Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 03/14/2017 **Proposed SN:** 025-0110 **Route:** FAS 2801/ Illinois Route 128
Revised Date: 4/21/2017 **Existing SN:** 025-0065 **Section:** (103BR)B-1
Geotechnical Engineer: Edgar A. Galofre **County:** Effingham
Structural Engineer: Al-Barrae R. Shebib **Contract:** 74352

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing):
The proposed structure will be a single span 36" Steel I Beam superstructure on integral abutments with a 0° right forward skew. The substructure will consist of open abutments supported by piles. The new structure will have an approximate back to back abutment length of 85'-6"., a width of 35'-2", and clear roadway width of 32'.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot):
The existing structure consists in a single span, PPC Deck Beam bridge with a 0° right forward skew. The single span structure is 39'-0" wide with a clear roadway width of 37'-0". It has a 55'-6" clear span with closed abutments. Three soil borings were performed by IDOT, Borings 1 and 2 in 1989 and Boring 3 in 2011. (See attachment A- Boring Logs).

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary:
The proposed roadway profile will be raised approximately 2.0 feet; settlement calculations were performed at each abutment due to increased loading from new embankment and a settlement magnitude of less than 1 inch was obtained, with no more than 0.4 inches occurring below the abutment caps (See attachment B – Settlement Analysis). Based on this value, no ground improvement is necessary nor will downdrag forces be assumed to act against piles.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis, or ground improvement/treatment is necessary:
The proposed end-slopes at the North and South Abutments are composed of 2 Horizontal to 1 Vertical (2H:1V). Based on our slope stability analyses, the Factor of Safety against slope failure is satisfactory (See atachment C - Slope Stability Analysis).

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics Report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations:
The scour elevations will be located at the bottom of the abutment caps. The Design Scour Elevation Table is as follows:

Event/Limit State	Design Scour Elevations (ft.)		Item 113
	N. Abut.	S. Abut.	
Q100	549.75	551.58	8
Q200	549.75	551.58	
Design	549.75	551.58	
Check	549.75	551.58	

Determine the seismic Soil Site Class, the Seismic Performance Zone, the 0.2 and 1.0 second design spectral accelerations and indicate if the soils are liquefiable:
Seismic Data
Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.211g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.469g
Soil Site Class = D

(See attachment D – Site Class Determination and Seismic Data)

Liquefaction analyses were conducted using Design Guide AGMU Memo 10.1 – *Liquefaction Analysis*; it indicates that the factor of safety against liquefaction is greater than 1 (See attachment E- Liquefaction Analysis). Therefore, no concern for liquefaction is necessary.

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed:

Based on the proposed preliminary length of 89.0 ft. back to back of Abutments and bridge skew of 0°, integral abutments will be feasible, according to the 2012 Integral Abutment Bridge Policies and Details (ABD 12.3).

Steel H-piles are feasible and we therefore recommend using H-piles driven to refusal based on the proximity to top of rock which is located at an approximate elevation of 530 at the North Abutment and 529 at the South Abutment, based on the borings. Metal shell (MS) piles do not appear feasible based on the proximity to top of rock and the risk to damage the piles. An estimated factored load of 1355 kips in each abutment was provided by the Planning Engineer.
Pile cut-off elevations of 552 (North Abut.) and 554 (South Abut.) were used to estimate the pile lengths (See attachment F – Estimated Pile Lengths) shown in the Pile Design Table below:

Pile Design Table

Pile Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Location	Estimated Pile Length (ft.)
HP 12x53	418	230	North Abut.	30
		230	South Abut.	30
HP 14x73	578	318	North Abut.	31
		318	South Abut.	31
HP 14x89	705	388	North Abut.	33
		388	South Abut.	33

Test Pile: A test pile at the North Abutment is recommended.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat:
Cofferdams are not needed.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns:
Based on the TSL and Structure Report the District recommends road closure with marked route detour. Therefore, no soil retention will be needed and temporary construction slopes can be used.

Attachment A

Boring Logs

Illinois Department of Transportation

Division of Highways
ILLINOIS DOT

SOIL BORING LOG

Date 7/11/89

ROUTE FAS 2801 (IL 128) DESCRIPTION Moccasin Creek LOGGED BY R. Metheney

SECTION (103BR)B-1 LOCATION NW 1/4 - Sec 19, SEC. , TWP. 8 N, RNG. 4 E, 3 PM

COUNTY Effingham DRILLING METHOD Solid stem auger HAMMER TYPE Auto 140#

STRUCT. NO. 025-0110
Station 1088+06

BORING NO. 1 (1989) N Abut
Station 1087+78
Offset 6.0ft Lt
Ground Surface Elev. 556.00 ft

Surface Water Elev. 540.9 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ First Encounter 541.5 ft
▼ Upon Completion 539.6 ft
▼ After 22 Hrs. 542.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Bituminous surface on PCC Pavement.
554.80				
				Loose, damp, fine grained, SANDY LOAM.
	6		15	
-5				
550.50				
	5	0.3 S	20	Loose, very damp, SANDY CLAY LOAM to SANDY CLAY, w/ organic odor.
548.00				
	4	0.2 S	14	Very soft, very damp, SANDY CLAY to CLAY, w/ 1/4" to 1" thick Sand lenses.
-10				
	2	0.2 S	20	
544.00				Very soft, very damp to wet, CLAY LOAM w/ roots and organics.
▼	2	0.1 S	23	
▽ 541.50				
-15				Very loose, wet, SANDY LOAM to SANDY CLAY LOAM.
▼	2		22	
538.00				
	2	0.3 S	20	Soft, very damp to wet, SANDY CLAY to CLAY, w/ 1/2" thick Sand lenses.
-20				
				Soft, very damp to wet, SANDY CLAY to CLAY, w/ 1/2" thick Sand lenses. *(continued)*
534.50	4	0.6 S	15	Medium, very damp, CLAY TILL.
533.00				
	24	3.9 S	11	Very stiff, damp, CLAY TILL.
-25				
530.00				
	22	1.4 S	15	Stiff, damp, very weathered, soft, CLAY SHALE.
528.00				
	100/5"		8	Very dense, very moist, CLAY SHALE.
-30				
	100/2"		7	
	100/2"		8	
522.00				
				Extent of exploration.
-35				
				Benchmark: Crown grade at center of existing bridge, Sta 1088+10 = 556.7' estimated.
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\EFFINGHAM CO (025)\025-0065 SOIL 1989.GPJ Data Template D6TEMPLT.GDT Date Printed 11/10/04
Latitude Longitude Datum Job Number

Illinois Department of Transportation

Division of Highways
ILLINOIS DOT

SOIL BORING LOG

Date 7/11/89

ROUTE FAS 2801 (IL 128) DESCRIPTION Moccasin Creek LOGGED BY R. Metheney

SECTION (103BR)B-1 LOCATION NW 1/4 - Sec 19, SEC. , TWP. 8 N, RNG. 4 E, 3 PM

COUNTY Effingham DRILLING METHOD Solid stem auger HAMMER TYPE Auto 140#

STRUCT. NO. 025-0110
Station 1088+06

BORING NO. 2 (1989) S Abut
Station 1088+43
Offset 6.0ft Rt
Ground Surface Elev. 557.6 ft

Surface Water Elev. 540.9 ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ First Encounter 539.6 ft
▼ Upon Completion 541.0 ft
▼ After Hrs. N/A ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Bituminous surface on PCC Pavement.
556.40				
				Very soft, very damp, CLAY LOAM.
	3	0.2 S	22	
-5				
552.10				
				Medium to soft, very damp, CLAY.
551.10				
	5	0.1 B	26	Very soft, wet, SILTY CLAY LOAM to SILTY CLAY, organic w/ odor.
549.60				
				Very loose, very damp, SANDY CLAY LOAM.
	3	0.3 S	20	
-10				
	2	0.3 S	18	
543.60				
	3	0.3 S	18	Soft, very damp, CLAY.
-15				
542.10				
				Very loose, wet, SANDY CLAY w/ 1/4" thick Sand lenses, organic w/ wood & odor. ▼
	2	0.1 S	23	
▽ 539.60				
				Very loose, wet, fine grained, SAND w/ 1" thick lenses of Sandy Clay Loam.
	4		26	
-20				

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
537.10				
	25	3.0 E	15	Very stiff, damp, CLAY to CLAY TILL w/ 1" thick lenses of fine grain Sand.
534.60				
	26	3.7 S	11	Very stiff, damp, CLAY TILL.
-25				
531.10				
	19	1.6 S	15	Stiff, damp, very weathered, soft, CLAY SHALE.
529.60				
	100/4"		7	Very dense, moist, CLAY SHALE.
-30				
	100/3"		7	
523.60	100/2"		7	
				Extent of exploration.
-35				
				Benchmark: Crown grade at center of existing bridge, Sta 1088+10 = 556.7' estimated.
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
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File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\EFFINGHAM CO (025)\025-0065 SOIL 1989.GPJ Data Template D6TEMPLT.GDT Date Printed 11/10/04
Latitude Longitude Datum Job Number

Illinois Department of Transportation

Division of Highways
ILLINOIS DOT

SOIL BORING LOG

Date 9/20/11

ROUTE FAS 2801 (IL 128) DESCRIPTION Moccasin Creek LOGGED BY E. Sandschafer

SECTION (103BR)B-1 LOCATION NW 1/4 - Sec 19, SEC. , TWP. 8 N, RNG. 4 E, 3 PM

COUNTY Effingham DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 025-0110
Station 1088+06

BORING NO. 3 (2011) S Abut
Station 1088+63
Offset 14.0ft Lt
Ground Surface Elev. 556.99 ft

Surface Water Elev. 540.26 ft
Stream Bed Elev. 539.19 ft

Groundwater Elev.:
▽ First Encounter 537.5 ft
▼ Upon Completion Washed ft
▼ After 48 Hrs. 554.0 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				8" mixture of asphalt millings and aggregate, shoulder. 556.29
				Medium, damp, brown, SILTY CLAY.
	2			
	3	0.7	19	
	3	B		
				552.49
-5	1			Medium, damp, brown, SILTY CLAY LOAM.
	2	0.7	19	
	2	B		
				549.49
	1			Soft, damp, brown, SANDY LOAM.
	2	0.3	16	
	2	BS		
				547.49
-10	1			Medium to soft, damp, dark brown, SILTY LOAM.
	1	0.6	21	
	1	B		
	1			
	1	0.5	18	
	1	BS		
-15	0			
	1	0.3	23	
	1	B		
				539.99
	0			Soft, damp, gray, SANDY LOAM.
	0	0.3	37	
	1	B		
▽				
536.99 -20	2			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	2		27	Very loose, wet, gray, SANDY LOAM w/ small Gravel..
	2			
				534.99
	7			Hard, damp, gray, CLAY LOAM TILL.
	10	5.1	11	
	17	B		
-25	8			
	10	5.1	12	
	13	B		
	8			
	29	1.9	14	
	50/5"	B		
				527.49
-30	50/5"		7	Very dense, moist, gray, SANDY CLAY SHALE. 526.99
	50/2"			Borehole continued with rock coring.
	50/1"			
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\EFFINGHAM CO (025)\025-0065 SOIL 1989.GPJ Data Template D6TEMPLT.GDT Date Printed 11/10/04
Latitude W 88 deg 48.334 min Longitude N 39 deg 07.639 min Datum Job Number

Illinois Department of Transportation
Division of Highways
ILLINOIS DOT

ROCK CORE LOG

Date 9/20/11

ROUTE FAS 2801 (IL 128) DESCRIPTION Moccasin Creek LOGGED BY E. Sandschafer

SECTION (103BR)B-1 LOCATION NW 1/4 - Sec 19, SEC. , TWP. 8 N, RNG. 4 E, 3 PM

COUNTY Effingham CORING METHOD Rotary, surf set diamond bit

STRUCT. NO. 025-0110
Station 1088+06

CORING BARREL TYPE & SIZE NW, conv dbl bbl split inner

Core Diameter 2.06 in
Top of Rock Elev. 527.49 ft
Begin Core Elev. 526.99 ft

BORING NO. 3 (2011) S Abut
Station 1088+63
Offset 14.0ft Lt
Ground Surface Elev. 556.99 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray, slightly weathered, SANDY CLAY SHALE.	526.99		B3C1	83	72	1.1	
Rock core B3C1 from 32.0' to 32.5' depth Qu = 52.8 tsf.							
	524.09						
Gray, SANDSTONE.	523.99						
Gray, slightly weathered, SANDY CLAY SHALE.		-35					
			B3C2	89	88	1.2	
	520.99						
Dark gray, slighty weathered, SILTY CLAY SHALE.							
Rock core B3C2 from 38.0' to 38.5' depth Qu = 19.4 tsf.							
	516.99	-40					
Gray, slight to moderate weathered, soapy, SILTY CLAY SHALE.			B3C3	98	77	1.7	
	514.69						
Black, Estimated COAL, sample cracked in vertical and horizontal directions.	513.89						
Gray, slightly weathered, SILTY CLAY SHALE. *Rock core B3C3 from 43.3' to 43.8' depth Qu = 3.5 tsf.*							
	511.99	-45					
Extent of exploration.							
Benchmark: BM 524 chiseled square on top of North Abutment extention, East end, Sta 1087+78.3, 21' Lt = 552.76' elevation.		-50					

Color pictures of the cores Available on request
Cores will be stored for examination until 09/20/2016
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 025-0065 SOIL 1989.GPJ D6TEMPLT.GDT 11/10/04

PROPOSED 025-0110

Field Rock Core Log a.xls

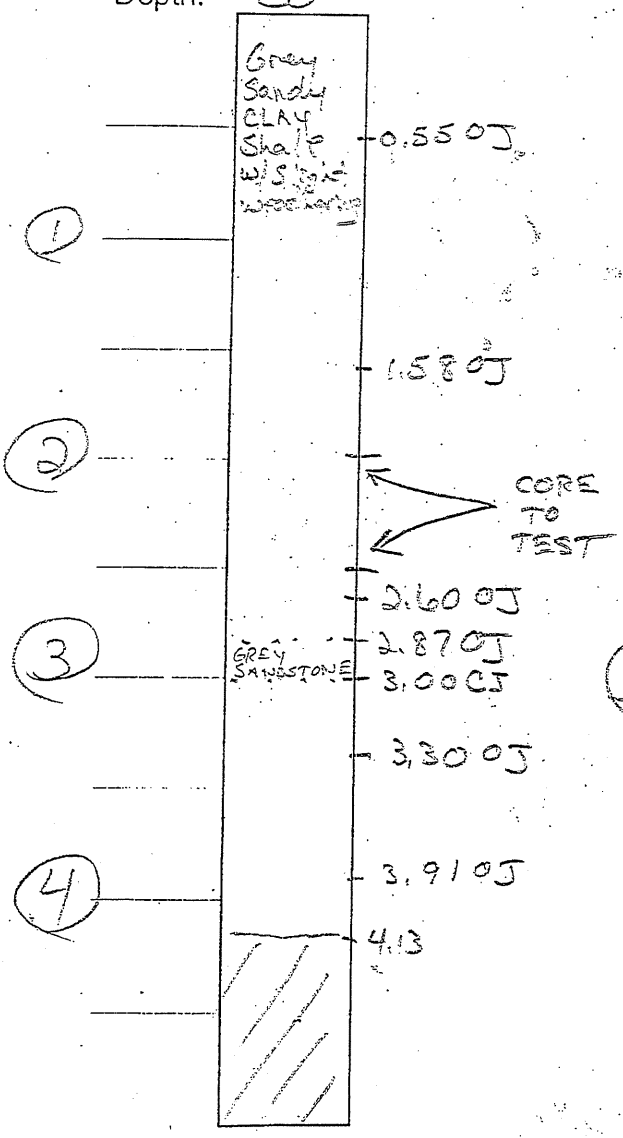
Field Rock Core Log

Date: 9-20-11

Structure #: 025-0065 Boring #: B3 SABUT

Rock Core #: B3 C1

Depth: 30'



RQD
0.55
1.01
1.00
2.42
3.61
3.59
71.8

Depth: 35'

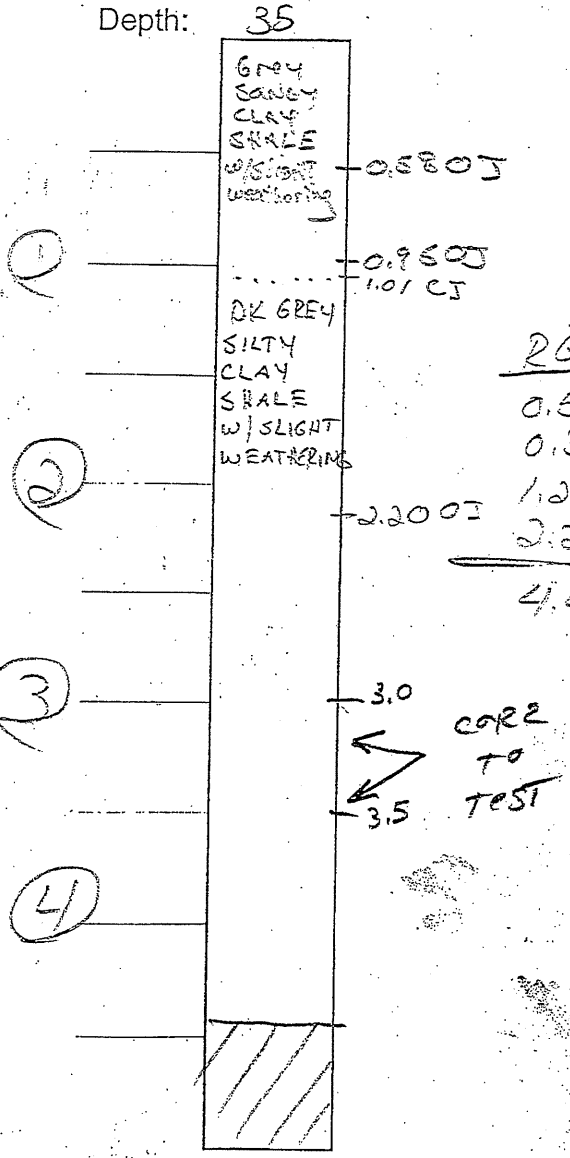
Core Time: 5:20

Recovery: 82.6%

RQD: 71.8%

Rock Core #: B3 C2

Depth: 35'



RQD
0.58
0.35
1.24
2.23
4.40

Depth: 40'

Core Time: 6:02

Recovery: 89%

RQD: 88%

Logged By: Eric Sandschafer

PROPOSED 025-0110

Field Rock Core Log a.xls

Field Rock Core Log

Date: 9-20-11

Structure #: 025-0065 Boring #: B3 S. ABUT

Rock Core #: B3 C111

Rock Core #:

~~Fuel Filter #'s~~

~~1677004691~~

3233

~~ENT 01/466~~

~~DTA~~

~~FF 5019 - 3336~~

~~FF 5020 - 3341~~

Depth: 40'

Depth:

RQD

0.62
1.70
0.62
0.42
0.50
3.86
77.2

Grey SILTY CLAY SHALE w/SLIGHT to MODERATE WEATHERING SOOPY — 0.62 OJ

(1)

(2)

SOFT CLAY SHALE — 2.09 CJ
2.24
BLK COAL w/vertical + horizontal CRACKS — 2.32 OJ
2.40 OJ
2.59 OJ
2.76 OJ
2.92 OJ
3.00 OJ
3.14 OJ

(3)

Grey SILTY Clay Shale — 3.3 CORE TO TEST — 3.75 OJ

(4)

softer than the Shale above — 4.21 OJ

Slight weathering — 4.71 OJ
4.88

Depth: 45'

Core Time: 8:21

Recovery: 97.6

RQD: 77.2%

Logged By: Eric Sandschafer

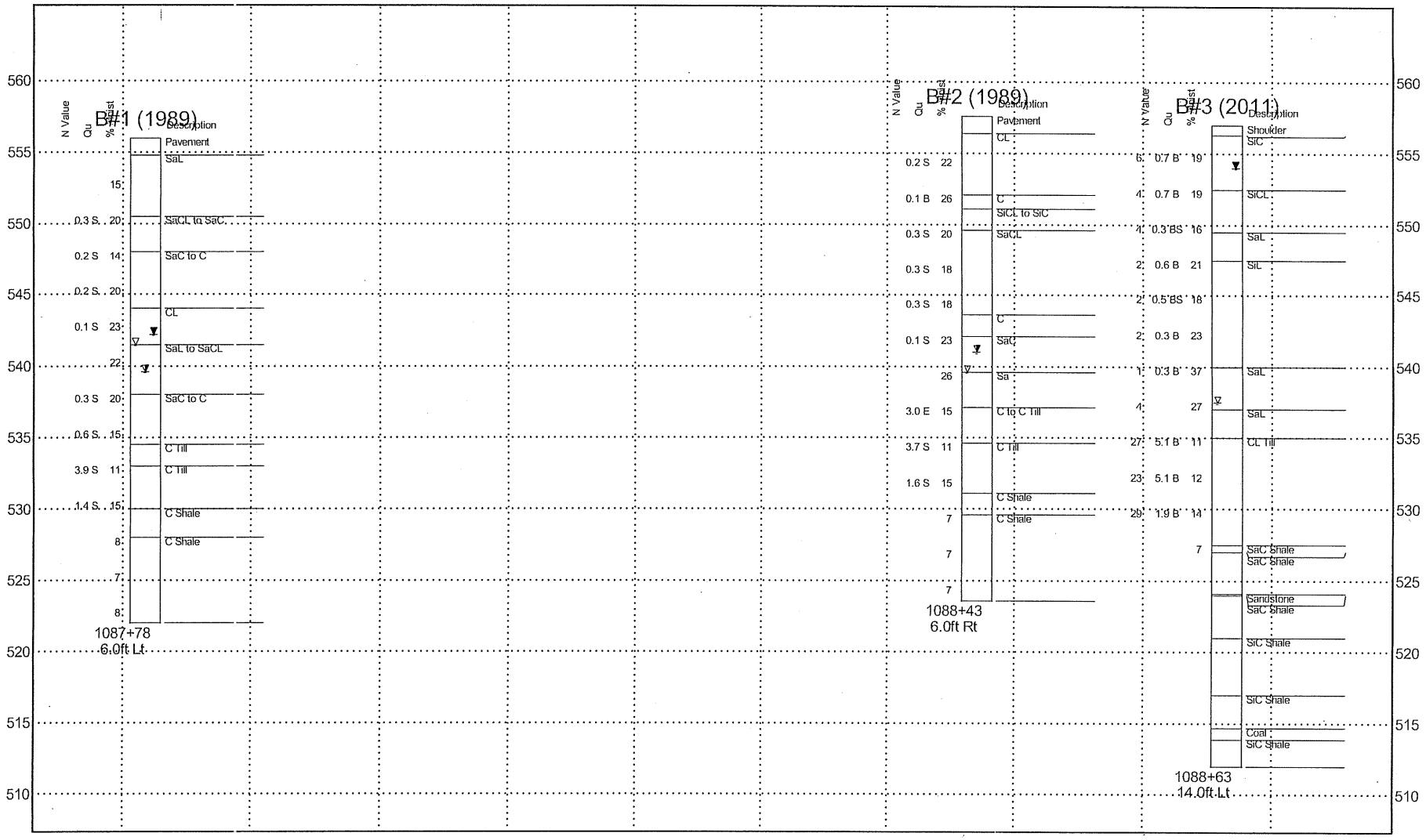
Depth:

Core Time:

Recovery:

RQD:

Structure Number 025-0110 Moccasin Creek
Located in the NW 1/4 - Sec 19 of Section , Township 8 N, Range 4 E of the 3 P.M.



NOT TO HORIZONTAL SCALE

VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Groundwater
- First Encounter
- Completion
- after (refer to log) hours

Abbreviations
WOH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Seating

Illinois Department of Transportation
Division of Highways
ILLINOIS DOT

SUBSURFACE DATA PROFILE

Route: FAS 2801 (IL 128)

Section: (103BR)B-1

County: Effingham

TEST FENCE 2_025-0065 SOIL_1989.GPJ_D6TEMPLT.GDT 11/10/04

TEST FENCE 2_025-0065 SOIL_1989.GPJ_D6TEMPLT.GDT 11/10/04

Attachment B

Settlement Analysis

COHESIVE SOIL SETTLEMENT ESTIMATE

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

LOCATION AND BORING USED ===== North Abutment / Boring 1
TYPE OF SURCHARGE ========== 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 16 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 2 FT
- PROPOSED WIDTH AT TOP ========== 35 FT
- PROPOSED WIDTH AT BOTTOM ========== 43 FT (which is a 2.0:1 slope)

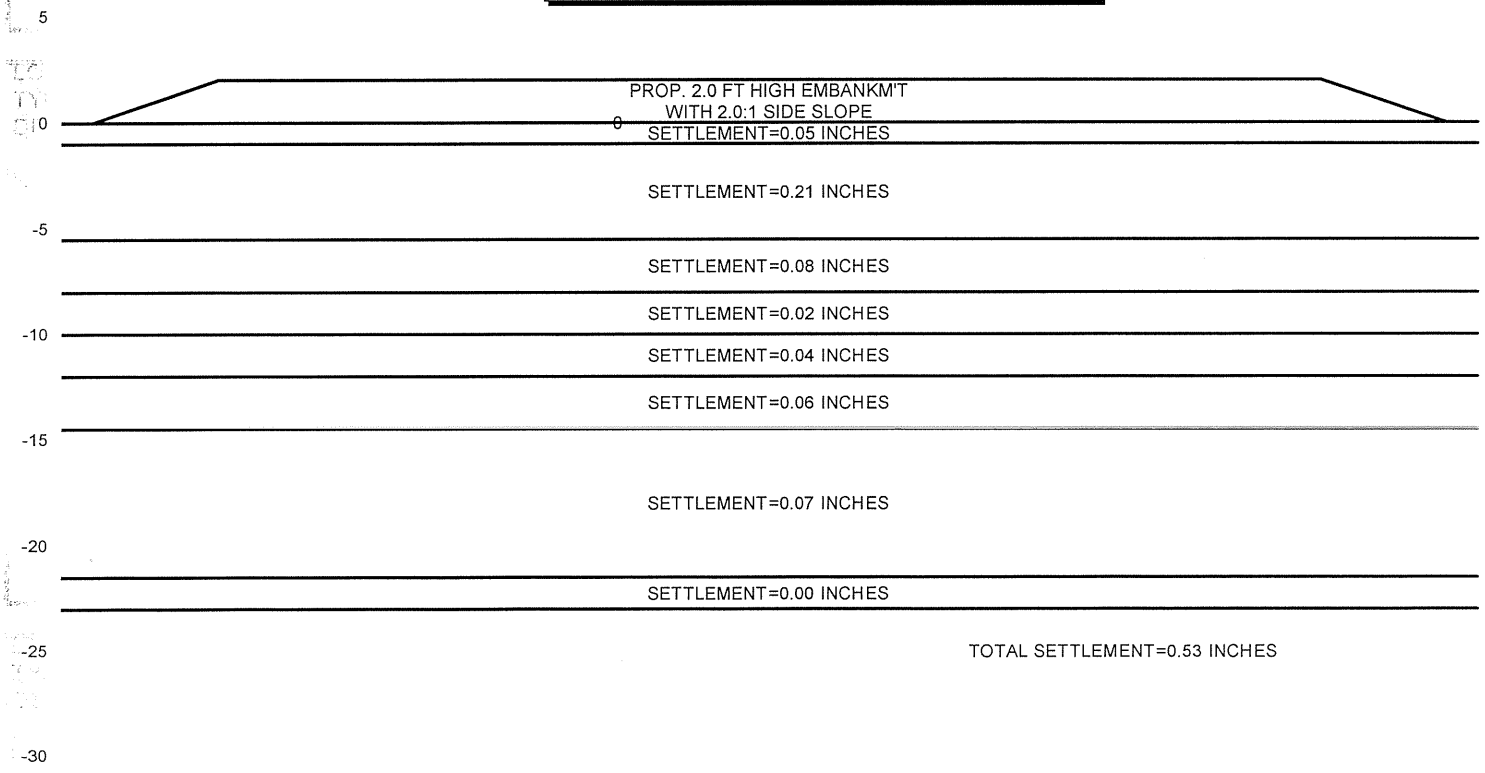
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 0 PCF
- EXISTING EMBANKMENT HEIGHT ========== 0 FT
- EXISTING WIDTH AT TOP ========== 0 FT
- EXISTING WIDTH AT BASE ========== 0 FT (which is a 0.0:1 slope)

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.)*
1.0	120	1.00	15	0.060	0.230	0.405	0.045	0.200	**0.05**
4.5	120	0.20	15	0.390	0.188	0.405	0.045	0.700	**0.21**
2.5	120	0.30	20	0.810	0.159	0.540	0.090	0.550	**0.08**
2.0	120	0.20	14	1.080	0.148	0.378	0.036	0.700	**0.02**
2.0	120	0.20	20	1.320	0.140	0.540	0.090	0.700	**0.04**
2.5	120	0.10	23	1.590	0.132	0.621	0.117	0.850	**0.06**
7.0	120	0.30	20	2.035	0.118	0.540	0.090	0.550	**0.07**
1.5	120	0.60	15	2.280	0.106	0.405	0.045	0.309	**0.00**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.53 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 ===== South Abutment / Boring 2
TYPE OF SURCHARGE ========== 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 16 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 2 FT
- PROPOSED WIDTH AT TOP ========== 35 FT
- PROPOSED WIDTH AT BOTTOM ========== 43 FT (which is a 2.0:1 slope)

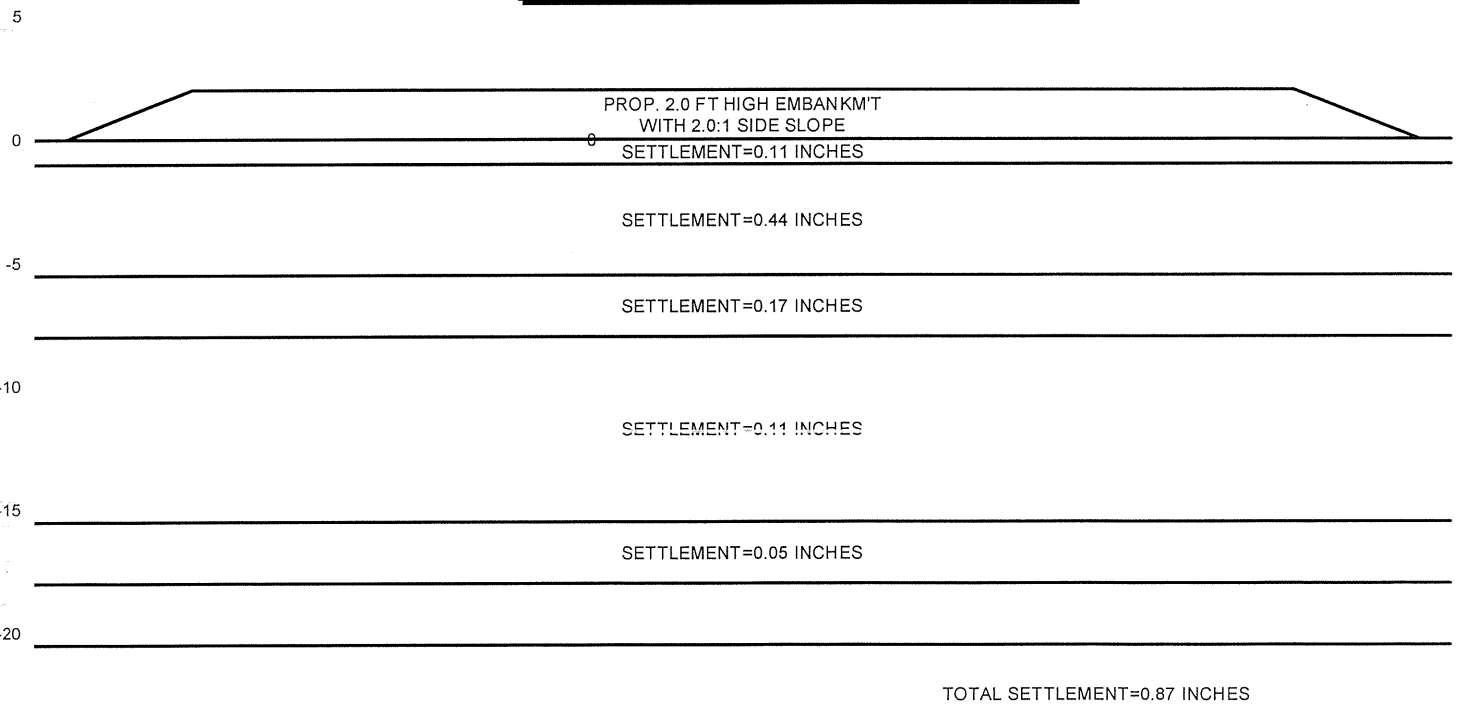
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 0 PCF
- EXISTING EMBANKMENT HEIGHT ========== 0 FT
- EXISTING WIDTH AT TOP ========== 0 FT
- EXISTING WIDTH AT BASE ========== 0 FT (which is a 0.0:1 slope)

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.)*
1.0	120	1.00	22	0.060	0.230	0.594	0.108	0.200	**0.11**
4.5	120	0.20	22	0.390	0.188	0.594	0.108	0.700	**0.44**
2.5	120	0.10	26	0.810	0.159	0.702	0.144	0.850	**0.17**
7.5	120	0.30	19	1.410	0.137	0.513	0.081	0.550	**0.11**
2.5	120	0.10	23	1.963	0.121	0.621	0.117	0.850	**0.05**
2.5	120		26	2.107	0.114	0.702	0.144	1.000	**Granular**

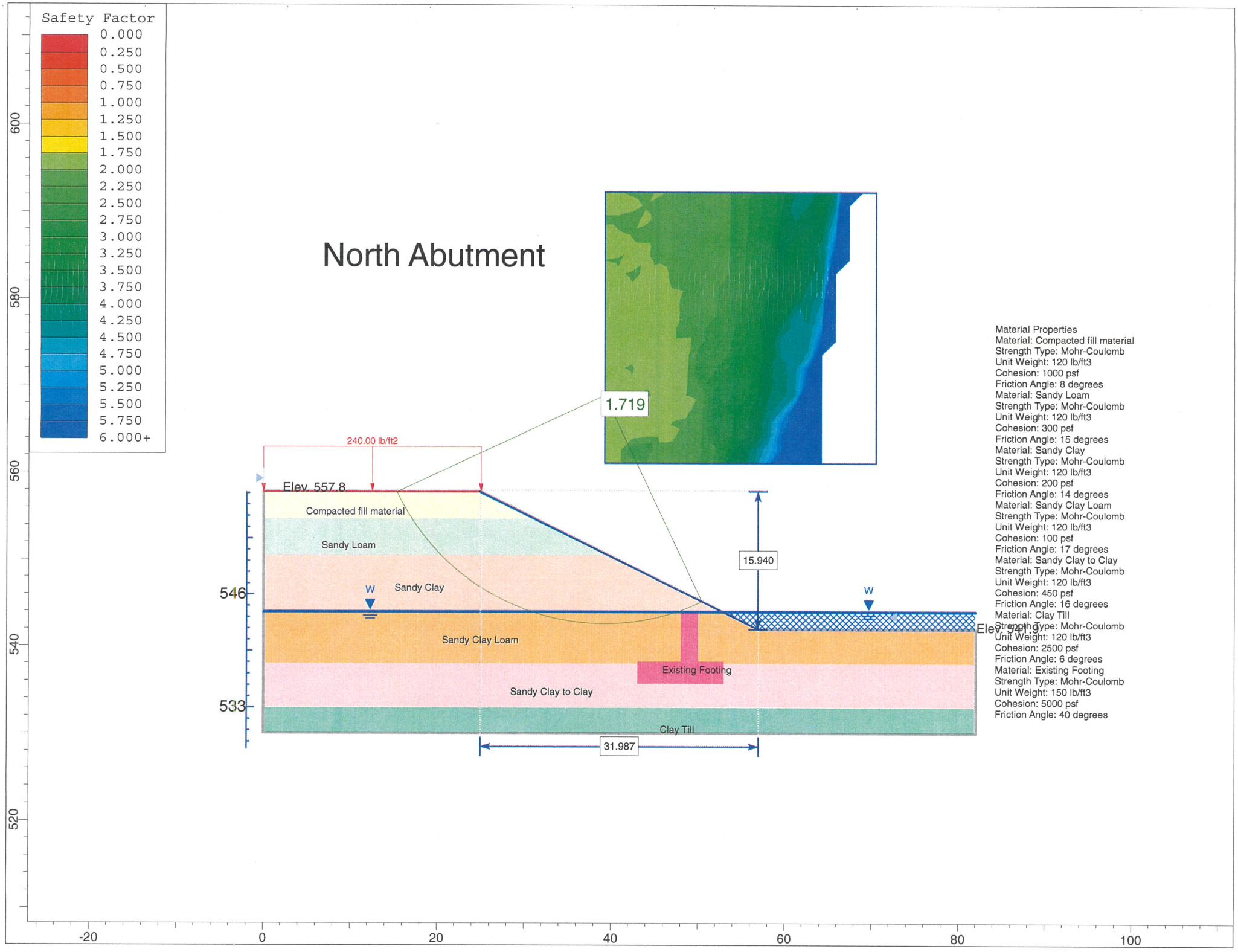
TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.87 IN.

EMBANKMENT AND SOIL PROFILE

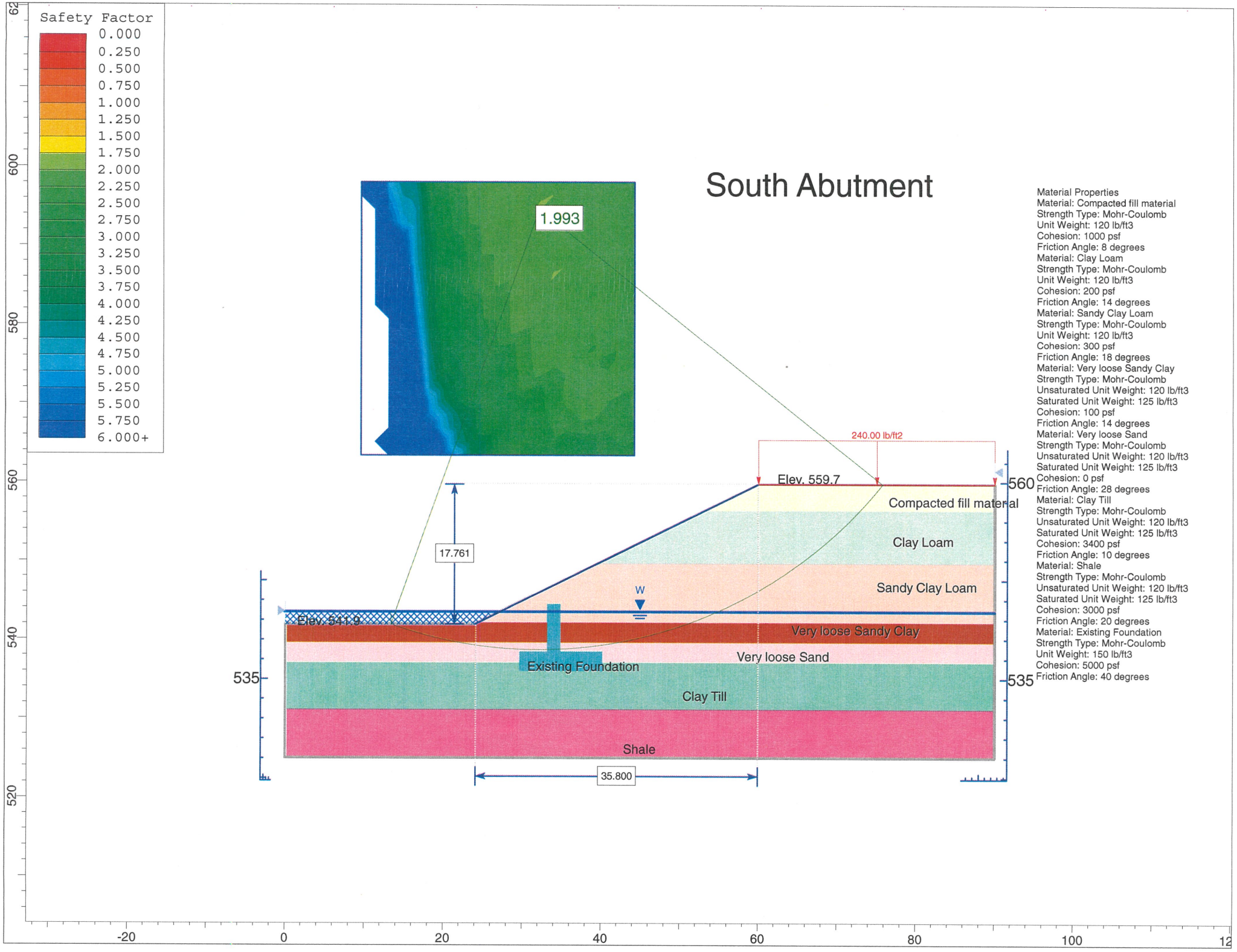


Attachment C

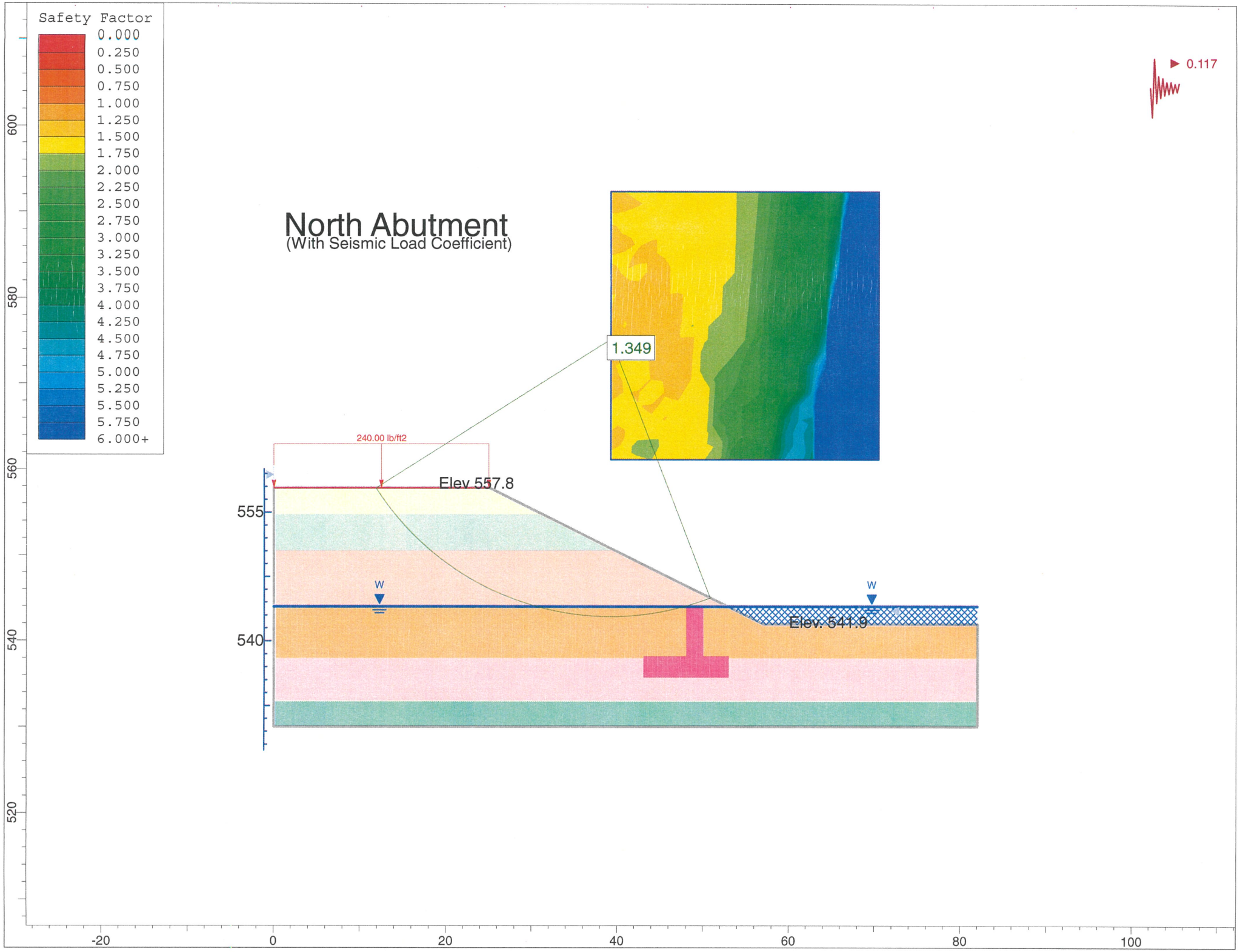
Slope Stability Analysis


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+
North Abutment
1.719
240.00 lb/ft2
Elev. 557.8
Compacted fill material
Sandy Loam
Sandy Clay
Sandy Clay Loam
Existing Footing
Sandy Clay to Clay
Clay Till
15.940
31.987
546
533
W
Elev. 541.9
600
580
560
540
520
-20
0
20
40
60
80
100
Material Properties
Material: Compacted fill material
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 8 degrees
Material: Sandy Loam
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 300 psf
Friction Angle: 15 degrees
Material: Sandy Clay
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 200 psf
Friction Angle: 14 degrees
Material: Sandy Clay Loam
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 17 degrees
Material: Sandy Clay to Clay
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 450 psf
Friction Angle: 16 degrees
Material: Clay Till
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 2500 psf
Friction Angle: 6 degrees
Material: Existing Footing
Strength Type: Mohr-Coulomb
Unit Weight: 150 lb/ft3
Cohesion: 5000 psf
Friction Angle: 40 degrees

South Abutment



Material Properties
Material: Compacted fill material
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 8 degrees
Material: Clay Loam
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 200 psf
Friction Angle: 14 degrees
Material: Sandy Clay Loam
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 300 psf
Friction Angle: 18 degrees
Material: Very loose Sandy Clay
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 125 lb/ft3
Cohesion: 100 psf
Friction Angle: 14 degrees
Material: Very loose Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Material: Clay Till
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 125 lb/ft3
Cohesion: 3400 psf
Friction Angle: 10 degrees
Material: Shale
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 125 lb/ft3
Cohesion: 3000 psf
Friction Angle: 20 degrees
Material: Existing Foundation
Strength Type: Mohr-Coulomb
Unit Weight: 150 lb/ft3
Cohesion: 5000 psf
Friction Angle: 40 degrees


Safety Factor
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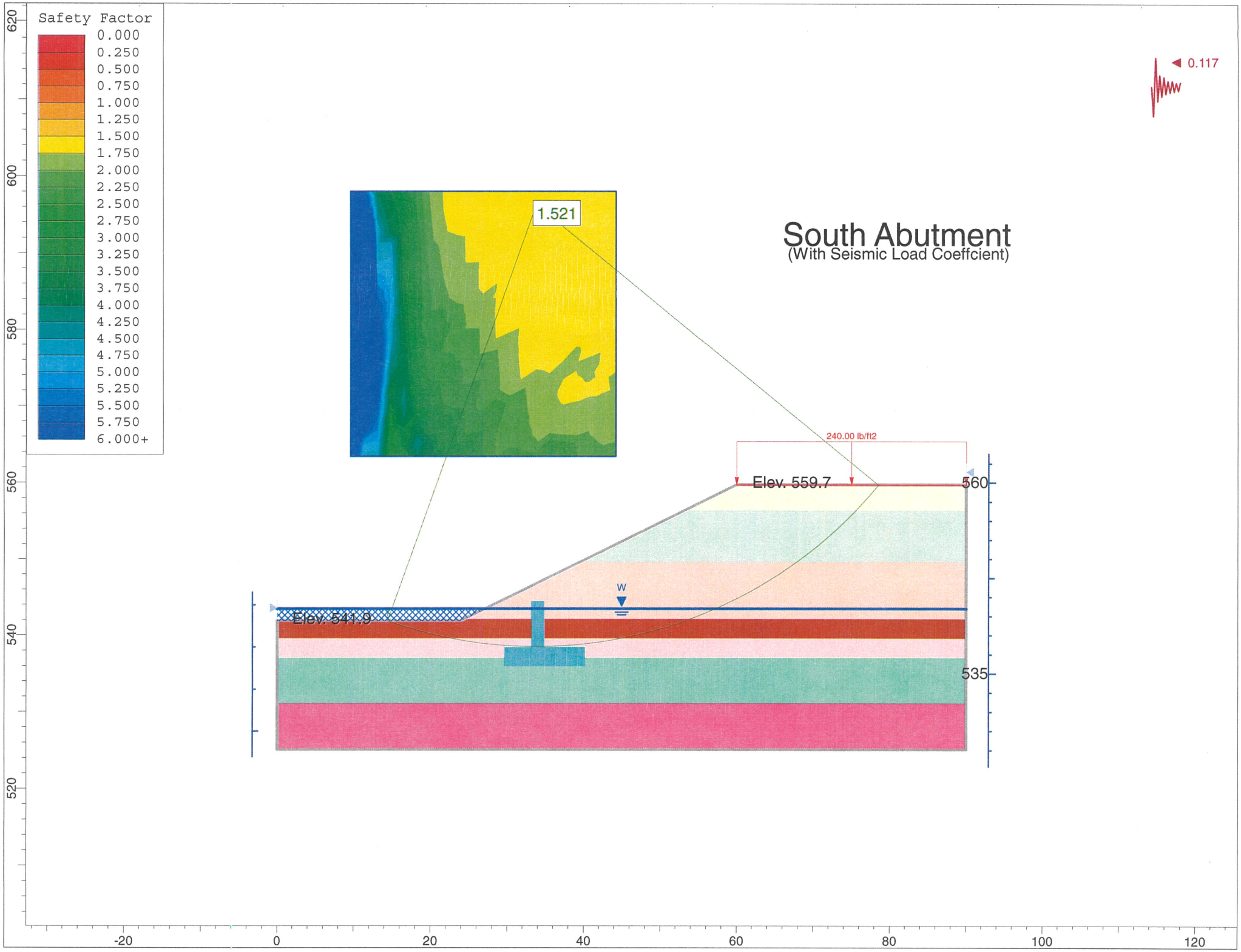
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.117
North Abutment
(With Seismic Load Coefficient)
1.349
240.00 lb/ft2
Elev 557.8
Elev. 541.9
W
W
555
540
600
580
560
540
520
-20
0
20
40
60
80
100


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+
0.117
1.521
South Abutment
(With Seismic Load Coeffcient)
240.00 lb/ft2
Elev. 559.7
560
W
Elev. 541.9
535
620
600
580
560
540
520
-20
0
20
40
60
80
100
120

Attachment D

Site Class Determination and Seismic Data

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	550	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1	
Top of Boring Elev.	556	ft.
Approximate Fixity Elev.	544	ft.

Individual Site Class Definition:

N (bar): 16 (Blows/ft.) Soil Site Class D
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.07 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	544.0	12.00	11	1.50	B
6.0	538.0	6.00	2	0.10	B
9.5	534.5	3.50	2	0.30	B
11.0	533.0	1.50	4	0.60	B
14.0	530.0	3.00	24	3.90	B
16.0	528.0	2.00	22	1.40	B
100.0	444.0	84.00	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	552	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2	
Top of Boring Elev.	558	ft.
Approximate Fixity Elev.	546	ft.

Individual Site Class Definition:

N (bar): 23 (Blows/ft.) Soil Site Class D
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 1.23 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	546.0	12.00	9	4.80	B
2.0	544.0	2.00	2	0.30	B
3.5	542.5	1.50	3	0.30	B
8.5	537.5	5.00	3	0.10	B
11.0	535.0	2.50	25	3.00	B
14.5	531.5	3.50	26	3.70	B
16.0	530.0	1.50	19	1.60	B
100.0	446.0	84.00	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): _____ (Blows/ft.) NA
N_{ch} (bar): _____ (Blows/ft.) NA
s_u (bar): _____ (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): _____ (Blows/ft.) NA
N_{ch} (bar): _____ (Blows/ft.) NA
s_u (bar): _____ (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Global Site Class Definition: Substructures 1 through 2

N (bar): 20 (Blows/ft.) Soil Site Class D
N_{ch} (bar): _____ (Blows/ft.) NA
s_u (bar): 1.15 (ksf) Soil Site Class D <----Controls

Text1

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
Latitude = 39.127557
Longitude = -088.805630
Site Class B
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)		
0.0	0.144	PGA,	Site Class B
0.2	0.300	Ss,	Site Class B
1.0	0.088	S1,	Site Class B

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 39.127557
Longitude = -088.805630
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.51, Fa = 1.56, Fv = 2.40
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)		
0.0	0.225	As,	Site Class D
0.2	0.469	SDs,	Site Class D
1.0	0.211	SD1,	Site Class D

Attachment E

Liquefaction Analysis

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/24/10

REFERENCE BORING NUMBER ========== B-1 N. Abut.
ELEVATION OF BORING GROUND SURFACE ========== 556.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 14.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 5.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.117 (PGA (0.073) x Fpga (1.6) (Table 3.10.3.2-1)
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 2.00 FT. (Fill Height)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER==========2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V_{s,40'}$ = **311** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 221.8
Ground Motion Prediction Equations = NMSZ
PGA = **0.073**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
550.5	5.5	6		35	5	40	15	0.113	0.622	8.873	15.648	0.167	0.051	0.521	0.677	1.455	**0.230**	0.844	**0.083**	N.L. (2)
548	8	5	0.3	40	11	41	20	0.108	0.892	6.980	13.375	0.144	0.046	0.636	0.948	1.356	**0.185**	0.790	**0.090**	N.L. (2)
546	10	4	0.2	50	15	41	14	0.104	1.100	5.585	11.702	0.128	0.042	0.720	1.156	1.299	**0.158**	0.748	**0.091**	N.L. (2)
544	12	2	0.2	50	15	41	20	0.104	1.308	2.762	8.314	0.099	0.042	0.804	1.365	1.239	**0.116**	0.709	**0.092**	N.L. (2)
541.5	14.5	2	0.1	50	11	39	23	0.035	1.395	2.812	8.374	0.099	0.035	0.891	1.609	1.212	**0.114**	0.663	**0.091**	N.L. (2)
538	18	2		30	10	40	22	0.048	1.563	2.800	7.938	0.095	0.048	1.059	1.995	1.164	**0.105**	0.608	**0.087**	N.L. (2)
534.5	21.5	2	0.3	40	11	41	20	0.046	1.724	2.757	8.308	0.099	0.046	1.220	2.374	1.130	**0.106**	0.563	**0.083**	N.L. (2)
533	23	4	0.6	85	18	41	15	0.053	1.804	5.450	11.541	0.127	0.053	1.300	2.548	1.125	**0.135**	0.547	**0.082**	N.L. (2)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/24/10

REFERENCE BORING NUMBER ========== B-2 S. Abut.
ELEVATION OF BORING GROUND SURFACE ========== 557.60 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 18.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 10.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.117 (PGA (0.073) x Fpga (1.6) (Table 3.10.3.2-1)
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 2.00 FT. (Fill Height)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER==========2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V_{s,40'}$ = **349** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 221.8
Ground Motion Prediction Equations = NMSZ
PGA = **0.073**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
552.1	5.5	3	0.2	50	11	39	22	0.104	0.572	4.507	10.409	0.117	0.104	0.812	0.812	1.252	**0.139**	0.871	**0.066**	N.L. (1)
549.6	8	5	0.1	70	11	41	20	0.098	0.817	7.134	13.561	0.146	0.098	1.057	1.057	1.193	**0.165**	0.824	**0.063**	N.L. (1)
543.6	14	3	0.3	20	11	41	19	0.108	1.465	4.115	8.057	0.096	0.046	1.333	1.707	1.107	**0.101**	0.712	**0.069**	N.L. (2)
539.6	18	2	0.1	30	14	43	23	0.098	1.857	2.613	7.723	0.094	0.160	1.973	2.597	1.016	**0.090**	0.647	**0.065**	N.L. (2)
537.1	20.5	4	0	10	7	30	23	-0.062	1.702	5.512	6.501	0.084	-0.062	1.818	2.598	1.033	**0.082**	0.612	**0.067**	N.L. (2)
531.1	26.5	13	3.3	80	15	45	13	0.074	2.146	17.054	25.465	0.301	0.074	2.262	3.416	0.979	**0.280**	0.548	**0.063**	N.L. (2)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR $w_c/LL \leq 0.85$
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Attachment F

Estimated Pile Lengths

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== North Abut.
REFERENCE BORING ========== 1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 552.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 550.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1355 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 32.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 338.75 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 127.03 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
418 KIPS	413 KIPS	227 KIPS	29 FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 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.)
548.00	2.00	0.30	5		1.9		4.7	2.8		***3.1***	3	0	0	2	4
546.00	2.00	0.20	4		1.3	2.8	6.0	1.9	0.3	***5.0***	5	0	0	3	6
544.00	2.00	0.20	2		1.3	2.8	***5.9***	1.9	0.3	6.8	6	0	0	3	8
541.50	2.50	0.10	2		0.8	1.4	***8.1***	1.2	0.2	8.1	8	0	0	4	11
538.00	3.50	0.20	2		2.3	2.8	11.8	3.3	0.3	***11.6***	12	0	0	6	14
534.50	3.50	0.30	2		3.4	4.1	19.3	4.9	0.5	***17.0***	17	0	0	9	18
533.00	1.50	0.60	4		2.7	8.3	67.5	4.0	0.9	***26.0***	26	0	0	14	19
530.00	3.00	3.90	24		22.1	53.7	55.1	32.4	5.9	***54.5***	55	0	0	30	22
528.00	2.00	1.40	22		7.3	19.3	165.6	10.6	2.1	***76.5***	76	0	0	42	24
527.00	1.00			Shale	49.4	122.5	215.0	72.3	13.4	***148.7***	149	0	0	82	25
526.00	1.00			Shale	49.4	122.5	264.5	72.3	13.4	***221.0***	221	0	0	122	26
525.00	1.00			Shale	49.4	122.5	313.9	72.3	13.4	***293.2***	293	0	0	161	27
524.00	1.00			Shale	49.4	122.5	***363.3***	72.3	13.4	365.5	363	0	0	200	28
523.00	1.00			Shale	49.4	122.5	***412.7***	72.3	13.4	437.7	413	0	0	227	29
522.00	1.00			Shale	49.4	122.5	***462.1***	72.3	13.4	510.0	~~462~~	*0*	*0*	~~*254*~~	~~*30*~~
521.00	1.00			Shale	49.4	122.5	***511.5***	72.3	13.4	582.2	~~512~~	*0*	*0*	~~*281*~~	~~*31*~~
520.00	1.00			Shale	49.4	122.5	***560.9***	72.3	13.4	654.5	~~561~~	*0*	*0*	~~*309*~~	~~*32*~~
519.00	1.00			Shale	49.4	122.5	***610.3***	72.3	13.4	726.7	~~610~~	*0*	*0*	~~*336*~~	~~*33*~~
518.00	1.00			Shale		122.5			13.4						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== South Abut.
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 554.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 552.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1355 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 32.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 338.75 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 127.03 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
418 KIPS	404 KIPS	222 KIPS	29 FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 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.)
550.00	2.00	0.10	5		0.7		4.8	1.0		***1.4***	1	0	0	1	4
547.00	3.00	0.30	3		2.9	4.1	7.7	4.2	0.5	***5.6***	6	0	0	3	7
544.50	2.50	0.30	2		2.4	4.1	10.1	3.5	0.5	***9.1***	9	0	0	5	10
542.00	2.50	0.30	3		2.4	4.1	***9.7***	3.5	0.5	12.4	10	0	0	5	12
539.50	2.50	0.10	2		0.8	1.4	***13.3***	1.2	0.2	13.9	13	0	0	7	15
537.00	2.50	0.30	4		2.4	4.1	52.9	3.5	0.5	***21.5***	21	0	0	12	17
534.50	2.50	3.00	25		15.2	41.3	74.5	22.2	4.5	***44.3***	44	0	0	24	20
531.00	3.50		26	Hard Till	3.9	47.8	52.7	5.8	5.2	***47.3***	47	0	0	26	23
530.00	1.00	1.60			4.0	22.0	157.2	5.8	2.4	***64.1***	64	0	0	35	24
529.00	1.00			Shale	49.4	122.5	206.6	72.3	13.4	***136.4***	136	0	0	75	25
528.00	1.00			Shale	49.4	122.5	256.0	72.3	13.4	***208.6***	209	0	0	115	26
527.00	1.00			Shale	49.4	122.5	305.4	72.3	13.4	***280.9***	281	0	0	154	27
526.00	1.00			Shale	49.4	122.5	354.8	72.3	13.4	***353.1***	353	0	0	194	28
525.00	1.00			Shale	49.4	122.5	***404.2***	72.3	13.4	425.4	404	0	0	222	29
524.00	1.00			Shale	49.4	122.5	***453.6***	72.3	13.4	497.6	~~454~~	*0*	*0*	~~250~~	~~30~~
523.00	1.00			Shale	49.4	122.5	***503.1***	72.3	13.4	569.9	~~503~~	*0*	*0*	~~277~~	~~31~~
522.00	1.00			Shale	49.4	122.5	***552.5***	72.3	13.4	642.1	~~552~~	*0*	*0*	~~304~~	~~32~~
521.00	1.00			Shale	49.4	122.5	***601.9***	72.3	13.4	714.4	~~602~~	*0*	*0*	~~331~~	~~33~~
520.00	1.00			Shale	49.4	122.5	***651.3***	72.3	13.4	786.6	~~651~~	*0*	*0*	~~358~~	~~34~~
519.00	1.00			Shale	49.4	122.5	***700.7***	72.3	13.4	858.9	~~701~~	*0*	*0*	~~385~~	~~35~~
518.00	1.00			Shale		122.5			13.4						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== North Abut.
REFERENCE BORING ========== 1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 552.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 550.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1355 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 32.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 338.75 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 127.03 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.25" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

NO FEASIBLE PILES: Risk for pile damage

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
413 KIPS	**399** KIPS	**219** KIPS	**24** 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 SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
548.00	2.00	0.30	5		2.8		***5.1***				5	0	0	3	4
546.00	2.00	0.20	4		1.9	2.3	***7.0***				7	0	0	4	6
544.00	2.00	0.20	2		1.9	2.3	***7.7***				8	0	0	4	8
541.50	2.50	0.10	2		1.2	1.2	***10.1***				10	0	0	6	11
538.00	3.50	0.20	2		3.3	2.3	***14.6***				15	0	0	8	14
534.50	3.50	0.30	2		4.9	3.5	***22.9***				23	0	0	13	18
533.00	1.50	0.60	4		4.0	7.0	***65.6***				66	0	0	36	19
530.00	3.00	3.90	24		32.0	45.7	***68.3***				68	0	0	38	22
528.00	2.00	1.40	22		10.5	16.4	***398.9***				399	0	0	219	24
527.00	1.00			Shale	230.7	336.5	***629.6***				~~630~~	*~~0~~*	*~~0~~*	*~~346~~*	*~~25~~*
526.00	1.00			Shale	230.7	336.5	***860.3***				~~860~~	*~~0~~*	*~~0~~*	*~~473~~*	*~~26~~*
525.00	1.00			Shale	230.7	336.5	***1091.0***				~~1091~~	*~~0~~*	*~~0~~*	*~~600~~*	*~~27~~*
524.00	1.00			Shale	230.7	336.5	***1321.7***				~~1322~~	*~~0~~*	*~~0~~*	*~~727~~*	*~~28~~*
523.00	1.00			Shale	230.7	336.5	***1552.5***				~~1552~~	*~~0~~*	*~~0~~*	*~~854~~*	*~~29~~*
522.00	1.00			Shale	230.7	336.5	***1783.2***				~~1783~~	*~~0~~*	*~~0~~*	*~~981~~*	*~~30~~*
521.00	1.00			Shale	230.7	336.5	***2013.9***				~~2014~~	*~~0~~*	*~~0~~*	*~~1108~~*	*~~31~~*
520.00	1.00			Shale	230.7	336.5	***2244.6***				~~2245~~	*~~0~~*	*~~0~~*	*~~1235~~*	*~~32~~*
519.00	1.00			Shale	230.7	336.5	***2475.4***				~~2475~~	*~~0~~*	*~~0~~*	*~~1361~~*	*~~33~~*
518.00	1.00			Shale		336.5									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== South Abut.
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 554.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 552.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1207 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 32.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 301.75 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.16 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.25" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

NO FEASIBLE PILES: Risk for pile damage

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
413 KIPS	399 KIPS	220 KIPS	24 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 SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
550.00	2.00	0.10	5		1.0		***4.5***				4	0	0	2	4
547.00	3.00	0.30	3		4.2	3.5	***8.6***				9	0	0	5	7
544.50	2.50	0.30	2		3.5	3.5	***12.1***				12	0	0	7	10
542.00	2.50	0.30	3		3.5	3.5	***13.2***				13	0	0	7	12
539.50	2.50	0.10	2		1.2	1.2	***16.8***				17	0	0	9	15
537.00	2.50	0.30	4		3.5	3.5	***51.9***				52	0	0	29	17
534.50	2.50	3.00	25		21.9	35.2	***169.9***				170	0	0	93	20
531.00	3.50		26	Hard Till	18.4	131.2	***75.8***				76	0	0	42	23
530.00	1.00	1.60			5.8	18.8	***399.3***				399	0	0	220	24
529.00	1.00			Shale	230.7	336.5	***630.0***				~~630~~	*0*	*0*	~~*347*~~	~~*25*~~
528.00	1.00			Shale	230.7	336.5	***860.7***				~~861~~	*0*	*0*	~~*473*~~	~~*26*~~
527.00	1.00			Shale	230.7	336.5	***1091.5***				~~1091~~	*0*	*0*	~~*600*~~	~~*27*~~
526.00	1.00			Shale	230.7	336.5	***1322.2***				~~1322~~	*0*	*0*	~~*727*~~	~~*28*~~
525.00	1.00			Shale	230.7	336.5	***1552.9***				~~1553~~	*0*	*0*	~~*854*~~	~~*29*~~
524.00	1.00			Shale	230.7	336.5	***1783.6***				~~1784~~	*0*	*0*	~~*981*~~	~~*30*~~
523.00	1.00			Shale	230.7	336.5	***2014.4***				~~2014~~	*0*	*0*	~~*1108*~~	~~*31*~~
522.00	1.00			Shale	230.7	336.5	***2245.1***				~~2245~~	*0*	*0*	~~*1235*~~	~~*32*~~
521.00	1.00			Shale	230.7	336.5	***2475.8***				~~2476~~	*0*	*0*	~~*1362*~~	~~*33*~~
520.00	1.00			Shale	230.7	336.5	***2706.5***				~~2707~~	*0*	*0*	~~*1489*~~	~~*34*~~
519.00	1.00			Shale	230.7	336.5	***2937.3***				~~2937~~	*0*	*0*	~~*1615*~~	~~*35*~~
518.00	1.00			Shale		336.5									