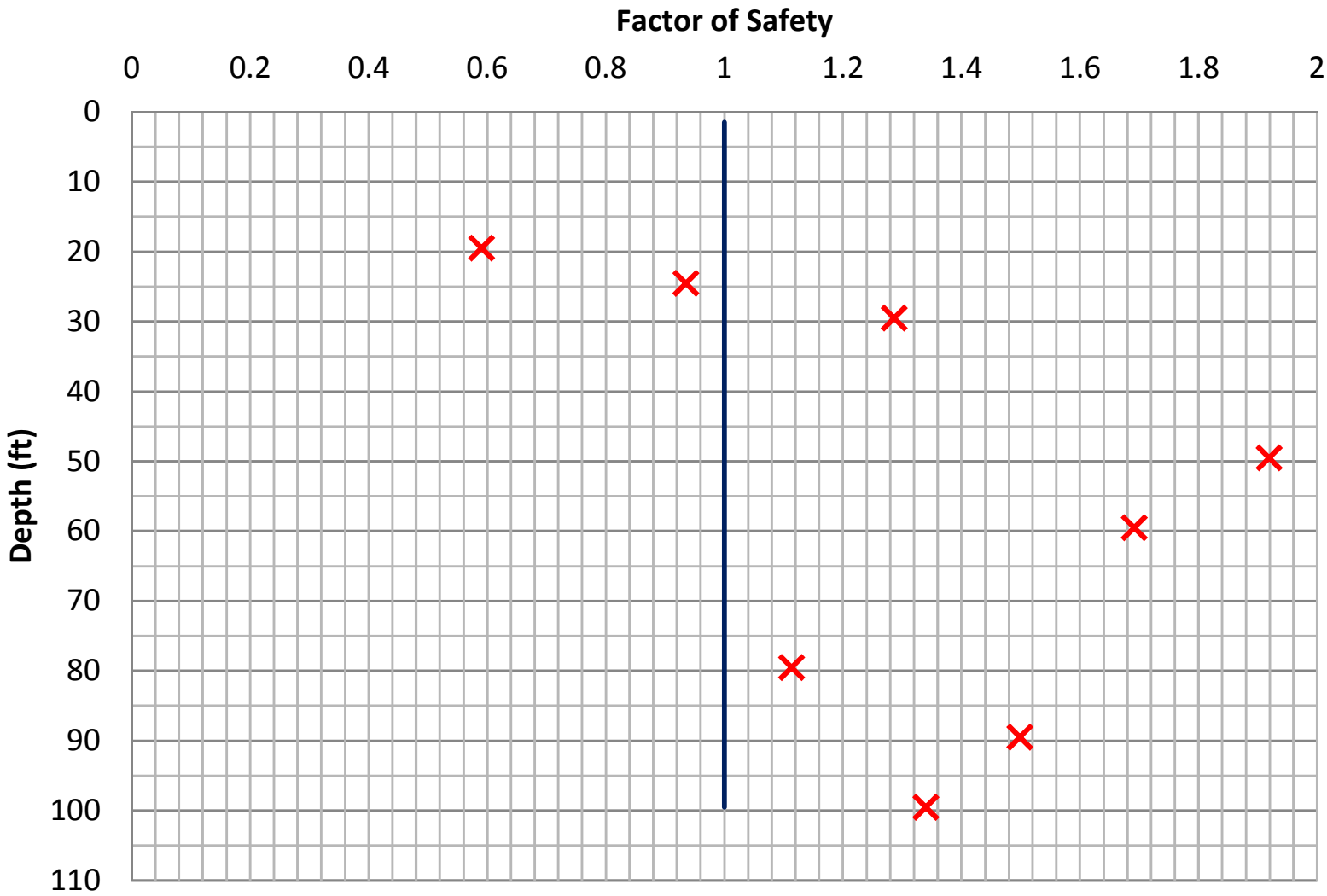
Results of Liquefaction Analyses - Watt St over BNSF Railroad
Station 11+00, 30 ft Left (Boring S4)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas



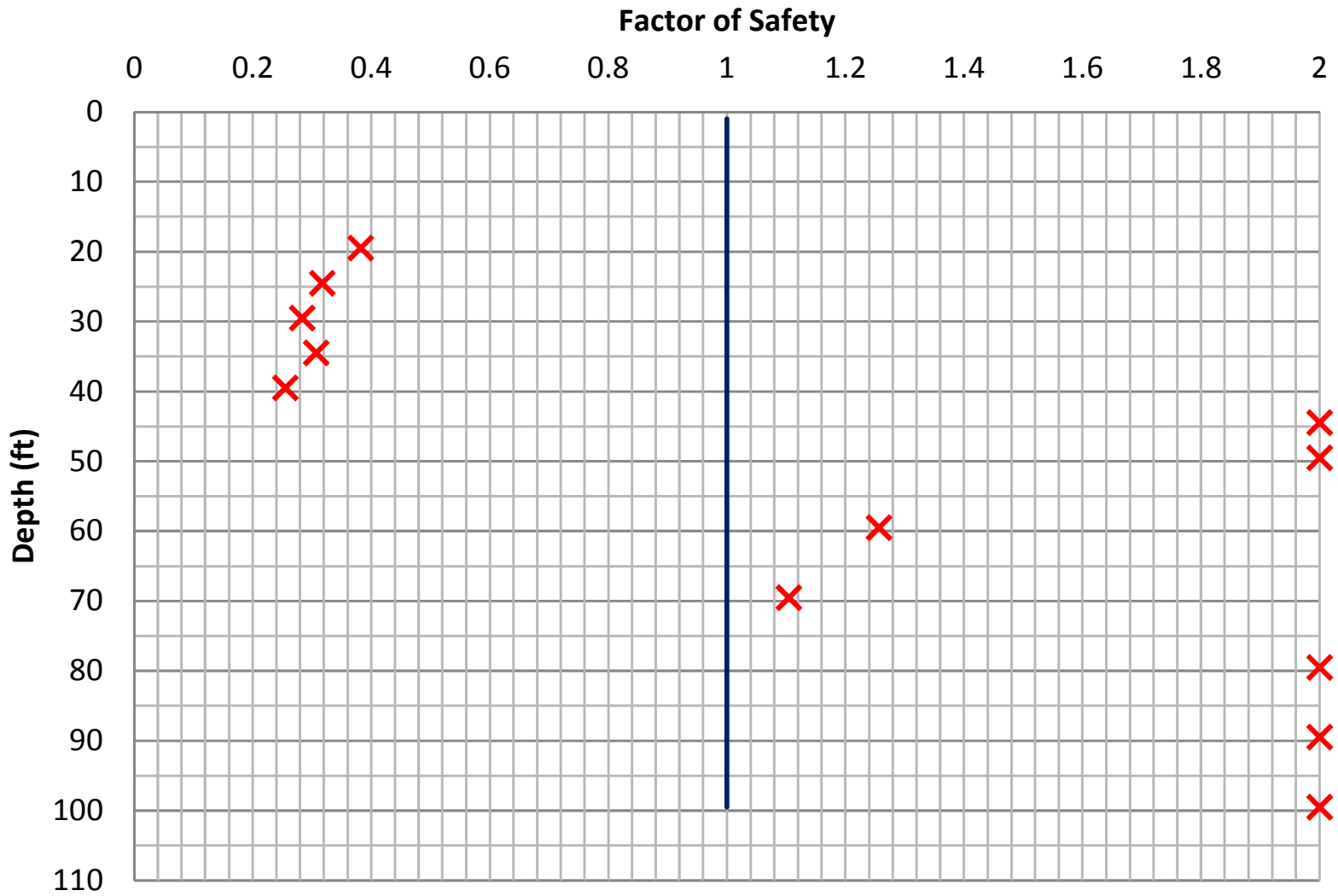
Results of Liquefaction Analyses - Watt St over BNSF Railroad
Station 10+50, 20 ft Right (Boring S5)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas



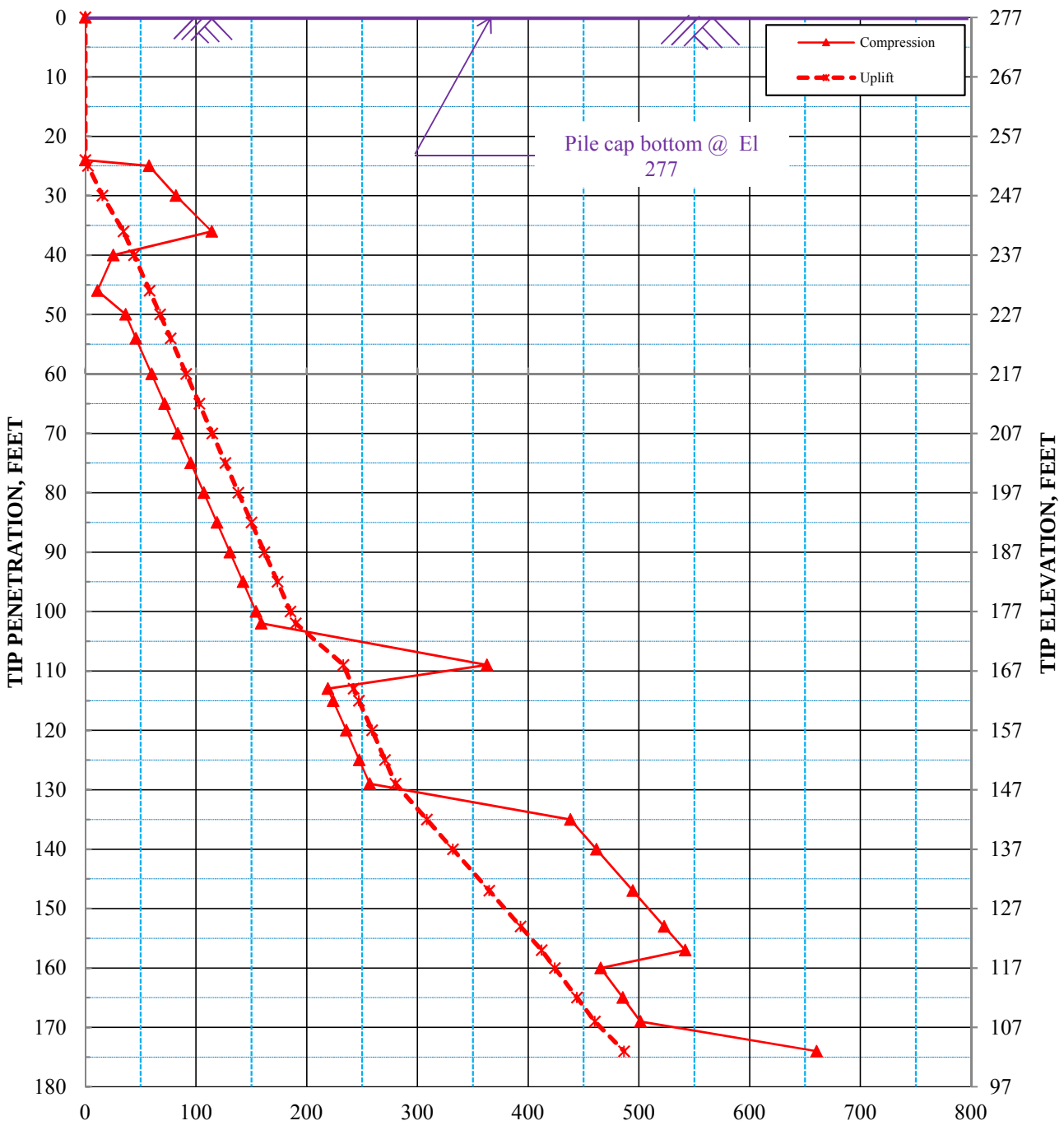
Results of Liquefaction Analyses - Watt St over BNSF Railroad
Station 09+40, 30 ft Left (Boring S6)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas



Results of Liquefaction Analyses - Watt St over BNSF Railroad
Station 08+90, 20 ft Right (Boring S7)
AHTD Job No. 100824: HWY 18 Railroad Overpass
Jonesboro, Arkansas

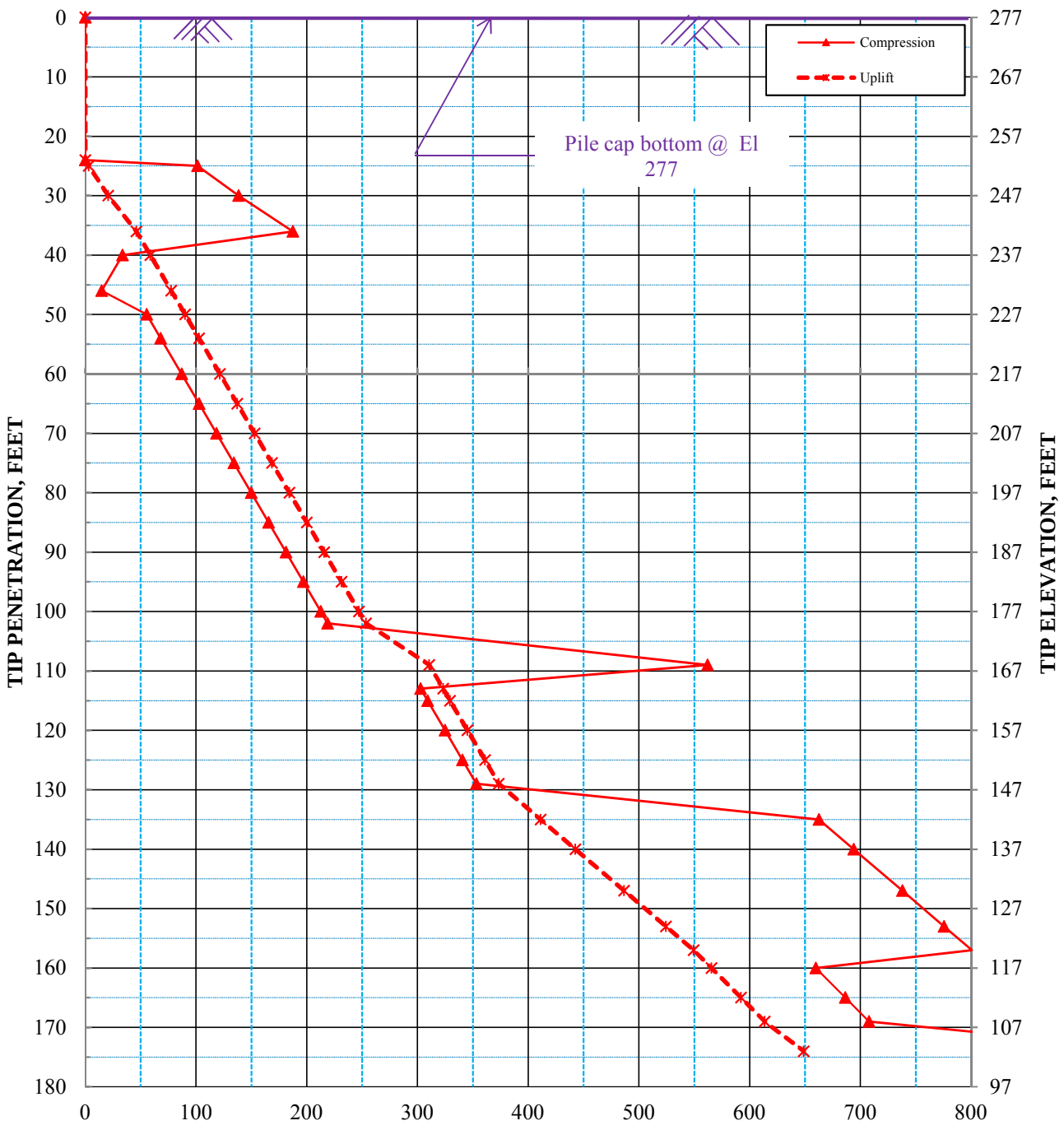


ATTACHMENT 8



NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 1 (West Abutment) - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

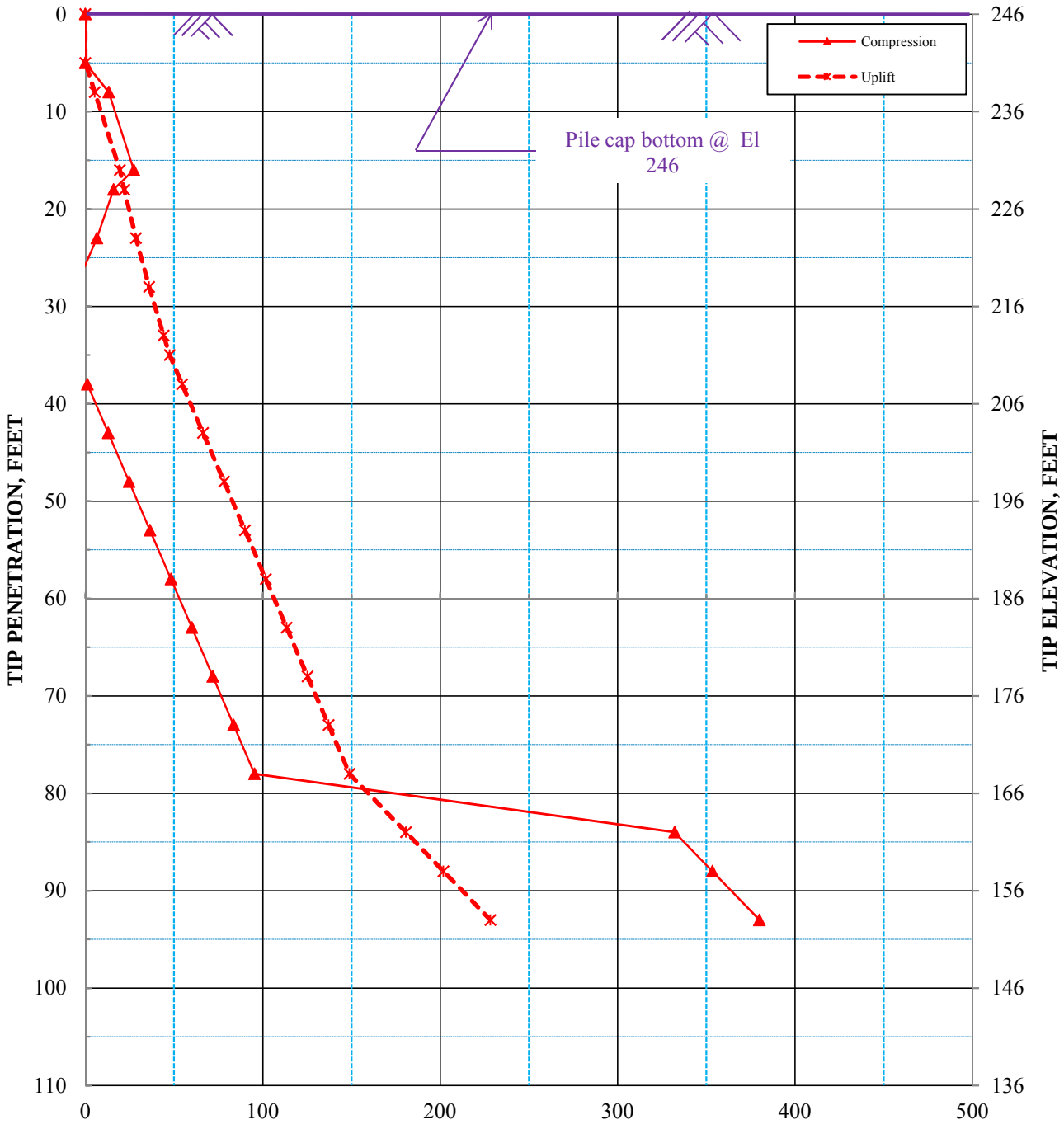
Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 241 to El 231.



NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells
Bent 1 (West Abutment) - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

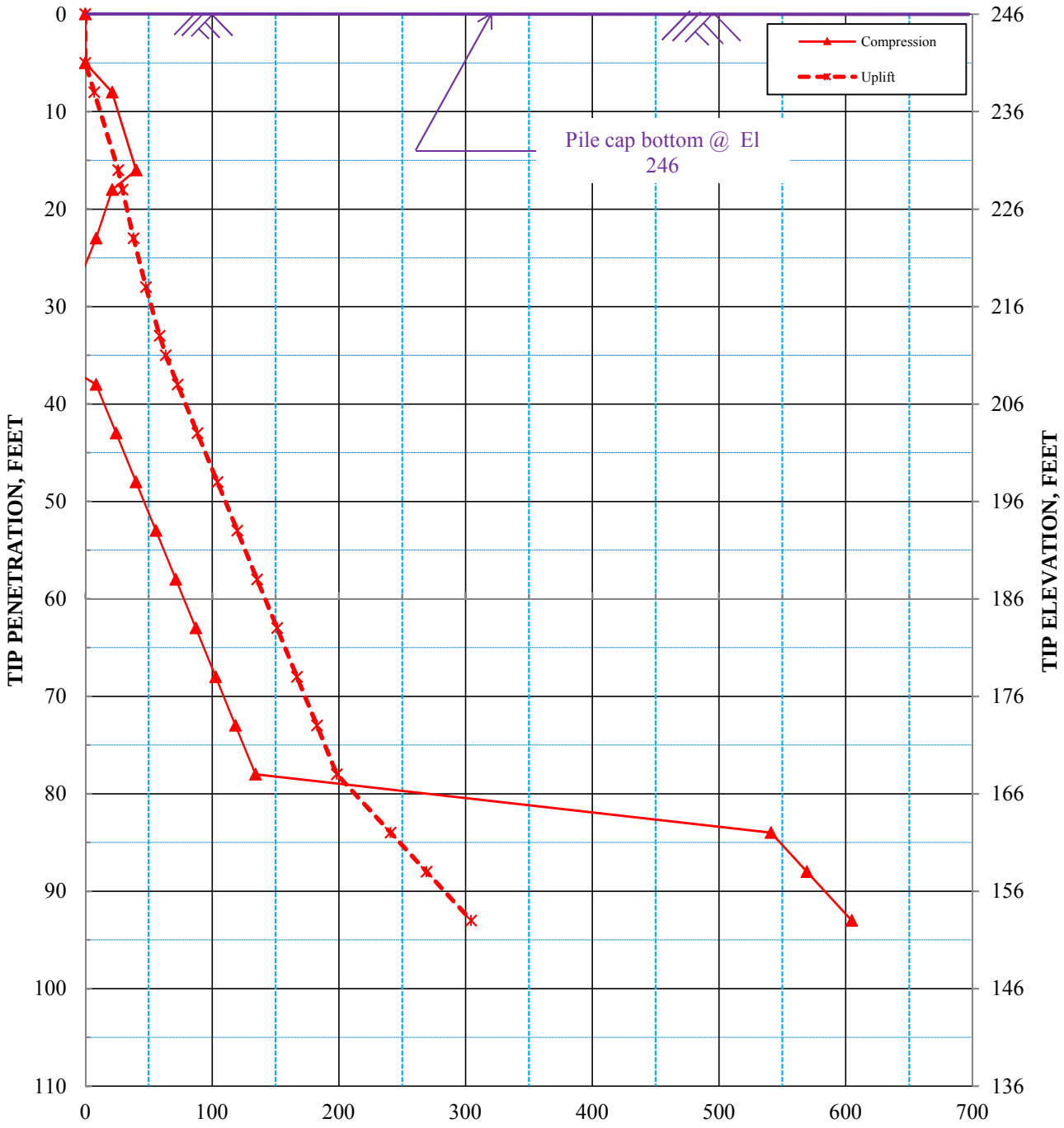
Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 241 to El 231.

NOMINAL SINGLE PILE CAPACITY, TONS



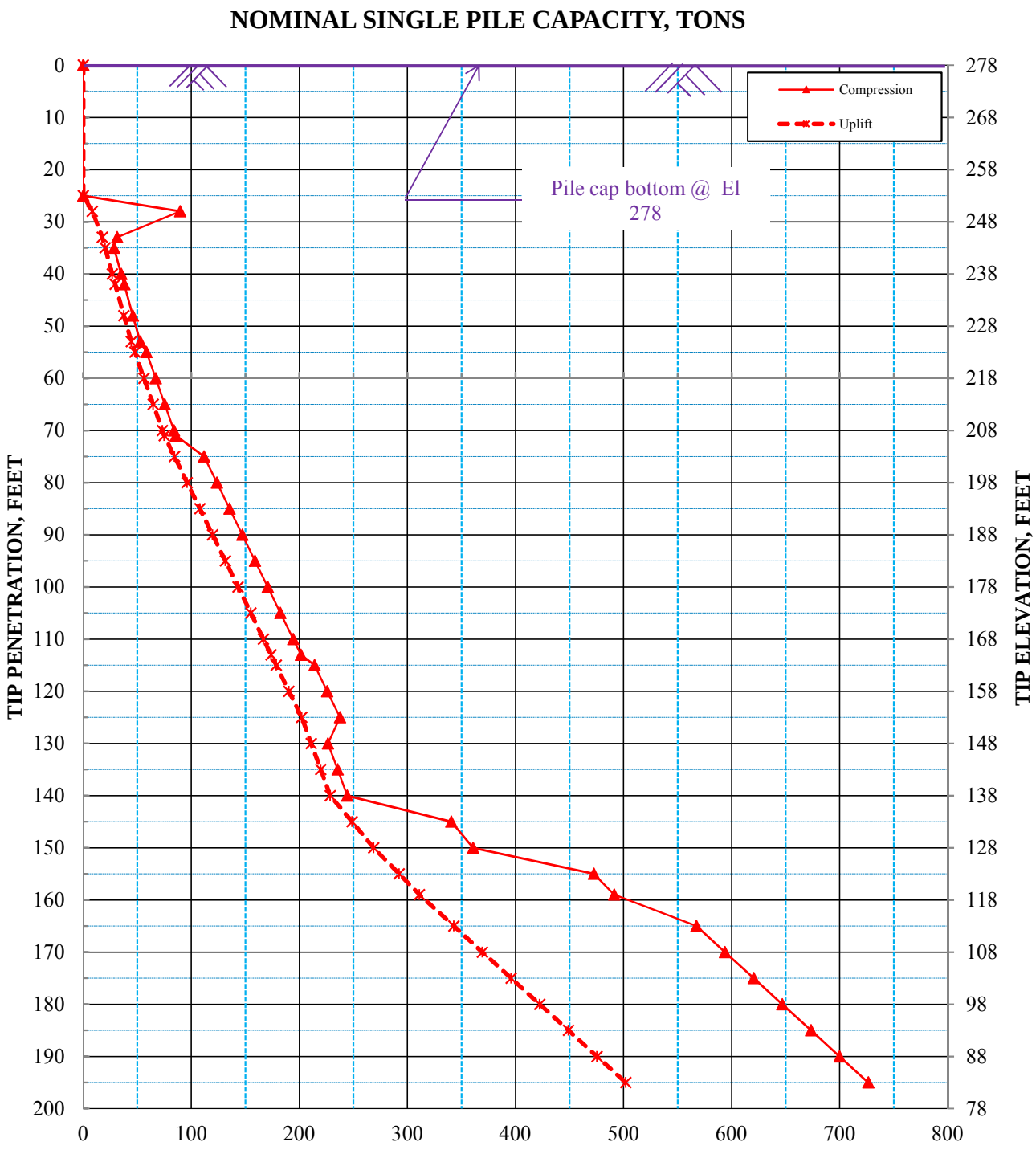
NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 2 - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 230 to El 210.



NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells
Bent 2 - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

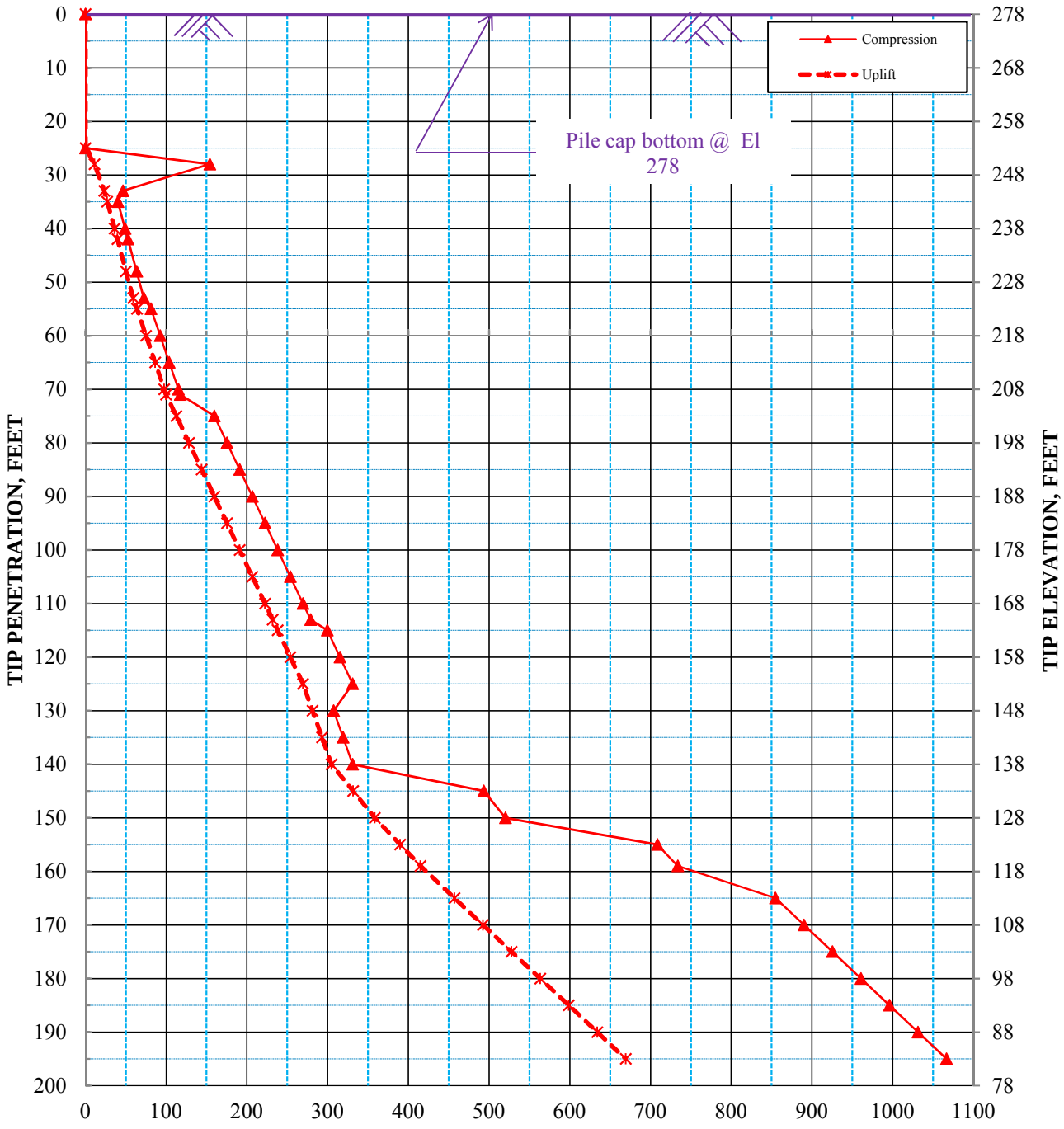
Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 230 to El 210.



NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 3 (East Abutment) - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Note: Piles assumed to be driven to plan tip elevation.

NOMINAL SINGLE PILE CAPACITY, TONS



NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells
Bent 3 (East Abutment) - Hwy 18 over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Note: Piles assumed to be driven to plan tip elevation.

SUMMARY of PILE REQUIREMENTS

PROJECT: AHTD JOB 100824: BNSF RAILROAD OVERPASS (Jonesboro) (P.E.)
LOCATION: Jonesboro, Arkansas
GHBW JOB No.: 16-022

Resistance factors (ϕstat) of 0.45 for end bearing and compression skin friction

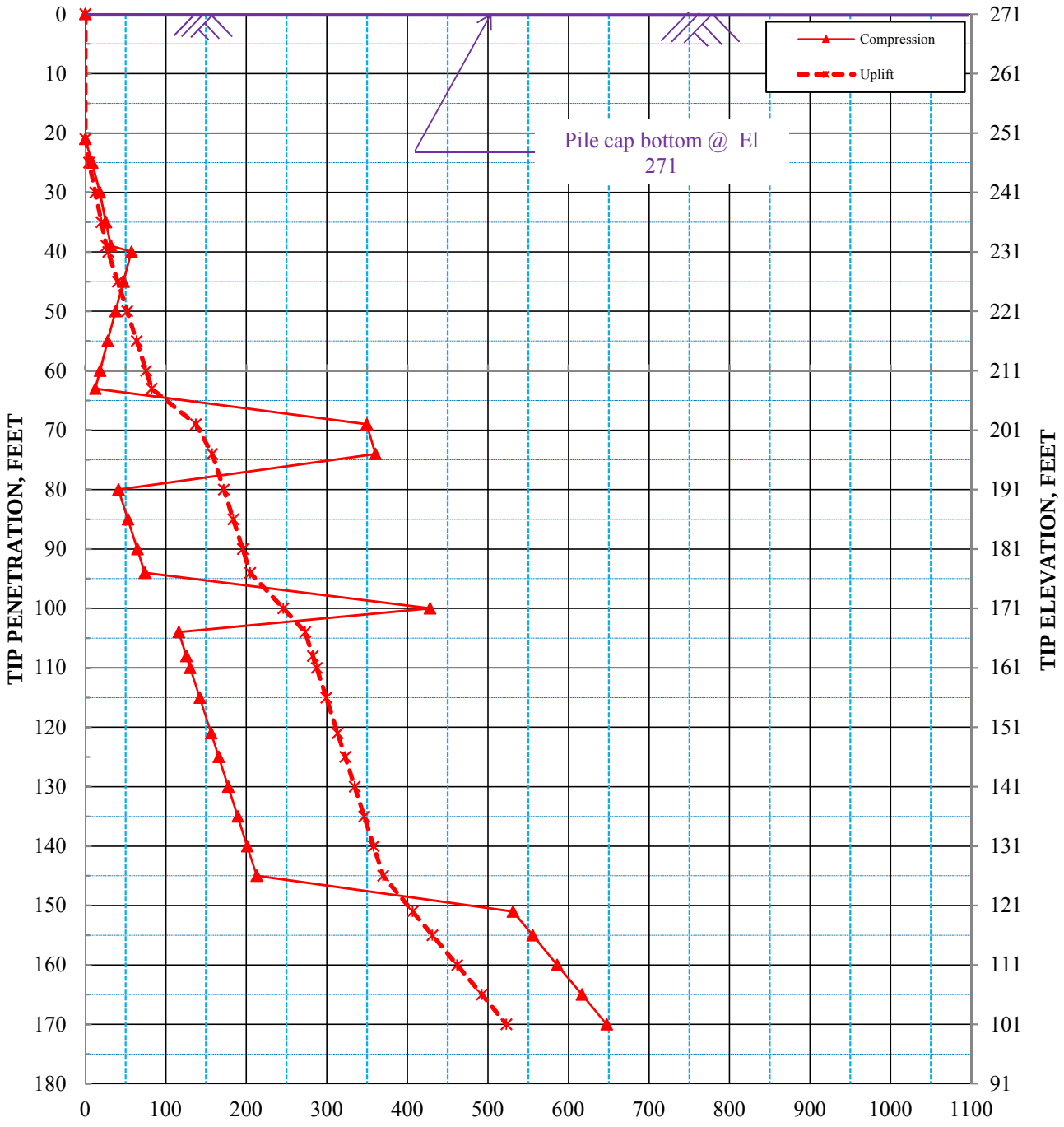
Hwy 18 - 18-in.-dia steel shells

Max Factored Bent Load at Top of Pile, Pu (kips)		MINIMUM PILE REQUIREMENTS				Calculated Downdrag Load, tons
	Bent No.	Nominal Capacity (tons/pile)	Estimated Pile Length, ft	Estimated Min Tip El, ft	Hammer Energy (ft-kips)	
252	1	280	130	147	198	24
226	2	251	82	164	107	41
253	3	281	141	137	198	0

Hwy 18 - 24-in.-dia steel shells

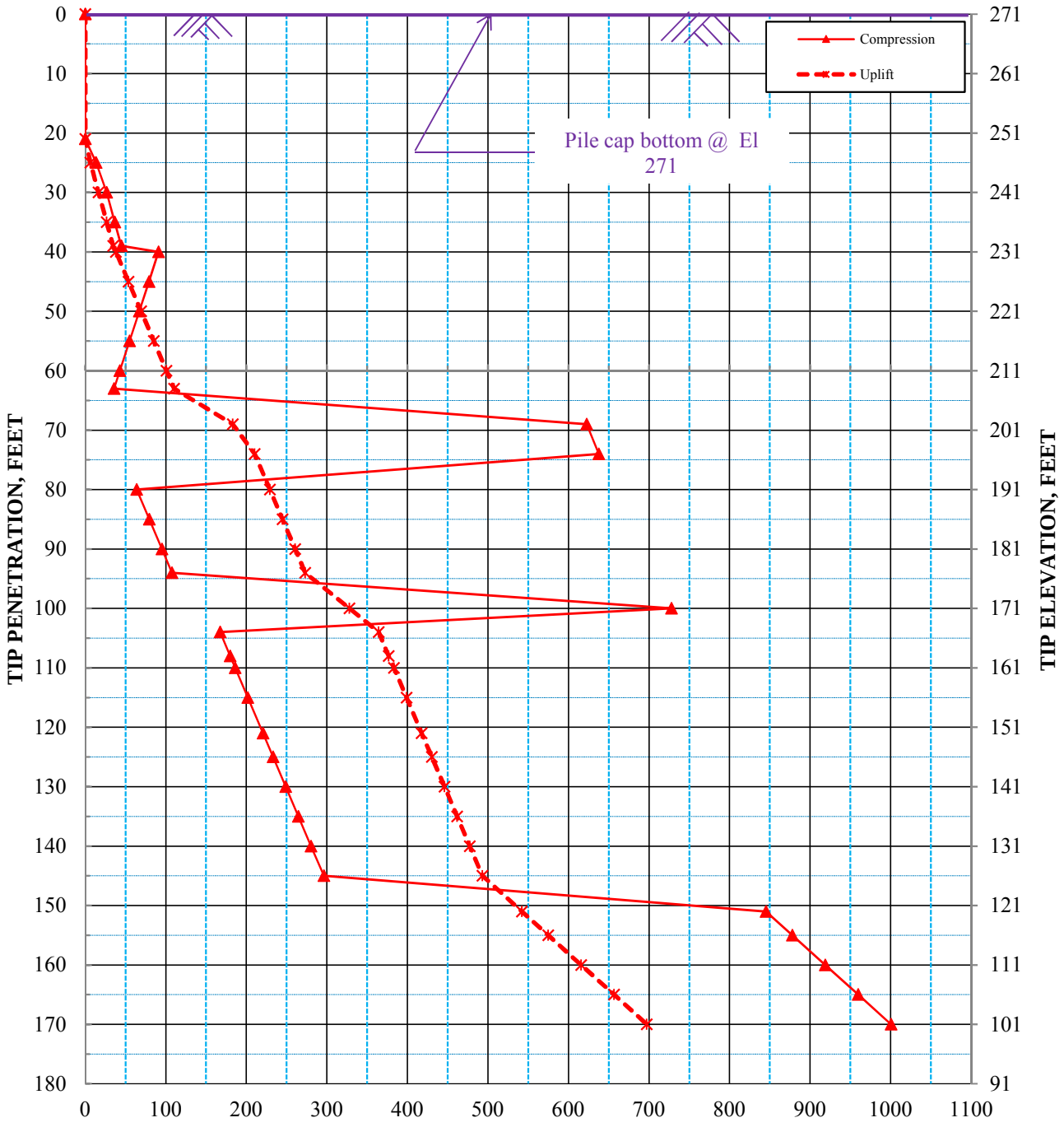
Max Factored Bent Load at Top of Pile, Pu (kips)		MINIMUM PILE REQUIREMENTS				Calculated Downdrag Load, tons
	Bent No.	Nominal Capacity (tons/pile)	Estimated Pile Length, ft	Estimated Min Tip El, ft	Hammer Energy (ft-kips)	
252	1	280	104	173	51	32
226	2	251	80	166	164	54
253	3	281	114	164	51	0

ATTACHMENT 9



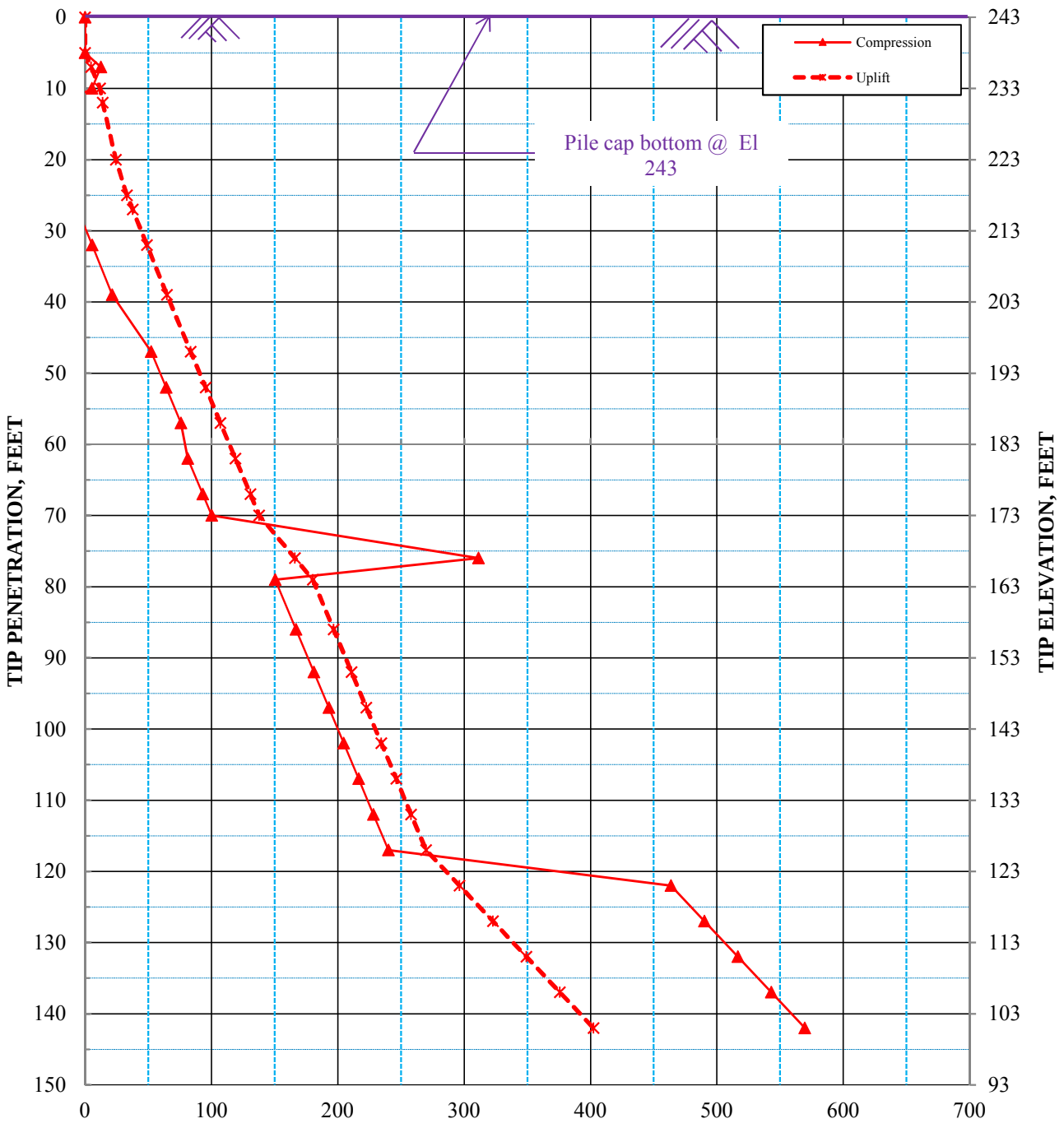
NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells - Jetted
Bent 1 (South Abutment) - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be jetted through dense granular soil strata.
2. Downdrag considered from El 232 to El 208.



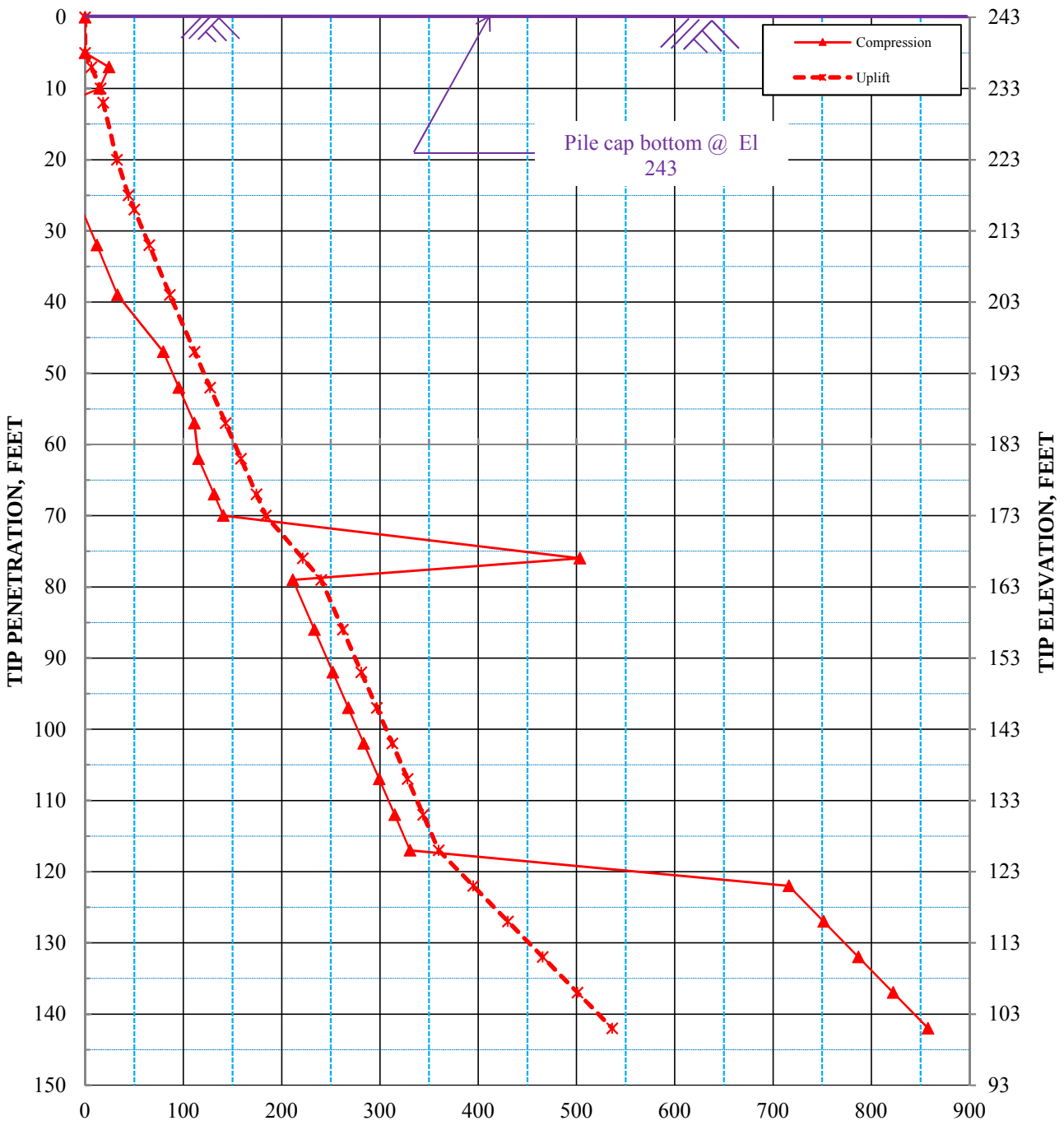
NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells - Jetted
Bent 1 (South Abutment) - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be jetted through dense granular soil strata.
2. Downdrag considered from El 232 to El 208.



NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 2 - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

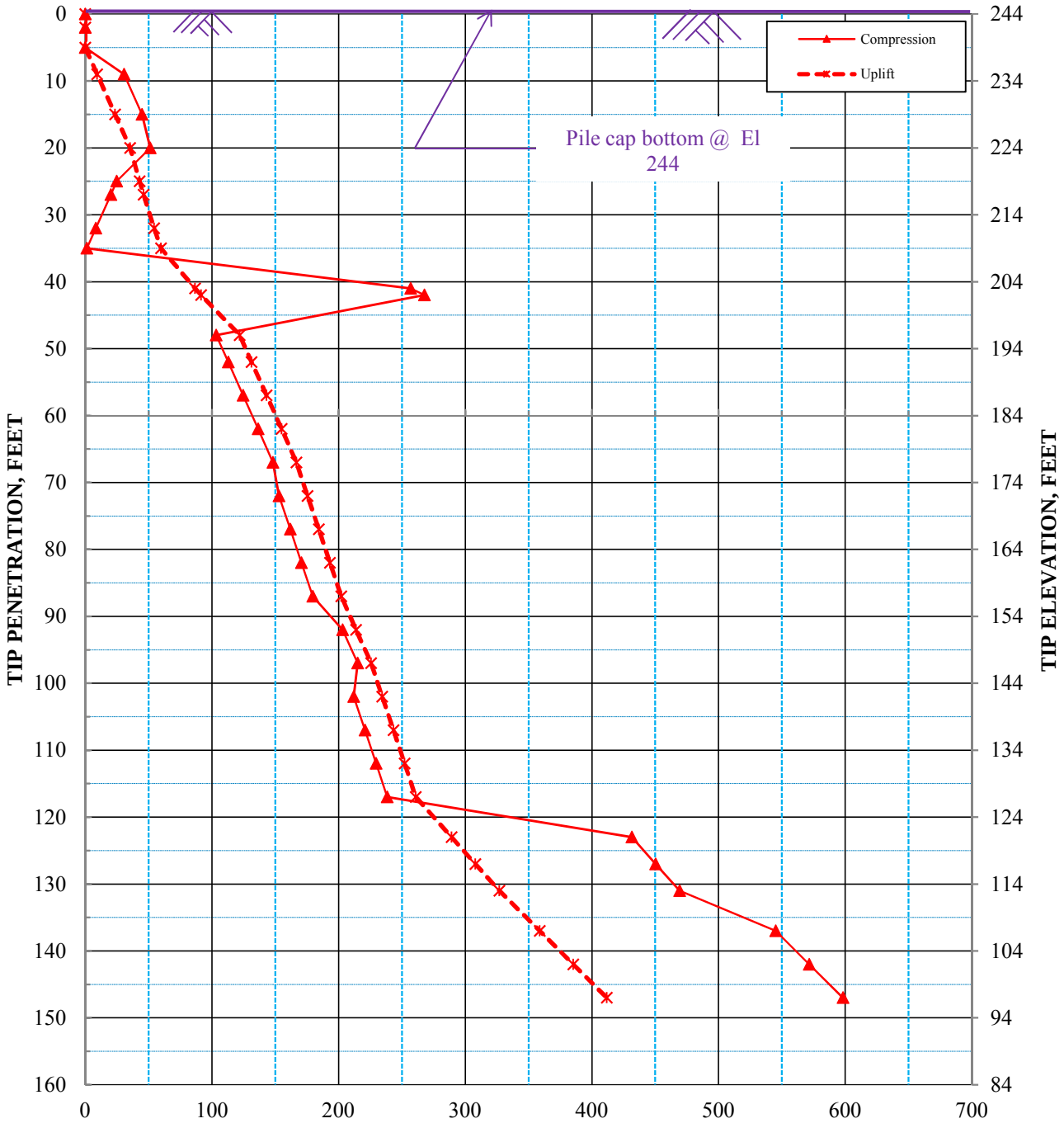
Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered between El 233 and El 223.



NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells
Bent 2 - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

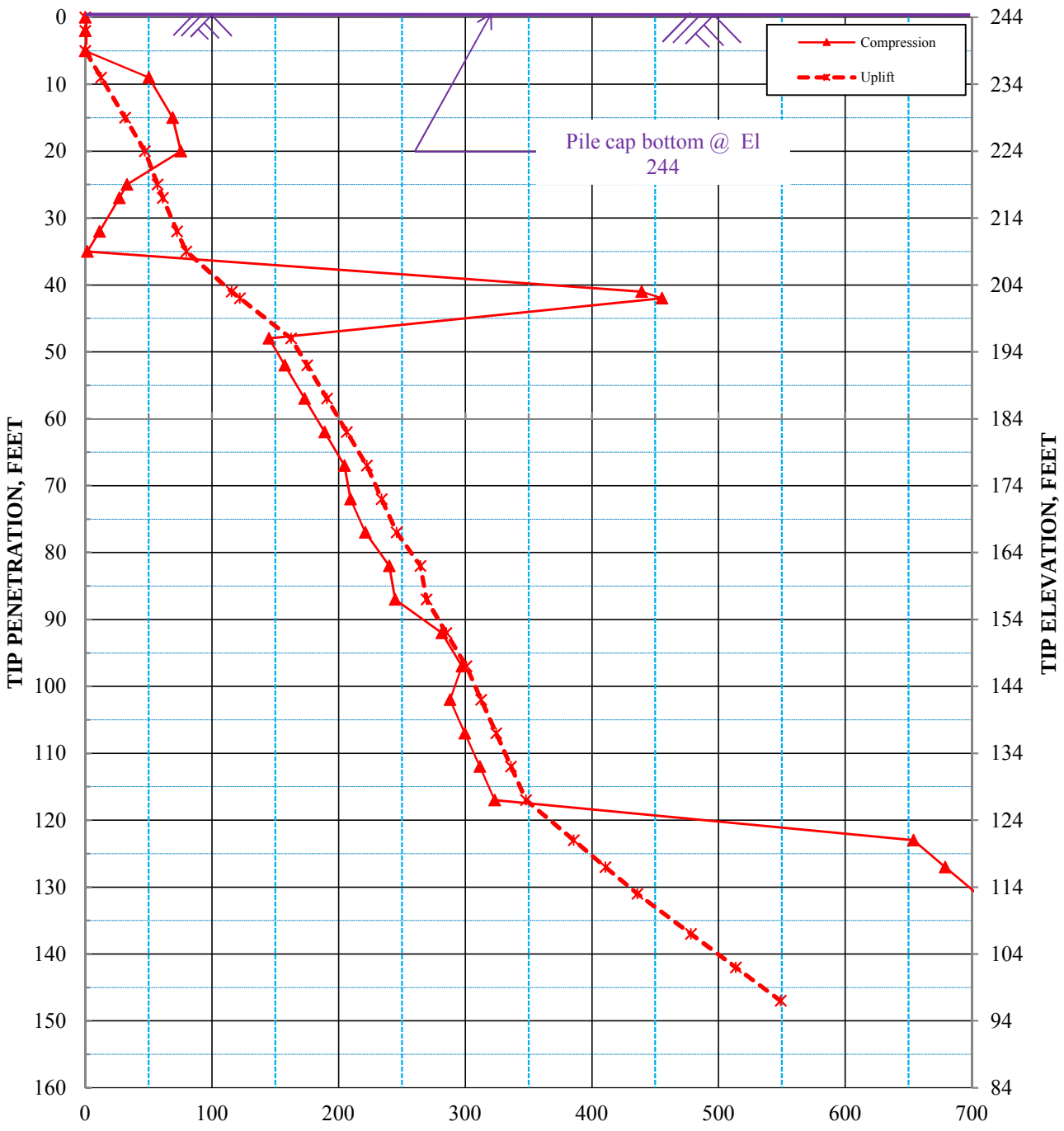
Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered between El 233 and El 223.

NOMINAL SINGLE PILE CAPACITY, TONS



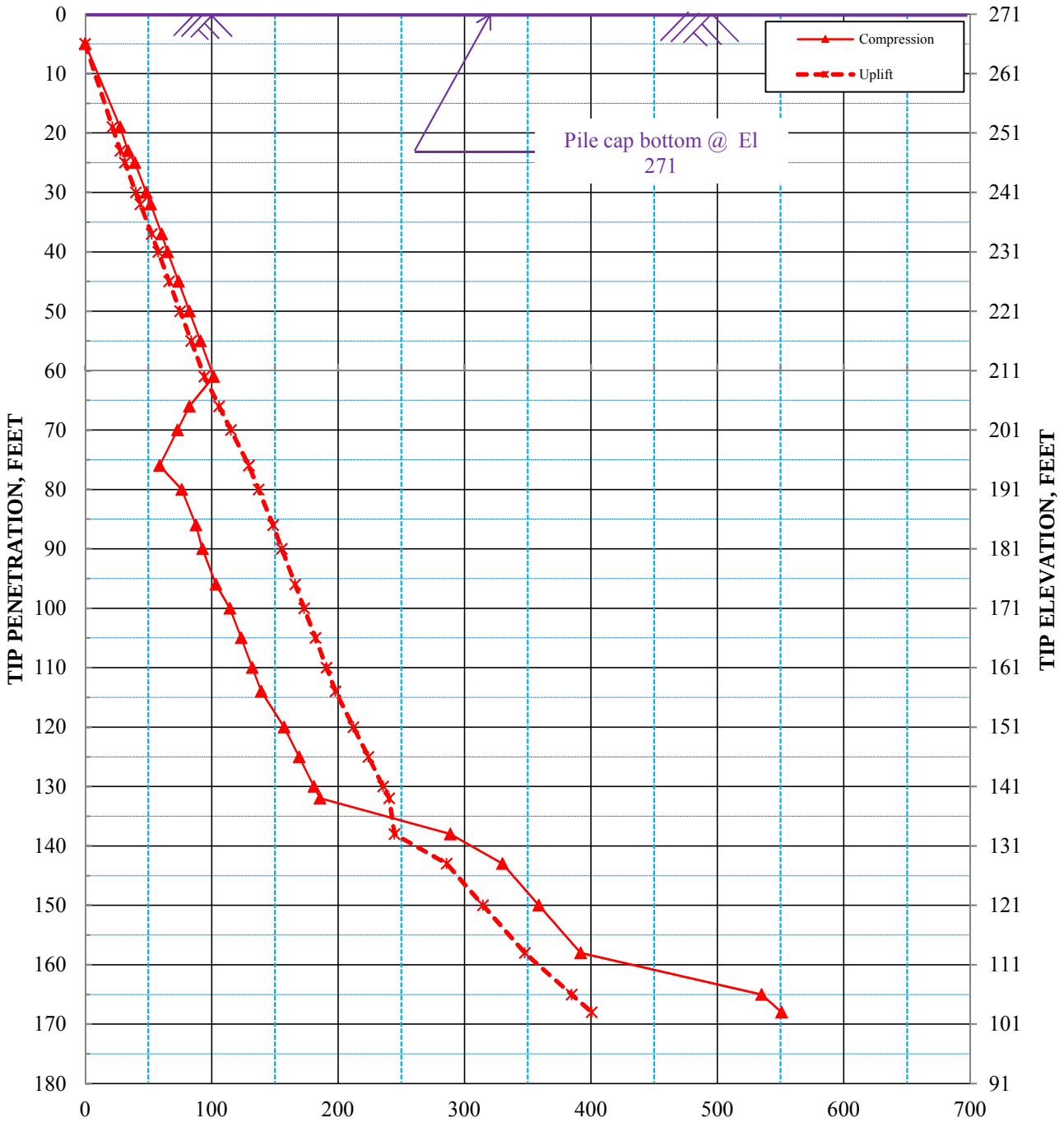
NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 3 - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 224 to El 209.



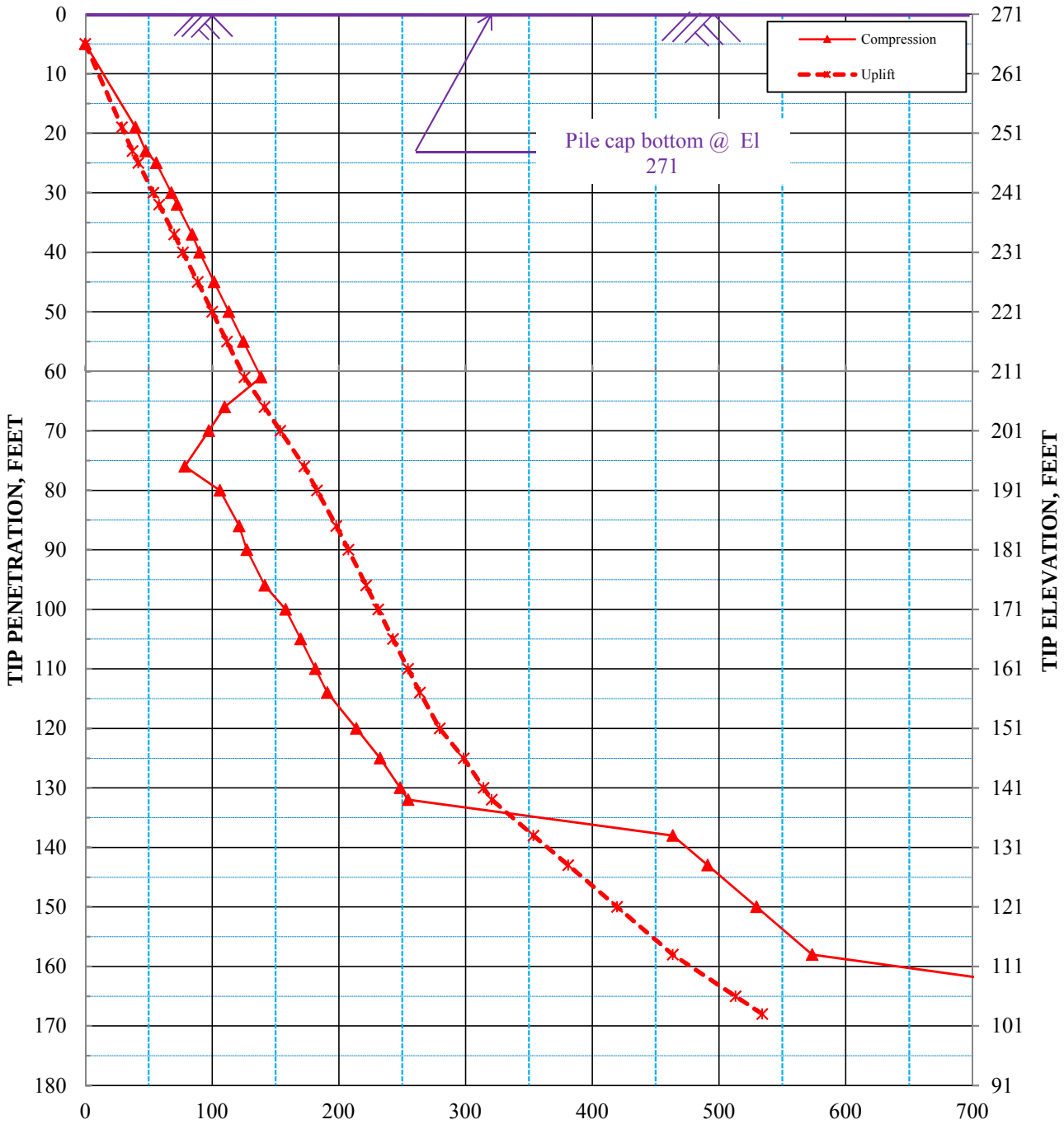
NOMINAL SINGLE PILE CAPACITY, TONS
24-in.-diameter Steel Shells
Bent 3 - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 224 to El 209.



NOMINAL SINGLE PILE CAPACITY, TONS
18-in.-diameter Steel Shells
Bent 4 (North Abutment) - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 210 to El 195.



24-in.-diameter Steel Shells
Bent 4 (North Abutment) - Watt St over BNSF Railroad
100824: BNSF Railroad Overpass (Jonesboro)(P.E.)
Craighead County, Arkansas

Notes: 1. Piles assumed to be driven to plan tip elevation.
2. Downdrag considered from El 210 to El 195.

SUMMARY of PILE REQUIREMENTS

PROJECT: AHTD JOB 100824: BNSF RAILROAD OVERPASS (Jonesboro) (P.E.)
LOCATION: Jonesboro, AR
GHBW JOB No.: 16-022

Resistance factors (jstat) of 0.45 for end bearing and compression skin friction

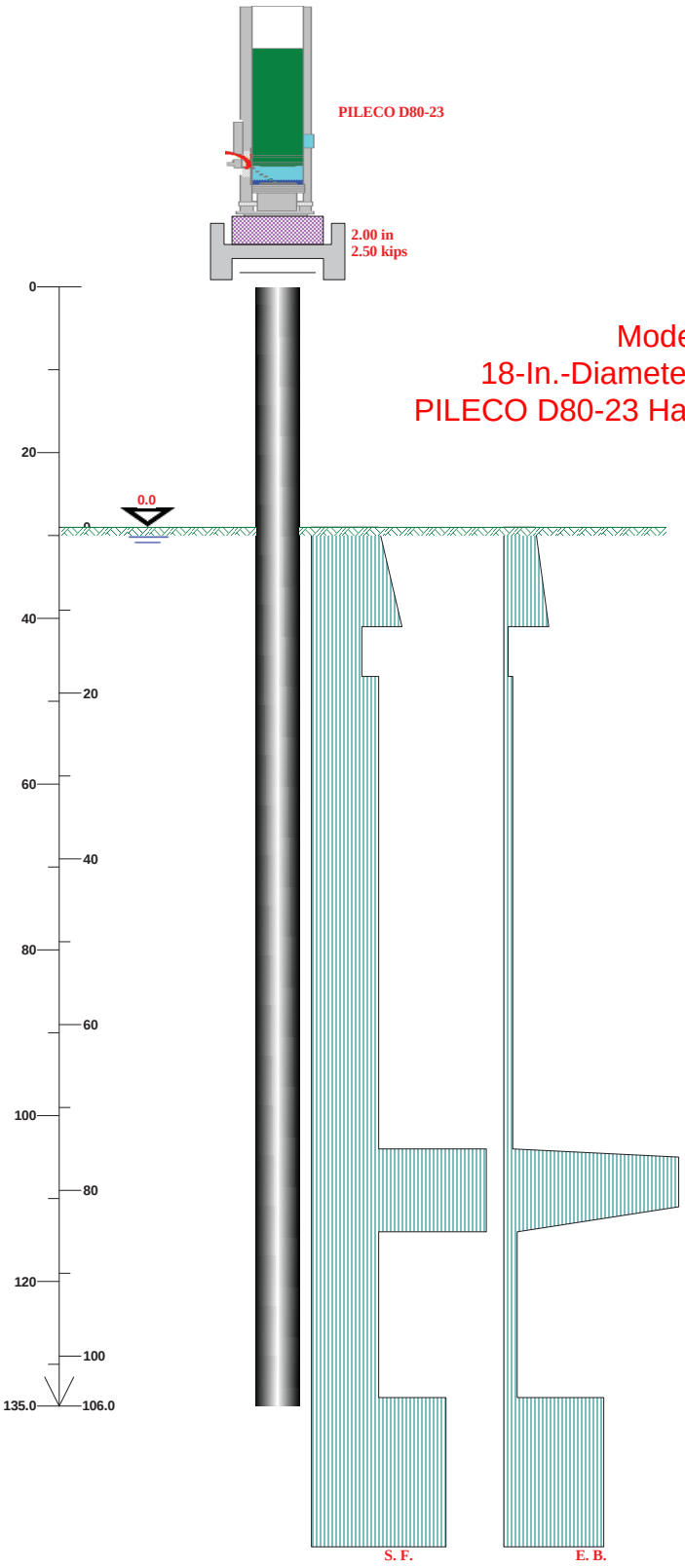
Watt St - 18-in.-dia steel shells

Max Factored Bent Load at Top of Pile, Pu (kips)		MINIMUM PILE REQUIREMENTS				Calculated Downdrag Load, tons
	Bent No.	Nominal Capacity (tons/pile)	Estimated Pile Length, ft	Estimated Min Tip El, ft	Min Hammer Energy (ft-kips)	
243	1	270	146	125	89 (jetted)	57
215	2	239	117	126	90	17
215	3	239	118	126	90	34
191	4	212	133	138	90	36

Watt St - 24-in.-dia steel shells

Max Factored Bent Load at Top of Pile, Pu (kips)		MINIMUM PILE REQUIREMENTS				Calculated Downdrag Load, tons
	Bent No.	Nominal Capacity (tons/pile)	Estimated Pile Length, ft	Estimated Min Tip El, ft	Min Hammer Energy (ft-kips)	
243	1	270	136	135	107 (jetted)	75
215	2	239	90	153	135	22
215	3	239	85	159	135	46
191	4	212	120	151	90	47

ATTACHMENT 10

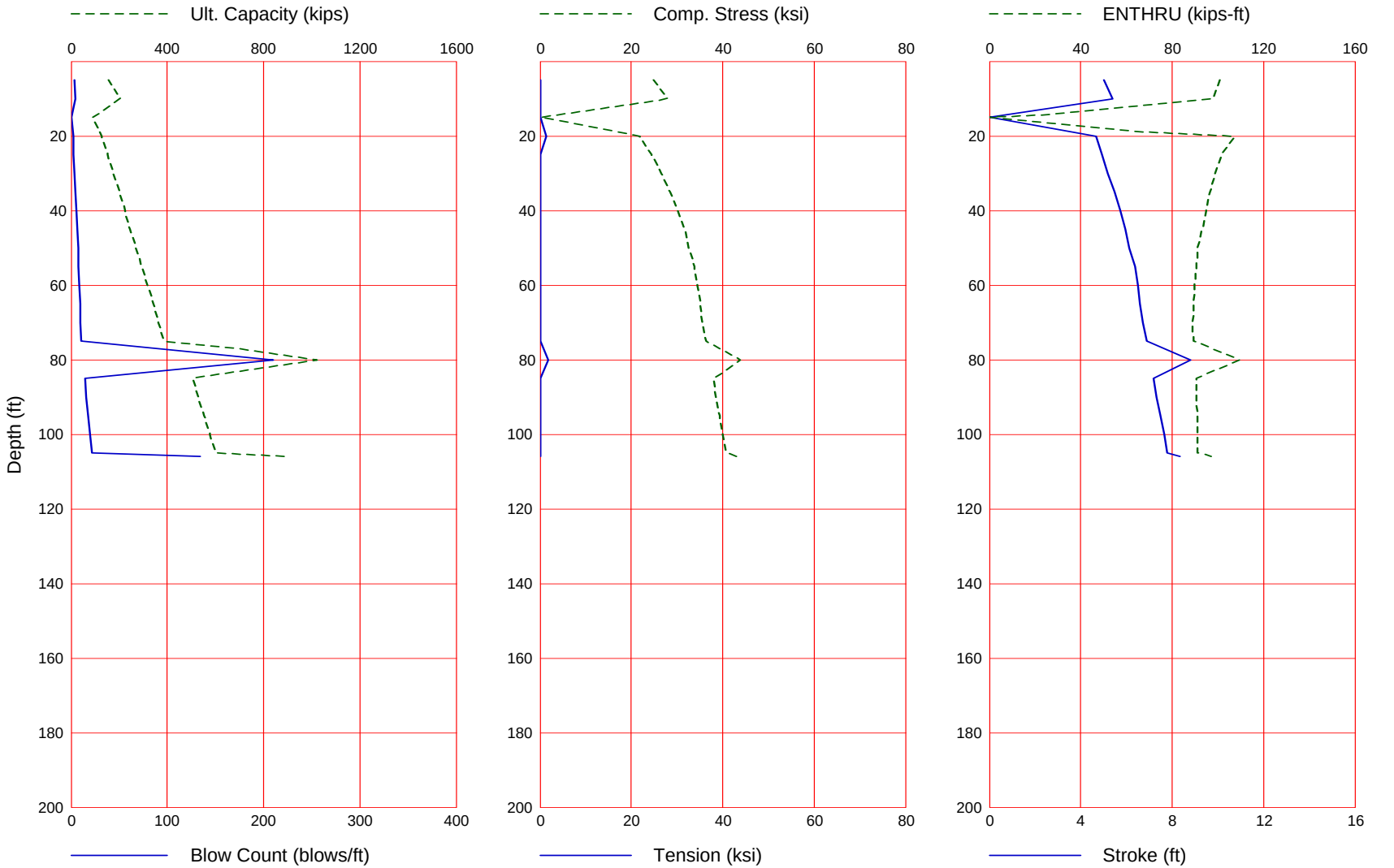


Model for Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
PILECO D80-23 Hammer: E = 197.6 ft-kips; W = 17.64 kips
HWY 18 - Bent 1

Grubbs, Hoskyn, Barton & Wyatt, Inc.
16-022_Hwy 18_Bent 1

Jul 13 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



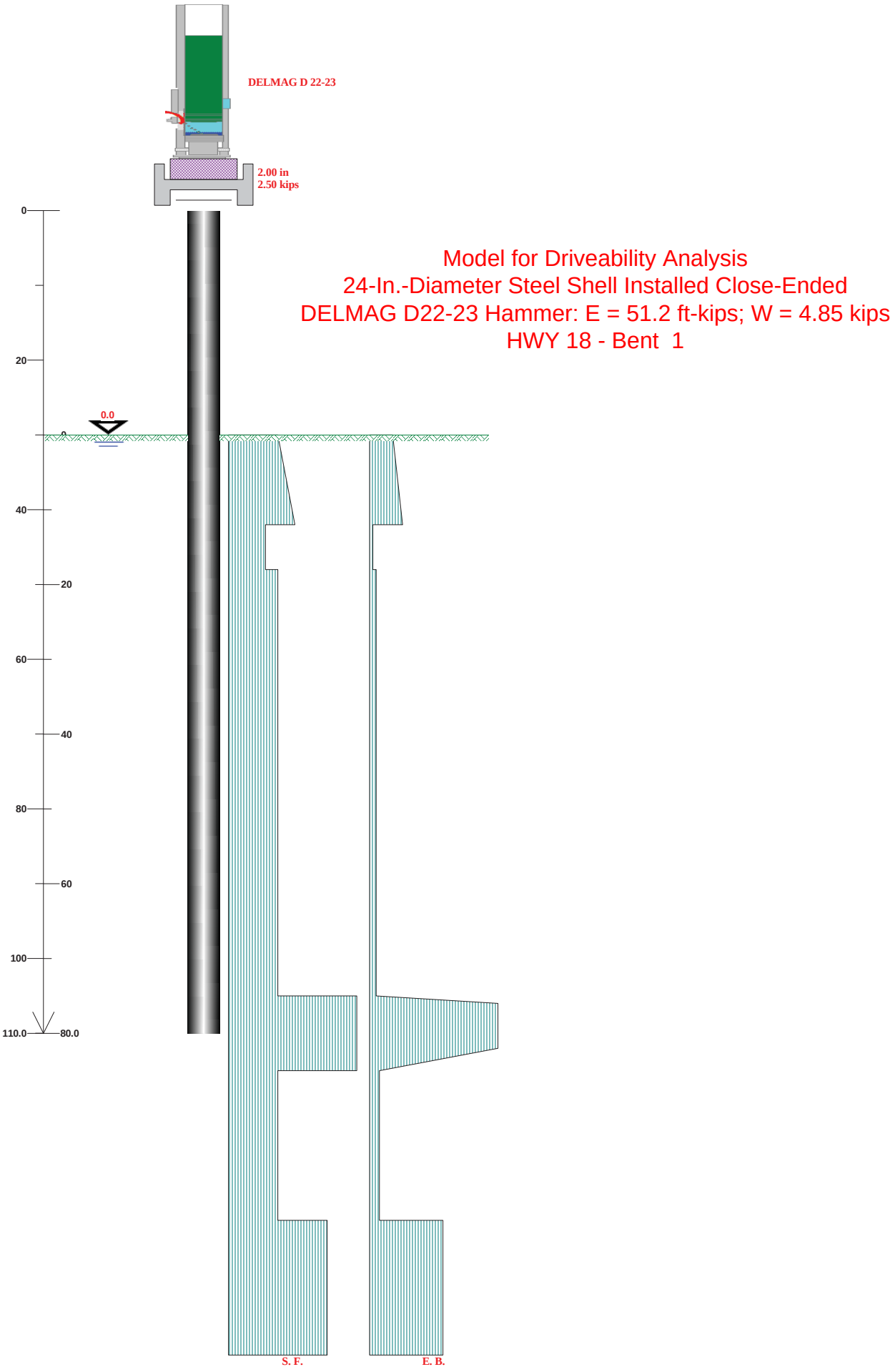
Results of Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
PILECO D80-23 Hammer: E = 197.6 ft-kips; W = 17.64 kips
HWY 18 - Bent 1

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	156.2	25.3	131.0	3.2	24.844	0.000	5.01	100.8
10.0	204.7	53.9	150.8	4.2	27.775	0.000	5.40	97.8
15.0	92.8	76.9	15.9	-1.0	0.000	0.000	0.00	0.0
20.0	128.7	97.0	31.8	2.2	21.936	-1.329	4.67	107.1
25.0	152.3	120.5	31.8	3.0	24.372	0.000	4.92	101.9
30.0	175.8	144.1	31.8	3.7	26.472	0.000	5.20	98.7
35.0	199.4	167.6	31.8	4.4	28.427	0.000	5.48	96.5
40.0	222.9	191.2	31.8	5.2	30.252	0.000	5.73	94.9
45.0	246.5	214.8	31.8	6.1	31.707	0.000	5.97	93.4
50.0	270.1	238.3	31.8	7.1	32.540	0.000	6.12	91.2
55.0	293.6	261.9	31.8	7.9	33.799	0.000	6.36	90.6
60.0	317.2	285.4	31.8	8.6	34.453	0.000	6.50	89.7
65.0	340.7	309.0	31.8	9.3	35.143	0.000	6.61	89.5
70.0	364.3	332.6	31.8	10.1	35.493	0.000	6.70	88.9
75.0	387.9	356.1	31.8	11.0	36.420	0.000	6.87	89.3
80.0	1024.5	407.1	617.4	209.8	43.855	-1.771	8.79	109.4
85.0	505.8	458.2	47.6	14.6	38.061	0.000	7.21	90.6
90.0	529.4	481.7	47.6	16.1	38.507	0.000	7.33	90.6
95.0	552.9	505.3	47.6	17.7	39.382	0.000	7.49	91.0
100.0	576.5	528.8	47.6	19.4	39.946	0.000	7.64	91.1
105.0	600.0	552.4	47.6	21.4	40.866	0.000	7.78	91.1
106.0	914.6	561.8	352.8	133.9	42.908	0.000	8.36	97.0

Total Continuous Driving Time 47.00 minutes; Total Number of Blows 1951

Results of Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
PILECO D 80-23 Hammer: E = 197.6 ft-kips; W = 17.64 kips
HWY 18 - Bent 1

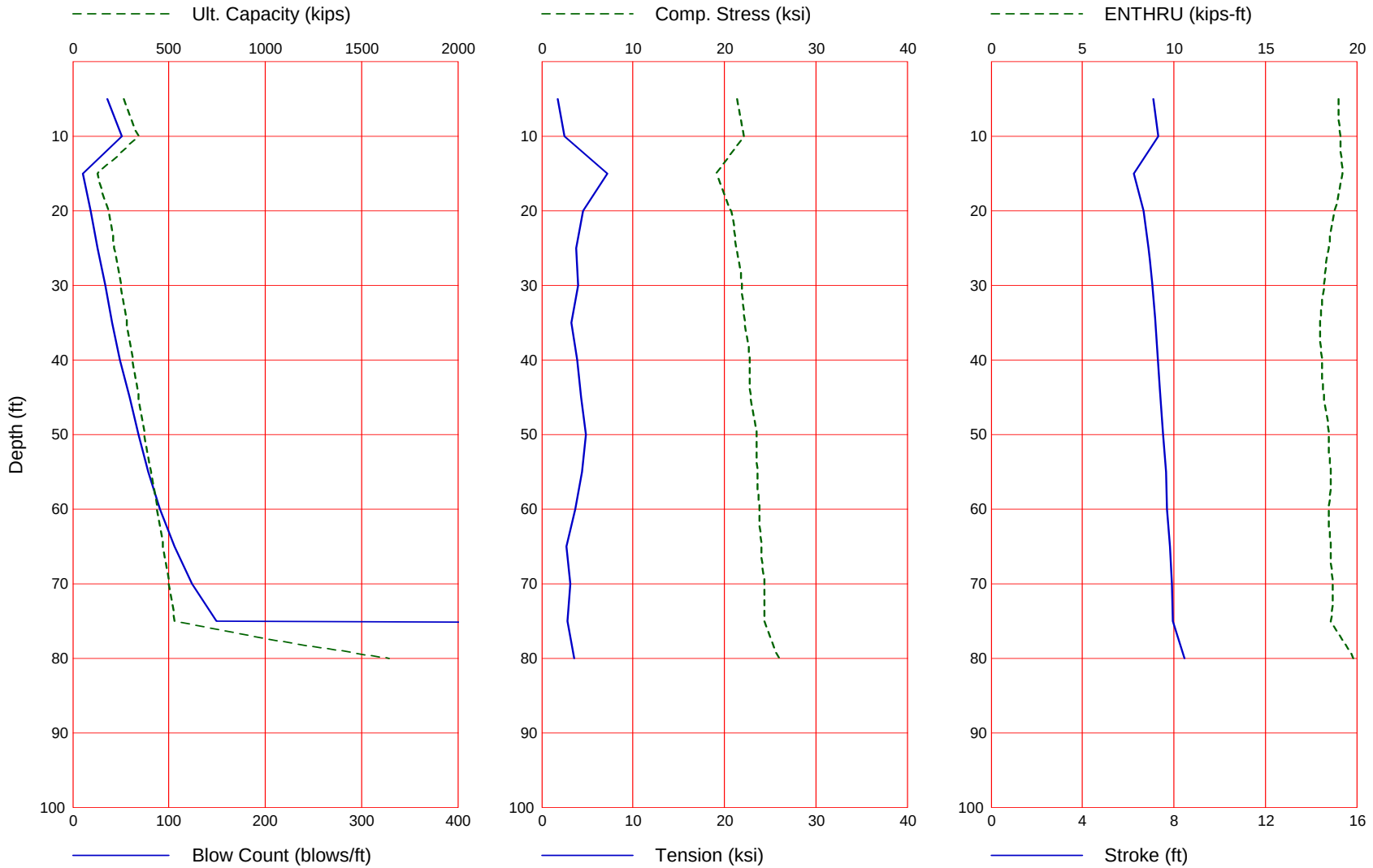


Model for Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D22-23 Hammer: E = 51.2 ft-kips; W = 4.85 kips
HWY 18 - Bent 1

Grubbs, Hoskyn, Barton & Wyatt, Inc.
16-022_Hwy 18_Bent 1

Aug 11 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



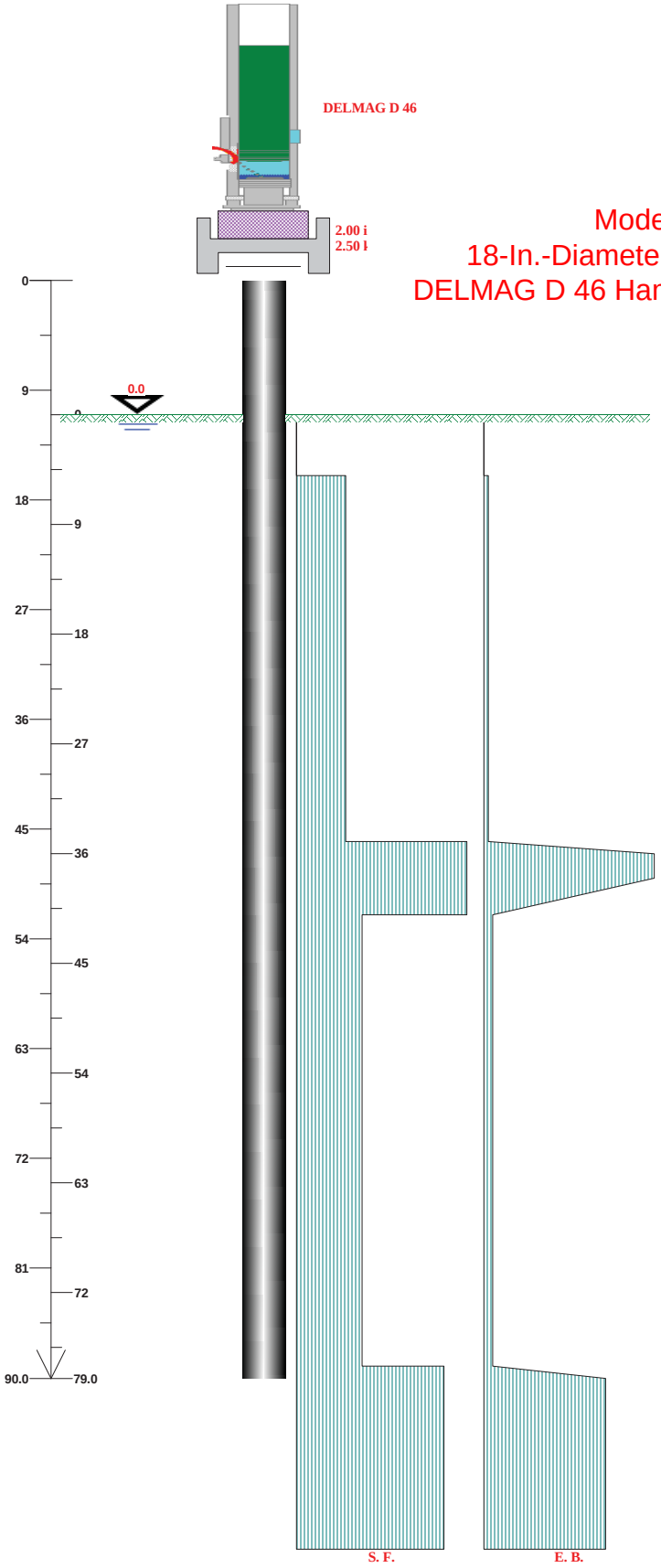
Results of Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D22-23 Hammer: E = 51.2 ft-kips; W = 4.85 kips
HWY 18 - Bent 1

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	266.9	33.7	233.3	36.0	21.410	-1.740	7.11	19.0
10.0	340.5	71.9	268.6	50.7	22.144	-2.559	7.33	19.1
15.0	130.8	102.6	28.3	10.8	19.152	-7.176	6.26	19.2
20.0	185.8	129.3	56.5	19.2	20.729	-4.541	6.69	18.8
25.0	217.2	160.7	56.5	26.1	21.270	-3.768	6.89	18.5
30.0	248.7	192.1	56.5	33.7	21.920	-4.021	7.04	18.2
35.0	280.1	223.5	56.5	41.0	22.208	-3.214	7.18	18.0
40.0	311.5	254.9	56.5	49.2	22.724	-3.888	7.30	18.1
45.0	342.9	286.4	56.5	59.0	22.901	-4.315	7.42	18.2
50.0	374.3	317.8	56.5	68.6	23.469	-4.828	7.55	18.5
55.0	405.7	349.2	56.5	78.8	23.585	-4.459	7.67	18.6
60.0	437.1	380.6	56.5	91.1	23.876	-3.712	7.70	18.5
65.0	468.6	412.0	56.5	105.9	24.010	-2.705	7.82	18.6
70.0	500.0	443.4	56.5	123.8	24.416	-3.173	7.90	18.7
75.0	531.4	474.8	56.5	149.4	24.330	-2.867	7.96	18.6
80.0	1642.5	542.9	1099.6	9999.0	25.965	-3.552	8.45	19.8

Refusal occurred; no driving time output possible

Results of Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D22-23 Hammer: E = 51.2 ft-kips; W = 4.85 kips
HWY 18 - Bent 1

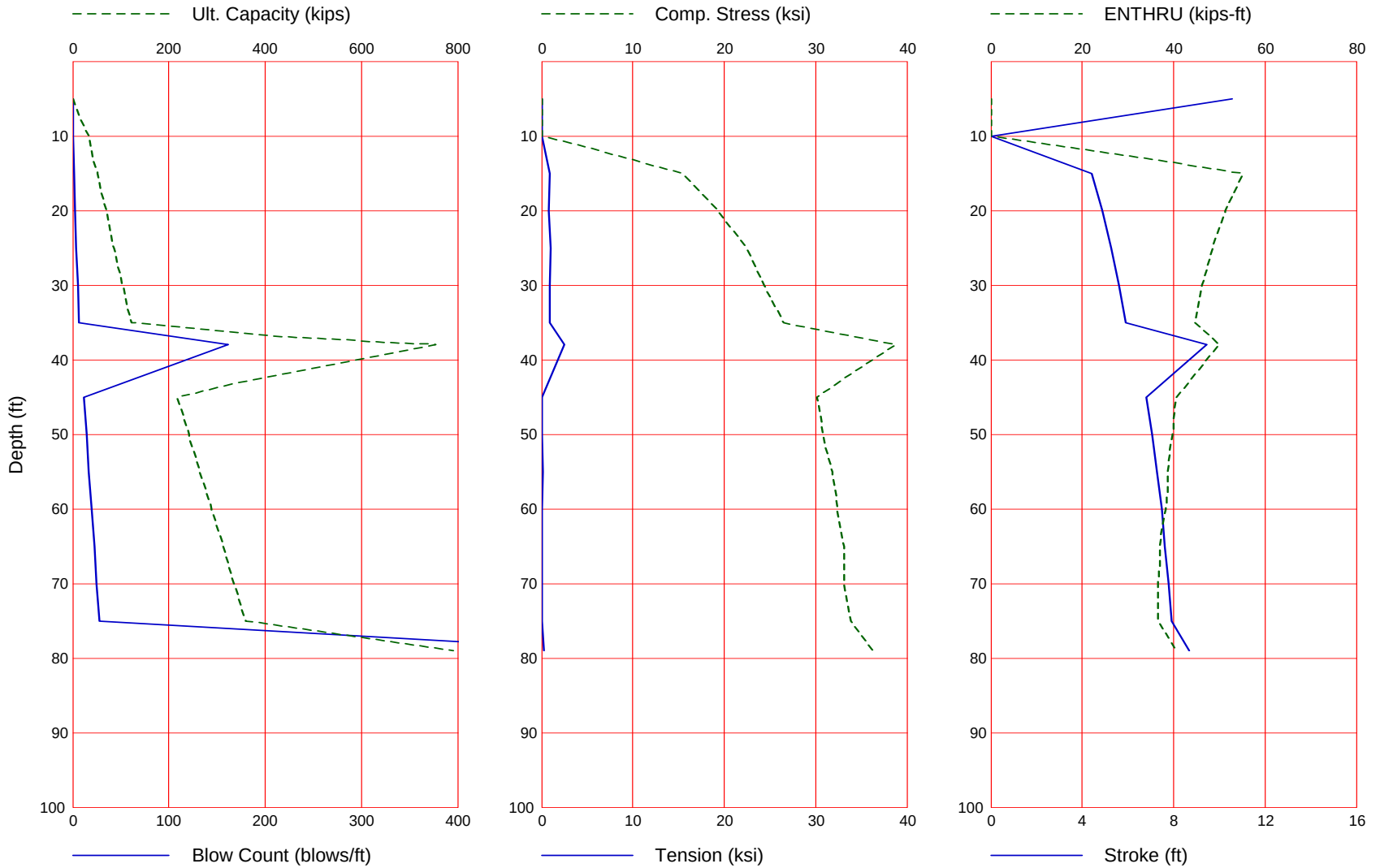


Model for Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 46 Hammer: E = 107.1 ft-kips; W = 10.14 kips
HWY 18 - Bent 2

Grubbs, Hoskyn, Barton & Wyatt, Inc.
16-022_Driveability_HWY 18_Bent 2

Aug 11 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



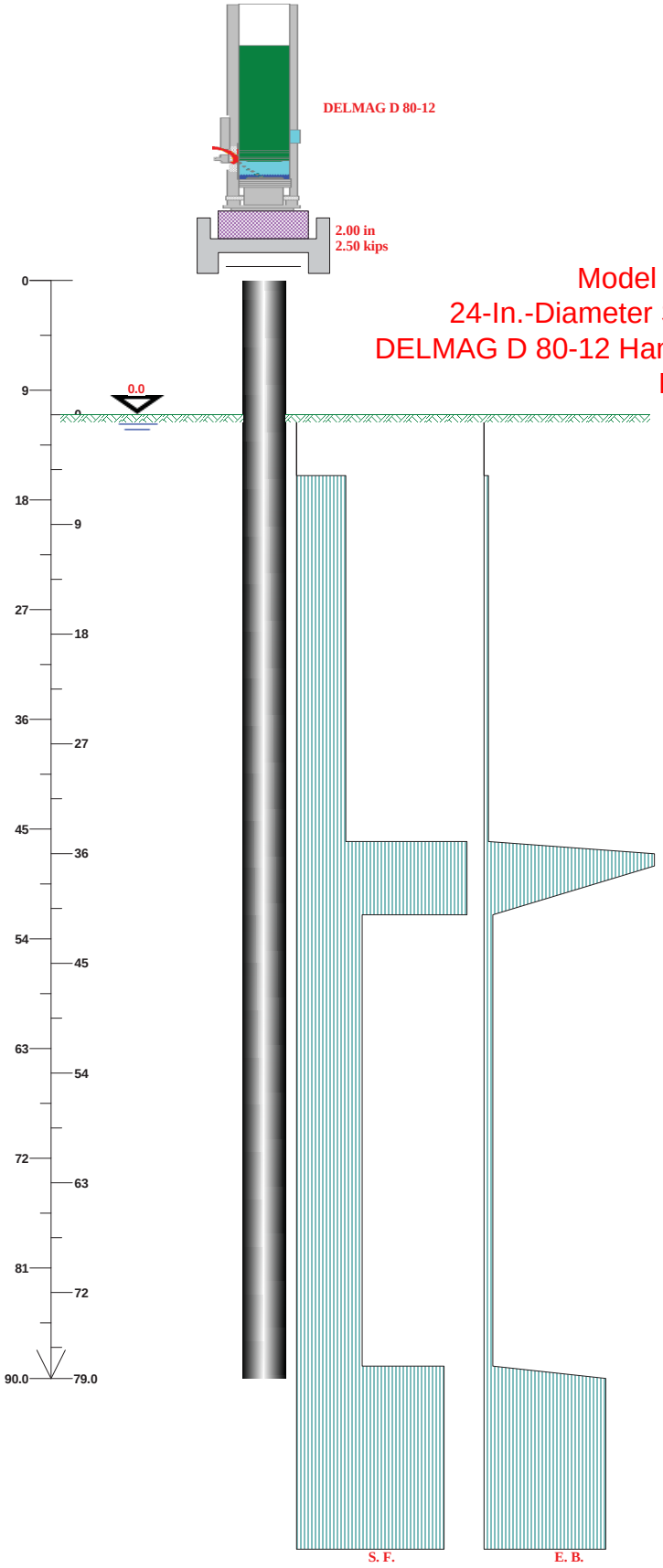
Results of Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 46 Hammer: E = 107.1 ft-kips; W = 10.14 kips
HWY 18 - Bent 2

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	0.0	0.0	0.0	0.0	0.000	0.000	10.56	0.0
10.0	33.6	17.7	15.9	-1.0	0.000	0.000	0.00	0.0
15.0	51.2	35.3	15.9	2.0	15.406	-0.862	4.43	55.2
20.0	68.9	53.0	15.9	2.9	19.412	-0.814	4.88	51.2
25.0	86.6	70.7	15.9	3.9	22.493	-0.980	5.29	48.5
30.0	104.2	88.4	15.9	5.1	24.396	-0.903	5.60	46.2
35.0	121.9	106.0	15.9	6.2	26.477	-0.859	5.93	44.7
38.0	754.0	136.6	617.4	161.9	38.746	-2.457	9.47	50.1
45.0	217.8	186.1	31.8	11.8	30.166	0.000	6.80	40.6
50.0	241.4	209.7	31.8	14.3	30.779	0.000	7.05	39.8
55.0	265.0	233.2	31.8	17.2	31.829	-0.120	7.26	38.8
60.0	288.5	256.8	31.8	19.9	32.323	-0.039	7.50	38.3
65.0	312.1	280.3	31.8	22.5	33.076	0.000	7.63	37.0
70.0	335.6	303.9	31.8	25.2	33.164	0.000	7.77	36.5
75.0	359.2	327.5	31.8	28.3	33.908	0.000	7.90	36.6
79.0	791.4	350.4	441.0	565.0	36.199	-0.238	8.69	40.5

Total Continuous Driving Time 68.00 minutes; Total Number of Blows 2727

Results of Driveability Analysis
18-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 46 Hammer: E = 107.1 ft-kips; W = 10.14 kips
HWY 18 - Bent 2

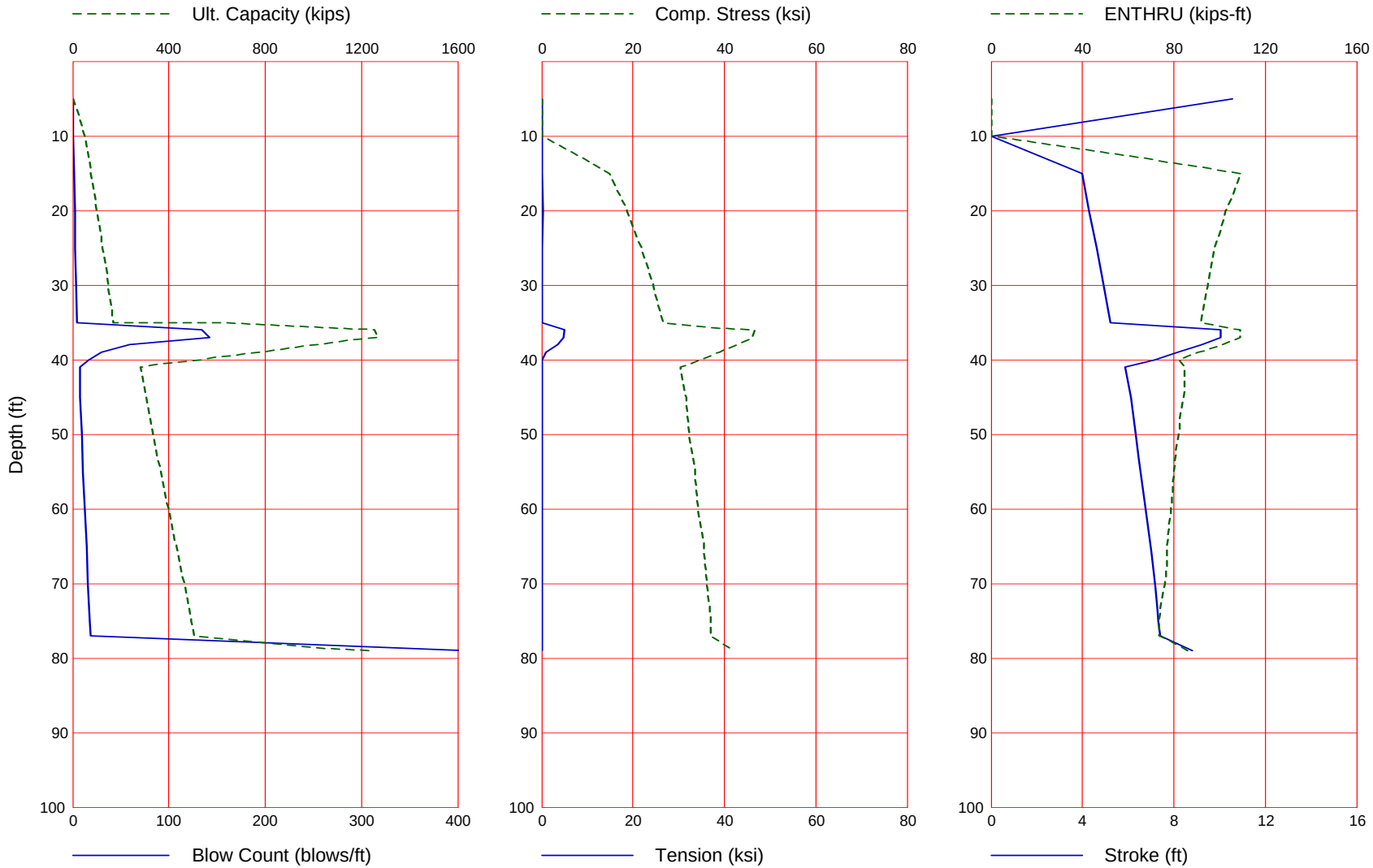


Model for Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 80-12 Hammer: E = 186.2 ft-kips; W = 17.62 kips
HWY 18 - Bent 2

Grubbs, Hoskyn, Barton & Wyatt, Inc.
16-022_Driveability_HWY 18_Bent 2

Aug 11 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



Results of Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 80-12 Hammer: E = 186.2 ft-kips; W = 17.62 kips
HWY 18 - Bent 2

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	0.0	0.0	0.0	0.0	0.000	0.000	10.57	0.0
10.0	51.8	23.6	28.3	-1.0	0.000	0.000	0.00	0.0
15.0	75.4	47.1	28.3	1.6	14.774	0.000	3.97	109.6
20.0	99.0	70.7	28.3	2.3	18.563	-0.384	4.28	102.7
25.0	122.5	94.2	28.3	3.0	21.952	-0.132	4.62	98.1
30.0	146.1	117.8	28.3	3.7	24.412	0.000	4.94	94.8
35.0	169.6	141.4	28.3	4.5	26.531	-0.071	5.22	91.9
36.0	1254.6	155.0	1099.6	134.1	46.541	-4.961	10.04	109.1
37.0	1268.2	168.6	1099.6	141.9	46.131	-4.789	10.04	109.1
38.0	1021.0	182.2	838.8	58.9	42.765	-3.583	9.25	101.3
39.0	773.9	195.8	578.1	29.6	38.925	-1.019	8.17	90.6
40.0	526.7	209.4	317.3	16.4	34.942	0.000	7.15	82.1
41.0	279.6	223.0	56.5	7.1	30.432	0.000	5.87	84.9
45.0	304.7	248.1	56.5	8.0	31.583	0.000	6.12	84.2
50.0	336.1	279.6	56.5	9.4	32.289	0.000	6.33	82.0
55.0	367.5	311.0	56.5	11.0	33.637	0.000	6.57	80.2
60.0	398.9	342.4	56.5	12.8	34.289	0.000	6.78	78.7
65.0	430.4	373.8	56.5	14.8	35.436	0.000	6.96	76.9
70.0	461.8	405.2	56.5	16.1	36.098	0.000	7.20	76.0
75.0	493.2	436.6	56.5	17.8	36.979	0.000	7.33	73.8
77.0	505.8	449.2	56.5	18.5	36.955	0.000	7.39	73.5
79.0	1252.7	467.3	785.4	408.3	42.216	0.000	8.81	85.9

Total Continuous Driving Time 32.00 minutes; Total Number of Blows 1330

Results of Driveability Analysis
24-In.-Diameter Steel Shell Installed Close-Ended
DELMAG D 80-12 Hammer: E = 186.2 ft-kips; W = 17.62 kips
HWY 18 - Bent 2

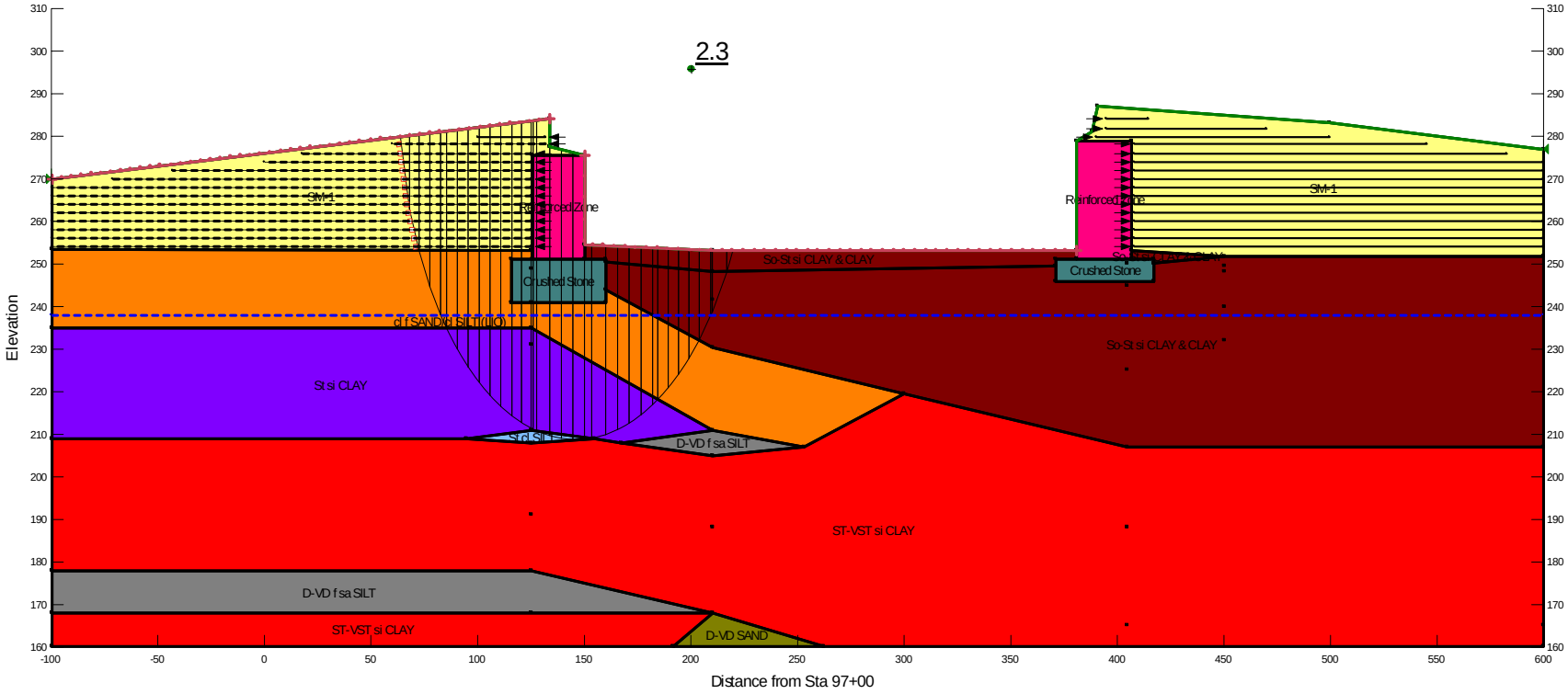
ATTACHMENT 11

Summary of Stability Analysis Results
MSE Wall AA @ West Bridge Abutment (Bent 1)
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

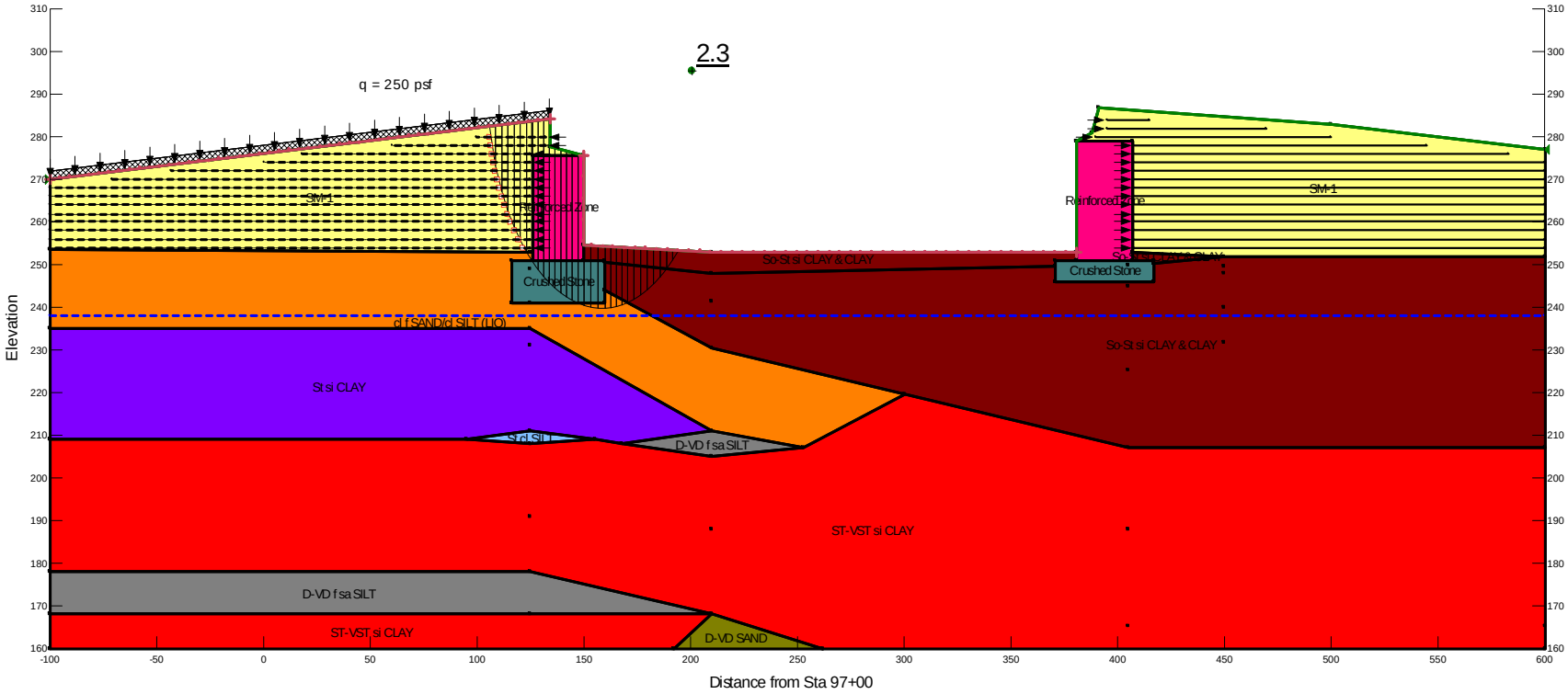
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 1 (West Abutment)	End of Construction	2.3
	Long Term	2.3
	Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

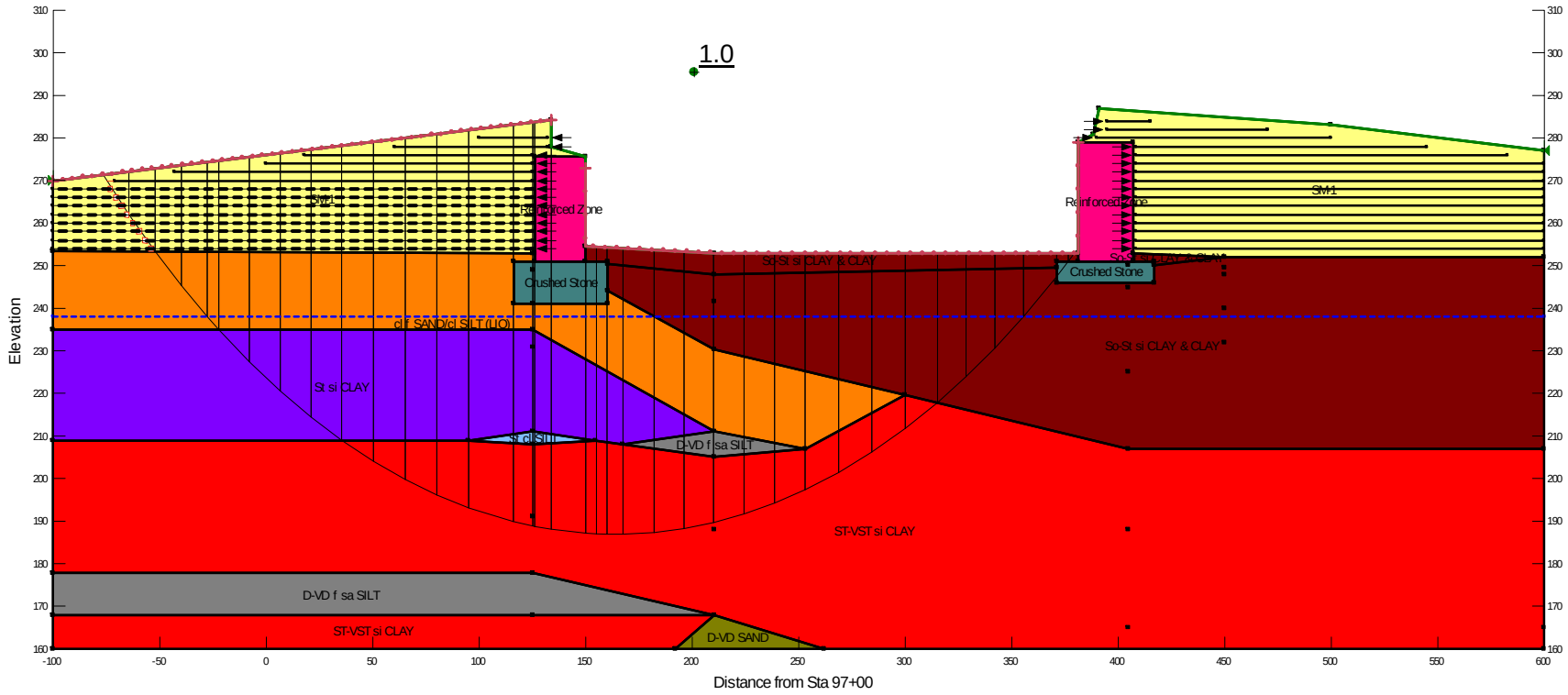
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
SM-1	125	--	--	32
Crushed Stone	140	--	--	38
Soft to Stiff Clay and silty Clay	120	1.2	200	24
clayey fine Sand and clayey Silt (Liquefiable)	120	--	--	32
Stiff silty Clay	120	1.5	200	24
Stiff clayey Silt	120	1.0	250	25
Dense to Very Dense fine sandy Silt	125	--	--	35
Stiff to Very Stiff silty Clay	120	2.4	300	23
Dense to Very Dense Sand	130	--	--	38



Results of Stability Analyses – End of Construction Condition
MSE Wall AA @ West Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall AA @ West Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



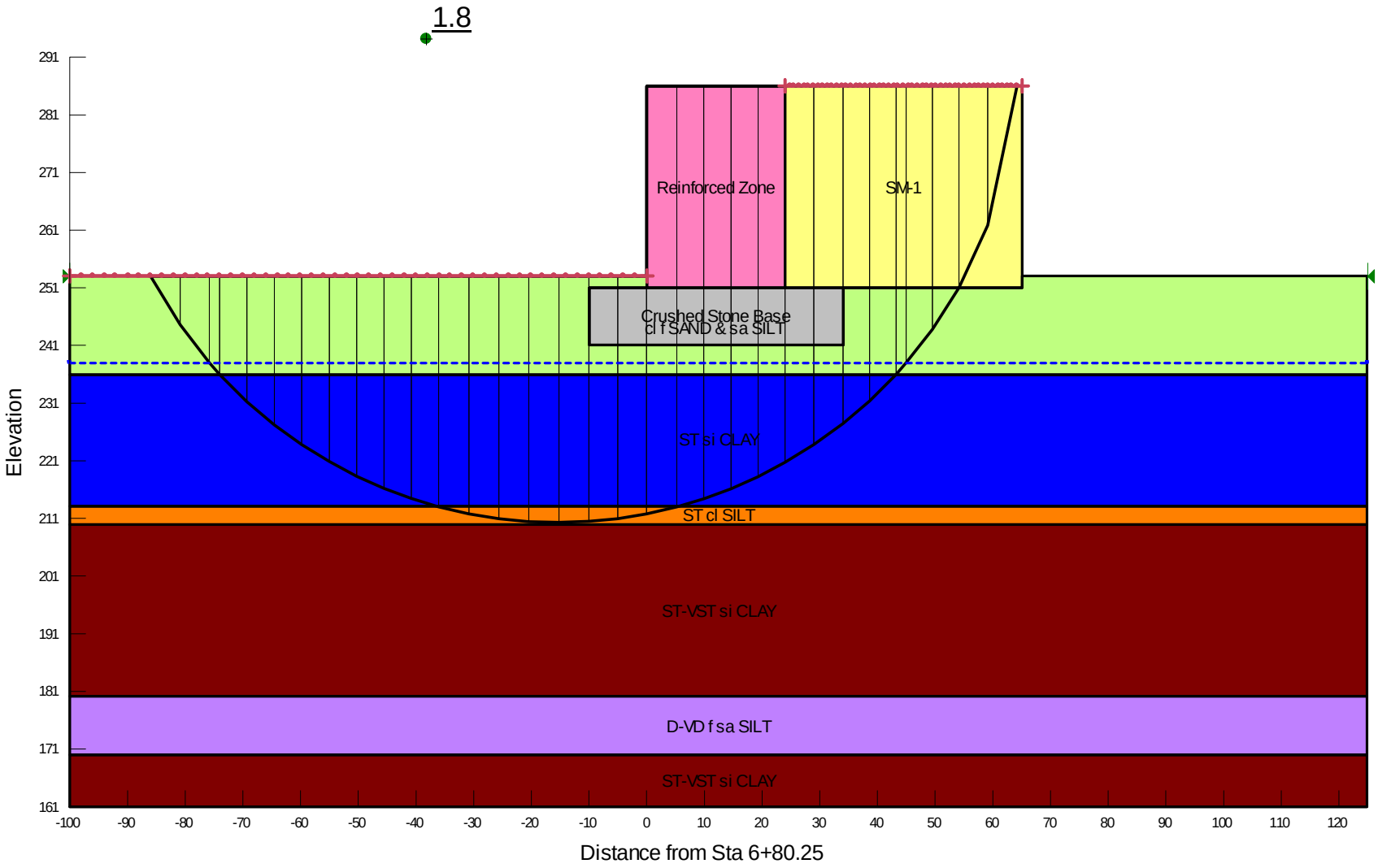
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall AA @ West Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
MSE Wall AA @ Wall AA Sta 6+80
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

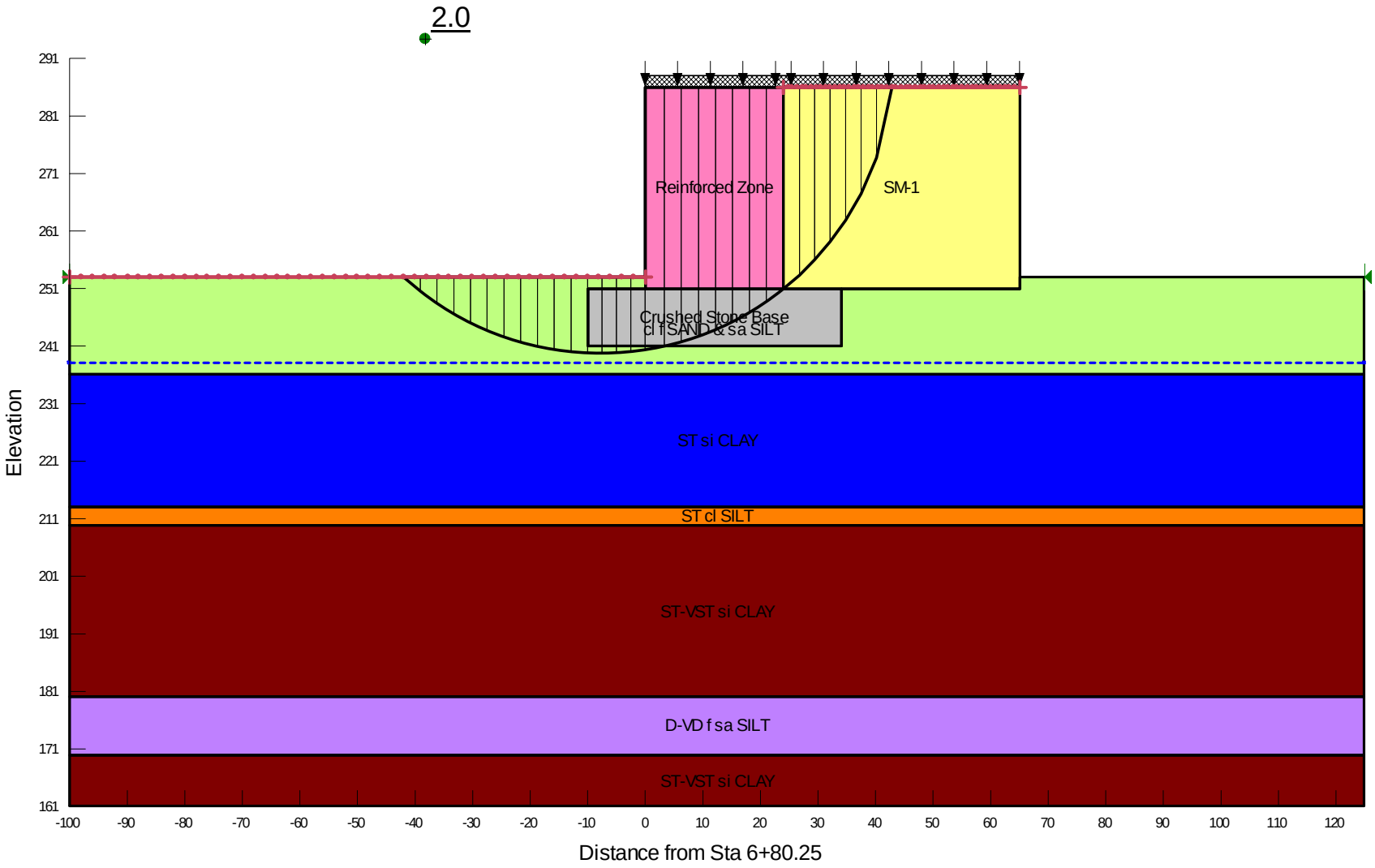
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	1.8
Long Term	2.0
Seismic ($k_h = 0.5A_S = 0.34$)	1.1

Summary of Soil Strength Parameters

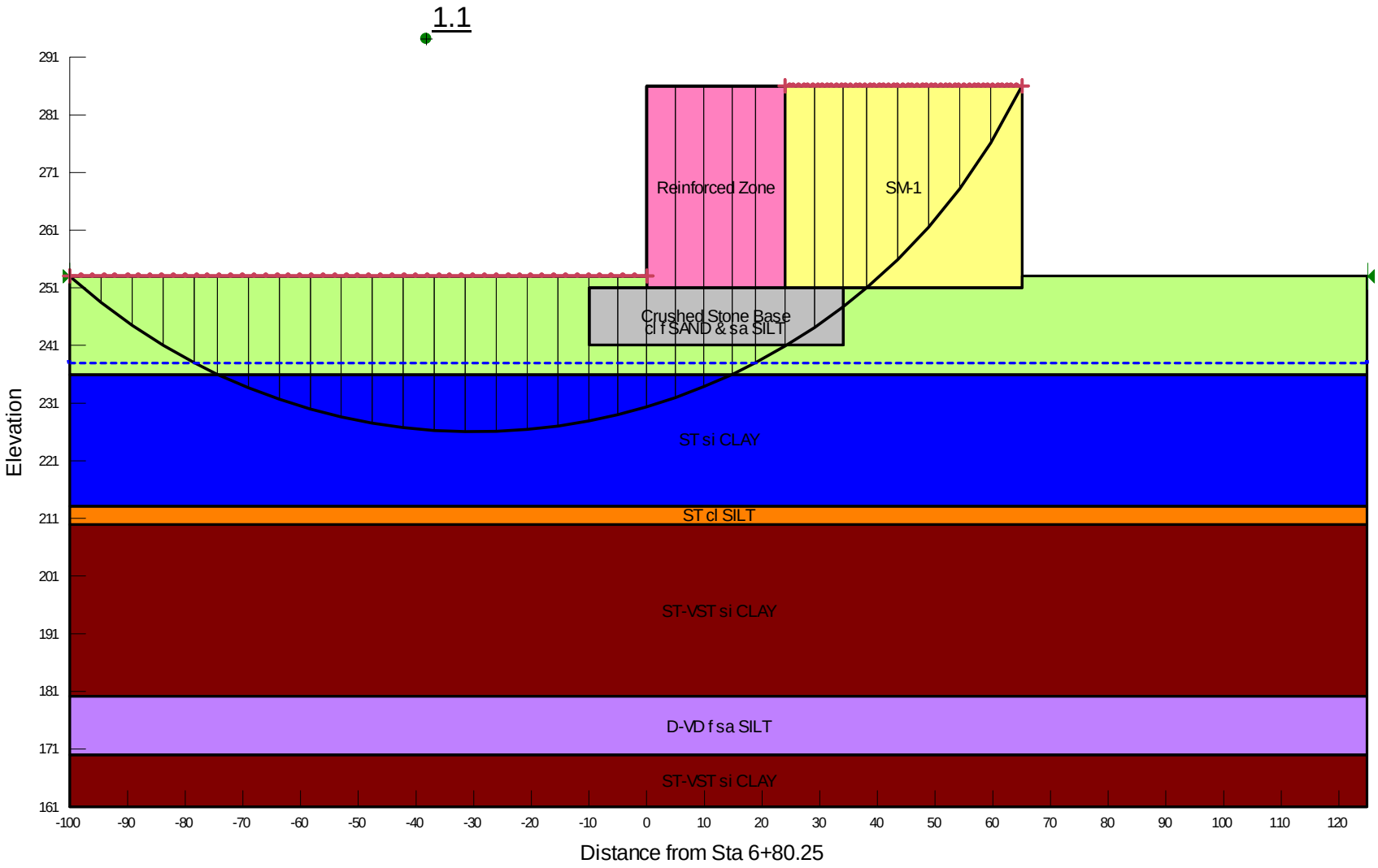
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
SM-1	125	--	--	32
Crushed Stone	140	--	--	38
clayey fine Sand and clayey Silt	120	--	--	32
Stiff silty Clay	120	1.5	200	24
Stiff clayey Silt	120	1.0	250	25
Dense to Very Dense fine sandy Silt	125	--	--	35
Stiff to Very Stiff silty Clay	120	2.4	300	23



Results of Stability Analyses – End of Construction Condition
MSE Wall AA @ Wall AA Sta 6+80
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall AA @ Wall AA Sta 6+80
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



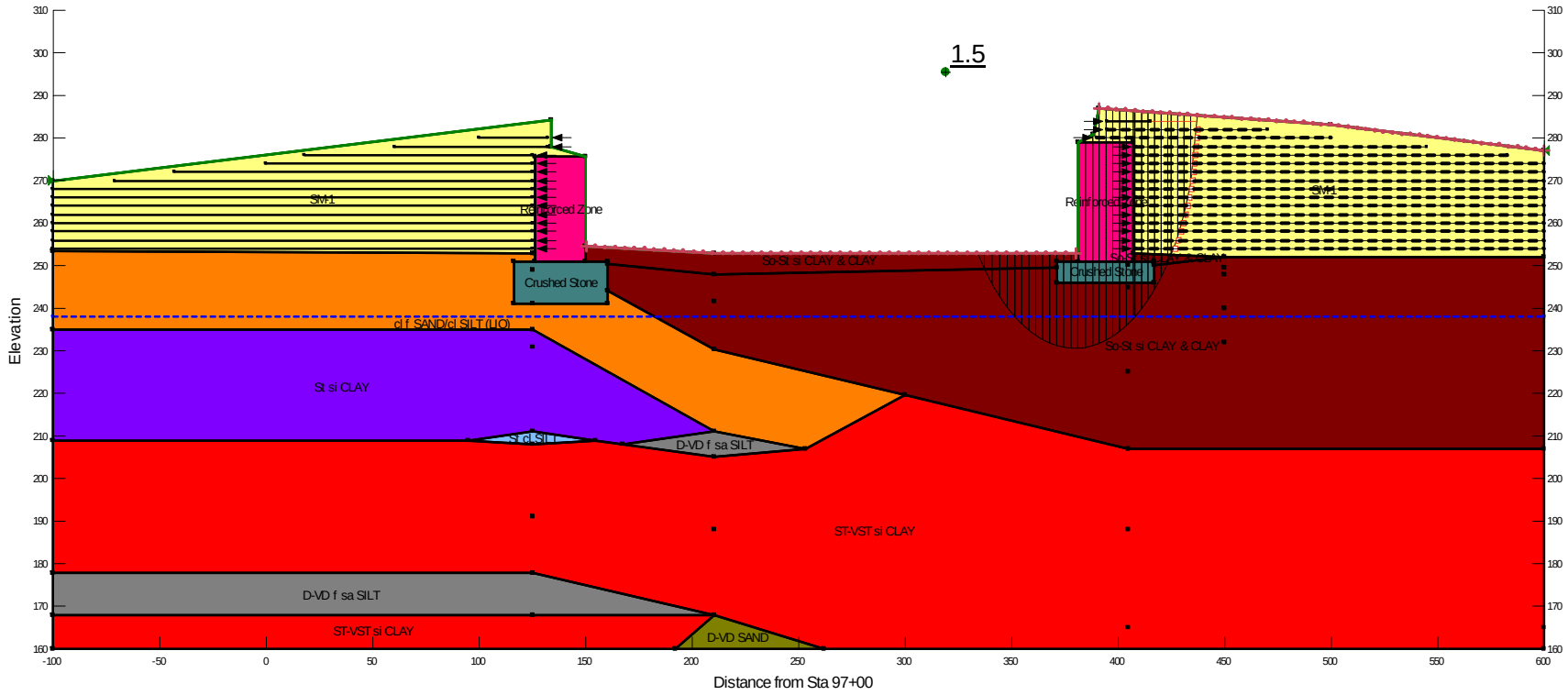
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall AA @ Wall AA Sta 6+80
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
MSE Wall BB @ East Bridge Abutment (Bent 3)
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

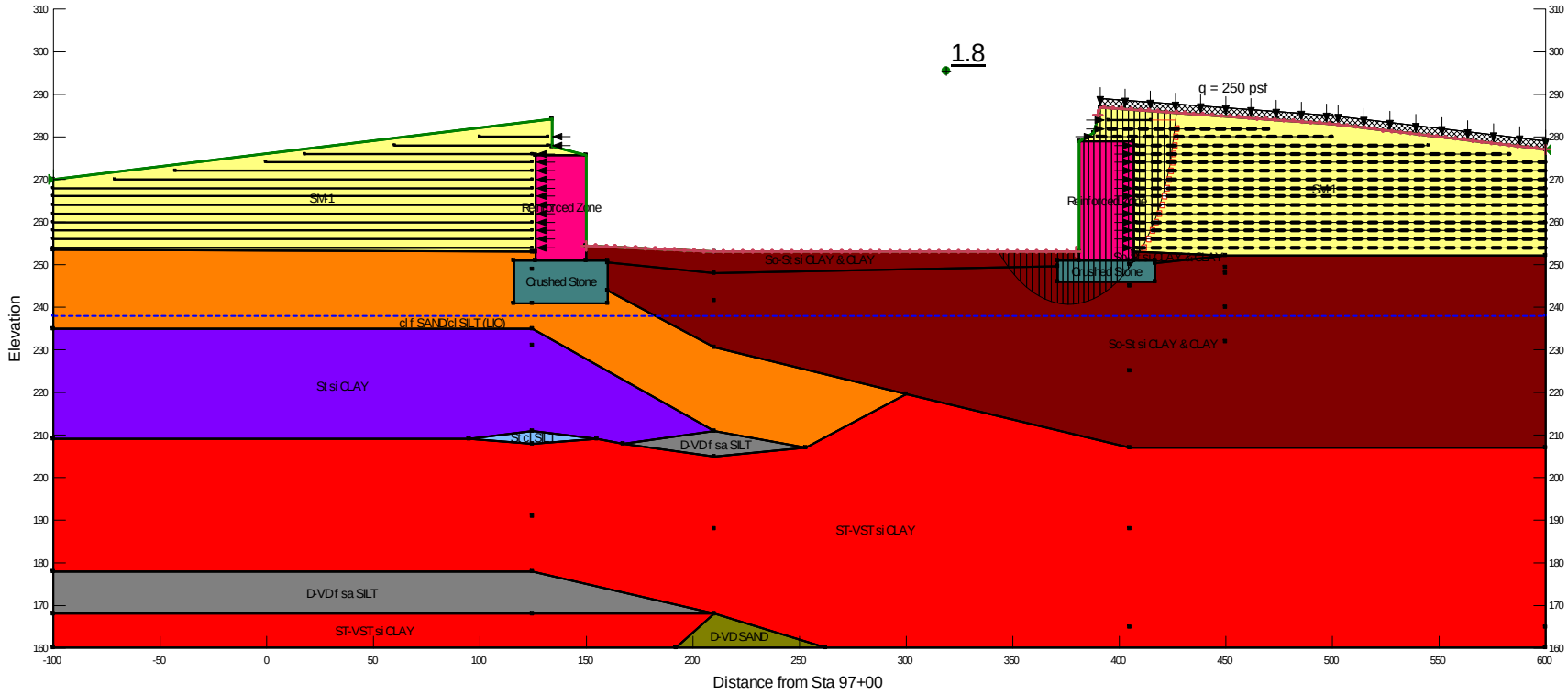
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 4 (North Abutment)	End of Construction	1.5
	Long Term	1.8
	Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

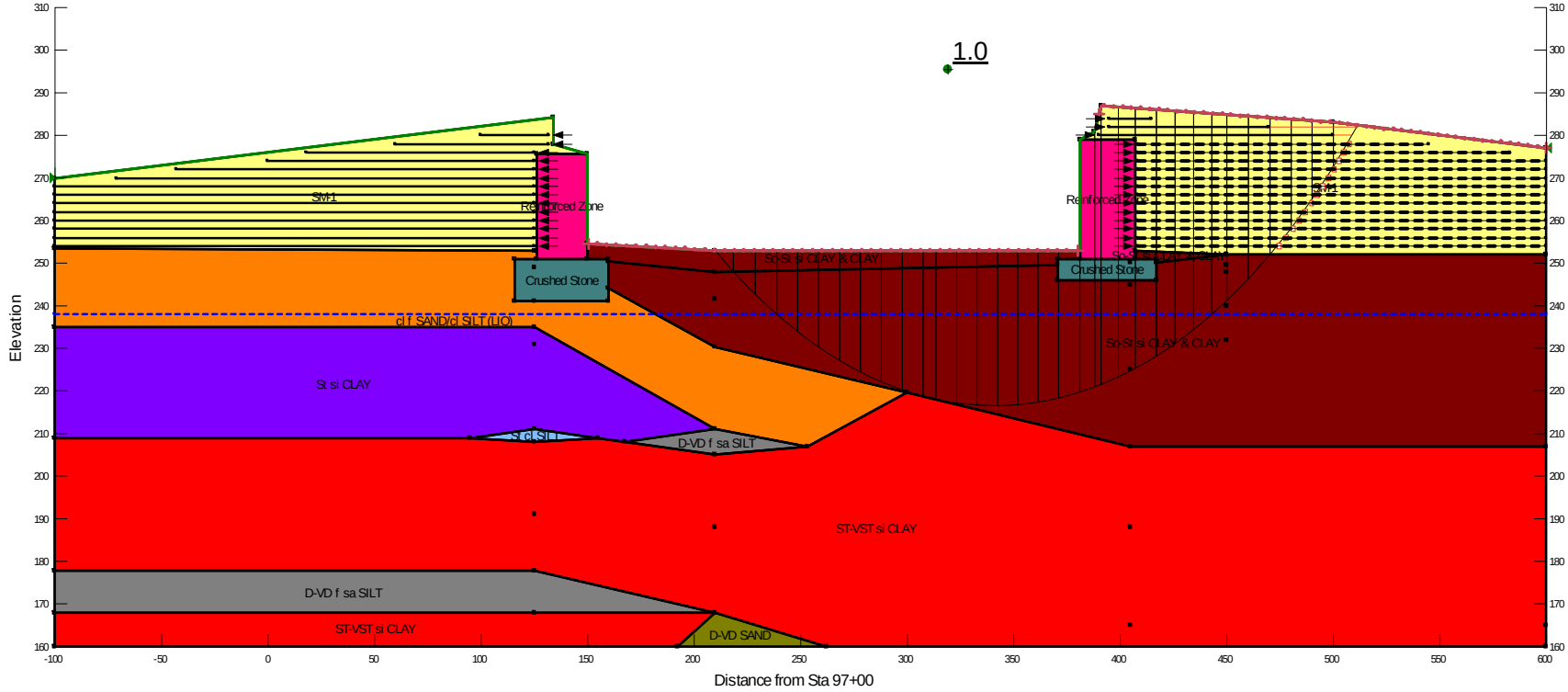
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
SM-1	125	--	--	32
Crushed Stone	140	--	--	38
Soft to Stiff Clay and silty Clay	120	1.2	200	24
clayey fine Sand and clayey Silt (Liquefiable)	120	--	--	32
Stiff silty Clay	120	1.5	200	24
Stiff clayey Silt	120	1.0	250	25
Dense to Very Dense fine sandy Silt	125	--	--	35
Stiff to Very Stiff silty Clay	120	2.4	300	23
Dense to Very Dense Sand	130	--	--	38



Results of Stability Analyses – End of Construction Condition
MSE Wall BB @ East Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall BB @ East Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



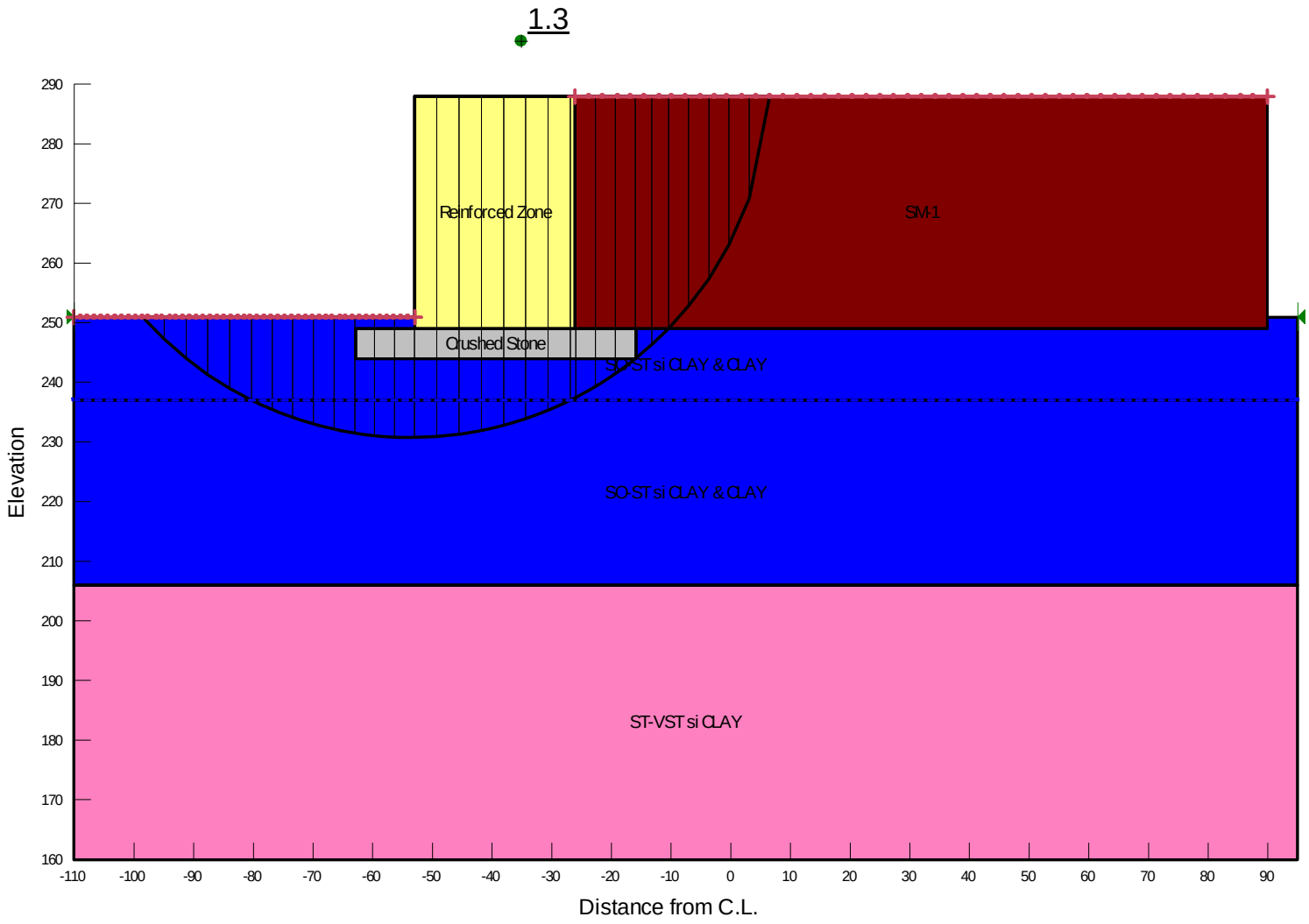
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall BB @ East Bridge Abutment
Cross Section @ Center Line Bridge
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
MSE Wall BB @ Wall BB Sta 7+47
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

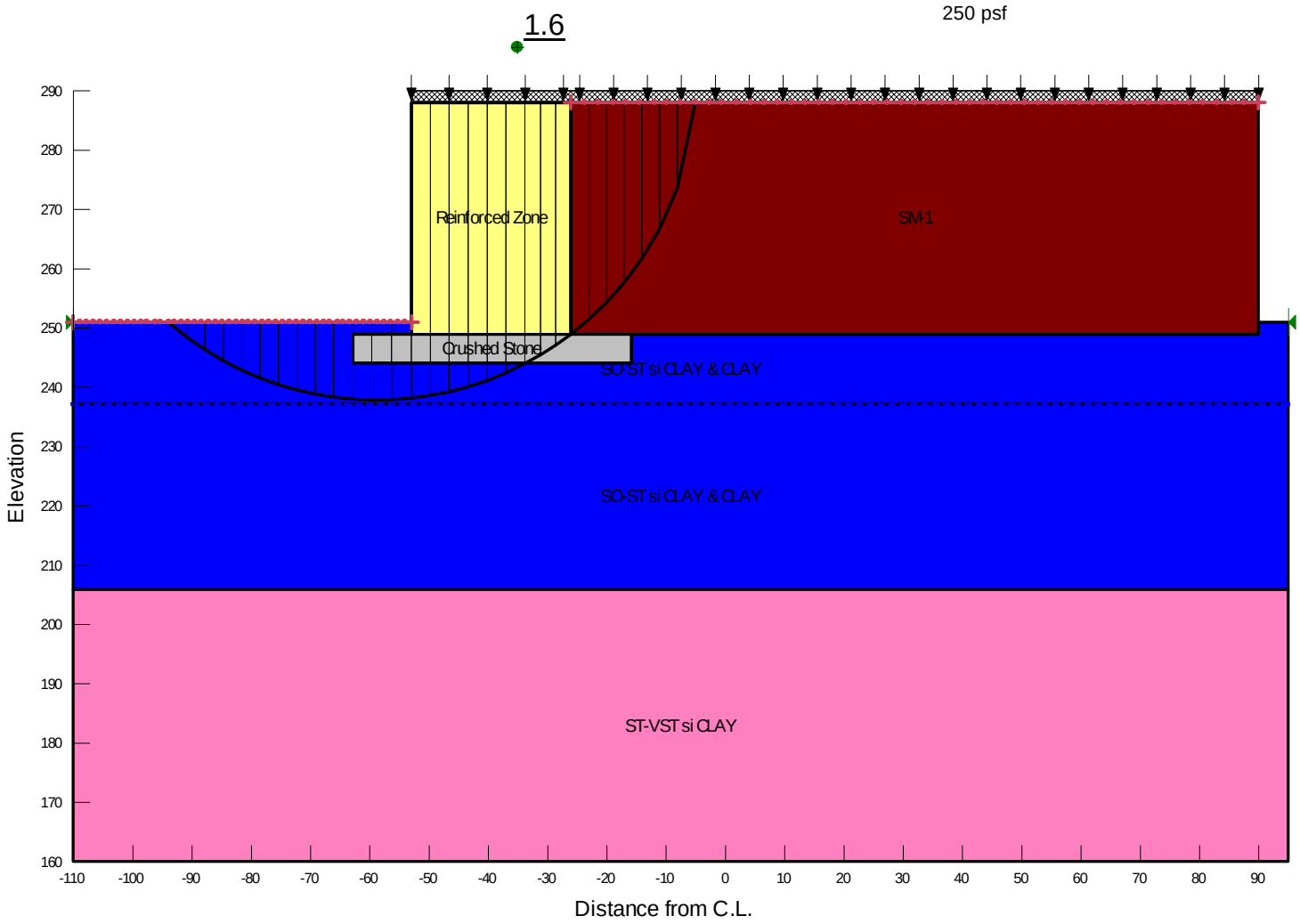
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	1.3
Long Term	1.6
Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

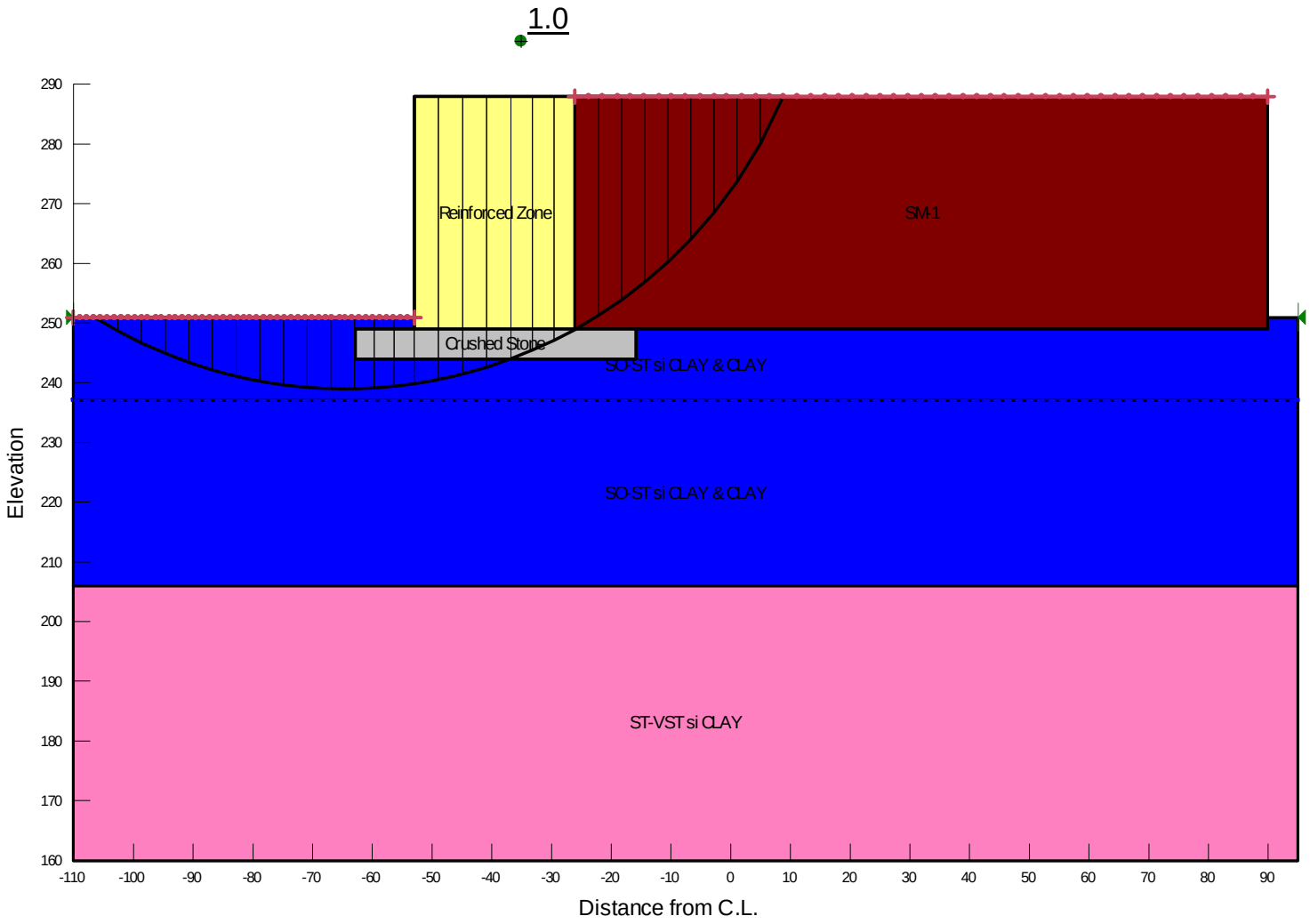
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
SM-1	125	--	--	32
Crushed Stone	140	--	--	38
Soft to Stiff Clay and silty Clay	120	1.2	200	24
Stiff to Very Stiff silty Clay	120	2.4	300	23



Results of Stability Analyses – End of Construction Condition
MSE Wall BB @ East Bridge Abutment
MSE Wall BB @ Wall BB Sta 7+47
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall BB @ East Bridge Abutment
MSE Wall BB @ Wall BB Sta 7+47
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall BB @ East Bridge Abutment
MSE Wall BB @ Wall BB Sta 7+47
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

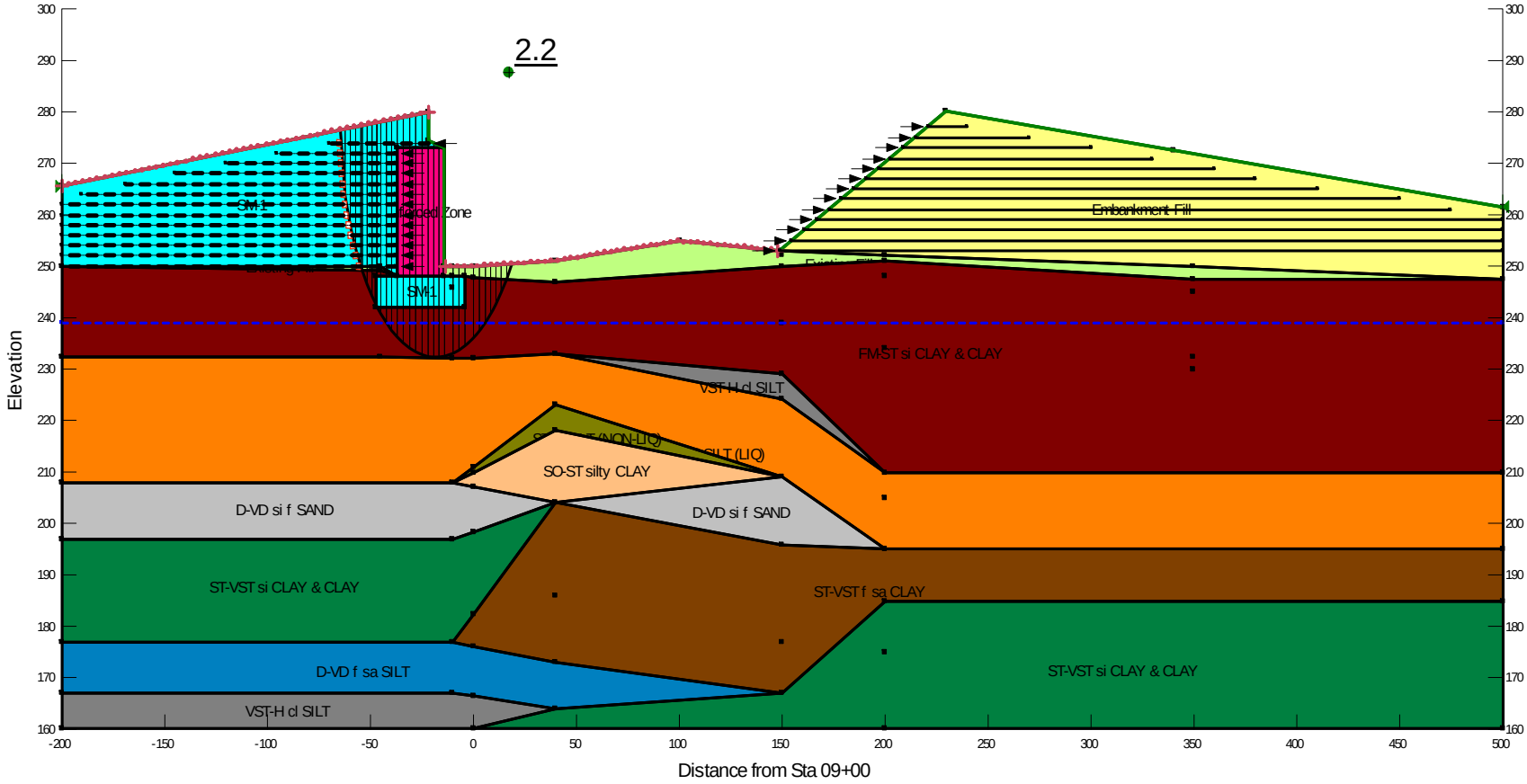
ATTACHMENT 12

Summary of Stability Analysis Results
MSE Wall CC @ South Bridge Abutment (Bent 1)
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

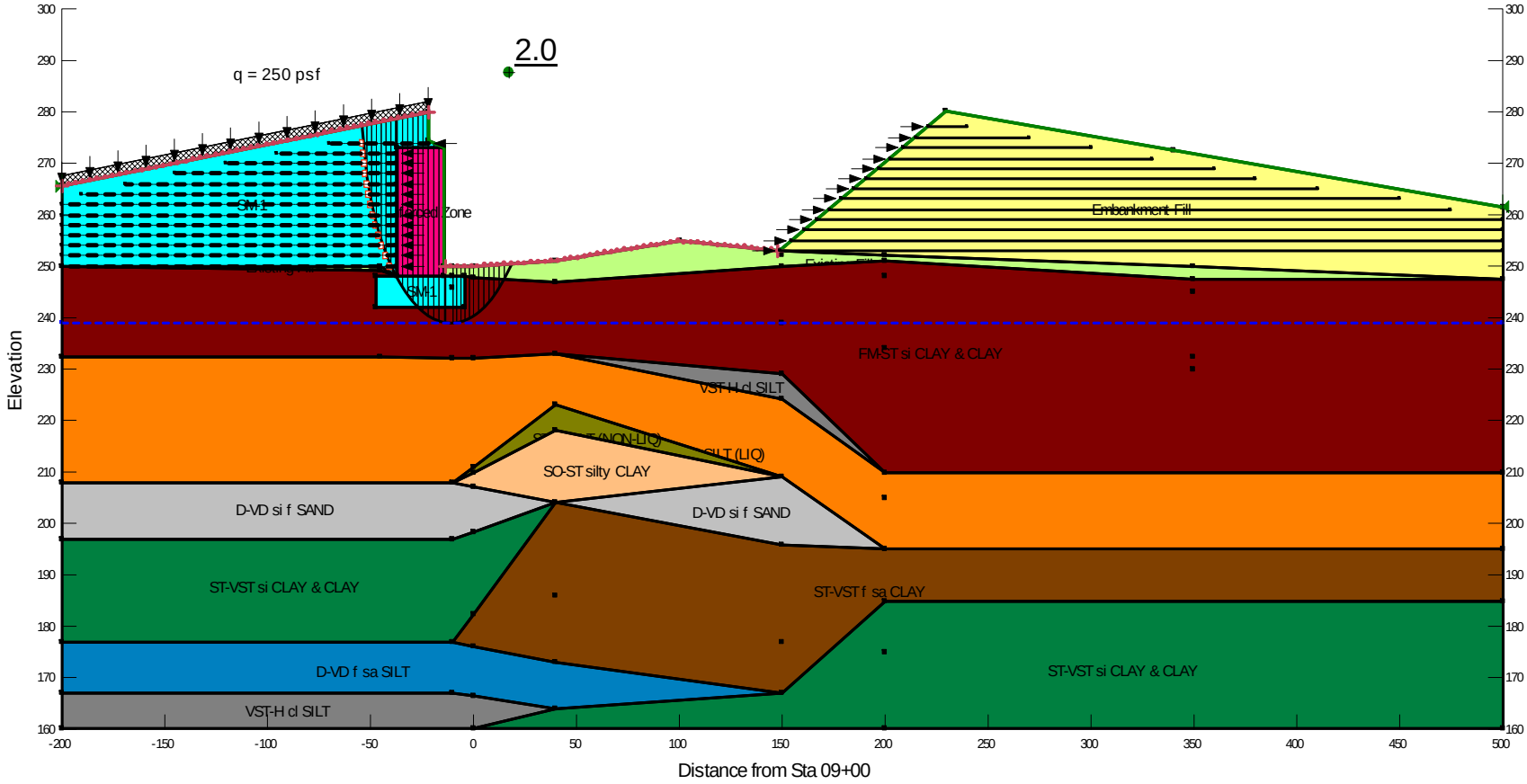
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 1 (South Abutment)	End of Construction	2.2
	Long Term	2.0
	Seismic ($k_h = 0.5A_S = 0.34$)	1.2

Summary of Soil Strength Parameters

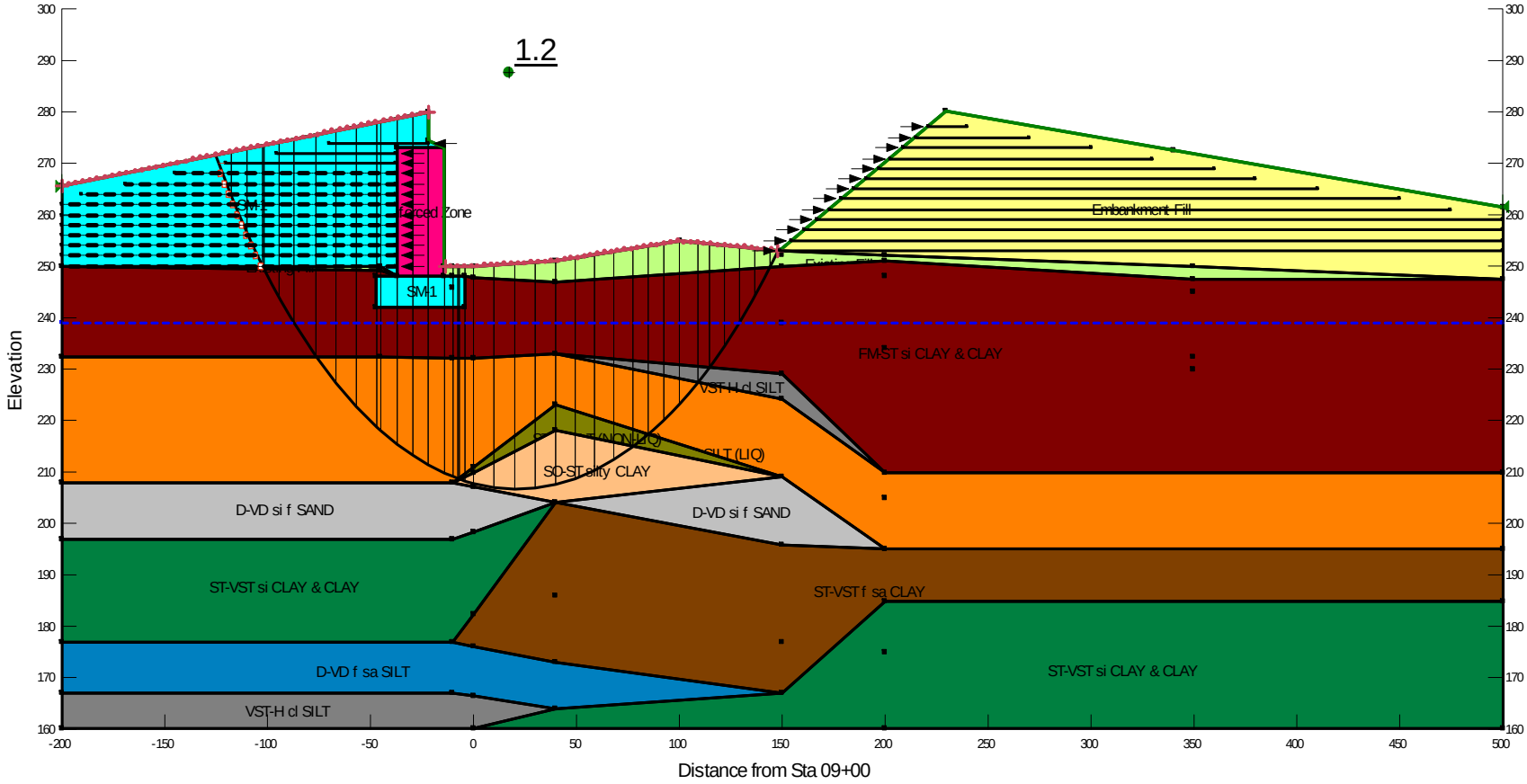
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Existing Fill / Embankment Fill	125	750	750	0
Firm to Stiff silty Clay and Clay	120	1500	200	25
Firm to Stiff clayey Silt (Liquefiable)	120	---	---	32
Stiff clayey Silt (Non-liquefiable)	120	1000	250	25
Dense to Very Dense silty fine Sand	125	0	0	38
Dense to Very Dense fine sandy Silt	120	0	0	35
Stiff to Very Stiff fine sandy Clay	125	2000	500	20
Soft to Stiff silty Clay	118	875	100	20
Stiff to Very Stiff silty Clay and Clay	120	2250	200	24
Very Stiff to Hard clayey Silt	120	3000	250	25
SM-1	125	0	0	32



Results of Stability Analyses – End of Construction Condition
MSE Wall CC @ South Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall CC @ South Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



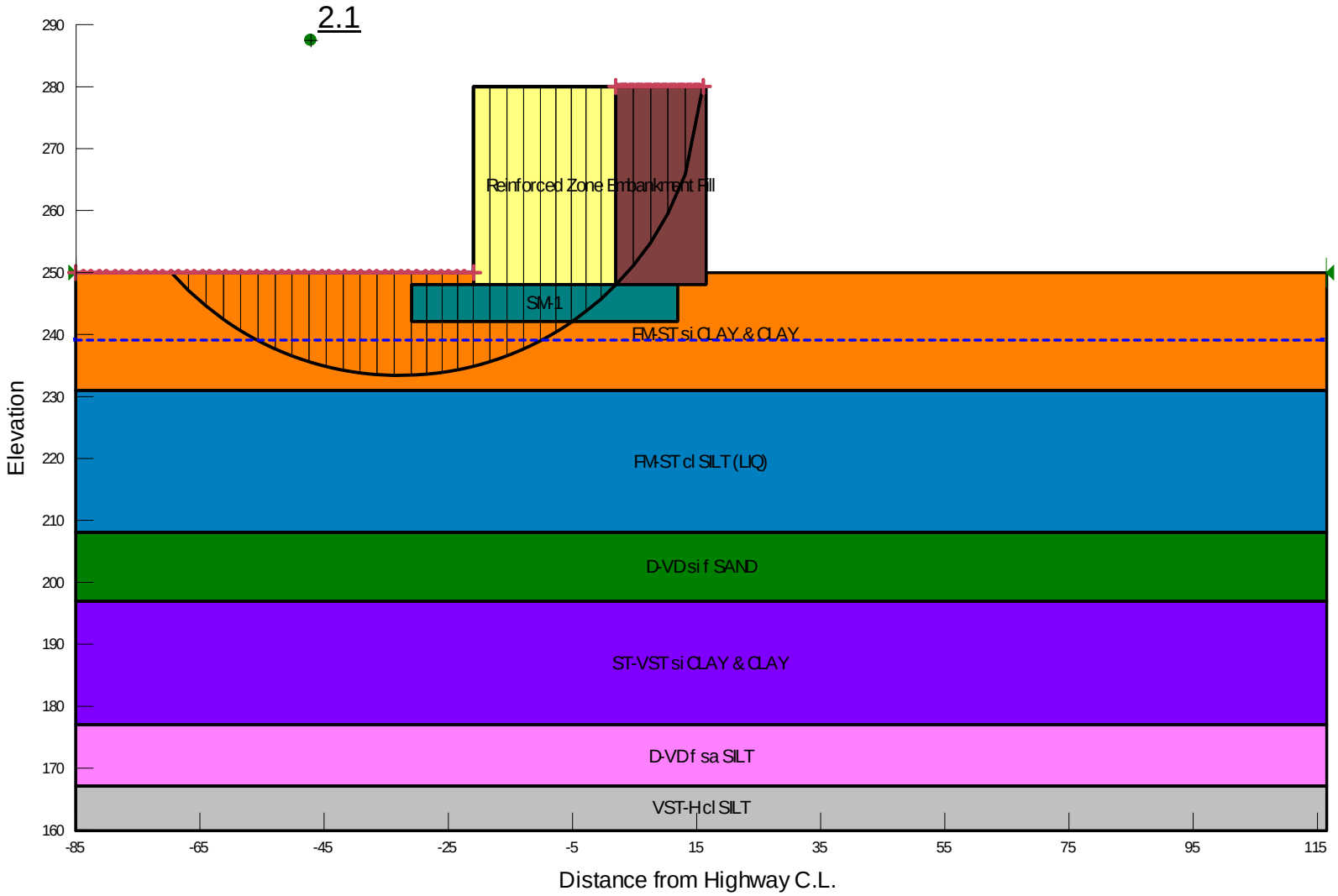
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall CC @ South Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
MSE Wall CC @ Wall CC Sta 4+69
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

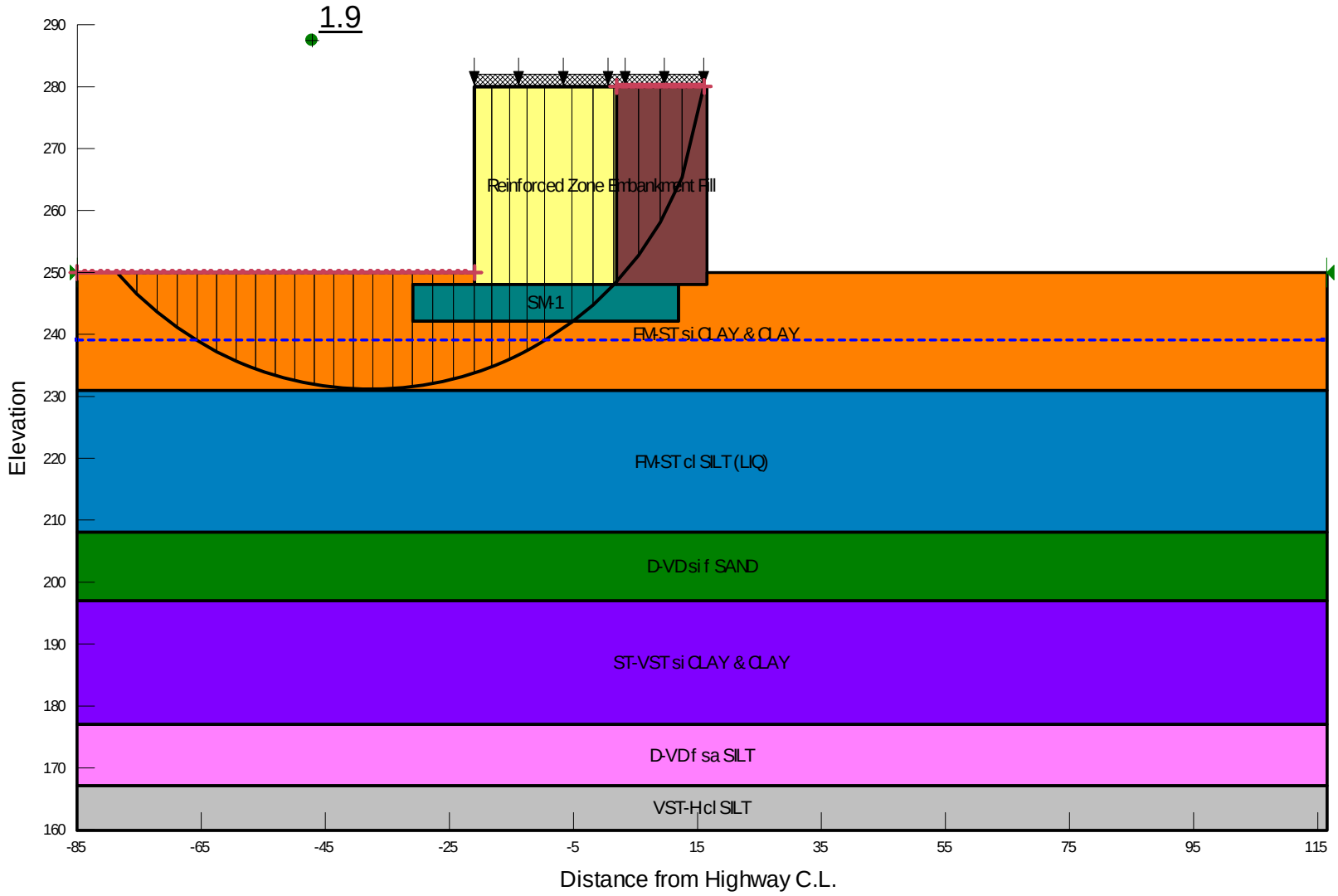
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	2.1
Long Term	1.9
Seismic ($k_h = 0.5A_S = 0.34$)	1.3

Summary of Soil Strength Parameters

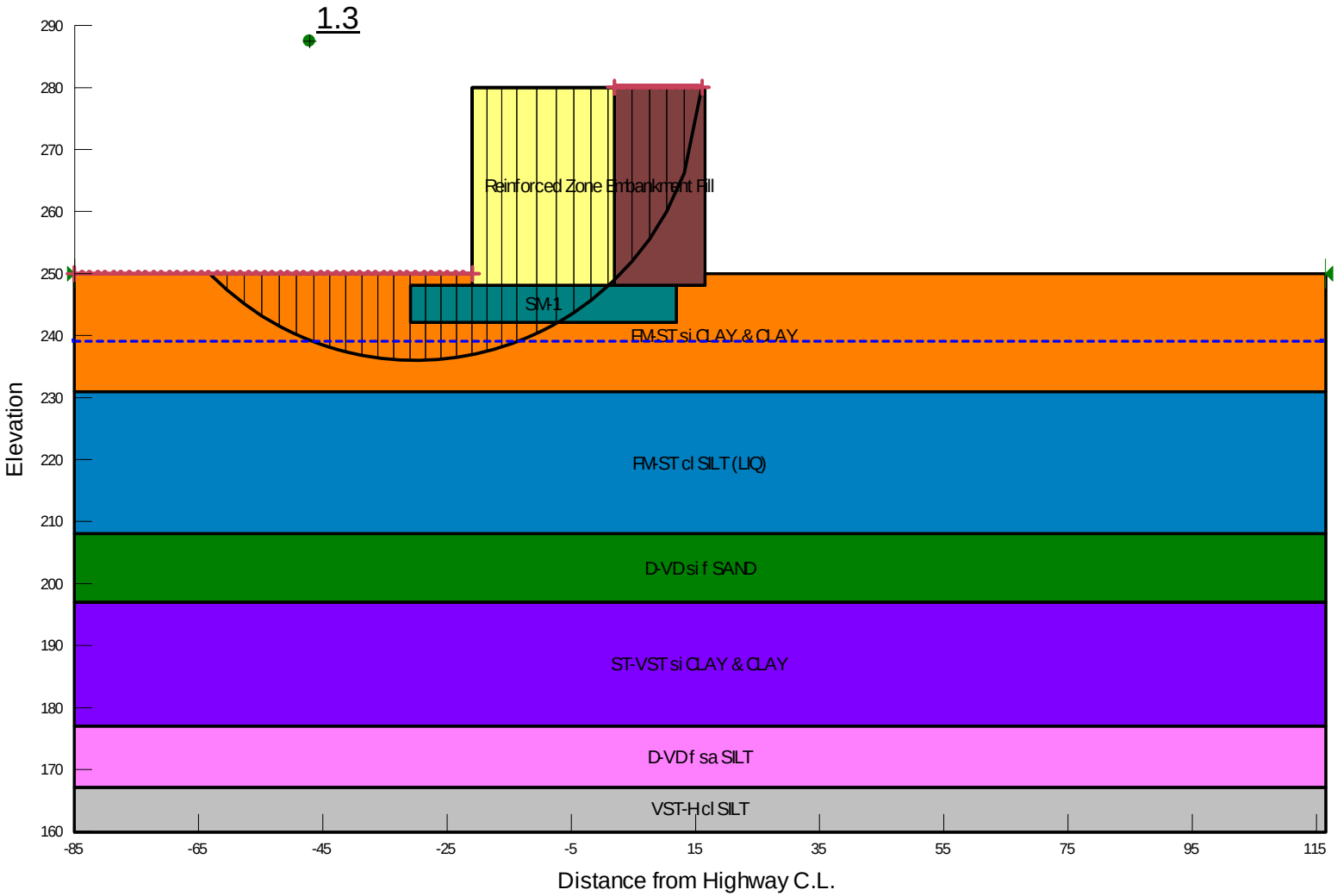
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Embankment Fill	125	750	750	0
Firm to Stiff silty Clay and Clay	120	1500	200	25
Firm to Stiff clayey Silt (Liquefiable)	120	---	---	32
Dense to Very Dense silty fine Sand	125	0	0	38
Dense to Very Dense fine sandy Silt	120	0	0	35
Stiff to Very Stiff silty Clay and Clay	120	2250	200	24
Very Stiff to Hard clayey Silt	120	3000	250	25
SM-1	125	0	0	32



Results of Stability Analyses – End of Construction Condition
MSE Wall CC @ Wall CC Sta 4+69
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall CC @ Wall CC Sta 4+69
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



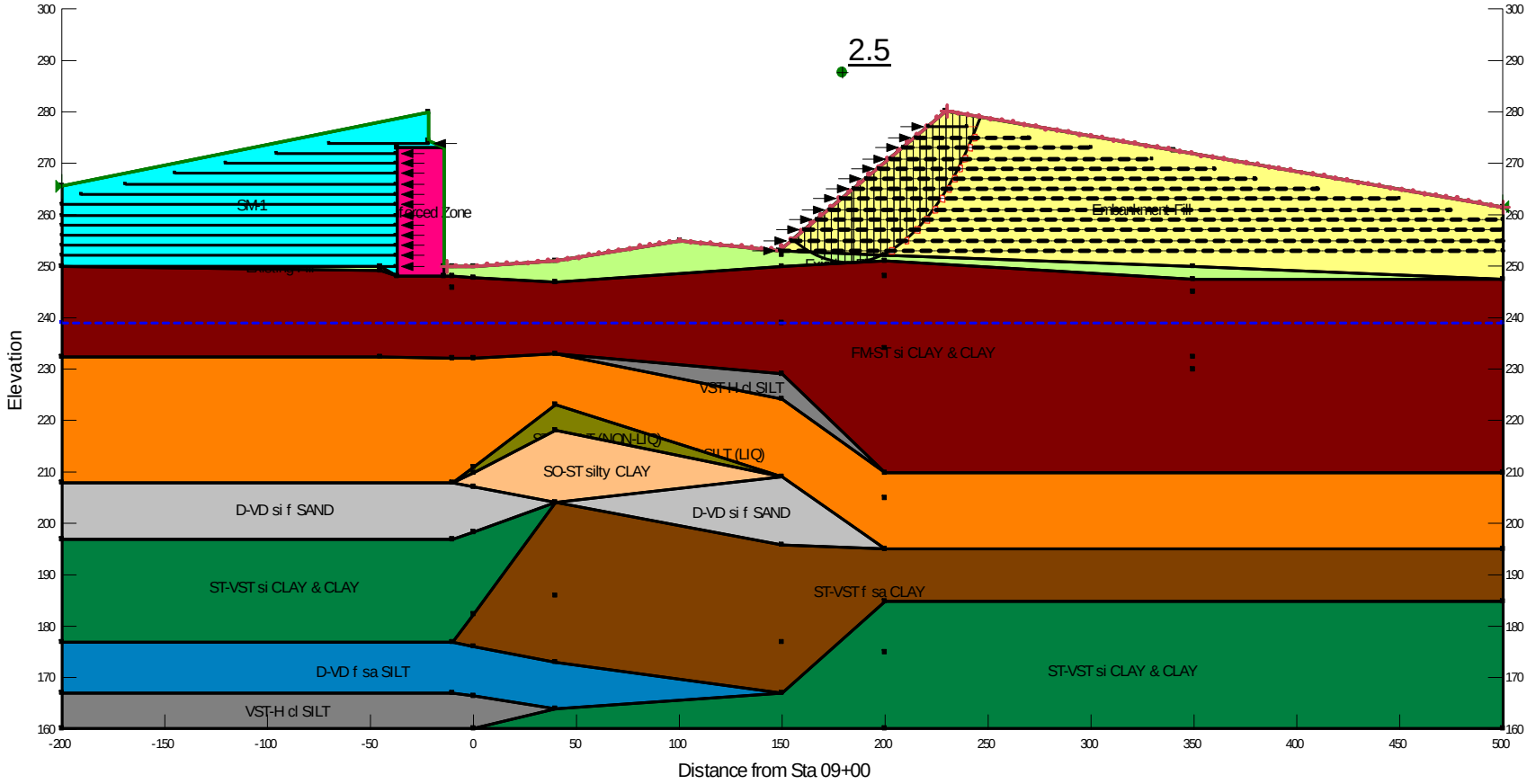
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall CC @ Wall CC Sta 4+69
16-022 – Highway 18 over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
3H:1V End Slope @ North Bridge Abutment (Bent 4)
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

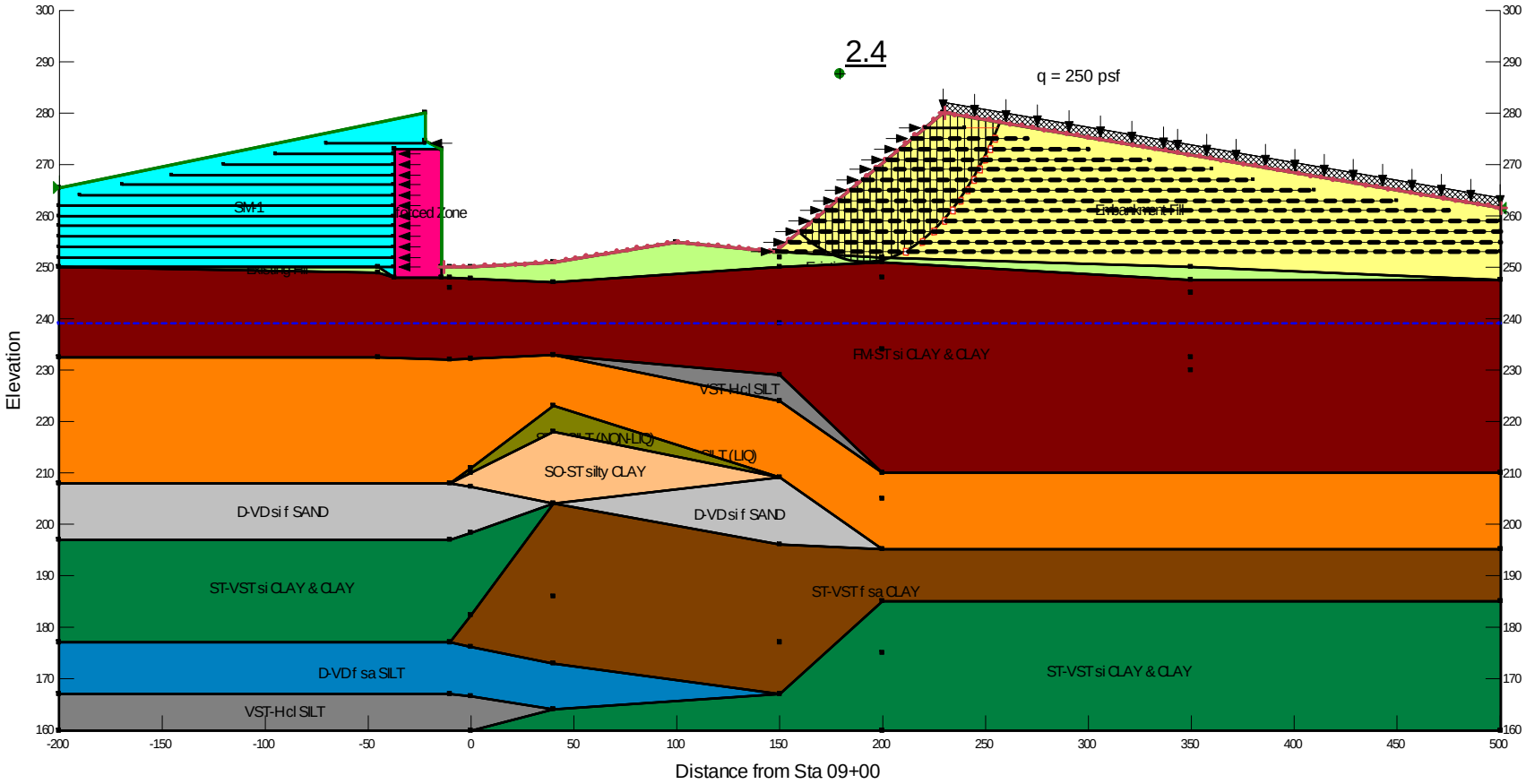
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 4 (North Abutment)	End of Construction	2.5
	Long Term	2.4
	Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

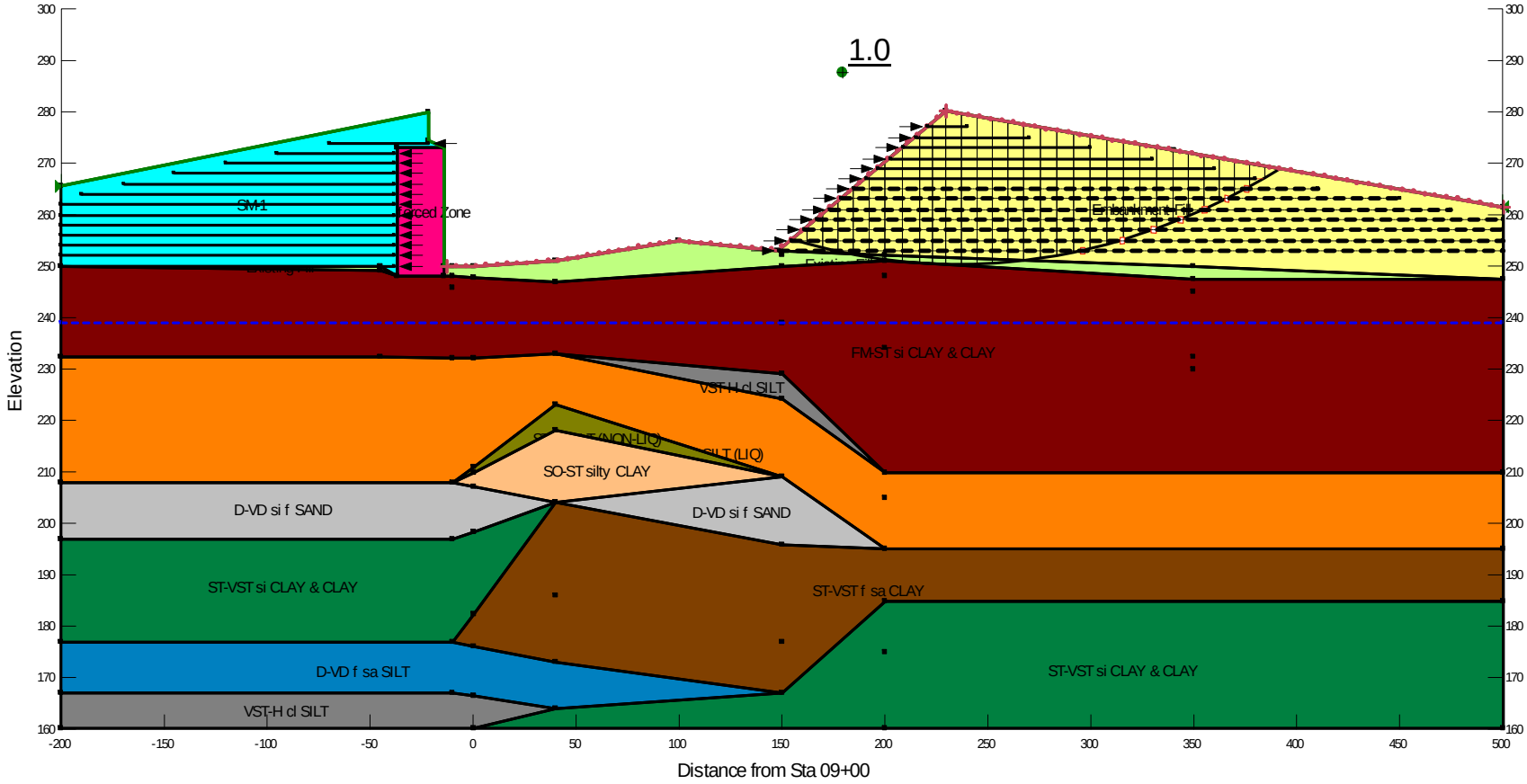
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Existing Fill / Embankment Fill	125	750	750	0
Firm to Stiff silty Clay and Clay	120	1500	200	25
Firm to Stiff clayey Silt (Liquefiable)	120	---	---	32
Stiff clayey Silt (Non-liquefiable)	120	1000	250	25
Dense to Very Dense silty fine Sand	125	0	0	38
Dense to Very Dense fine sandy Silt	120	0	0	35
Stiff to Very Stiff fine sandy Clay	125	2000	500	20
Soft to Stiff silty Clay	118	875	100	20
Stiff to Very Stiff silty Clay and Clay	120	2250	200	24
Very Stiff to Hard clayey Silt	120	3000	250	25
SM-1	125	0	0	32



Results of Stability Analyses – End of Construction Condition
3H:1V End Slope @ North Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
3H:1V End Slope @ North Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



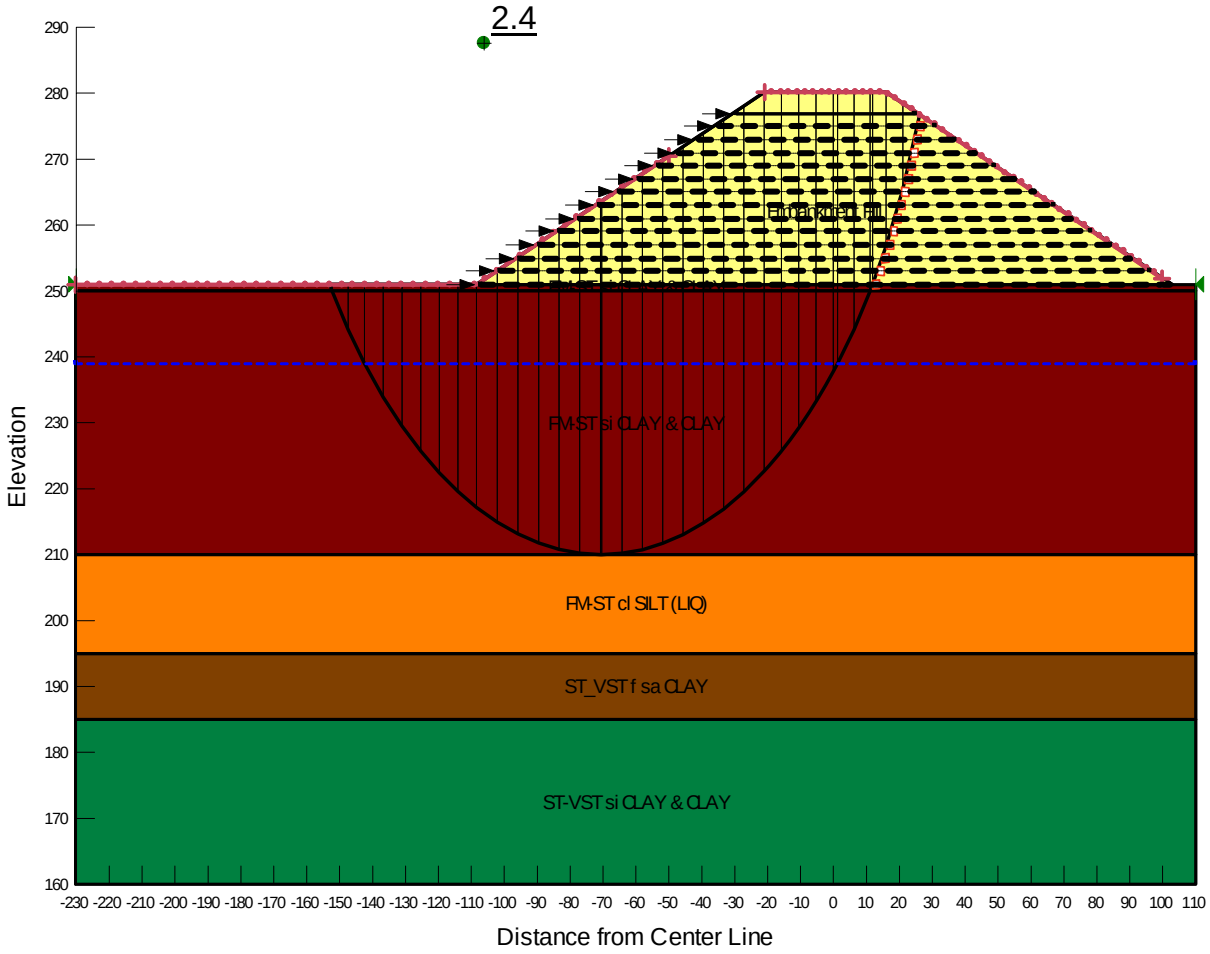
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
3H:1V End Slope @ North Bridge Abutment
Cross Section @ Center Line Bridge
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

Summary of Stability Analysis Results
3H:1V Side Slope @ North Bridge Abutment (Bent 4)
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

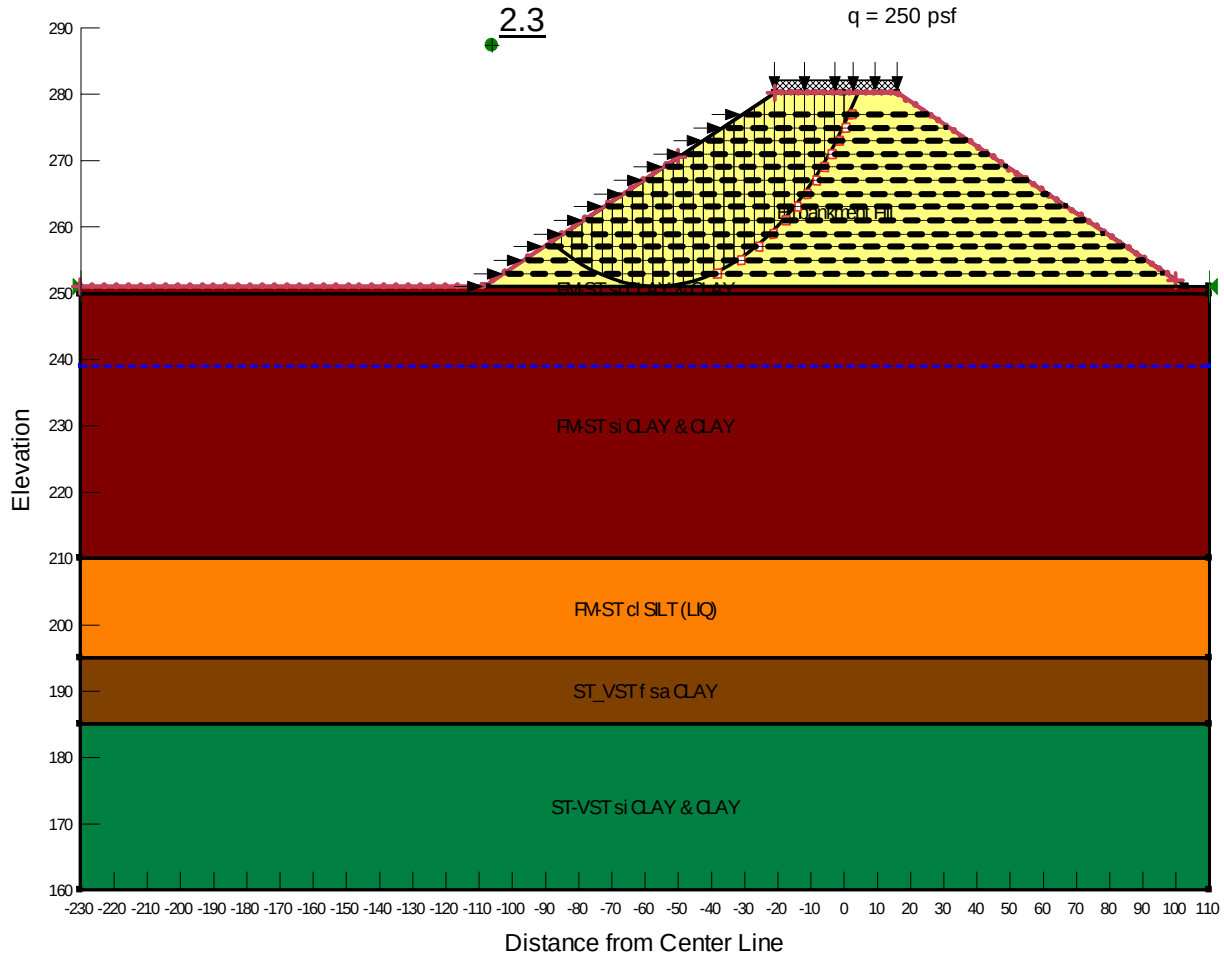
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 4 (North Abutment)	End of Construction	2.4
	Long Term	2.3
	Seismic ($k_h = 0.5A_S = 0.34$)	1.0

Summary of Soil Strength Parameters

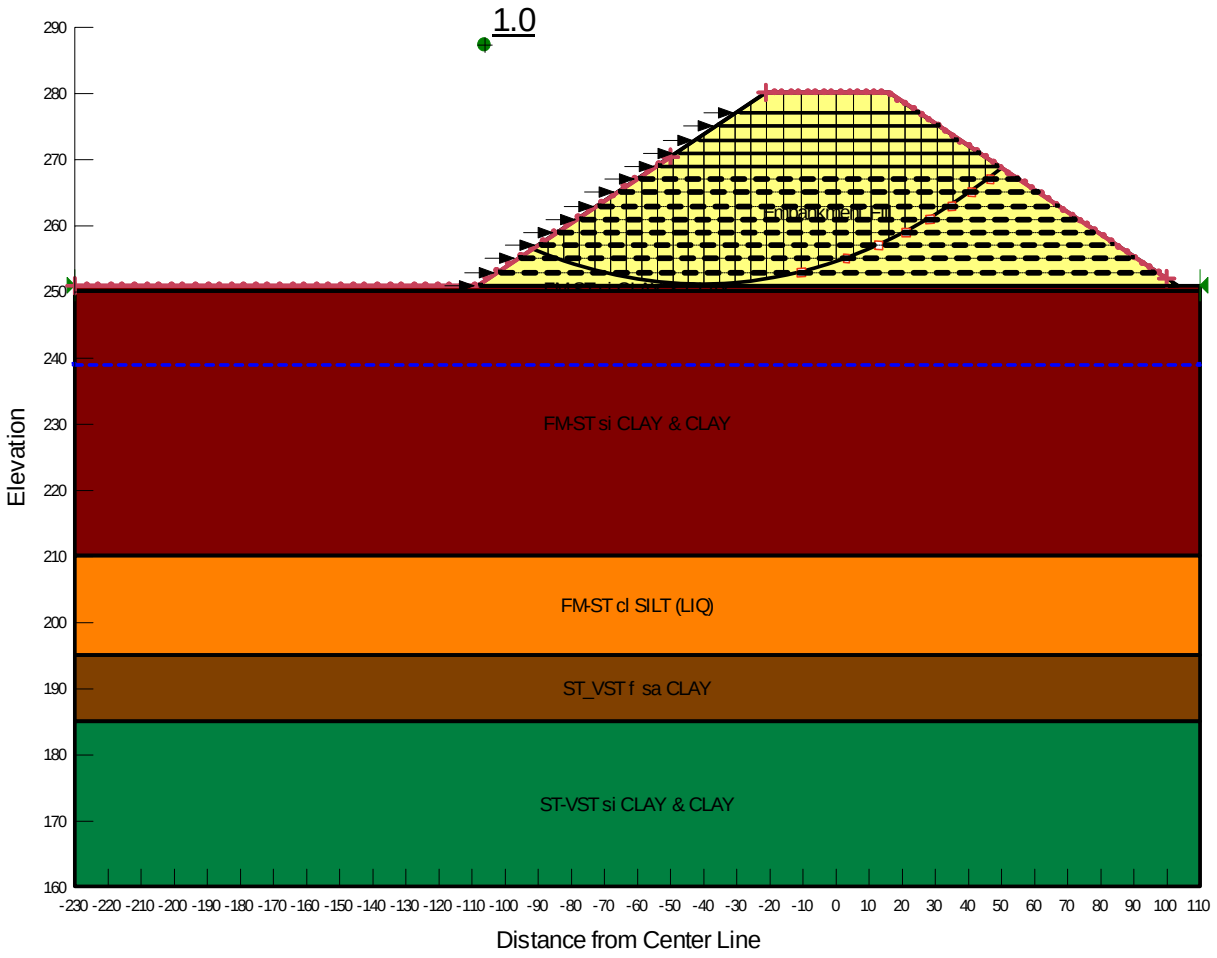
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Existing Fill / Embankment Fill	125	750	750	0
Firm to Stiff silty Clay and Clay	120	1500	200	25
Firm to Stiff clayey Silt (Liquefiable)	120	---	---	32
Stiff to Very Stiff fine sandy Clay	125	2000	500	20
Stiff to Very Stiff silty Clay and Clay	120	2250	200	24



Results of Stability Analyses – End of Construction Condition
3H:1V Side Slope @ North Bridge Abutment
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
3H:1V Side Slope @ North Bridge Abutment
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
3H:1V Side Slope @ North Bridge Abutment
Cross Section @ Sta 11+29
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

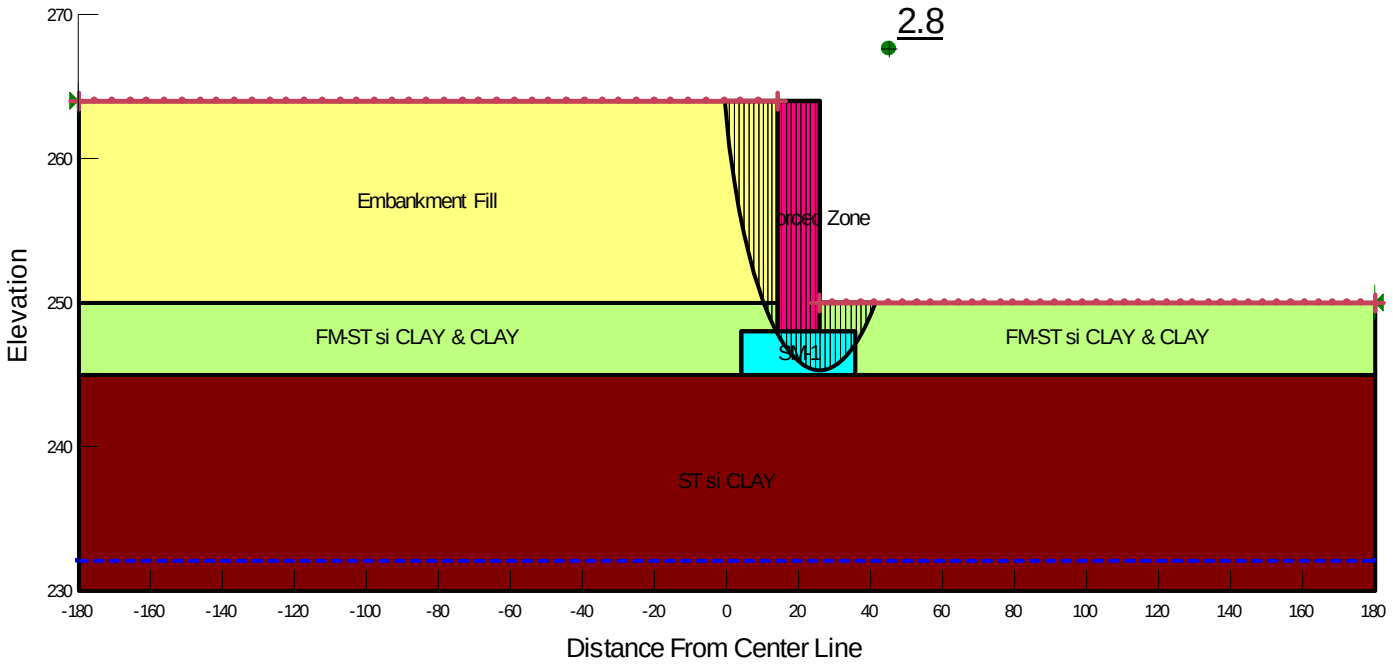
ATTACHMENT 13

Summary of Stability Analysis Results
MSE Wall DD
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

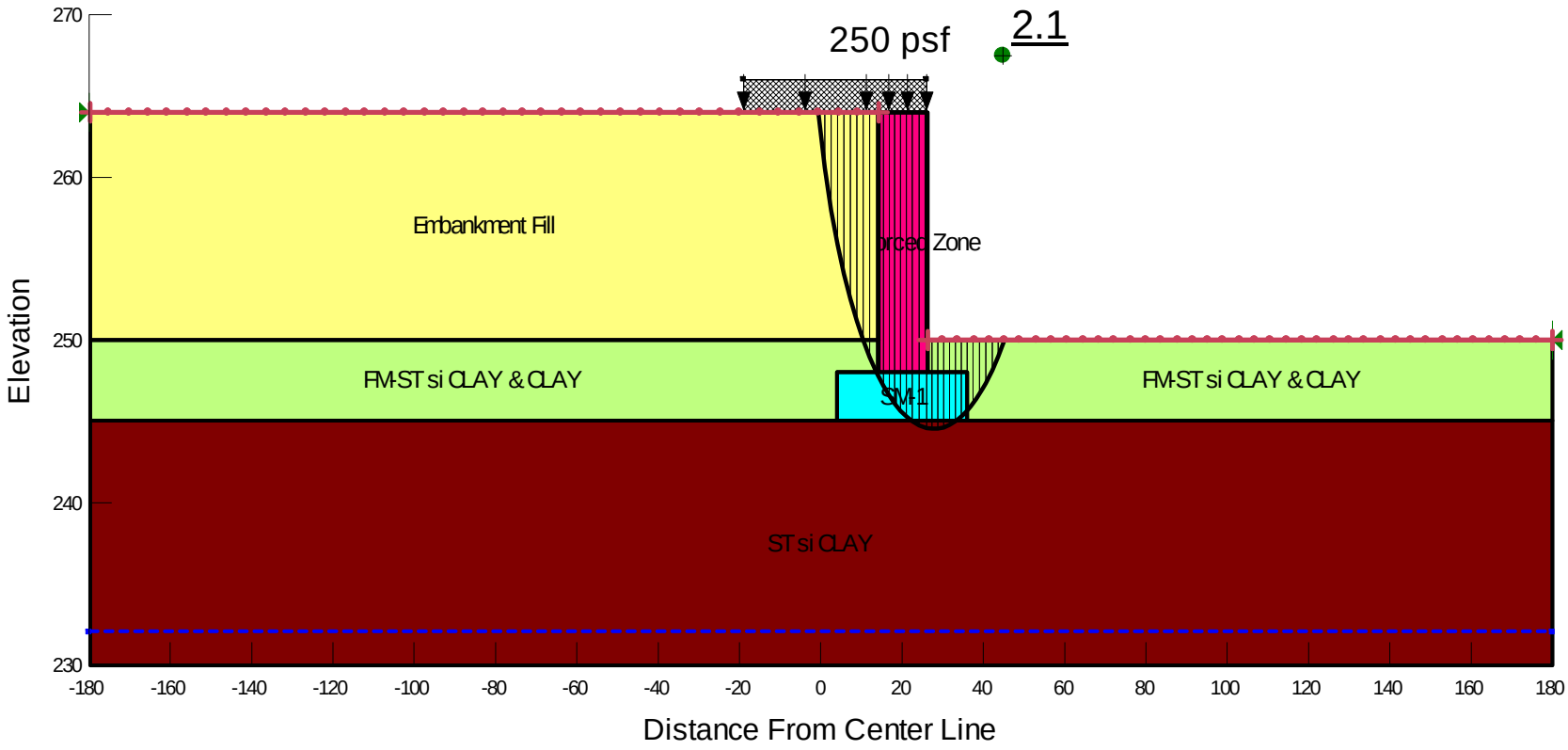
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	2.8
Long Term	2.1
Seismic ($k_h = 0.5A_S = 0.34$)	1.3

Summary of Soil Strength Parameters

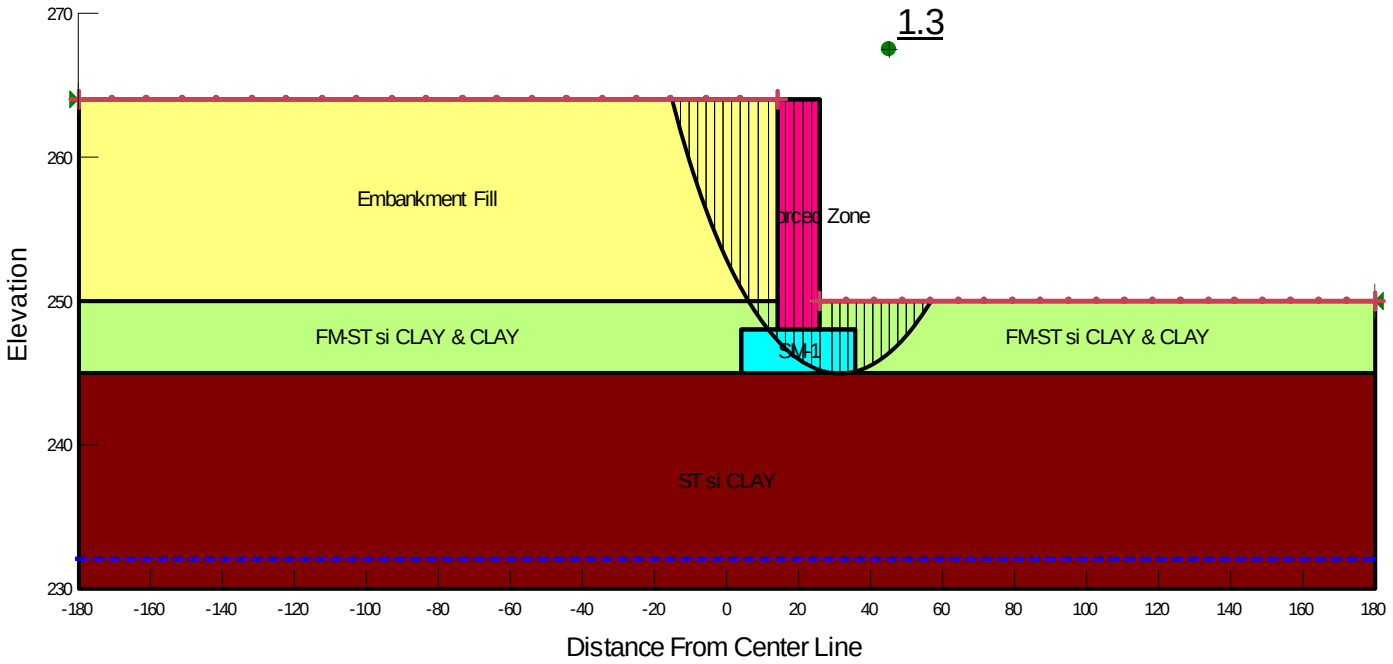
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Embankment Fill	125	750	750	0
Firm to Stiff silty Clay and Clay	120	1000	150	20
Stiff silty Clay	124	1120	200	25
SM-1	125	0	0	32



Results of Stability Analyses – End of Construction Condition
MSE Wall DD
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Long Term Condition
MSE Wall DD
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.34$)
MSE Wall DD
16-022 - Watt Street over BNSF Railroad
AHTD Job No. 100824 – BNSF Railroad Overpass (Jonesboro)(P.E.)

ATTACHMENT 14

Summary of Preliminary Recommendations for Retaining Walls

PROJECT: AHTD Job No. 100824 – BNSF Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

Wall	Wall Type	Wall Station	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (Tan δ)	Comments
Wall AA	MSE	Sta 1+00 to Sta 2+50	150	6 to 12	W1	5.9	0.7H ≥ 8	Minimal	Stiff to very stiff silty clay & clay	0.35	
Wall AA	MSE	Sta 2+50 to Sta 4+75	225	12 to 27	W3	9.3	0.7H	2	Stiff silty clay	0.35	Backfill undercut with SM-1 or approved alternate.
~~Wall AA~~	~~MSE~~	~~Sta 4+75 to Sta 7+50~~	~~275~~	~~22 to 35~~	~~S1~~	~~10.3~~	~~1.1H~~	~~10~~	~~Stiff clayey silt~~	~~0.40~~	Backfill undercut with Crushed Stone Base (Class 7). Select granular fill (AASHTO M 43) in the retained zone.
Wall AA	MSE	Sta 4+75 to Sta 7+50	275	22 to 35	S1	12.0	0.85H	RAP Alternative	RAP/clayey sand	0.40	RAP @ 30% Area Ratio, 30 in. dia., L = 10 ft
Wall AA	MSE	Sta 7+50 to Sta 9+50	200	18 to 31	W4	10.0	0.7H	Minimal	Stiff clay	0.32	
Wall AA	MSE	Sta 9+50 to Sta 11+96	246	6 to 18	W2	10.0	0.7H ≥ 8	Minimal	Very stiff silty clay	0.35	
Wall BB	MSE	Sta 2+00 to Sta 3+00	100	8 to 12	W9	6.0	0.7H ≥ 8	Minimal	Firm to stiff clay	0.32	
Wall BB	MSE	Sta 3+00 to Sta 5+75	275	12 to 26	W19, W20	9.3	0.7H	2	Stiff silty clay	0.40	Backfill undercut with SM-1 or approved alternate.
Wall BB	MSE	Sta 5+75 To Sta 8+25	250	25 to 39	S3	14.0	0.8H	RAP	RAP/Clay	0.40	RAP @ 30% Area Ratio, 30 in. dia., L = 22 ft
Wall BB	MSE	Sta 8+25 to 10+00	175	28 to 37	W5	14.0	0.7H	RAP	RAP/silty clay	0.40	RAP @ 30% Area Ratio, 30 in. dia., L = 15 ft
Wall BB	MSE	Sta 10+00 to Sta 11+46	146	13 to 28	W7, R5	8.4	0.8H	Minimal	Stiff to very stiff silty clay	0.35	

Summary of Preliminary Recommendations for Retaining Walls

PROJECT: AHTD Job No. 100824 – BNSF Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

Wall	Wall Type	Wall Station	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (Tan δ)	Comments
Wall CC	MSE	Sta 2+35 to Sta 3+80	145	8 to 26	W16	10.0	0.7H ≥ 8	Minimal	Stiff clay	0.35	
Wall CC	MSE	Sta 3+80 to Sta 4+40	60	26 to 30	W15	10.0	0.7H	Minimal	Stiff to very stiff silty clay	0.35	
Wall CC	MSE	Sta 4+40 to Sta 5+75	135	27 to 32	S7	9.0	1.1H	6	Stiff silty clay	0.40	Backfill undercut with SM-1 or approved alternate. Select granular fill (AASHTO M 43) in the retained zone.
Wall CC	MSE	Sta 4+40 to Sta 5+75	135	27 to 32	S7	10.7	0.9H	RAP Alternative	RAP/silty clay	0.40	RAP @ 20% Area Ratio, 30 in. dia., L = 12 ft
Wall CC	MSE	Sta 5+75 to Sta 6+80	105	18 to 27	W17	10.0	0.7H	Minimal	Stiff to very stiff clay	0.32	
Wall CC	MSE	Sta 6+80 to Sta 7+50	70	10 to 18	W18	7.0	0.7H ≥ 8	3	Stiff silty clay	0.35	Backfill undercut with SM-1 or approved alternate.
Wall DD	MSE	Sta 7+50 to Sta 8+00	50	12 to 16	W13	7.5	0.7H	2	Stiff silty clay	0.40	Backfill undercut with SM-1 or approved alternate.
Wall DD	MSE	Sta 8+00 to Sta 8+99	99	7 to 12	W14	4.4	0.7H ≥ 8	Minimal	Medium dense clayey fine sand	0.35	

Summary of Preliminary Recommendations for Retaining Walls

PROJECT: AHTD Job No. 100824 – BNSF Railroad Overpass
LOCATION: Jonesboro, Arkansas
JOB NUMBER: 16-022

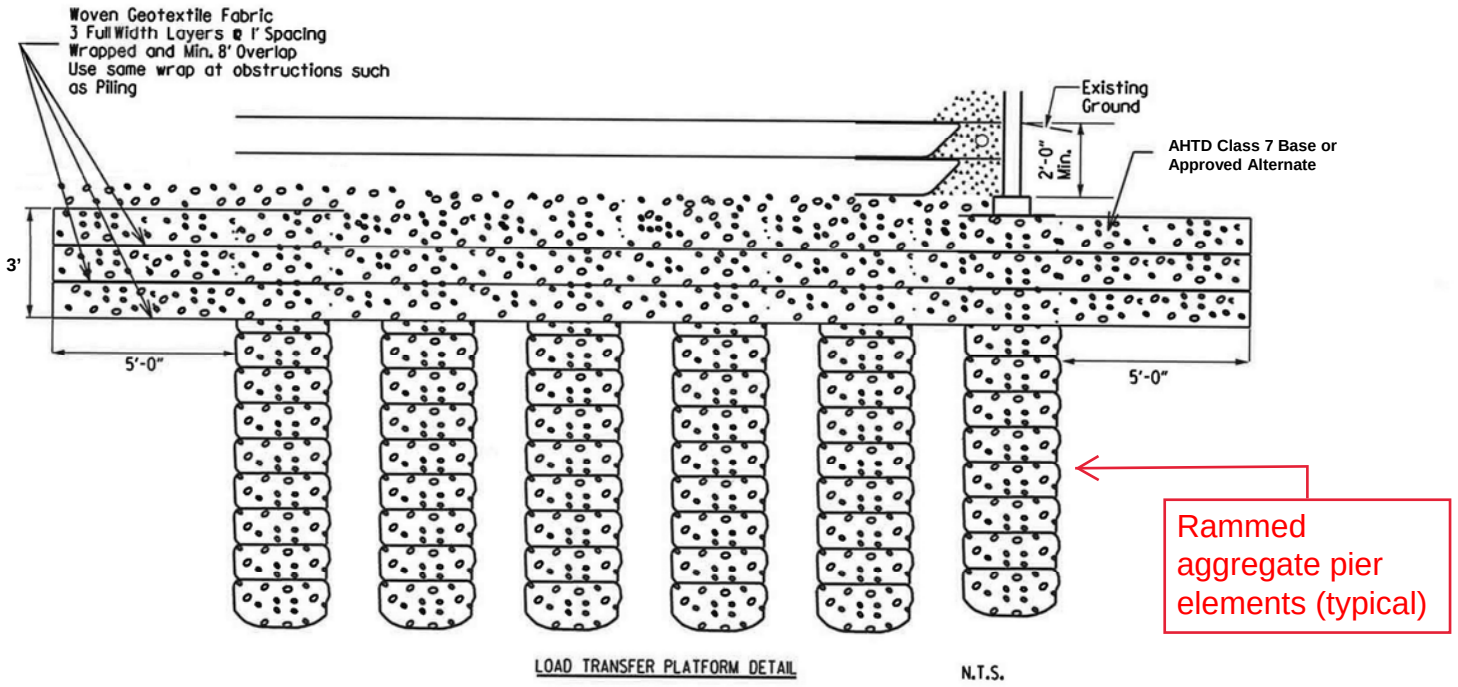
Wall	Wall Type	Wall Station	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (Tan δ)	Comments
Wall EE	Conventional Cantilever	Sta 4+00 to Sta 5+23	123	3 to 6	W1, W2, R1	4.5	NA	Minimal	Stiff to very stiff clay and silty clay	0.32	
Wall FF	Conventional Cantilever	Sta 5+00 to Sta 5+60	60	4 to 8	R5, W7, W9	4.5	NA	Minimal	Firm to very stiff clay and silty clay	0.32	

Notes:

1. Strap length is an estimate only. The Designer must select the length for use in final design.
2. The suitability of the wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. Undercuts required to develop suitable bearing should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), crushed stone base (AHTD SS 303, Class 7), or an approved alternate.
4. Undercuts should extend at least 10 ft outside the reinforced zone to the extent possible.
5. Criteria above provided for information only. Final design to be developed by Others.

ATTACHMENT 15

CONCEPT DRAWING FOR INFORMATION ONLY



Note: Concept initially developed by AHTD

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 100824

WOVEN GEOTEXTILE FABRIC FOR SUBGRADE REINFORCEMENT

Description: This item shall consist of furnishing and installing a woven geotextile for subgrade reinforcement system in close conformity with the lines, grades and dimensions as established by the Engineer.

Materials: Geotextile fabric shall be woven synthetic fiber fabric meeting the following requirements:

The geotextile structure shall remain dimensionally stable under construction stresses and have a high resistance to damage during construction, to ultraviolet degradation and to all forms of chemical and biological degradation encountered in the soil being reinforced.

> Provide a woven geotextile with a minimum tensile strength of 1500 lbs/ft in the Cross Machine Direction (CD) at 5% strain and minimum tensile strength of 1500 lbs/ft in the Machine Direction (MD) at 5% strain when tested in accordance with ASTM D4595. The geotextile fabric shall also meet the requirements of Type 10 geotextile fabric as described in Section 625 of the Standard Specifications for Highway Construction 2014 Edition.

Identify, store and handle geotextile according to ASTM D 4873. Limit geotextile fabric exposure to ultraviolet radiation to less than 10 days.

The Contractor shall furnish to the Engineer a production certification that the geotextile supplied meets the respective criteria set forth in these specifications. The certification shall state the name of the manufacturer, product name, style number, chemical composition of the filaments, ribs, or yarns, and other information to fully describe the fabric. The manufacturer shall have an on site GAI-LAP accredited laboratory used for their quality control program. The production lot number must be provided with the supplied material. Quality control test results shall be provided upon request by the Engineer. Independent third party test data used to identify values for creep, durability and installation damage must be included with the production certification.

Construction Methods: The woven geotextile fabric shall be installed at locations shown in the plans or as directed by the Engineer and shall follow manufacturer's installation requirements. The woven geotextile fabric shall be oriented such that the roll length runs parallel to the centerline. Adjacent rolls shall be overlapped a minimum of 2 feet and shall be tied together using pins or staples, unless otherwise recommended by the manufacturer. Care shall be taken to ensure that the geotextile fabric sections do not separate during construction. The placement of the geotextile fabric around corners may

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB 100824

WOVEN GEOTEXTILE FABRIC FOR SUBGRADE REINFORCEMENT

require cutting and diagonal lapping. The geotextile fabric shall be pinned at the beginning of the roll, but shall be left free elsewhere to relieve wrinkles or folds in the material during the placement of the base material. Sections of geotextile fabric which are damaged by construction activity shall be repaired or replaced at the Contractor's expense.

Rubber-tired vehicles shall be driven at speeds less than 10 mph and in straight paths over the fabric. A minimum fill thickness of 6" is required prior to operation of tracked construction equipment over the fabric. Tracked construction equipment shall not be operated directly upon fabric.

Method of Measurement: Woven Geotextile Fabric will be measured by the square yard of horizontal surface area covered by the material. No measurement will be made for lapping of the material required by the plans or required by the manufacturers installation requirements.

Basis of Payment: Work completed and accepted and measured as provided will be paid for at the contract unit price bid per square yard for Woven Geotextile Fabric, which price shall be full compensation for furnishing, storing, and placing materials; for lapping and/or splicing; for necessary repairs; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Woven Geotextile Fabric	Square Yard