Structure Geotechnical Report

(In-House)

US 52 over Elkhorn Creek

Bridge Replacement

Proposed Structure Number:	071-0098
Existing Structure Number:	071-0070
Contract Number:	64H57
Route:	US-50
Section:	16BR-1
County:	Ogle
Project Number:	P-92-029-12

Prepared For:	Bridge Planning and Design Units
Prepared By:	Foundations and Geotechnical Unit
	Suhaib Ibrahim
	217-557-8239
	Suhaib.Ibrahim@illlinois.gov
Report Date:	3/22/2017

1.0 Scope of Work

This project consists of replacing the existing bridge carrying U.S. 52 over Elkhorn Creek. The site is located immediately Southeast of Brookville in Western Ogle County (see Site Location Map in Appendix A).

The existing structure is a 3-span bridge (SN: 071-0070) that is 124'-5'' back to back abutments. It consists of stub abutments with two rows of metal shell piles (the front row is battered) and pile bent piers with HP 10X42 steel piles driven to rock.

The existing structure will be replaced by a proposed 3-span bridge with a total back to back length of 225', utilizing integral abutments. All substructures will be supported by H-piles driven to rock.

The proposed structure (SN: 071-0098) will be designed with the 2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 and 2016 Interims. Preliminary factored loadings are as follows:

Estimated Factored Substructure Loads (kips)	W. Abut	Pier 1	Pier 2	E. Abut
	847	1540	1644	847

2.0 Subsurface Data

Two borings were drilled in January and February of 2012 for subsurface exploration. Boring B-1, drilled near the West Abutment, is only 44 feet deep and does not reach rock. Boring B-2, drilled near the East Abutment, is 52 feet deep and shows a bedrock elevation of 711.80. Note that only one of the 2012 borings extends into rock. These borings shall be referenced as Boring B-1(2012) and Boring B-2(2012). To better ascertain the top of rock across the site, we have also employed the use of the two older borings that were drilled in November of 1979 for the existing bridge. Both borings extend into rock. These borings shall be referenced as Boring B-1(1979) and Boring B-2(1979).

Please see Appendix C for the Subsurface Data Plot and Appendix D for the borings. In addition, existing pile driving records are included in Appendix E.

3.0 Geotechnical Evaluation and Recommendation

3.1 Settlement

Approximately 2 feet of new fill will be required at the proposed West Abutment and 1.5 feet at the proposed East Abutment. The resulting settlement will be less than 0.4 inches in both abutments; therefore, no downdrag forces are anticipated at the abutments. See Appendix G for results.

3.2 Slope Stability Analysis

Based on our analysis, the slope stability is satisfactory. See Appendix G for results.

3.3 Scour

The raw scour depths from the 2016 Hydraulic Report are in the table below:

	Contraction Scour (ft)	Pier Scour (ft)	Total (ft)
Q100	13	5	18
Q200	15	5	20

Based on the abutments being protected with riprap in accordance with the ABD memo 14.2 and the raw scour depths being adjusted at the piers based on boring data, The Design Scour Elevations Table is as follows:

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut	Pier 1	Pier 2	E. Abut	
Q100	758.65	734.80	728.40	759.05	5
Q200	758.65	732.80	726.40	759.05	
Design	758.65	734.80	728.40	759.05	
Check	758.65	732.80	726.40	759.05	

3.4 Seismic Considerations

The LRFD seismic data for the structure is as follows:

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.057g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.097g
Soil Site Class = C

The above data is based on latitude= 42.047754, and longitude =-89.678776.

Because the site is located in SPZ 1, no liquefaction analysis is required.

4.0 Foundation Recommendations

Abutments:

H-piles driven to their maximum nominal bearing in rock are recommended as the foundation choice for the abutments. Integral Abutments are feasible for this project and are the preferred option. As per the ABD memo 12.3, feasible H-pile types for the abutment are HP10X42 and larger. Please see Pile Design Tables on page 4 for Abutment piles.

Metal shell piles were not considered as a foundation type for the abutments due to the presence of rock relatively close to the surface.

Piers:

H-piles driven to their maximum nominal bearing in rock are recommended as the foundation choice for the piers; scour has been taken into consideration for their design. Please see Pile Design Tables on page 5 for Pier piles.

Metal shell piles were not considered as a foundation type for the piers due to the presence of rock relatively close to the surface.

Drilled shafts are a feasible foundation option at the piers, however, more rock cores will be required in order to provide any drilled shaft foundation design recommendations.

Pile Design Tables for Abutments

West Abutment (B-1 (2012) data)

Pile cutoff elevation 760.65

Pile type	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
HP 12 X 53	419	230	52
HP 12 X 74	589	324	53
HP 12 X 84	664	365	53
HP 14 X 73	578	318	53
HP 14 X 89	705	388	53
HP 14 X 102	810	445	53
HP 14 X 117	929	511	54

East Abutment (B-2 (2012) data)

Pile cutoff elevation 761.05

Pile type	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
HP 12 X 53	419	230	51
HP 12 X 74	589	324	52
HP 12 X 84	664	365	53
HP 14 X 73	578	318	53
HP 14 X 89	705	388	53
HP 14 X 102	810	445	53
HP 14 X 117	929	511	54

Pile Design Tables for Piers

Pier 1 (B-2 (1979) data)

Pile cutoff elevation 761.68

Pile type	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
HP 12 X 53	419	200	48
HP 12 X 74	589	293	49
HP 12 X 84	664	334	49
HP 14 X 73	578	282	50
HP 14 X 89	705	352	50
HP 14 X 102	810	409	50
HP 14 X 117	929	474	51

Pier 2 (B-1 (1979) data)

Pile cutoff elevation 761.84

Pile type	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
HP 12 X 53	419	202	58
HP 12 X 74	589	296	59
HP 12 X 84	664	336	60
HP 14 X 73	578	285	60
HP 14 X 89	705	355	60
HP 14 X 102	810	413	60
HP 14 X 117	929	477	61

Pile Shoes:
Pile shoes are recommended for all piles since they are to be driven into hard rock.

Test Piles:
We recommend one test pile at each one of the four elements of the structure.

Lateral Load Analysis
No formal lateral load analyses were required. Based on the structure being integral with fixed piers, along with what appears to be sufficient pier pile embedment remaining upon a scour event occurring (thereby providing fixity) and the structure being located in SPZ 1, lateral loading should not be a concern.

5.0 Construction Considerations

5.1 Cofferdam and Sealcoat

A Cofferdam with Sealcoat will be required at Pier 2. Therefore, a Cofferdam Type 2 with Sealcoat needs to be indicated on the plans. Pier 1 will not require a Cofferdam.

5.2 Temporary Soil Retention

The TSL is showing that the traffic will be detoured; therefore no soil retention will be needed for Stage Construction.

6.0 Appendixes

Appendix A: Location Map
Appendix B: Preliminary Type, Size, and Location
Appendix C: Subsurface Data Plot
Appendix D: Boring Logs
Appendix E: Existing Pile Driving Records (1983)
Appendix F: Existing General Plan and Elevation
Appendix G: Spreadsheets (Settlement, Seismic Site Class Determination, and Estimating Pile Length) and Computer Outputs (*SLIDE* Slope Stability)

Appendix A

Location map


Brookville Rd
N Brookville Rd
N Brookville Rd
24
52
W Taylor St
24
52
N Eldorado St
W Young St
W Chambers St
W Chambers St
071-0098
52
52
Elkhorn Creek
N Eagle Creek Rd

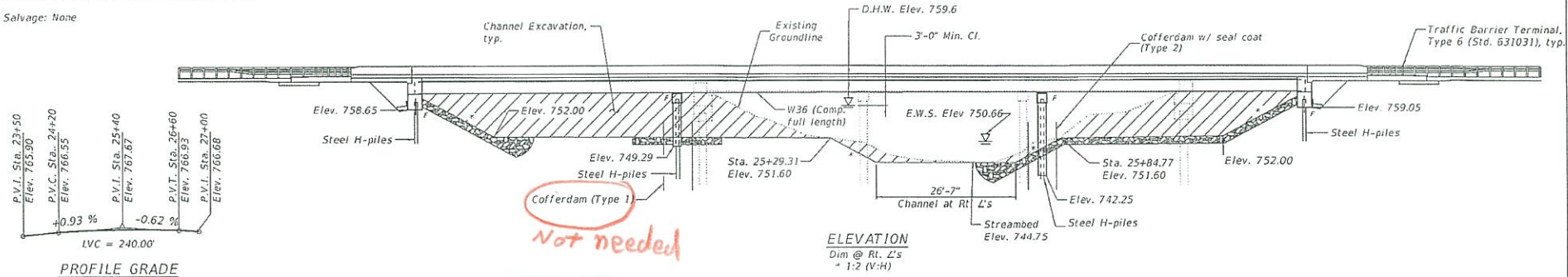
Appendix B

Preliminary Type, Size, and Location

Bench Mark: Chiseled "□" in top of NE Wingwall. Station 26+11.8640/17.1214 Lt. Elevation = 764.64.

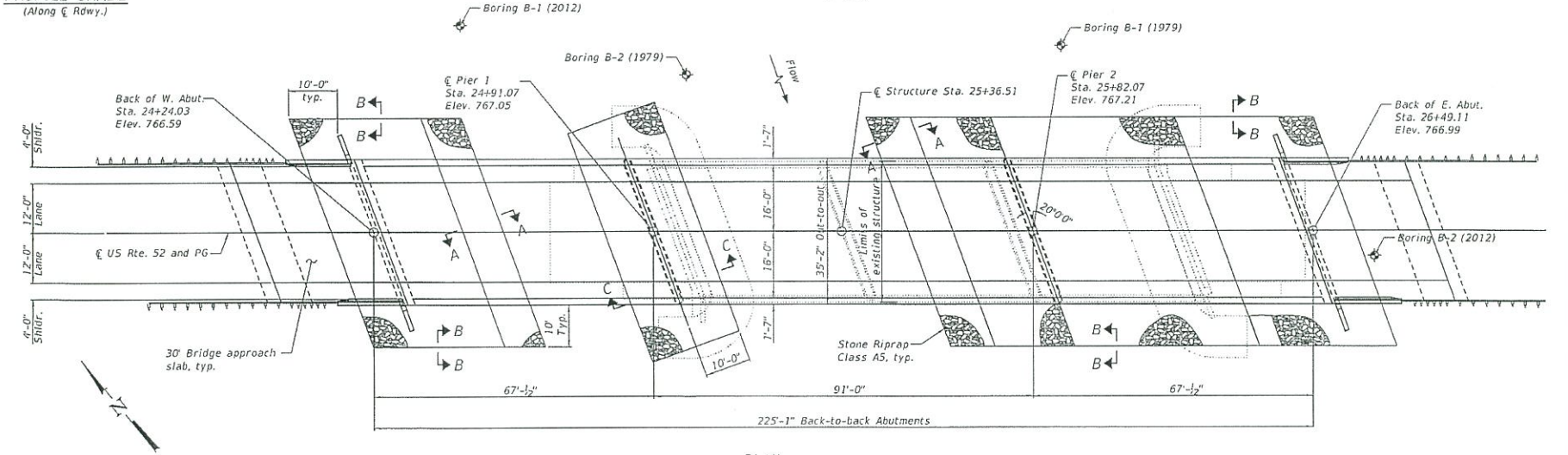
Existing Structure: Structure No. 071-0070 is a 3 span PPC deck beam bridge, originally built in 1983 as F.A.S. 2079 (US Route 52), Section 16-BR at Station 971+50.04. Both abutments are open stub abutments supported on concrete piles and the two bent type piers are supported on steel H-Piles. The back to back abutment length is 124'-4⅞", the out to out deck width is 31'-2" with a clear roadway width of 28'-0" and a 20° right-forward skew. Existing structure is to be removed and replaced. Traffic will be detoured.

Salvage: None



PROFILE GRADE
(Along ℄ Rdwy.)

ELEVATION
Dim @ Rt. L's
* 1:2 (V:H)



PLAN

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 and 2016 Interims

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50W)

HIGHWAY CLASSIFICATION

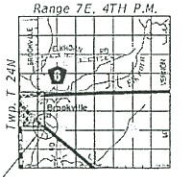
F.A.S. Rte. 2079 -U.S. Rte. 52
Functional Class: Major Collector
ADT: 750 (2022); 890 (2042)
ADTT: 196 (2022); 233 (2042)
DHV: 89
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

LOADING HL-93

Allow 50 lb/sq. ft. for future wearing surface.

SEISMIC DATA

Seismic Performance Zone (SPZ) = SPZ 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.057g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.097g
Soil Site Class = C



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
U.S. ROUTE 52 OVER ELKHORN CREEK
F.A.S. RTE. 2079 - SEC. 16BR-1
OGLE COUNTY
STATION 25+36.51
STRUCTURE NO. 071-0098

DESIGNED -	NEPHTALI RIVERA-MARTINEZ
CHECKED -	AL-BARRAE SHEBIB
DRAWN -	IAN ANDREWS
CHECKED -	N.R.M., A.A.S.

FEBRUARY 28, 2017

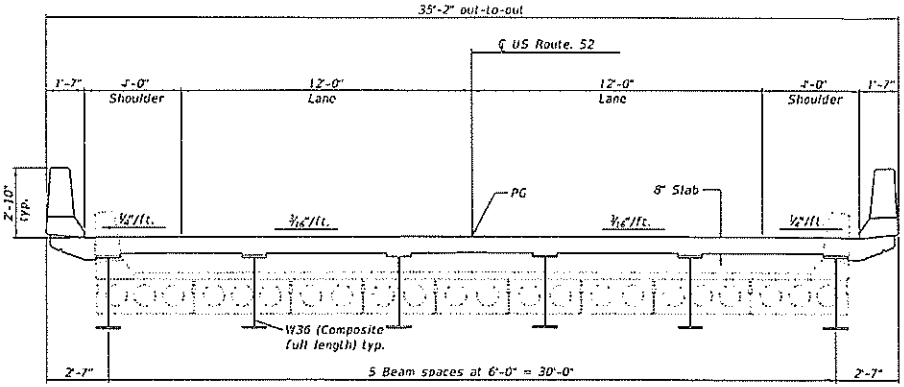
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

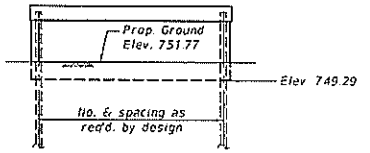
F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
2079	16BR-1	OGLE	2	1

CONTRACT NO. 64H57

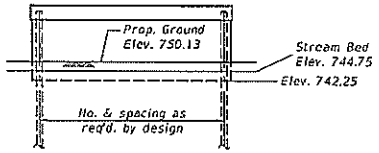
ILLINOIS | FED. AID PROJECT



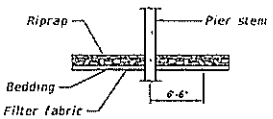
CROSS SECTION



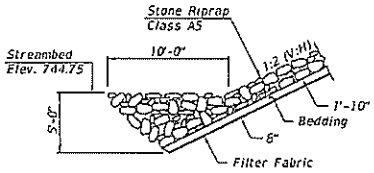
PIER 1 SKETCH



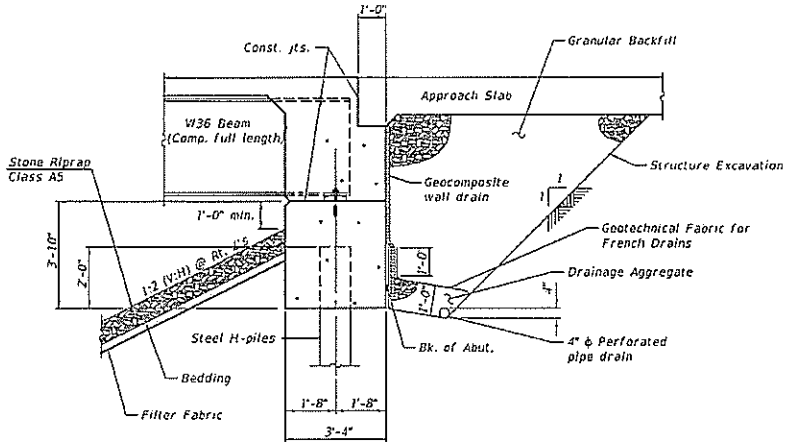
PIER 2 SKETCH



SECTION C-C



SECTION A-A



SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. ∠'s)

WATERWAY INFORMATION

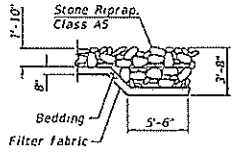
Existing Overtopping Elev. = 761.1 at Sta. 17+85
Drainage Area = 46.8 sq. mi. Proposed Overtopping Elev. = 762.0 at Sta. 17+05

Flood Event	Freq. Yr.	Discharge CFS	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	3500	685	709	758.5	1.2	0.9	759.7	759.4
Design	50	5530	756	908	759.6	1.8	1.4	761.4	761.0
Base	100	6430	776	962	759.9	1.7	1.4	761.6	761.3
Scour Design Check	200	7375	822	1038	760.3	1.7	1.6	762.0	761.9
Overtop Existing	40	5000	737	-	759.4	1.7	-	761.1	-
Overtop Proposed	300	7750	-	1061	760.4	-	1.7	-	762.1
Max. Calc.	500	8680	861	1117	760.7	1.7	1.5	762.4	762.2

10 Year Velocity Through Existing Bridge = 5.1 ft/s
10 Year Velocity Through Proposed Bridge = 4.9 ft/s

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
0100	758.65	734.80	728.40	759.05	
0200	758.65	732.80	726.40	759.05	
Design	758.65	734.80	728.40	759.05	5
Check	758.65	732.80	726.40	759.05	



SECTION B-B

DETAILS
U.S. ROUTE 52 OVER
ELKHORN CREEK
F.A.S. RTE. 2079 - SEC. 16BR-1
OGLE COUNTY
STATION 25+36.51
STRUCTURE NO. 071-0098

DESIGNED -	NEPHTALI RIVERA-MARTINEZ
CHECKED -	AL-BARRAE SHEBIB
DRAWN -	IAN ANDREWS
CHECKED -	N.R.M., A.R.S.

FEBRUARY 28, 2017

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

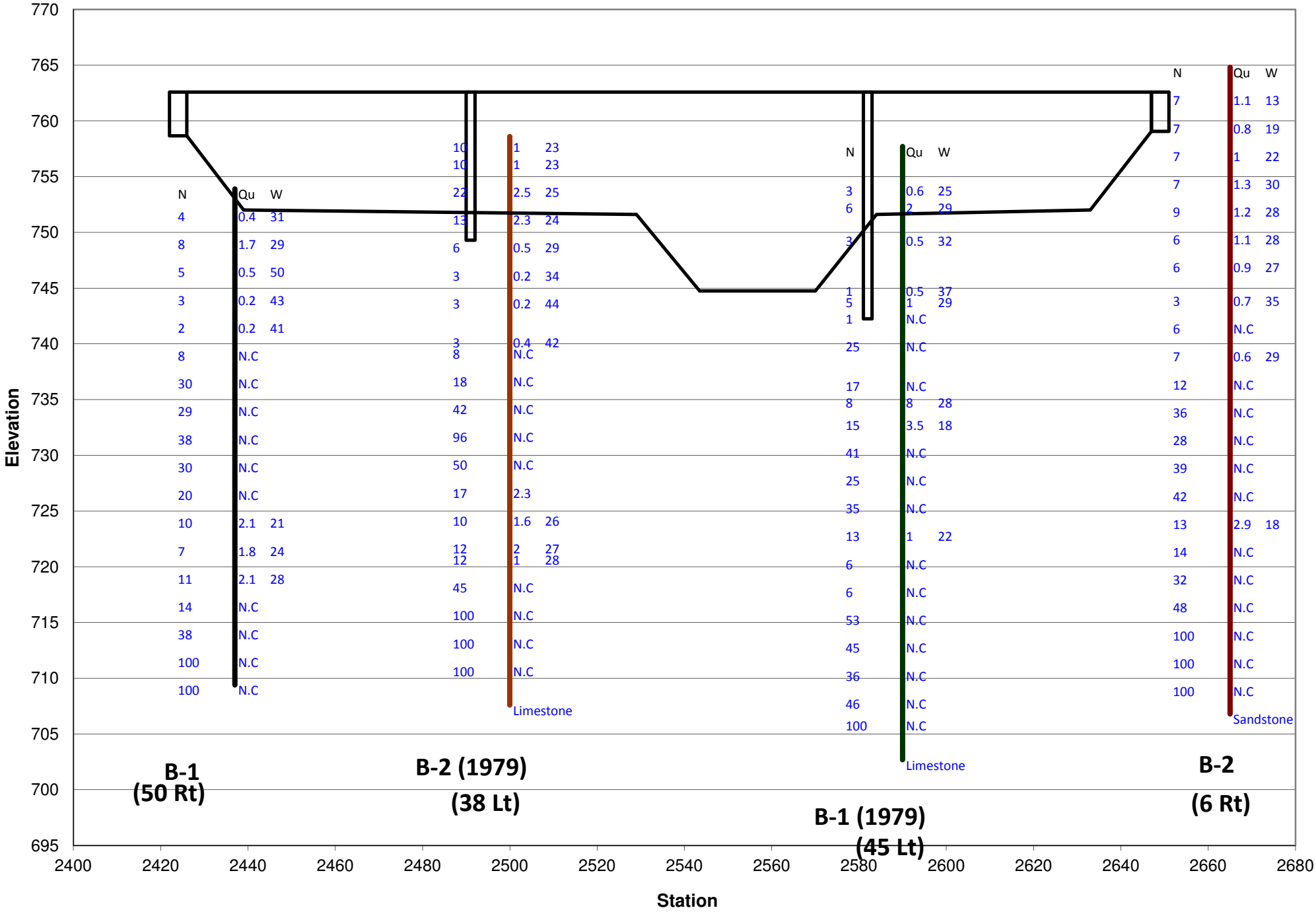
SHEET NO. 2 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
2079	16BR-1	OGLE	2	2
		CONTRACT NO. 64H57		
		ILLINOIS FED. AID PROJECT		

Appendix C

Subsurface Data Plot

071-0098


Elevation
Station
770
765
760
755
750
745
740
735
730
725
720
715
710
705
700
695
2400
2420
2440
2460
2480
2500
2520
2540
2560
2580
2600
2620
2640
2660
2680
B-1
(50 Rt)
B-2 (1979)
(38 Lt)
B-1 (1979)
(45 Lt)
B-2
(6 Rt)
Limestone
Limestone
Sandstone

Appendix D

Boring logs
(Including 2012 Borings and Existing 1979 Borings)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 2/17/12

ROUTE US 52 DESCRIPTION 071-0070 P92-029-12 Bridge, US 52, .5 m. S. of IL 64 over Elkhorn Creek LOGGED BY W. Garza

SECTION _____ LOCATION Brookville Twp. - 27NW, SEC. , TWP. 24N, RNG. 7E

COUNTY Ogle DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 071-0070
Station _____

BORING NO. B-1
Station 970+38
Offset 50.00ft Lt CL
Ground Surface Elev. 753.9 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 739.4 ft ▼
Upon Completion Wash ft
After _____ Hrs. _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SOFT brown SILTY CLAY LOAM			0.4 P	31
751.90				
STIFF brown SILTY CLAY LOAM		4 4 4	1.7 B	29
750.40				
MEDIUM dark gray SILTY CLAY LOAM	-5	2 2 3	0.5 B	50
747.90				
VERY SOFT gray SILTY LOAM		1 1 2	0.2 B	43
745.40				
VERY SOFT gray SILTY LOAM with SAND lens	-10	0 0 2	0.2 B	41
742.40				
LOOSE tan SAND		0 2 6		
740.40				
▼ MEDIUM/DENSE tan SANDY GRAVEL	-15	14 15 15		
737.90				
Wash MEDIUM tan SANDY GRAVEL		9 13 16		
735.40				
DENSE tan SANDY GRAVEL	-20	13		
DENSE tan SANDY GRAVEL *(continued)*		22 16		
732.90				
MEDIUM/DENSE tan clean medium coarse SAND with medium GRAVEL		10 15 15		
730.40				
MEDIUM tan clean medium coarse SAND	-25	10 10 10		
727.40				
VERY STIFF gray SILTY CLAY		2 4 6	2.1 B	21
725.40				
STIFF gray SILTY CLAY	-30	2 2 5	1.8 B	24
722.90				
VERY STIFF gray SILTY CLAY		3 5 6	2.1 B	28
719.90				
MEDIUM tan fine SAND	-35	1 2 12		
717.90				
Wash DENSE tan clean medium coarse SAND with fine SAND lens		9 18 20		
715.40				
	-40	20		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 2/17/12

ROUTE US 52 DESCRIPTION 071-0070 P92-029-12 Bridge, US 52, .5 m. S. of IL 64 over Elkhorn Creek LOGGED BY W. Garza

SECTION _____ LOCATION Brookville Twp. - 27NW, SEC. , TWP. 24N, RNG. 7E

COUNTY Ogle DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 071-0070
Station _____

BORING NO. B-1
Station 970+38
Offset 50.00ft Lt CL
Ground Surface Elev. 753.9 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 739.4 ft
Upon Completion Wash ft
After ____ Hrs. _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
	100/7"			Wash VERY DENSE white fine SAND *(continued)*
712.90				
	100/3"			Wash VERY DENSE white fine SAND
709.90				End of Boring
-45				
-50				
-55				
-60				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 3/5/12

ROUTE US 52 DESCRIPTION 071-0070 P92-029-12 Bridge, US 52, .5 m. S. of IL 64 over Elkhorn Creek LOGGED BY W. Garza

SECTION _____ LOCATION Brookville Twp. - 27NW, SEC. , TWP. 24N, RNG. 7E

COUNTY Ogle DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 071-0070
Station _____

BORING NO. B-2
Station 972+57
Offset 6.00ft Rt CL
Ground Surface Elev. 764.81 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 742.3 ft ▼
Upon Completion Wash ft
After _____ Hrs. _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
STIFF gray LOAM			1.1 P	13
	762.31			
MEDIUM gray SILTY CLAY LOAM		3 3 4	0.8 P	19
	760.81			
	-5			
STIFF gray SANDY LOAM		1 3 4	1.0 P	22
	758.31			
STIFF gray SILTY LOAM		2 3 4	1.3 B	30
	755.81			
	-10			
STIFF gray SILTY LOAM		2 4 5	1.2 B	28
	753.31			
STIFF gray SILTY CLAY LOAM		2 2 4	1.1 P	
	750.81			
	-15			
MEDIUM gray SILTY LOAM with ORGANICS		2 3 3	0.9 B	27
	748.31			
MEDIUM gray SILTY LOAM with SAND lens		2 1 2	0.7 B	35
	745.31			
	-20			
LOOSE gray moist fine SAND		2 2 4		
	742.81			
MEDIUM gray SILTY LOAM with SAND lens		1 2 5	0.6 P	29
	740.31			
	-25			
MEDIUM tan SANDY GRAVEL		6 4 8		
	737.81			
DENSE tan weathered LIMESTONE		13 16 20		
	735.81			
	-30			
MEDIUM tan weathered LIMESTONE		17 14 14		
	733.31			
DENSE tan weathered LIMESTONE		16 20 19		
	730.81			
	-35			
DENSE tan weathered LIMESTONE		20 20 22		
	727.81			
VERY STIFF gray CLAY LOAM TILL		4 5 8	2.9 B	18
	725.31			
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 3/5/12

ROUTE US 52 DESCRIPTION 071-0070 P92-029-12 Bridge, US 52, .5 m. S. of IL 64 over Elkhorn Creek LOGGED BY W. Garza

SECTION _____ LOCATION Brookville Twp. - 27NW, SEC. , TWP. 24N, RNG. 7E

COUNTY Ogle DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. 071-0070
Station _____

BORING NO. B-2
Station 972+57
Offset 6.00ft Rt CL
Ground Surface Elev. 764.81 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 742.3 ft
Upon Completion Wash ft
After _____ Hrs. _____ ft

		DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM tan fine SAND			9 10 4		
	723.31				
Wash DENSE tan fine SAND			11 15 17		
	720.81	-45			
DENSE tan fine SAND			10 14 34		
	718.31				
VERY DENSE tan fine SAND			100/9"		
	715.81	-50			
Wash VERY DENSE off-white fine SAND			100/3"		
	713.31				
VERY DENSE white fine SAND	711.81		100/4"		
Borehole continued with rock coring.		-55			
		-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 3/5/12

ROUTE US 52 DESCRIPTION 071-0070 P92-029-12 Bridge, US 52, .5 m. S. of IL 64 over Elkhorn Creek LOGGED BY W. Garza

SECTION _____ LOCATION Brookville Twp. - 27NW, SEC. , TWP. 24N, RNG. 7E

COUNTY Ogle CORING METHOD _____

STRUCT. NO. 071-0070
Station _____

CORING BARREL TYPE & SIZE _____

Core Diameter 2 in
Top of Rock Elev. 717.31 ft
Begin Core Elev. 711.81 ft

BORING NO. B-2
Station 972+57
Offset 6.00ft Rt CL
Ground Surface Elev. 764.81 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Sandstone: tan-white, fine to medium grained, crumbly and soft, mostly washed out, no testable segments retrieved. 711.81	-55	1	40	0	1.6	
706.81						
Sandstone: as above.	-60	2	30	0	1.4	
701.81						
End of Boring	-65					
	-70					

Color pictures of the cores _____
Cores will be stored for examination until _____
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

NW¼, Section 27, T 24 N, R 7 E, 4th PM

Near Ctr. W½, SE¼, NW¼, 27-24N-7E

Illinois Department of Transportation

Bridge Foundation Boring Log

Sh. 1 of 2 Sh.

PROJECT P-92-061-78 BRIDGE Elkhorn Creek Date 11-8-79

ROUTE FAS 2079 (U.S.52) 071-0032 Bored By Crofton & Wildman

SEC. 16-BR STA. 971+50 (inc. to SE) Checked By R. Wildman

COUNTY Ogle

Boring No. B-1
Station 971+82
Offset 45'L

Surface Water El. —
Groundwater El. at Completion wash
After 120 Hours 254.0

	Elevation	N	Qu t/s.f.	w (%)
Ground Surface (751.7±) 261.2	0			
Medium Silty Clay Loam			E 0.5	25
Stiff, Silty Clay Loam Black	-5	6	P 2.0	29
Soft Black Loam		3	P .5	32
Same As Above	-10	1	P .5	37
Soft, Blue-Grey Silt ▽		5	P 1.0	29
Dirty Sand & Gravel	-15	1		
Medium Sand & Gravel		25		
Same As Above	-20	17		
Soft Gray Silt		8	8	28
Medium Sand & Gravel with a Silt Layer	-25	15	3.5	18
Dense Sand & Gravel		41		
Medium Sand & Gravel	-30	25		
Dense Sand Gray Fine		35		
Stiff Clay Gray with Sand & Gravel Lense	-35	13	1.0	22
Loose Sand Yellow Fine		6		
Same As Above	-40	6		
Very Dense Sand & Gravel Coarse Sand & 1" Gravel		53		
Dense Sand & Gravel, Yellow Coarse Sand	-45	45		

N-Standard Penetration Test-Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 No. hammer falling 30".

Qu-Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight-%.

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value
P - Penetrometer

BD 137 (Rev. 4-78)

X USGS equiv.

BRIDGE FOUNDATION BORING LOG

P-92-061-78
FAS 2079
16BR
Ogle County
Boring B-Y 1

Elevation	N	Qu t/s.f.	w (%)	Elevation	N	Qu t/s.f.	w (%)
-45				-75			
Dense Sand & Gravel Coarse Sand Predominant	36						
Same As Above	46						
-50							
Very Dense Limestone with Gravel	100	6"pene.					
Auger Refusal				-80			
-55							
-60				-85			
-65				-90			
-70				-95			

Illinois Department of Transportation

Bridge Foundation Boring Log

Sh.1 of 2 Sh.

PROJECT P-92-061-78 BRIDGE Elkhorn Creek Date 11-15-79

ROUTE FAS 2079 (U.S.52) 071-0032 Bored By R. Wildman

SEC. 16BR STA. 971+50 Checked By R. Wildman

COUNTY Ogle

Boring No. B-2
Station 970+92
Offset 38' L

Surface Water El. —

Groundwater El. at Completion Wash

After — Hours —

Elevation	Description	N	Qu t/s.f.	w (%)
262.1	Ground Surface (758.6±)			
	Medium Silty Clay Loam Brown	10 E	1.0 E	23
	Very Stiff, Silty Clay Black	22	P 2.5	25
-5	Same As Above	13	B 2.3	24
	Soft Silty Clay Gray	6	B 0.5	29
-10	Very Soft Silty Clay Loam, Gray with Sand Lenses	3	B 0.2	34
	Very Soft Silt Gray, Sand Lenses	3	0.2 B	44
-15	Soft Silt Gray with Gravel	3	B 0.4	42
	Loose Sand & Gravel Yellow-Brown	8		
-20	Medium Sand & Gravel Limestone with Granite Particles Also	18		
	Dense Sand & Gravel	42		
-25	Very Dense Limestone & Sand & Gravel	96		
	Dense Limestone - Yellow	50		
-30	Very Stiff Silt, Gray to Brown Mottled	17	B 2.3	
	Stiff Silty Clay Gray	10	B 1.6	26
-35	Very Stiff Silty Clay Gray	12	B 2.0	27
	Stiff, Same As Above	12	B 1.0	28
-40	Loose Sand Yellow Coarse			
	Dense Highly Fractured Limestone with Sand Coarse	45		
	Very Dense Fractured Limestone with Gray Clay Matrix	100	6"	pene
-45				

N-Standard Penetration Test-Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 No. hammer falling 30"

Qu-Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight-%

Type failure
B - Bulge Failure
S - Shear Failure
E - Estimated Value
P - Penetrometer

BD 137 (Rev. 4-78)

FORM NO. B D 131 REV. 9-88

Sh. 2 of 2 Sh.

BRIDGE FOUNDATION BORING LOG

FAS 2079
16-BR
Ogle County
P-92-061-78
Boring B-2

	Elevation	N	Qu t/s.f.	w (%)
	-45			
Very Dense Sand White Medium		100	6" pene.	
Same As Above with Limestone Gravel		100	6" pene.	
End of Boring	-50			
	-55			
	-60			
	-65			
	-70			
	-75			
	-80			
	-85			
	-90			
	-95			

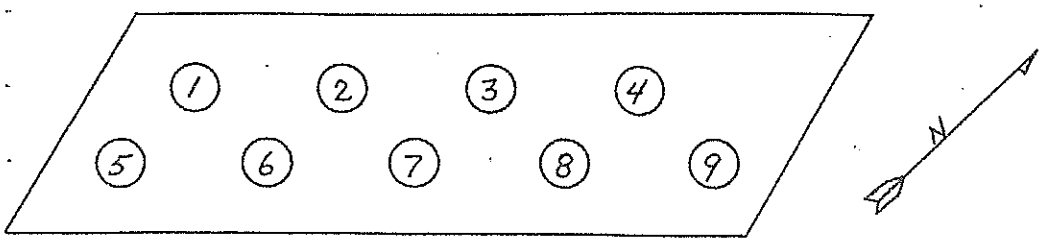
Appendix E

Existing Pile Driving Records

PILING DIAGRAM

County Ogle
Section 16 BR
Route FAS-2079
District 2
Contract No. 36446
Job No. C92-110-83
Project BR-2-2079 (102)

Station 972 + 12.20 (EAST ABUT)
Type Of Piling METAL SHELL
Plan Length 35'
Ordered Length 33'
Date Driven 9-6-83
Hammer Make & Model DELMAG 15
Test Pile Length _____ No. _____
Location _____
Res. Eng. J. Westervelt



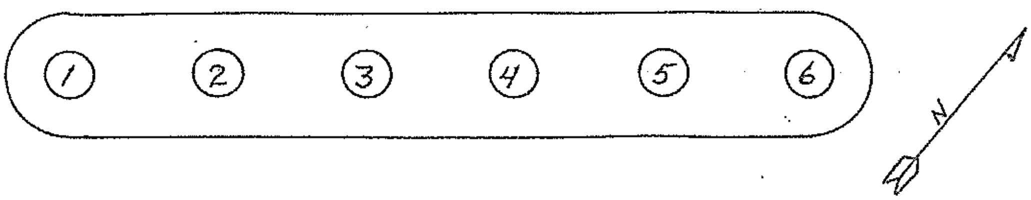
PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
1	33	31.7	35.6
2	46	39.0	40.3
3	42.9	39.5 34.5	42.2
4	33	29.2	41.3
5	33	28.5	35.9
6	33	28.1	39.5
7	33	29.6	38.4
8	~~42.6~~ 36.6	38.1	41.3
9	33	31.0	37.5
TOTALS		329.0	294.7

PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING

PILING DIAGRAM

County Ogle
Section 16 BR
Route FAS - 2079
District 2
Contract No. 36446
Job No. C92-110-83
Project BR-2-2079 (102)

Station 971 + 30.14 (Pier #1)
Type Of Piling Steel HP 10×42
Plan Length 51
Ordered Length 51
Date Driven 8-27-83
Hammer Make & Model Delmag 15
Test Pile Length ______ No. ______
Location ______
Res. Eng. J. Westervelt



PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
1	51	48.4	60.5
2	51	48.5	63.1
3	51	47.7	57.8
4	51	48.0	60.0
5	51	48.3	63.1
6	51	48.6	60.0

PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
TOTALS 6	306	289.5	

Illinois Department of Transportation

Memorandum

To: Carl Thunman

From: Ralph C. Wehner BY: W. Rex Heacock

Subject: Piling Diagrams

Date: August 9, 1984

ROUTE FAS 2079

SECTION 16-BR

COUNTY Ogle

PROJECT BR-S-2079(102)

JOB NO. C-92-110-83

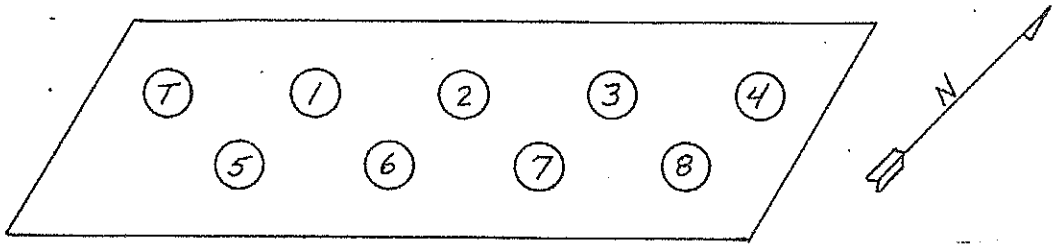
CONTRACT NO. 36446

CONTRACTOR Belvidere Costruction Company

PILING DIAGRAM

County Ogle
Section 16 BR
Route FAS-2079
District 2
Contract No. 36446
Job No. C92-110-83
Project BR-2-2079 (102)

Station 970+87.74 (West Abut)
Type Of Piling METAL SHELL
Plan Length 30
Ordered Length 33'
Date Driven 9-12-83
Hammer Make & Model DELMAG 15
Test Pile Length 30.67 No. T
Location 970+87.74
Res. Eng. J. Westervelt



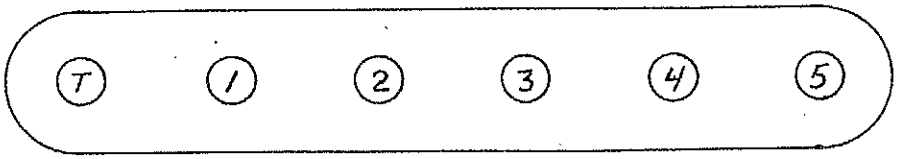
PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
1	33	23.6	43 T
2	33	23.8	46 T
3	33	23.3	49.5+T
4	33	24.5	41.3 T
5	33	23.7	42.2 T
6	33	22.5	41.3 T
7	33	24.4	49.5 T
8	33	22.3	49.5 T

PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
TOTALS	8	264	188.1

PILING DIAGRAM

County Ogle
Section 16 BR
Route FAS-2079
District 2
Contract No. 36446
Job No. C92-110-83
Project BR-2-2079 (102)

Station 971 +69.93 (Pier # 2)
Type Of Piling Steel HP 10 x 42
Plan Length 51 ft
Ordered Length 51 ft
Date Driven 8-25-83
Hammer Make & Model Delmag 15
Test Pile Length 48.66 ft No. T
Location 971 +69.93 16'3" LT
Res. Eng. J. Westervelt

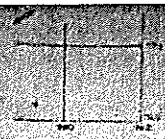


PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING
1	51	48.5	68 T
2	51	48.5	63 T
3	51	49.2	70.3 T
4	51	48.7	60 T
5	51	48.4	63.1 T
TOTALS	5	255	243.3

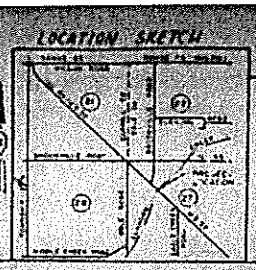
PILE NO.	LENGTH FURNISHED	LENGTH REMAINING IN PLACE	FINAL BEARING

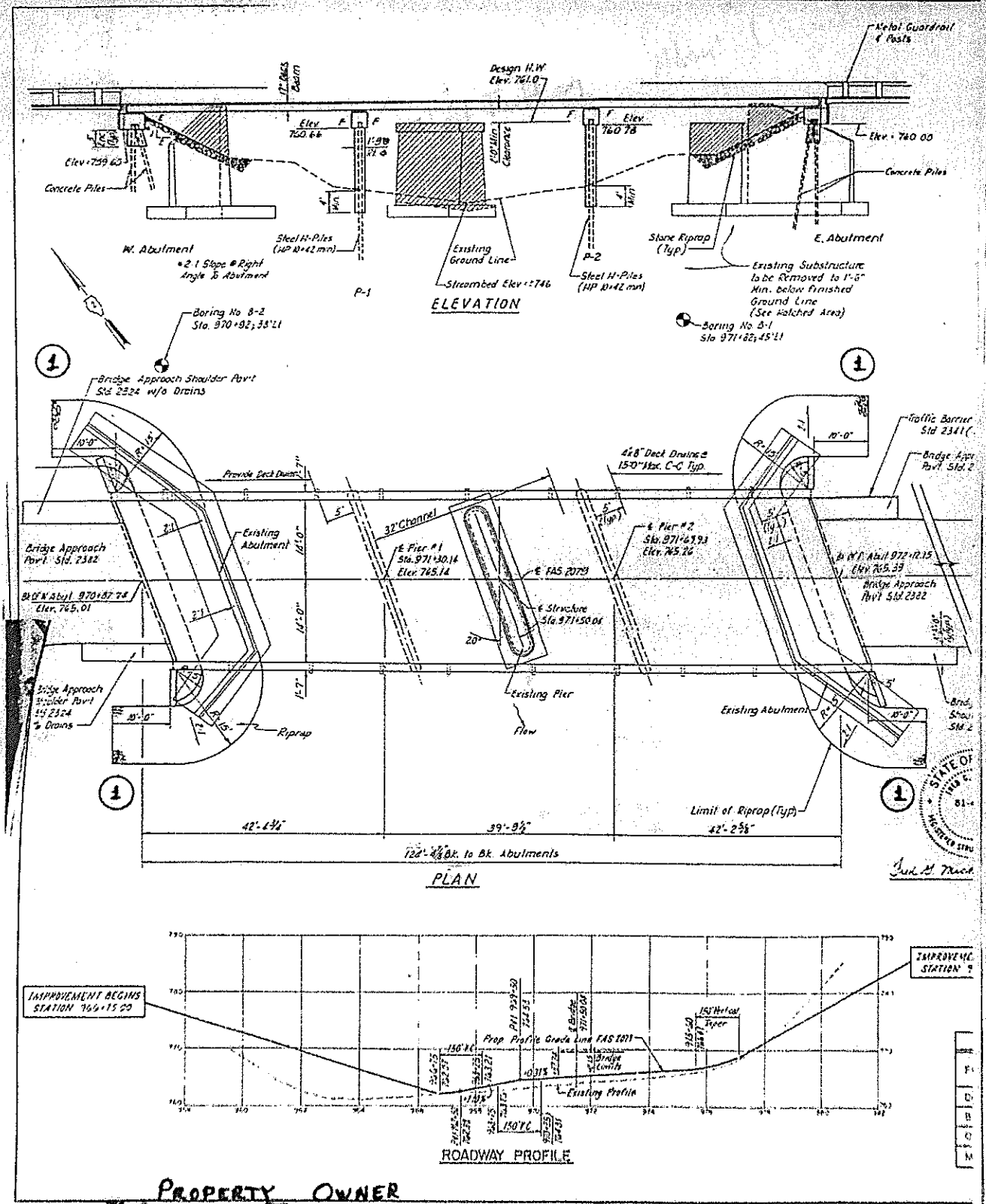
Appendix F

Existing General Plan and Elevation



Freq.	Flow W	Q C.F.S.	Opening Sq. Ft. Exist	Opening Sq. Ft. Prop.	HW Elev. H.W.E.	Head-ft. Exist	Head-ft. Prop.	Headwater El. Exist	Headwater El. Prop.
Design	50	5440	660	882	761.0	2.40	1.26	76314	76226
Base	100	7070	660	939	761.6	2.34	1.91	76394	76351
Overtopping	80	6735	660	921	761.4		1.81		76321
Max. Calc.	500								





PROPERTY OWNER

(1) DAVID L. INTYRE
BOX 85
POLO, IL

(815) 946-2695

Appendix G

Spreadsheets and Computer Outputs

(Settlement, Seismic Site Class Determination, Estimating Pile Length, and *SLIDE* Slope Stability)

COHESIVE SOIL SETTLEMENT ESTIMATE

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified on 12/9/14

LOCATION AND BORING USED ===== East Abutment B-2 (2012)
TYPE OF SURCHARGE ========== 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 7 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 1.5 FT
- PROPOSED WIDTH AT TOP ========== 32 FT
- PROPOSED WIDTH AT BOTTOM ========== 38 FT (which is a 2.0:1 slope)

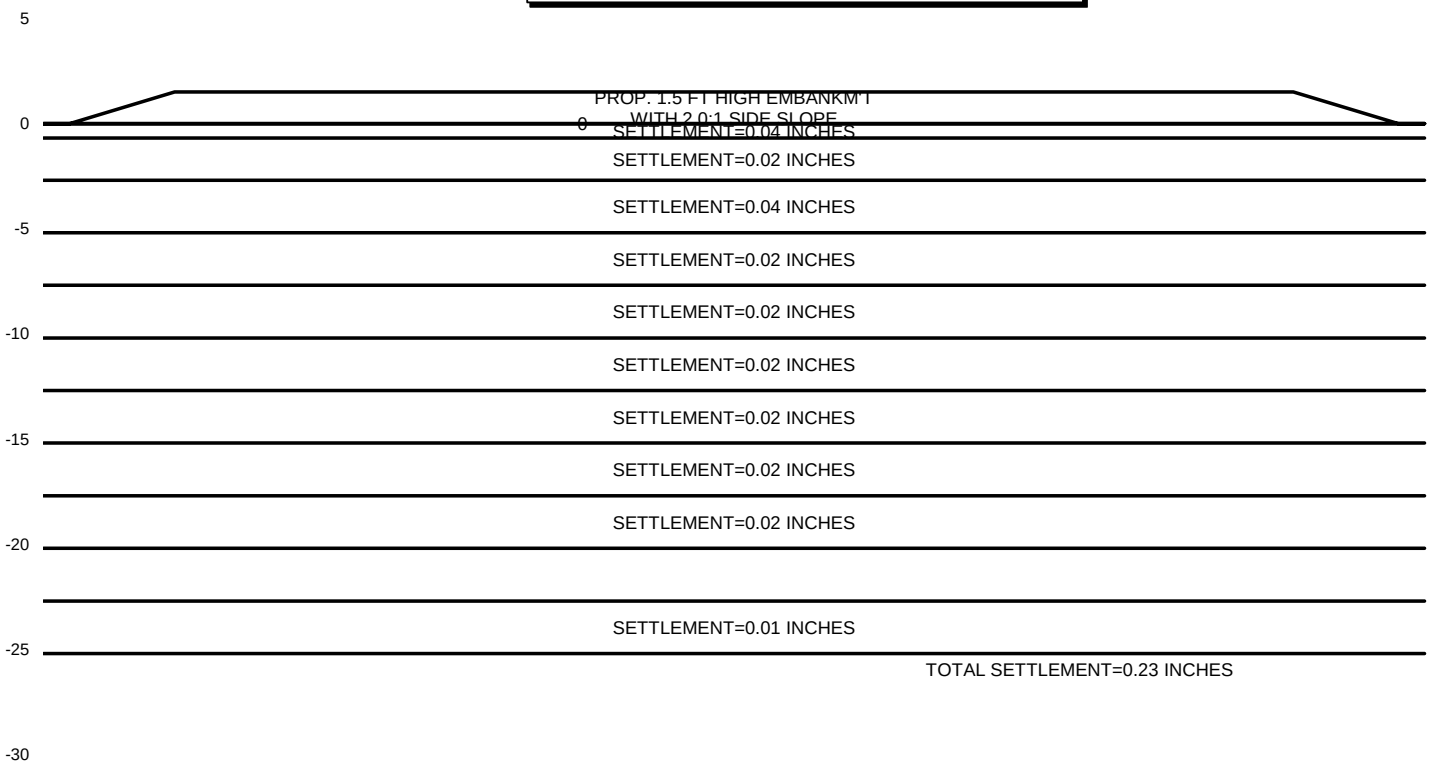
ASSUMPTIONS:
- Soil Deposit is Normally Consolidated
- Cohesive Layers are Saturated
- Soils have a Low Sensitivity
- Liquid Limit (LL)=Moist. Content (MC%)
- Initial Void Ratio (Eo)=2.7*(MC%)/100
- Comp. Index (Cc)=0.009*(LL-10)
- Neglecting Granular & Secondary Settlem't

EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== PCF
- EXISTING EMBANKMENT HEIGHT ========== FT
- EXISTING WIDTH AT TOP ========== FT
- EXISTING WIDTH AT BASE ========== FT (which is a 0.0:1 slope)

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
0.7	120	1.00	15	0.041	0.173	0.405	0.045	0.200	**0.04**
2.0	120	1.10	13	0.203	0.151	0.351	0.027	0.184	**0.02**
2.5	120	0.80	19	0.473	0.127	0.513	0.081	0.242	**0.04**
2.5	120	1.00	22	0.773	0.113	0.594	0.108	0.200	**0.02**
2.5	120	1.30	30	0.952	0.105	0.810	0.180	0.160	**0.02**
2.5	120	1.20	28	1.096	0.098	0.756	0.162	0.171	**0.02**
2.5	120	1.10	28	1.240	0.091	0.756	0.162	0.184	**0.02**
2.5	120	0.90	27	1.384	0.086	0.729	0.153	0.219	**0.02**
2.5	120	0.70	35	1.528	0.080	0.945	0.225	0.271	**0.02**
2.5	120	0.00		1.672	0.075			1.000	**Granular**
2.5	120	0.60	29	1.816	0.071	0.783	0.171	0.309	**0.01**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.23 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified on 12/9/14

LOCATION AND BORING USED ===== West Abutment/ B-1 (2012)
TYPE OF SURCHARGE ========== 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 19 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 2 FT
- PROPOSED WIDTH AT TOP ========== 32 FT
- PROPOSED WIDTH AT BOTTOM ========== 40 FT (which is a 2.0:1 slope)

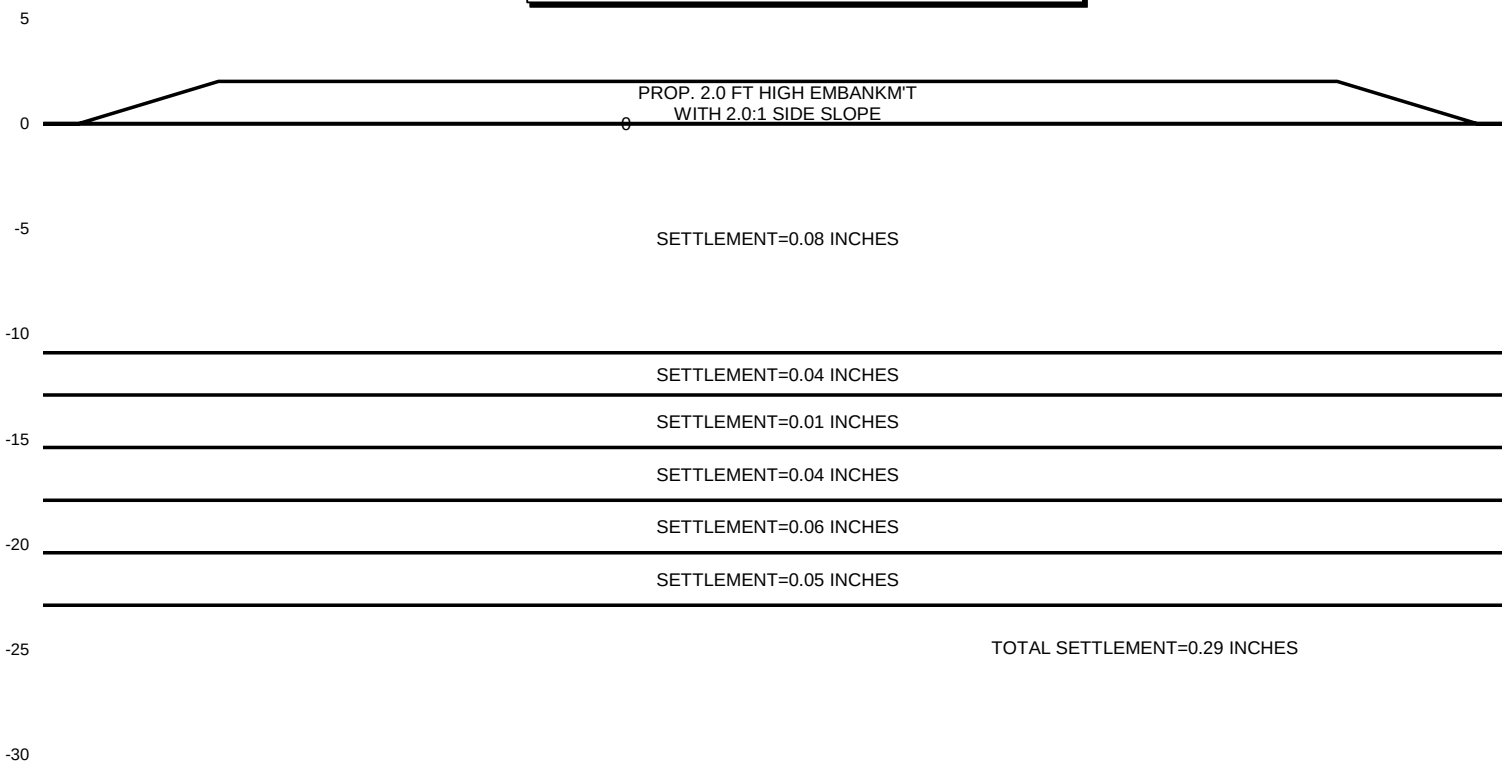
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== PCF
- EXISTING EMBANKMENT HEIGHT ========== FT
- EXISTING WIDTH AT TOP ========== FT
- EXISTING WIDTH AT BASE ========== FT (which is a 0.0:1 slope)

ASSUMPTIONS:
- Soil Deposit is Normally Consolidated
- Cohesive Layers are Saturated
- Soils have a Low Sensitivity
- Liquid Limit (LL)=Moist. Content (MC%)
- Initial Void Ratio (Eo)=2.7*(MC%)/100
- Comp. Index (Cc)=0.009*(LL-10)
- Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
10.9	120	1.00	15	0.654	0.167	0.405	0.045	0.200	**0.08**
2.0	120	0.40	31	1.428	0.135	0.837	0.189	0.436	**0.04**
2.5	120	1.70	29	1.698	0.127	0.783	0.171	0.127	**0.01**
2.5	120	0.50	50	1.998	0.119	1.350	0.360	0.361	**0.04**
2.5	120	0.20	43	2.289	0.111	1.161	0.297	0.700	**0.06**
2.5	120	0.20	41	2.433	0.104	1.107	0.279	0.700	**0.05**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.29 IN.

EMBANKMENT AND SOIL PROFILE



Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	758.92	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1	
Top of Boring Elev.	753.9	ft.
Approximate Fixity Elev.	752.92	ft.

Individual Site Class Definition:

N (bar):	21	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	63	(Blows/ft.)	Soil Site Class C
s_u (bar):	2.24	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
1.0	751.9	2.00	4	0.40	
2.5	750.4	1.50	8	1.70	
5.0	747.9	2.50	5	0.50	
7.5	745.4	2.50	3	0.20	
10.5	742.4	3.00	2	0.20	B
12.5	740.4	2.00	8	0.00	
15.0	737.9	2.50	30	0.00	
17.5	735.4	2.50	29	0.00	
20.0	732.9	2.50	38	0.00	
22.5	730.4	2.50	30	0.00	
25.5	727.4	3.00	20	0.00	B
27.5	725.4	2.00	10	2.10	
30.0	722.9	2.50	7	1.80	
33.0	719.9	3.00	11	2.10	B
35.0	717.9	2.00	14	0.00	
37.5	715.4	2.50	38	0.00	
40.0	712.9	2.50	100	0.00	
43.0	709.9	3.00	100	0.00	
46.0	706.9	3.00	100	0.00	B
100.0	652.9	54.00	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	749.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2 (E)	
Top of Boring Elev.	758.6	ft.
Approximate Fixity Elev.	743.5	ft.

Individual Site Class Definition:

N (bar):	35	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	75	(Blows/ft.)	Soil Site Class C
s_u (bar):	3.16	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	756.1	2.50	10	1.00	B
	754.1	2.00	22	2.50	
	751.6	2.50	13	2.30	B
	749.1	2.50	6	0.50	
	746.6	2.50	3	0.20	
	744.1	2.50	3	0.20	
2.9	740.6	3.50	3	0.40	B
4.4	739.1	1.50	8		
6.9	736.6	2.50	18		
9.4	734.1	2.50	42		
11.9	731.6	2.50	96		
14.4	729.1	2.50	50		B
16.9	726.6	2.50	17	2.30	
19.4	724.1	2.50	10	1.60	
21.9	721.6	2.50	12	2.00	
23.4	720.1	1.50	12	1.00	B
25.4	718.1	2.00	12		B
100.0	643.5	74.60	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	751.6	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1 (E)	
Top of Boring Elev.	757.7	ft.
Approximate Fixity Elev.	745.6	ft.

Individual Site Class Definition:

N (bar):	29	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	39	(Blows/ft.)	Soil Site Class D <----Controls
s_u (bar):	3.97	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	753.7	4.00	7	0.50	B
	752.7	1.00	6	2.00	B
	749.7	3.00	3	0.50	
0.4	745.2	4.50	1	0.50	B
1.4	744.2	1.00	5	1.00	B
2.9	742.7	1.50	1		
5.9	739.7	3.00	25		
8.4	737.2	2.50	17		B
9.9	735.7	1.50	8	8.00	B
11.4	734.2	1.50	15	3.50	B
14.4	731.2	3.00	41		
17.4	728.2	3.00	25		B
18.9	726.7	1.50	25		B
21.4	724.2	2.50	14	1.00	B
23.4	722.2	2.00	6		
25.9	719.7	2.50	6		B
28.4	717.2	2.50	53		B
30.9	714.7	2.50	45		B
33.4	712.2	2.50	36		
36.9	708.7	3.50	46		B
100.0	645.6	63.10	100	5.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)	759.38	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2	
Top of Boring Elev.	764.81	ft.
Approximate Fixity Elev.	753.38	ft.

Individual Site Class Definition:

N (bar):	25	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	51	(Blows/ft.)	Soil Site Class C <----Controls
s_u (bar):	2.22	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	762.3	2.50	6	1.10	
	760.8	1.50	7	0.80	
	758.3	2.50	7	1.00	
	755.8	2.50	7	1.30	
0.1	753.3	2.50	9	1.20	
2.6	750.8	2.50	6	1.10	
5.1	748.3	2.50	6	0.90	B
8.1	745.3	3.00	3	0.70	B
10.1	743.3	2.00	6	0.00	B
12.6	740.8	2.50	7	0.60	B
15.1	738.3	2.50	12	0.00	B
17.1	736.3	2.00	36	0.00	
19.6	733.8	2.50	28	0.00	
22.1	731.3	2.50	39	0.00	
25.1	728.3	3.00	42	0.00	B
27.6	725.8	2.50	13	2.90	B
30.1	723.3	2.50	14	0.00	
32.6	720.8	2.50	32	0.00	
35.1	718.3	2.50	48	0.00	B
37.6	715.8	2.50	100	0.00	
42.1	711.3	4.50	100	0.00	B
100.0	653.4	57.90	100	5.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar):	28	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	57	(Blows/ft.)	Soil Site Class C <----Controls
s_u (bar):	2.91	(ksf)	Soil Site Class C

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE========== east abutment
REFERENCE BORING ========== B-2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 761.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 759.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 424.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==== 434.00 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1245 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 34.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ====== 292.94 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ====== 109.85 KIPS

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
578 KIPS	**578** KIPS	**318** KIPS	**51** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
757.81	1.19	1.30			4.9		30.0	7.2		***9.9***	10	0	0	5	3
755.31	2.50	1.30			10.2	25.1	38.3	15.2	2.7	***24.9***	25	0	0	14	6
752.81	2.50	1.20			9.6	23.2	46.0	14.3	2.5	***39.0***	39	0	0	21	8
750.31	2.50	1.10			9.0	21.3	***51.1***	13.4	2.3	51.9	51	0	0	28	11
747.81	2.50	0.90			7.7	17.4	***54.9***	11.4	1.9	62.9	55	0	0	30	13
744.81	3.00	0.70			7.4	13.5	***69.4***	11.0	1.5	74.6	69	0	0	38	16
742.31	2.50		6	Fine Sand	1.2	20.6	***61.6***	1.8	2.2	75.5	62	0	0	34	19
739.81	2.50	0.60			5.4	11.6	96.6	8.0	1.2	***86.7***	87	0	0	48	21
737.31	2.50		12	Sandy Gravel	3.3	41.2	151.5	4.9	4.4	***97.1***	97	0	0	53	24
735.31	2.00		36	Hard Till	3.8	92.8	134.6	5.6	10.0	***100.5***	100	0	0	55	26
732.81	2.50		28	Hard Till	3.6	72.1	166.5	5.3	7.8	***108.8***	109	0	0	60	28
730.31	2.50		39	Hard Till	5.2	100.5	179.5	7.7	10.8	***117.4***	117	0	0	65	31
727.31	3.00		42	Hard Till	6.9	108.2	134.2	10.3	11.7	***122.1***	122	0	0	67	34
724.81	2.50	2.90			17.5	56.0	***143.8***	26.0	6.0	147.3	144	0	0	79	36
722.81	2.00		14	Fine Sand	2.3	48.1	207.9	3.3	5.2	***157.3***	157	0	0	87	38
720.31	2.50		32	Fine Sand	6.6	109.9	269.5	9.8	11.8	***173.0***	173	0	0	95	41
717.81	2.50		48	Fine Sand	12.6	164.9	460.8	18.8	17.8	***211.0***	211	0	0	116	43
715.31	2.50		100	Fine Sand	42.1	343.5	502.8	62.4	37.0	***273.4***	273	0	0	150	46
711.31	4.00		100	Fine Sand	67.3	343.5	505.7	99.9	37.0	***366.3***	366	0	0	201	50
710.81	0.50			Sandstone	48.8	279.1	554.5	72.4	30.1	***438.8***	439	0	0	241	50.2
710.31	0.50			Sandstone	48.8	279.1	603.3	72.4	30.1	***511.2***	511	0	0	281	50.7
709.81	0.50			Sandstone	48.8	279.1	652.1	72.4	30.1	***583.6***	~~584~~	~~0~~	~~0~~	~~321~~	~~51.2~~
709.31	0.50			Sandstone	48.8	279.1	700.9	72.4	30.1	***656.0***	~~656~~	~~0~~	~~0~~	~~361~~	~~51.7~~
708.81	0.50			Sandstone	48.8	279.1	749.7	72.4	30.1	***728.4***	~~728~~	~~0~~	~~0~~	~~401~~	~~52.2~~
708.31	0.50			Sandstone	48.8	279.1	***798.5***	72.4	30.1	800.8	~~798~~	~~0~~	~~0~~	~~439~~	~~52.7~~
707.81	0.50			Sandstone	48.8	279.1	***847.2***	72.4	30.1	873.2	~~847~~	~~0~~	~~0~~	~~466~~	~~53.2~~
707.31	0.50			Sandstone	48.8	279.1	***896.0***	72.4	30.1	945.6	~~896~~	~~0~~	~~0~~	~~493~~	~~53.7~~
706.81	0.50			Sandstone	48.8	279.1	***944.8***	72.4	30.1	1018.0	~~945~~	~~0~~	~~0~~	~~520~~	~~54.2~~
706.31	0.50			Sandstone	48.8	279.1	***993.6***	72.4	30.1	1090.4	~~994~~	~~0~~	~~0~~	~~546~~	~~54.7~~
705.81	0.50			Sandstone	48.8	279.1	***1042.4***	72.4	30.1	1162.8	~~1042~~	~~0~~	~~0~~	~~573~~	~~55.2~~
705.31	0.50			Sandstone	48.8	279.1	***1091.2***	72.4	30.1	1235.2	~~1091~~	~~0~~	~~0~~	~~600~~	~~55.7~~
704.81	0.50			Sandstone	48.8	279.1	***1140.0***	72.4	30.1	1307.6	~~1140~~	~~0~~	~~0~~	~~627~~	~~56.2~~
704.31	0.50			Sandstone	48.8	279.1	***1188.8***	72.4	30.1	1380.1	~~1189~~	~~0~~	~~0~~	~~654~~	~~56.7~~
703.81	0.50			Sandstone	48.8	279.1	***1237.6***	72.4	30.1	1452.5	~~1238~~	~~0~~	~~0~~	~~681~~	~~57.2~~
703.31	0.50			Sandstone		279.1			30.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== pier 1
REFERENCE BORING ========== B-2 (1970s)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 761.68 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 749.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 732.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) === 434.00 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1540 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 40.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 307.96 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 115.48 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 84
Plugged Pile Perimeter========== 4.100 FT. Unplugged Pile Perimeter========== 5.942 FT.
Plugged Pile End Bearing Area========== 1.051 SQFT. Unplugged Pile End Bearing Area===== 0.171 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
664 KIPS	**610** KIPS	**304** KIPS	**49** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
749.10	0.40	0.50			0.6		3.6	0.9		***1.4***	1	0	0	0	13
746.60	2.50	0.20			1.7	2.9	5.3	2.4	0.5	***3.8***	4	1	0	1	15
744.10	2.50	0.20			1.7	2.9	9.9	2.4	0.5	***6.8***	7	2	0	2	18
740.60	3.50	0.40			4.6	5.9	139.4	6.6	1.0	***33.7***	34	5	0	14	21
732.00	8.60		50	Medium Sand	48.0	130.9	190.1	69.6	21.3	***103.7***	104	31	0	26	30
729.10	2.90		51	Medium Sand	16.8	133.5	***107.3***	24.4	21.7	111.9	107	31	0	28	33
726.60	2.50	2.30			13.1	33.9	***110.0***	18.9	5.5	129.1	110	31	0	29	35
724.10	2.50	1.60			10.3	23.6	***126.2***	14.9	3.8	145.0	126	31	0	38	38
721.60	2.50	2.00			11.9	29.4	***123.4***	17.3	4.8	159.9	123	31	0	37	40
719.60	2.00	1.00			5.8	14.7	234.9	8.4	2.4	***185.5***	186	31	0	71	42
715.10	4.50		46	Medium Sand	21.5	120.4	397.7	31.1	19.6	***239.6***	240	31	0	101	47
714.60	0.50			Limestone	51.1	261.8	448.8	74.0	42.6	***313.6***	314	31	0	141	47.1
714.10	0.50			Limestone	51.1	261.8	499.9	74.0	42.6	***387.6***	388	31	0	182	47.6
713.60	0.50			Limestone	51.1	261.8	551.0	74.0	42.6	***461.7***	462	31	0	223	48.1
713.10	0.50			Limestone	51.1	261.8	602.0	74.0	42.6	***535.7***	536	31	0	264	48.6
712.60	0.50			Limestone	51.1	261.8	653.1	74.0	42.6	***609.7***	610	31	0	304	49.1
712.10	0.50			Limestone	51.1	261.8	704.2	74.0	42.6	***683.7***	~~684~~	~~31~~	~~0~~	~~345~~	~~49.6~~
711.60	0.50			Limestone	51.1	261.8	***755.3***	74.0	42.6	757.7	~~755~~	~~31~~	~~0~~	~~384~~	~~50.1~~
711.10	0.50			Limestone	51.1	261.8	***806.3***	74.0	42.6	831.7	~~806~~	~~31~~	~~0~~	~~412~~	~~50.6~~
710.60	0.50			Limestone	51.1	261.8	***857.4***	74.0	42.6	905.8	~~857~~	~~31~~	~~0~~	~~440~~	~~51.1~~
710.10	0.50			Limestone	51.1	261.8	***908.5***	74.0	42.6	979.8	~~908~~	~~31~~	~~0~~	~~469~~	~~51.6~~
709.60	0.50			Limestone	51.1	261.8	***959.5***	74.0	42.6	1053.8	~~960~~	~~31~~	~~0~~	~~497~~	~~52.1~~
709.10	0.50			Limestone		261.8			42.6						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== B-1 (1970s)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 761.84 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 742.25 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 726.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==== 434.00 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1644 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 34.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ====== 386.82 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ====== 145.06 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
578 KIPS	**550** KIPS	**270** KIPS	**59** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
739.70	2.55		25	Medium Sand	5.5		33.2	8.1		***11.1***	11	3	0	3	22
736.70	3.00		17	Medium Sand	4.4	27.8	67.8	6.5	3.0	***20.8***	21	5	0	6	25
735.20	1.50	3.00			10.8	58.0	88.2	16.0	6.2	***37.9***	38	11	0	9	27
733.20	2.00	3.50	15		16.1	67.6	***36.7***	23.9	7.3	54.5	37	20	0	0	29
730.20	3.00				0.0	0.0	177.6	0.0	0.0	***69.7***	70	20	0	18	32
727.20	3.00		41	Sandy Gravel	21.1	140.9	140.2	31.3	15.2	***94.6***	95	32	0	20	35
726.40	0.80		24	Medium Sand	1.6	82.4	145.3	2.4	8.9	***97.5***	97	33	0	21	35
723.20	3.20		25	Medium Sand	6.9	85.9	186.5	10.2	9.3	***111.3***	111	33	0	29	39
721.70	1.50		35	Fine Sand	4.5	120.2	***90.1***	6.7	13.0	107.1	90	33	0	17	40
719.20	2.50	1.00			8.3	19.3	***99.7***	12.4	2.1	119.6	100	33	0	22	43
717.20	2.00		6	Fine Sand	1.0	20.6	***100.7***	1.4	2.2	121.1	101	33	0	23	45
714.70	2.50		6	Fine Sand	1.2	20.6	263.4	1.8	2.2	***140.3***	140	33	0	44	47
712.20	2.50		53	Sandy Gravel	30.7	182.1	266.6	45.6	19.6	***182.9***	183	33	0	68	50
709.70	2.50		45	Sandy Gravel	22.0	154.6	257.7	32.6	16.7	***212.2***	212	33	0	84	52
707.20	2.50		36	Sandy Gravel	13.3	123.7	305.3	19.7	13.3	***235.6***	236	33	0	97	55
704.70	2.50		46	Sandy Gravel	23.1	158.0	513.9	34.2	17.0	***289.8***	290	33	0	127	57
704.20	0.50			Limestone	58.5	343.5	572.4	86.9	37.0	***376.7***	377	33	0	174	57.6
703.70	0.50			Limestone	58.5	343.5	631.0	86.9	37.0	***463.6***	464	33	0	222	58.1
703.20	0.50			Limestone	58.5	343.5	689.5	86.9	37.0	***550.4***	550	33	0	270	58.6
702.70	0.50			Limestone	58.5	343.5	748.1	86.9	37.0	***637.3***	~~637~~	~~33~~	~~0~~	~~318~~	~~59.1~~
702.20	0.50			Limestone	58.5	343.5	806.6	86.9	37.0	***724.2***	~~724~~	~~33~~	~~0~~	~~366~~	~~59.6~~
701.70	0.50			Limestone	58.5	343.5	865.1	86.9	37.0	***811.1***	~~811~~	~~33~~	~~0~~	~~413~~	~~60.1~~
701.20	0.50			Limestone	58.5	343.5	923.7	86.9	37.0	***898.0***	~~898~~	~~33~~	~~0~~	~~461~~	~~60.6~~
700.70	0.50			Limestone	58.5	343.5	***982.2***	86.9	37.0	984.9	~~982~~	~~33~~	~~0~~	~~508~~	~~61.1~~
700.20	0.50			Limestone	58.5	343.5	***1040.8***	86.9	37.0	1071.8	~~1041~~	~~33~~	~~0~~	~~540~~	~~61.6~~
699.70	0.50			Limestone	58.5	343.5	***1099.3***	86.9	37.0	1158.7	~~1099~~	~~33~~	~~0~~	~~572~~	~~62.1~~
699.20	0.50			Limestone	58.5	343.5	***1157.9***	86.9	37.0	1245.6	~~1158~~	~~33~~	~~0~~	~~604~~	~~62.6~~
698.70	0.50			Limestone		343.5			37.0						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE========== west abut.
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 760.65 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 758.65 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 424.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==== 434.00 ft

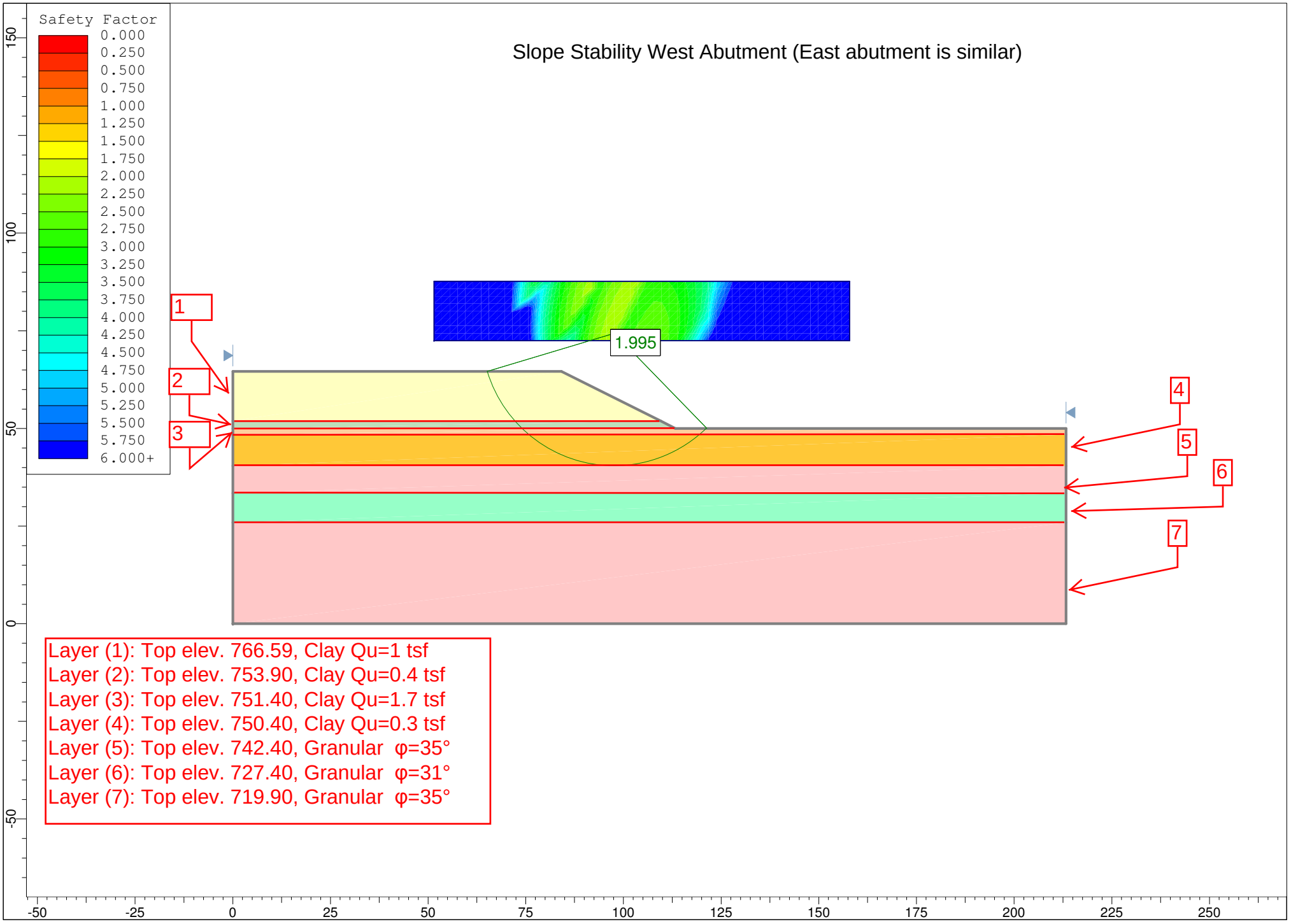
TOTAL FACTORED SUBSTRUCTURE LOAD ========= 847 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 34.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ====== 199.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ====== 74.74 KIPS

PILE TYPE AND SIZE ========== Steel HP 14 X 73
Plugged Pile Perimeter========== 4.700 FT. Unplugged Pile Perimeter========== 6.975 FT.
Plugged Pile End Bearing Area========== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
578 KIPS	**578** KIPS	**318** KIPS	**52** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
753.90	4.75	0.40			7.1		14.8	10.5		***11.3***	11	0	0	6	7
751.90	2.00	0.40			3.0	7.7	42.9	4.4	0.8	***18.5***	18	0	0	10	9
750.40	1.50	1.70			7.4	32.9	27.1	11.0	3.5	***26.9***	27	0	0	15	10
747.90	2.50	0.50			4.6	9.7	***25.9***	6.8	1.0	33.1	26	0	0	14	13
745.40	2.50	0.20			1.9	3.9	***27.8***	2.9	0.4	36.0	28	0	0	15	15
742.40	3.00	0.20			2.3	3.9	53.8	3.4	0.4	***42.0***	42	0	0	23	18
740.40	2.00		8	Medium Sand	1.4	27.5	130.7	2.0	3.0	***52.1***	52	0	0	29	20
737.90	2.50		30	Sandy Gravel	9.4	103.1	136.7	14.0	11.1	***65.7***	66	0	0	36	23
735.40	2.50		29	Sandy Gravel	8.9	99.6	176.5	13.2	10.7	***82.3***	82	0	0	45	25
732.90	2.50		38	Sandy Gravel	14.8	130.5	163.8	22.0	14.1	***101.3***	101	0	0	56	28
730.40	2.50		30	Sandy Gravel	9.4	103.1	138.9	14.0	11.1	***111.6***	112	0	0	61	30
727.40	3.00		20	Medium Sand	5.1	68.7	***115.9***	7.6	7.4	116.2	116	0	0	64	33
725.40	2.00	2.10			11.3	40.6	***121.4***	16.7	4.4	132.3	121	0	0	67	35
722.90	2.50	1.80			12.8	34.8	***140.0***	19.0	3.7	151.9	140	0	0	77	38
719.90	3.00	2.10			16.9	40.6	***164.4***	25.1	4.4	177.8	164	0	0	90	41
717.90	2.00		14	Medium Sand	2.4	48.1	249.3	3.6	5.2	***190.3***	190	0	0	105	43
715.40	2.50		38	Medium Sand	9.7	130.5	472.0	14.4	14.1	***227.6***	228	0	0	125	45
712.90	2.50		100	Clean Coarse Sand	54.9	343.5	526.8	81.4	37.0	***309.0***	309	0	0	170	48
709.90	3.00		100	Clean Coarse Sand	65.8	343.5	592.7	97.7	37.0	***406.7***	407	0	0	224	51
709.40	0.50			Limestone	58.5	343.5	651.2	86.9	37.0	***493.6***	494	0	0	271	51.3
708.90	0.50			Limestone	58.5	343.5	709.8	86.9	37.0	***580.5***	~~581~~	~~0~~	~~0~~	~~319~~	~~51.8~~
708.40	0.50			Limestone	58.5	343.5	768.3	86.9	37.0	***667.4***	~~667~~	~~0~~	~~0~~	~~367~~	~~52.3~~
707.90	0.50			Limestone	58.5	343.5	826.9	86.9	37.0	***754.3***	~~754~~	~~0~~	~~0~~	~~415~~	~~52.8~~
707.40	0.50			Limestone	58.5	343.5	885.4	86.9	37.0	***841.2***	~~841~~	~~0~~	~~0~~	~~463~~	~~53.3~~
706.90	0.50			Limestone	58.5	343.5	944.0	86.9	37.0	***928.1***	~~928~~	~~0~~	~~0~~	~~510~~	~~53.8~~
706.40	0.50			Limestone	58.5	343.5	***1002.5***	86.9	37.0	1014.9	~~1002~~	~~0~~	~~0~~	~~551~~	~~54.3~~
705.90	0.50			Limestone	58.5	343.5	***1061.0***	86.9	37.0	1101.8	~~1061~~	~~0~~	~~0~~	~~584~~	~~54.8~~
705.40	0.50			Limestone	58.5	343.5	***1119.6***	86.9	37.0	1188.7	~~1120~~	~~0~~	~~0~~	~~616~~	~~55.3~~
704.90	0.50			Limestone	58.5	343.5	***1178.1***	86.9	37.0	1275.6	~~1178~~	~~0~~	~~0~~	~~648~~	~~55.8~~
704.40	0.50			Limestone	58.5	343.5	***1236.7***	86.9	37.0	1362.5	~~1237~~	~~0~~	~~0~~	~~680~~	~~56.3~~
703.90	0.50			Limestone	58.5	343.5	***951.7***	86.9	37.0	1412.4	~~952~~	~~0~~	~~0~~	~~523~~	~~56.8~~
703.40	0.50				0.0	0.0	***951.7***	0.0	0.0	1412.4	~~952~~	~~0~~	~~0~~	~~523~~	~~57~~
702.90	0.50				0.0	0.0	***951.7***	0.0	0.0	1412.4	~~952~~	~~0~~	~~0~~	~~523~~	~~58~~
702.40	0.50				0.0	0.0	***951.7***	0.0	0.0	1412.4	~~952~~	~~0~~	~~0~~	~~523~~	~~58~~
701.90	0.50				0.0	0.0	***951.7***	0.0	0.0	1412.4	~~952~~	~~0~~	~~0~~	~~523~~	~~59~~
701.40	0.50					0.0			0.0						


Slope Stability West Abutment (East abutment is similar)
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.995
1
2
3
4
5
6
7
Layer (1): Top elev. 766.59, Clay Qu=1 tsf
Layer (2): Top elev. 753.90, Clay Qu=0.4 tsf
Layer (3): Top elev. 751.40, Clay Qu=1.7 tsf
Layer (4): Top elev. 750.40, Clay Qu=0.3 tsf
Layer (5): Top elev. 742.40, Granular φ=35°
Layer (6): Top elev. 727.40, Granular φ=31°
Layer (7): Top elev. 719.90, Granular φ=35°
150
100
50
0
-50
-50
-25
0
25
50
75
100
125
150
175
200
225
250