Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 1/13/2017 **Proposed SN:** 027-0104 **Route:** FAS 1522 (US 45)
Revised Date: 4/10/2017 **Existing SN:** 027-0012 **Section:** 31-X-BR
Geotechnical Engineer: Michael Short, IDOT District 3 **County:** Ford
Structural Engineer: Lori Sommer, Milhouse Engineering & Const. **Contract:** 66C84

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed structure is a three span bridge with a reinforced concrete deck. Integral abutments are preferred. The preliminary TS&L is attached. The proposed structure will be shifted approximately 8 feet north compared to the existing structure to improve the alignment with the channel.

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): Soil borings from June 2014 are attached. The existing structure is founded on 18" square precast concrete piles at the abutments and spread footings at the piers.

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 profile of the roadway is not expected to change and a site visit found no signs of settlement at the existing structure. Therefore, the soil is not anticipated to experience any additional loading that would result in settlement. No further analysis for settlement is warranted.

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: Because the proposed side slopes are less than 15 feet high and are a maximum of 1:3 (V:H) and because the existing slopes exhibit no slope stability issues, a side slope analysis was not performed. However, an end slope stability analysis was performed. The IDOT Geotechnical Manual requires a Factor of Safety of 1.5 because the analysis is based on Rimac samples. Based on the analysis of a 1:2 (V:H) end slope, the factor of safety against slope failure is 4.6. A printout of the slope configuration used in the analysis is attached. No further analysis for slope stability is warranted.

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 results from the hydraulic report indicate 6.0 feet of scour for the 100 year event and 10.7 feet of scour for the 200 year event. The soil borings indicate cohesive soils with unconfined compressive strength greater than 4.0 tsf. Therefore, a 50% scour reduction will be used. Based on this reduction, the scour elevation table will be as follows:

Design Scour Elevations (ft.)					Item 113
Event/Limit State	South Abutment	Pier 1	Pier 2	North Abutment	
Q100	731.50	709.40	709.40	730.50	8
Q200	731.50	707.05	707.05	730.50	
Design	731.50	709.40	709.40	730.50	
Check	731.50	707.05	707.05	730.50	

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable: The seismic soil site class is D. The seismic performance zone is 1. The 0.2 second design spectral acceleration is 0.204 g. The 1.0 second design spectral acceleration is 0.123 g. Liquefaction is not a concern at this location.

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:

Preliminary substructure loadings are attached.

The BB&S "Integral Abutment Feasibility Analysis" spreadsheet was used to determine the pile sizes available for use at the abutments, based on the current BB&S policy. The current policy would allow for the use of following piling sizes and shapes: HP10X42, HP12X53, HP10X57, HP12X74, HP14X73, HP12X84, HP14X89, HP14X102, and HP14X117. A draft version of the proposed revisions to the BB&S integral abutment policy was also used. The proposed draft policy expands this list by including MS12X0.179, MS12X0.25, MS14X0.25, MS14X0.312, MS 16X0.312 and MS 16X0.375. A copy of the results is attached. It is recommended to use the draft policy as it is expected that the policy will be adopted in the near future.

One test pile is recommended at each of the substructure units. The District prefers that the same pile type and size be used throughout the structure. Pile design tables were created using the BB&S "Pile Capacity and Length Estimates" spreadsheet. These tables are attached. At Pier 1, the tables were created assuming a 12 inch diameter pre core to elevation 696.0 prior to driving metal shell piles. This is necessary to prevent damage to metal shell piles during driving through the dense granular soils. By using a 12 inch diameter pre core with a 14 or 16 inch diameter metal shell pile, the risk of damage to the pile is minimized while still developing skin friction. This is necessary to ensure a minimum length of pile is installed prior to reaching the bearing capacity of the pile or damaging the pile.

Metal shell piles are preferred by the District because their estimated lengths are shorter than H piles. Additionally, the estimated lengths of metal shell piles are expected to be more predictable than the estimated length of H piles because the H piles will not encounter bedrock.

If metal shell piles are used, pile shoes are recommended to penetrate the dense granular soils. If H piles are used, pile shoes are not needed.

No underground Coal mines were identified near the project site according to the Illinois State Geological Survey website.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: The estimated water surface elevation (EWSE) is 715.9. A Type 1 cofferdam is necessary at each pier. A seal coat is not necessary.

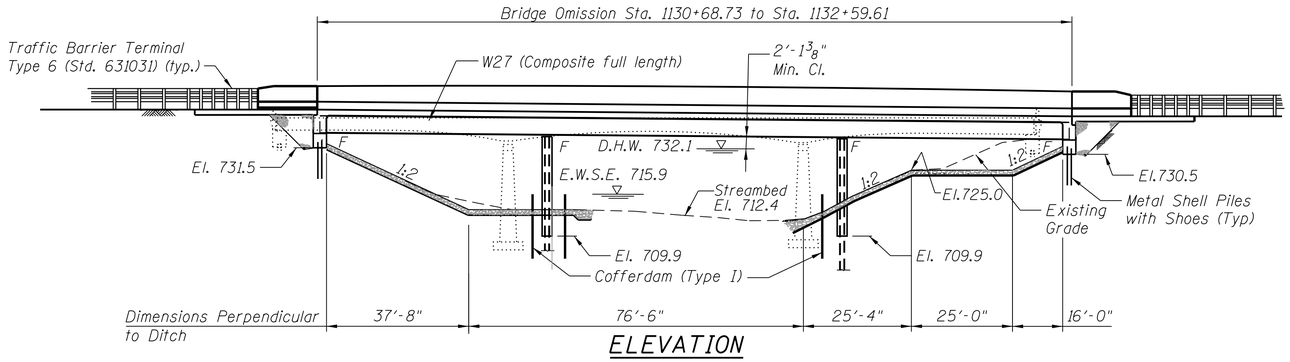
Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: Sheeting, soil retention, or temporary construction slopes will not be necessary for this stucture because the structure is expected to be constructed using a detour. If stage construction becomes necessary, temporary sheet piling is feasible because soils with strengths exceeding 4.5 tsf are below the required embedment depth.

Benchmark: Bm # 41A U.S.G.S. Benchmark disc on top of SW wingwall SN 027-0012. Sta. 1130+63.65. 21.22 Lt. Elev. 738.97

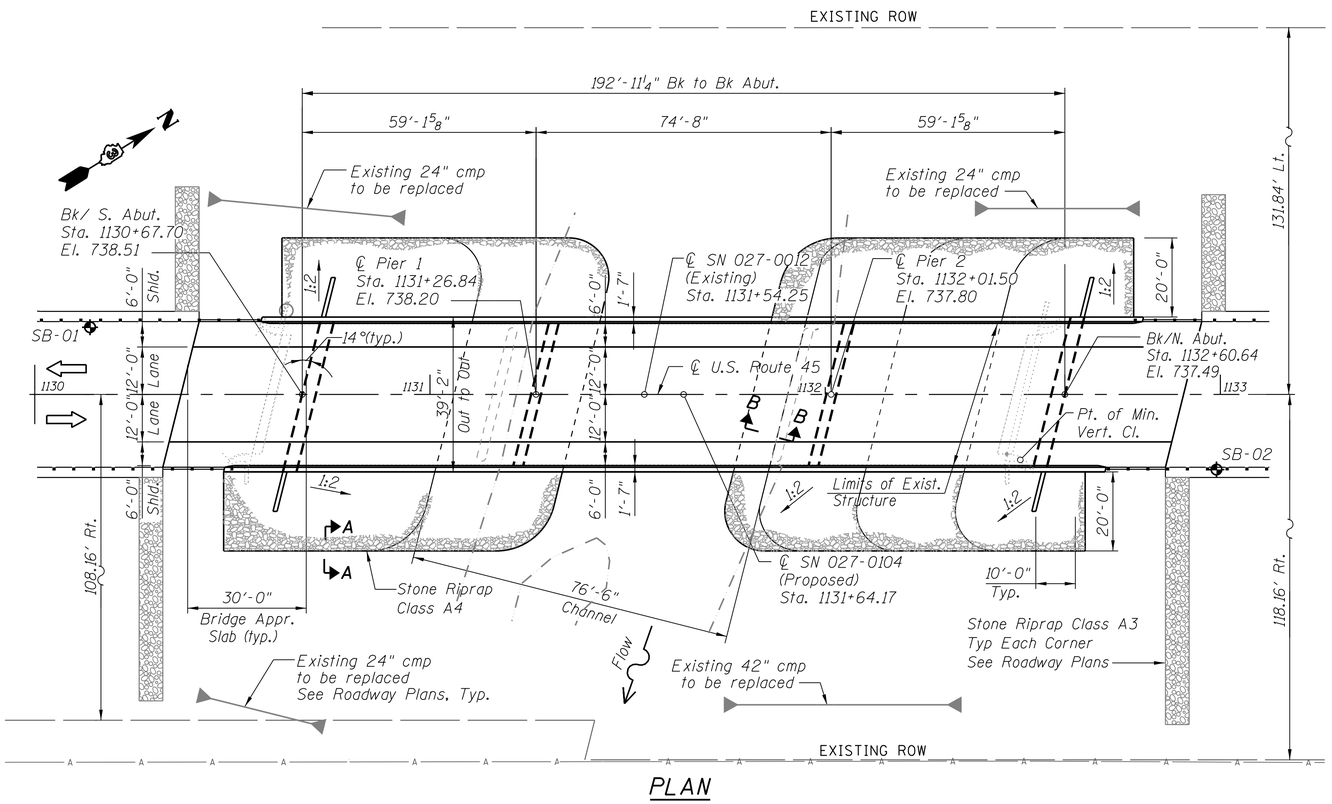
Existing Structure: SN 027-0012 was originally constructed in 1953 as SBI Rt 25, Section 31-X-B. The existing structure was patched and the deck expansion devices replaced in 1994 as Section 31 I & 32W & RS-1. The bridge was retrofitted with a curb mounted steel guardrail. The existing superstructure is a three span bridge (57'-5", 74'-8", 57'-5") constructed of reinforced T-beams and a 7" deck plus a $1\frac{1}{2}$" bituminous overlay. The bridge is 193'-10" back to back of abutments and is 35'-8" wide out to out of deck. It is skewed 14°left forward . The abutments are stub abutments supported on piles. The piers are solid shafts supported on spread footings

Traffic shall be detoured during construction.

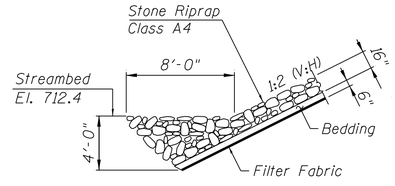
No Salvage



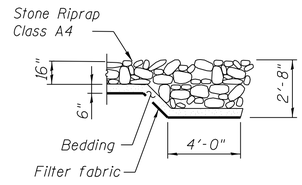
ELEVATION



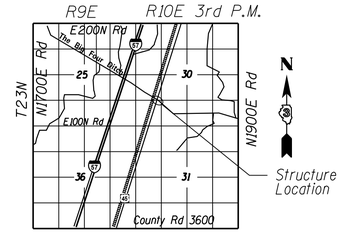
PLAN



SECTION B-B



SECTION A-A



LOCATION SKETCH

LOADING HL-93

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

HIGHWAY CLASSIFICATION

Route: FAS 1522 (US Route 45)
Functional Class: Major Collector
ADT: 3450 (2015), 4284 (2039)
DHV = 1000
ADTT = 110 (2015), 137 (2039)
Design Speed: 55 mph
Posted Speed: 55 mph
Directional Distribution: 50/50
Two Way Traffic

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration @ 1.0 sec (SD1) = .123g
Design Spectral Acceleration @ 0.2 sec (SDS) = .204g
Soil Site Class = D

DESIGN SPECIFICATIONS

AASHTO LRFD Bridge Design Specifications with 2015 & 2016 Interims

DESIGN STRESSES

FIELD UNITS

f'_c = 3,500 psi
f'_c = 4,000 psi (Superstructure Concrete)
f_y = 60,000 psi (Reinforcement)
F_y = 50,000 psi (M270 Grade 50W)

GENERAL PLAN
U.S. ROUTE 45 OVER BIG FOUR DITCH
FAS 1522 (US RTE 45)
SECTION 31-X-BR
FORD COUNTY
STA. 1131+64.17
STRUCTURE NO. 027-0104

FILE NAME = P:\2015\09566 IDOT D3 Various Phase II (PTB 145-18) W012 13 & 14\09566-05 (TSL US45 over Four Big Ditch\04-CADD\04-Sheet Files\TS&L Drawings\General Plan & Elevation.dgn

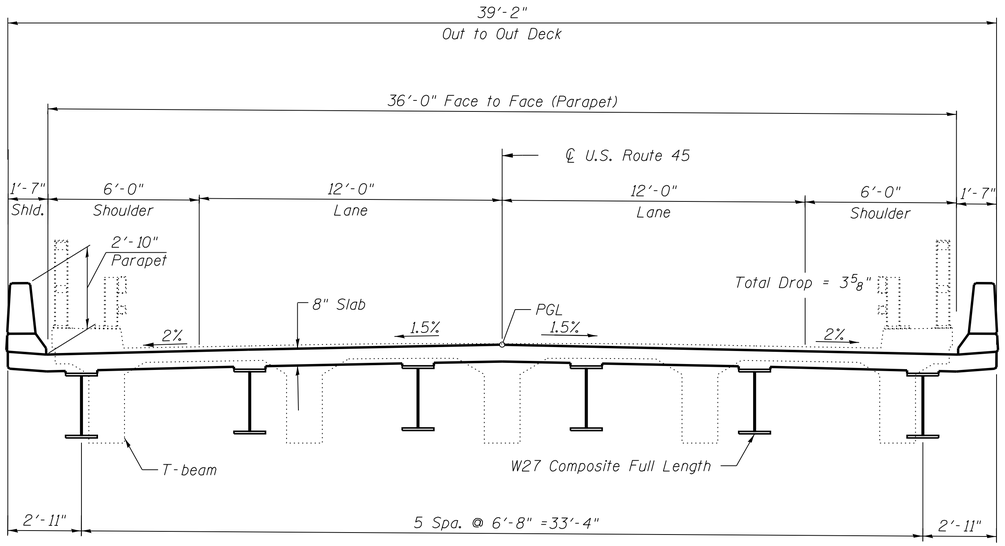
MILHOUSE ENGINEERING & CONSTRUCTION

USER NAME = tsledge	DESIGNED - LAS	REVISED -	
	CHECKED - DAZ	REVISED -	
PLOT SCALE = 19.1667 ' / in.	DRAWN - TCS	REVISED -	
PLOT DATE = 4/7/2017	CHECKED - LAS	REVISED -	

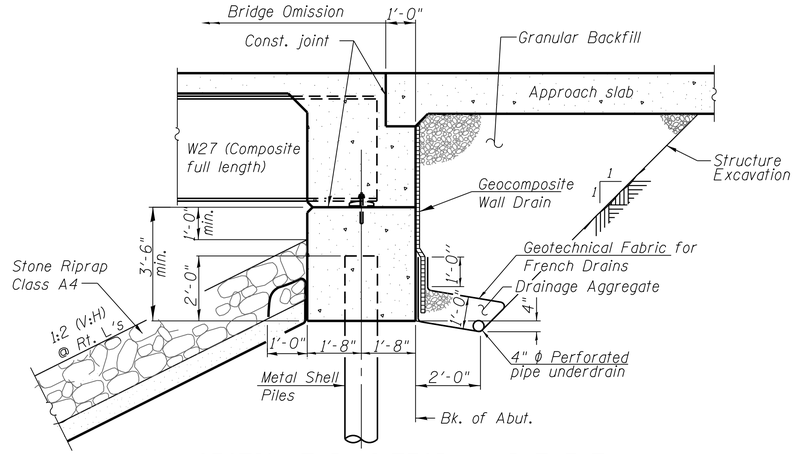
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 027-0104
SHEET NO. 1 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1522	31-X-BR	FORD		
		CONTRACT NO. 66C84		
	ILLINOIS FED. AID PROJECT			



CROSS SECTION
(Looking North)



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

PROFILE GRADE
(along ℄ US Route 45)

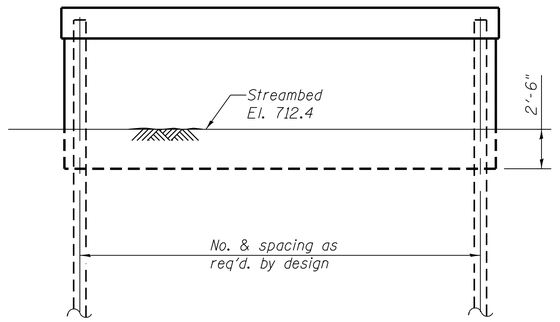
DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				
	S. Abut.	Pier 1	Pier 2	N. Abut.	Item 113
Q100	731.5	709.4	709.4	730.5	8
Q200	731.5	707.1	707.1	730.5	
Design	731.5	709.4	709.4	730.5	
Check	731.5	707.1	707.1	730.5	

WATERWAY INFORMATION

Drainage Area = -	159 sq. mi	Exist. Low Grade Elev. = 736.41 @ Sta. 1134+00 Prop. Low Grade Elev. = 736.41 @ Sta. 1134+00							
Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft.		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	5460	1826	1935	730.5	0.1	0.1	730.6	730.6
Hydraulic Design	50	8340	2074	2204	732.1	0.1	0.1	732.2	732.2
Base	100	9560	2188	2326	732.8	0.2	0.2	733.0	732.9
Scour Design	200	10846	2257	2398	733.2	0.2	0.2	733.4	733.4
Max. Calc.	500	12500	2371	2515	733.9	0.3	0.3	734.2	734.1
Overtopping	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

10-Year Velocity through Existing Bridge = 3.0 fps
10-Year Velocity through Proposed Bridge = 2.8 fps



PIER SKETCH

SECTIONS
U.S. ROUTE 45 OVER BIG FOUR DITCH
FAS 1522 (US RTE 45)
SECTION 31-X-BR
FORD COUNTY
STA. 1131+64.17
STRUCTURE NO. 027-0104

MILHOUSE ENGINEERING & CONSTRUCTION

USER NAME = tsledge	DESIGNED - LAS	REVISED -	
	CHECKED - DAZ	REVISED -	
PLOT SCALE = 12.0038 ' / in.	DRAWN - TCS	REVISED -	
PLOT DATE = 4/7/2017	CHECKED - LAS	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SECTIONS
STRUCTURE NO. 027-0104
SHEET NO. 2 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1522	31-X-BR	FORD		
		CONTRACT NO. 66C84		
		ILLINOIS FED. AID PROJECT		

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/19/14

ROUTE US 45 (SBI-25) **DESCRIPTION** US 45 over Big Four Ditch, 3.04 miles South of IL 9 **LOGGED BY** Larry Myers

SECTION 31-X-B **LOCATION** SW 1/4, **SEC.** 30, **TWP.** 23N, **RNG.** 10E, 3rd **PM**,
Latitude 40.418174, **Longitude** -88.113446

COUNTY Ford **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 027-0012 (Exist.)
Station 1131+54.25

BORING NO. 01 (S.W. Quad.)
Station 1130+14
Offset 17.0 ft Lt.
Ground Surface Elev. 738.59 ft

Surface Water Elev. 715.09 ft
Stream Bed Elev. 713.09 ft

Groundwater Elev.:
First Encounter 716.1 ft ▼
Upon Completion 698.6 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Gravel, Brown Silty Clay Loam Fill			
736.09			
Very Stiff Brown, Gray Silty Clay Loam Till Fill & Black Silty Clay Loam Fill	3		
	3 3	2.5 P	21
-5			
	3		
	2 3	2.5 P	15
	3		
	4 5	3.5 B	20
-10			
	2		
	4 5	2.7 B	19
	2		
	1 3	2.0 P	20
724.09			
Very Stiff Medium Black to Dark Gray Silty Clay Loam with Organics, Silt, Sand & Loam Layers - Alluvial Slack water deposits			
-15	2		
	2 4	2.5 P	23
	2		
	1 1	1.5 P	22
-20			
	WH		
	1 1	1.0 P	24
716.59			
Medium Gray Fine Sand to Coarse Gravel - Loamy with free water ▼	8		
	10 9		13
714.09			
Hard Gray Silty Clay Till			
-25	8		
	9 13	6.6 S	15
	5		
	7 12	6.8 S	15
-30			
	5		
	8 10	6.2 S	18
	5		
	8 11	6.0 S	25
704.09			
Hard Gray Silty Clay Loam Till with Silt Layers & Silty Loam Layers			
-35	10		
	8 8	5.0 S	18
701.09			
Very Dense Gray Fine Sand with no free water, Grading to Medium & Coarse Sand at 40'	27		
	43 45		13
▽ -40			

SOIL BORING 027-0012.GPJ IL_DOT.GDT 10/14/14

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)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/19/14

ROUTE US 45 (SBI-25) **DESCRIPTION** US 45 over Big Four Ditch, 3.04 miles South of IL 9 **LOGGED BY** Larry Myers

SECTION 31-X-B **LOCATION** SW 1/4, **SEC.** 30, **TWP.** 23N, **RNG.** 10E, 3rd **PM**, **Latitude** 40.418174, **Longitude** -88.113446

COUNTY Ford **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 027-0012 (Exist.)
Station 1131+54.25

BORING NO. 01 (S.W. Quad.)
Station 1130+14
Offset 17.0 ft Lt.
Ground Surface Elev. 738.59 ft

Surface Water Elev. 715.09 ft
Stream Bed Elev. 713.09 ft

Groundwater Elev.:
First Encounter 716.1 ft ▼
Upon Completion 698.6 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	24			Very Dense Gray Fine Sand with no free water, Grading to Medium & Coarse Sand at 40' *(continued)*
	33 40		2	
696.59				
	6			Very Stiff to Hard Gray Sandy Clay Loam Till with Coarse Sand Layers
	8 10	3.7 B	11	
-45	6			
	10 12	4.1 B	12	
	8			
	11 16	6.3 S	10	
689.59				
-50	5			Hard Black / Dark Brown Silty Clay Loam / Silty Clay - Paleosoil?
	11 16	>4.5 P	29	
683.59 -55				
	10			Hard to Very Stiff Dark Brown to Black Silty Clay Loam / Silty Loam with Layers of Loam, Silt & Sand - Lake / Swamp Deposits
	14 18	5.5 S	17	
-60				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	5			
	6 7	3.5 P	27	
677.09				
				End of Boring
-65				
-70				
-75				
-80				

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, form 137 (Rev. 8-99)

SOIL BORING 027-0012.GPJ IL_DOT.GDT 10/14/14

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/20/14

ROUTE US 45 (SBI-25) **DESCRIPTION** US 45 over Big Four Ditch, 3.04 miles South of IL 9 **LOGGED BY** Larry Myers

SECTION 31-X-B **LOCATION** SW 1/4, **SEC.** 30, **TWP.** 23N, **RNG.** 10E, 3rd **PM**, **Latitude** 40.418898, **Longitude** -88.113004

COUNTY Ford **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 027-0012 (Exist.)
Station 1131+54.25

BORING NO. 02 (N.E. Quad.)
Station 1132+99
Offset 19.0 ft Rt.
Ground Surface Elev. 736.91 ft

Surface Water Elev. 715.09 ft
Stream Bed Elev. 713.09 ft

Groundwater Elev.:
First Encounter 714.9 ft ▼
Upon Completion 696.9 ft ▽
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Gravel, Brown Silty Clay Loam Till Fill			
734.41			
Stiff to Very Stiff Brown & Gray Silty Clay Loam Till Fill & some Silty Clay Fill	2		
	2 3	2.0 P	19
-5			
	WH		
	2 2	1.5 P	23
729.91			
Stiff Black & Dark Brown Silty Clay Loam, Silty Loam, Silty Clay Fill	WH		
	1 3	1.5 P	24
-10			
	1		
	2 3	2.0 P	18
724.91			
Very Stiff Bluish Gray Silty Clay	2		
	3 4	2.0 P	24
722.41			
Very Stiff Brown & Gray Silty Clay Loess -15	1		
	3 5	2.5 P	25
719.91			
Hard Brown Silty Clay Loam Till	6		
	8 12	5.9 S	14
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	9		
Hard Brown Silty Clay Loam Till *(continued)*	11 16	8.4 S	13
714.41 ▼			
Hard Gray Silty Clay Loam / Silty Clay Till	9		
	14 18	10.9 S*	13
-25			
* Max Rimac @ 10%	9		
	11 13	8.0 S	15
	6		
	8 12	5.3 S	17
707.41			
Hard Brownish Gray Silty Loam / Silty Clay Loam Till with Silt Layers -30	7		
	9 10	4.6 S	14
	7		
	9 10	4.1 S	21
702.41			
Very Dense Gray Fine Sand to Fine Gravel Bedded with no free water -35	17		
	25 31		8
699.91			
Hard Gray Sandy Clay Loam Till with Sand Layers	6		
	7 13	4.2 S	13
▽ -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, form 137 (Rev. 8-99)

SOIL BORING 027-0012.GPJ IL_DOT.GDT 10/14/14

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/20/14

ROUTE US 45 (SBI-25) **DESCRIPTION** US 45 over Big Four Ditch, 3.04 miles South of IL 9 **LOGGED BY** Larry Myers

SECTION 31-X-B **LOCATION** SW 1/4, **SEC.** 30, **TWP.** 23N, **RNG.** 10E, 3rd **PM**, **Latitude** 40.418898, **Longitude** -88.113004

COUNTY Ford **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 027-0012 (Exist.)
Station 1131+54.25

BORING NO. 02 (N.E. Quad.)
Station 1132+99
Offset 19.0 ft Rt.
Ground Surface Elev. 736.91 ft

Surface Water Elev. 715.09 ft
Stream Bed Elev. 713.09 ft

Groundwater Elev.:
First Encounter 714.9 ft ▼
Upon Completion 696.9 ft ▽
After ____ **Hrs.** ____ ft

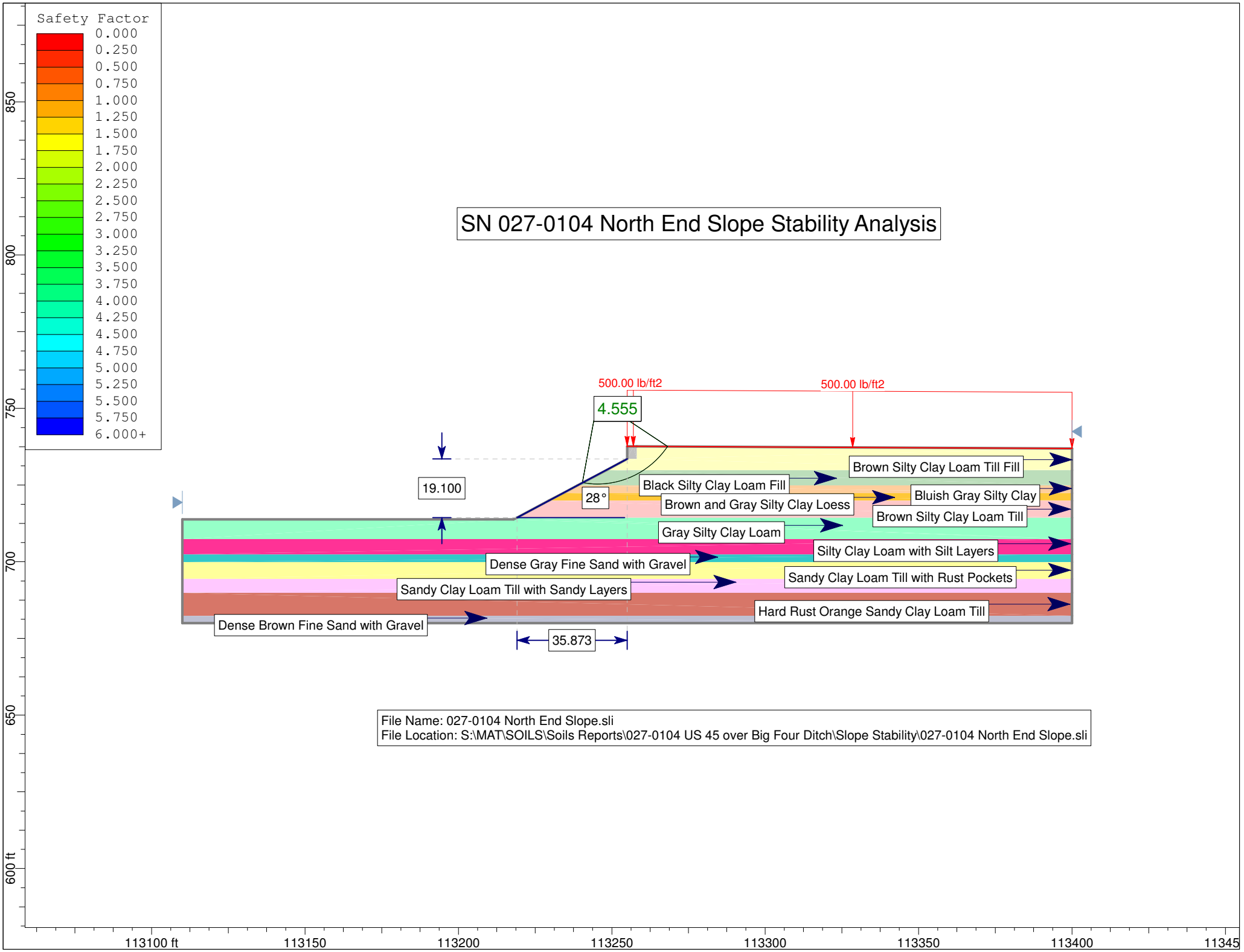
DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	7			Hard Gray Sandy Clay Loam Till with Sand Layers *(continued)*
	10 14	6.1 S	9	
694.41				
	8			Hard Brown & Gray Sandy Clay Loam Till with Heavy Rust Pockets
	10 15	6.1 S	13	
-45				
	10			
	11 14	6.1 S	18	
689.91				
	7			Hard Rust Orange Sandy Clay Loam Till
	9 12	5.4 S	15	
-50				
	7			
	7 8	5.3 S	14	
	7			
	9 10	5.1 S	16	
682.41				
-55				Dense Brown Fine Sand to Coarse Gravel with free water
	9			
	16 21		17	
	12			
	18 21		16	
-60				

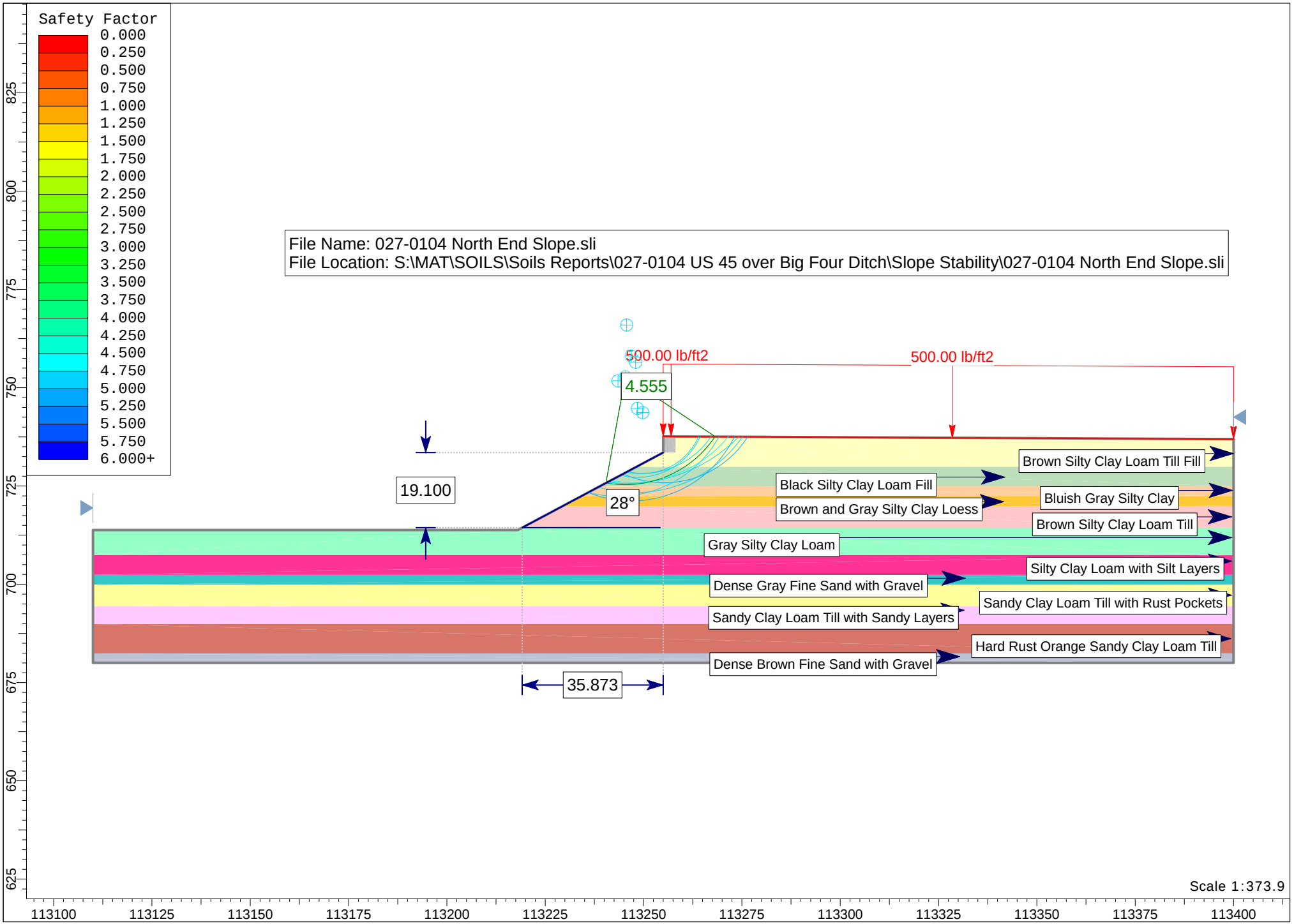
DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	10			Dense Brown Fine Sand to Coarse Gravel with free water *(continued)*
	19 30		16	
675.41				
				End of Boring
-65				
-70				
-75				
-80				

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, form 137 (Rev. 8-99)

SOIL BORING 027-0012.GPJ IL_DOT.GDT 10/14/14


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+
SN 027-0104 North End Slope Stability Analysis
500.00 lb/ft2
500.00 lb/ft2
4.555
19.100
28°
35.873
Brown Silty Clay Loam Till Fill
Black Silty Clay Loam Fill
Bluish Gray Silty Clay
Brown and Gray Silty Clay Loess
Brown Silty Clay Loam Till
Gray Silty Clay Loam
Silty Clay Loam with Silt Layers
Dense Gray Fine Sand with Gravel
Sandy Clay Loam Till with Rust Pockets
Sandy Clay Loam Till with Sandy Layers
Hard Rust Orange Sandy Clay Loam Till
Dense Brown Fine Sand with Gravel
File Name: 027-0104 North End Slope.sli
File Location: S:\MAT\SOILS\Soils Reports\027-0104 US 45 over Big Four Ditch\Slope Stability\027-0104 North End Slope.sli
850
800
750
700
650
600 ft
113100 ft
113150
113200
113250
113300
113350
113400
11345


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+
File Name: 027-0104 North End Slope.sli
File Location: S:\MAT\SOILS\Soils Reports\027-0104 US 45 over Big Four Ditch\Slope Stability\027-0104 North End Slope.sli
500.00 lb/ft2
500.00 lb/ft2
4.555
19.100
28°
35.873
Brown Silty Clay Loam Till Fill
Black Silty Clay Loam Fill
Bluish Gray Silty Clay
Brown and Gray Silty Clay Loess
Brown Silty Clay Loam Till
Gray Silty Clay Loam
Silty Clay Loam with Silt Layers
Dense Gray Fine Sand with Gravel
Sandy Clay Loam Till with Rust Pockets
Sandy Clay Loam Till with Sandy Layers
Hard Rust Orange Sandy Clay Loam Till
Dense Brown Fine Sand with Gravel
825
800
775
750
725
700
675
650
625
113100
113125
113150
113175
113200
113225
113250
113275
113300
113325
113350
113375
113400
Scale 1:373.9

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====SN 027-0104

Substructure 1 — South Abutment

Base of Substruct. Elev. (or ground surf for bents)	731.6	ft.
Pile or Shaft Dia.	12	inches
Boring Number	1	
Top of Boring Elev.	738.6	ft.
Approximate Fixity Elev.	725.6	ft.

Individual Site Class Definition:

N (bar): 13 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 3.84 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	736.1	2.50	2	1.00	B
	733.6	2.50	6	2.50	
	731.1	2.50	5	2.50	
	728.6	2.50	9	3.50	
	726.1	2.50	9	2.70	B
1.5	724.1	2.00	2	2.00	B
4.0	721.6	2.50	6	2.50	B
6.5	719.1	2.50	2	1.50	
9.0	716.6	2.50	2	1.00	B
11.5	714.1	2.50	19		B
14.0	711.6	2.50	22	6.60	
16.5	709.1	2.50	19	6.80	
19.0	706.6	2.50	18	6.20	
21.5	704.1	2.50	19	6.00	B
24.5	701.1	3.00	16	5.00	B
27.0	698.6	2.50	88		
29.0	696.6	2.00	73		B
31.5	694.1	2.50	18	3.70	
34.0	691.6	2.50	22	4.10	
36.0	689.6	2.00	27	6.30	B
39.0	686.6	3.00	27	4.50	
42.0	683.6	3.00	27	4.50	B
44.5	681.1	2.50	32	5.50	
47.0	678.6	2.50	32	5.50	B
48.5	677.1	1.50	13	3.50	B
51.5	674.1	3.00	24	4.50	
54.5	671.1	3.00	24	4.50	
57.5	668.1	3.00	24	4.50	
60.5	665.1	3.00	24	4.50	
63.5	662.1	3.00	24	4.50	
66.5	659.1	3.00	24	4.50	
69.5	656.1	3.00	24	4.50	
72.5	653.1	3.00	24	4.50	
75.5	650.1	3.00	24	4.50	
79.0	646.6	3.50	24	4.50	
82.5	643.1	3.50	24	4.50	
86.0	639.6	3.50	24	4.50	
89.5	636.1	3.50	24	4.50	
93.0	632.6	3.50	24	4.50	
96.5	629.1	3.50	24	4.50	
100.0	625.6	3.50	24	4.50	B

Substructure 2 — Pier 1

Base of Substruct. Elev. (or ground surf for bents)	709.9	ft.
Pile or Shaft Dia.	12	inches
Boring Number	1	
Top of Boring Elev.	738.6	ft.
Approximate Fixity Elev.	703.9	ft.

Individual Site Class Definition:

N (bar): 24 (Blows/ft.) Soil Site Class D
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 4.5 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	736.1	2.50	2	1.00	B
	733.6	2.50	6	2.50	
	731.1	2.50	5	2.50	
	728.6	2.50	9	3.50	
	726.1	2.50	9	2.70	B
	724.1	2.00	2	2.00	B
	721.6	2.50	6	2.50	B
	719.1	2.50	2	1.50	
	716.6	2.50	2	1.00	B
	714.1	2.50	19		B
	711.6	2.50	22	6.60	
	709.1	2.50	19	6.80	
	706.6	2.50	18	6.20	
	704.1	2.50	19	6.00	B
2.8	701.1	3.00	16	5.00	B
5.3	698.6	2.50	88		
7.3	696.6	2.00	73		B
9.8	694.1	2.50	18	3.70	
12.3	691.6	2.50	22	4.10	
14.3	689.6	2.00	27	6.30	B
17.3	686.6	3.00	27	4.50	
20.3	683.6	3.00	27	4.50	B
22.8	681.1	2.50	32	5.50	
25.3	678.6	2.50	32	5.50	B
26.8	677.1	1.50	13	3.50	B
31.3	672.6	4.50	24	4.50	
35.8	668.1	4.50	24	4.50	
40.3	663.6	4.50	24	4.50	
44.8	659.1	4.50	24	4.50	
49.3	654.6	4.50	24	4.50	
53.8	650.1	4.50	24	4.50	
58.3	645.6	4.50	24	4.50	
62.8	641.1	4.50	24	4.50	
67.3	636.6	4.50	24	4.50	
71.8	632.1	4.50	24	4.50	
76.3	627.6	4.50	24	4.50	
80.8	623.1	4.50	24	4.50	
85.3	618.6	4.50	24	4.50	
90.0	613.9	4.70	24	4.50	
95.0	608.9	5.00	24	4.50	
100.0	603.9	5.00	24	4.50	B

Substructure 3 — Pier 2

Base of Substruct. Elev. (or ground surf for bents)	709.9	ft.
Pile or Shaft Dia.	12	inches
Boring Number	2	
Top of Boring Elev.	736.9	ft.
Approximate Fixity Elev.	703.9	ft.

Individual Site Class Definition:

N (bar): 35 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 42 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 4.8 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	734.4	2.50	2	1.00	B
	731.9	2.50	5	2.00	
	729.9	2.00	4	1.50	B
	727.4	2.50	4	1.50	
	724.9	2.50	5	2.00	B
	722.4	2.50	7	2.00	B
	719.9	2.50	8	2.50	B
	717.4	2.50	20	5.90	
	714.4	3.00	27	8.40	B
	711.9	2.50	32	10.90	
	709.4	2.50	24	8.00	
	707.4	2.00	20	5.30	B
	704.9	2.50	19	4.60	
1.5	702.4	2.50	19	4.10	B
4.0	699.9	2.50	56		B
6.5	697.4	2.50	20	4.20	
9.5	694.4	3.00	24	6.10	B
12.0	691.9	2.50	25	6.10	
14.0	689.9	2.00	25	6.10	B
16.5	687.4	2.50	21	5.40	
19.0	684.9	2.50	15	5.30	
21.5	682.4	2.50	19	5.10	B
24.0	679.9	2.50	37		
26.5	677.4	2.50	39		
28.5	675.4	2.00	49		B
32.5	671.4	4.00	42		
37.0	666.9	4.50	42		
41.5	662.4	4.50	42		
46.0	657.9	4.50	42		
50.5	653.4	4.50	42		
55.0	648.9	4.50	42		
59.5	644.4	4.50	42		
64.0	639.9	4.50	42		
68.5	635.4	4.50	42		
73.0	630.9	4.50	42		
77.5	626.4	4.50	42		
82.0	621.9	4.50	42		
86.5	617.4	4.50	42		
91.0	612.9	4.50	42		
95.5	608.4	4.50	42		
100.0	603.9	4.50	42		B

Substructure 4 — North Abutment

Base of Substruct. Elev. (or ground surf for bents)	730.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	2	
Top of Boring Elev.	736.9	ft.
Approximate Fixity Elev.	724.5	ft.

Individual Site Class Definition:

N (bar): 27 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 42 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 4.26 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	734.4	2.50	2	1.00	B
	731.9	2.50	5	2.00	
	729.9	2.00	4	1.50	B
	727.4	2.50	4	1.50	
	724.9	2.50	5	2.00	B
2.1	722.4	2.50	7	2.00	B
4.6	719.9	2.50	8	2.50	B
7.1	717.4	2.50	20	5.90	
10.1	714.4	3.00	27	8.40	B
12.6	711.9	2.50	32	10.90	
15.1	709.4	2.50	24	8.00	
17.1	707.4	2.00	20	5.30	B
19.6	704.9	2.50	19	4.60	
22.1	702.4	2.50	19	4.10	B
24.6	699.9	2.50	56		B
27.1	697.4	2.50	20	4.20	
30.1	694.4	3.00	24	6.10	B
32.6	691.9	2.50	25	6.10	
34.6	689.9	2.00	25	6.10	B
37.1	687.4	2.50	21	5.40	
39.6	684.9	2.50	15	5.30	
42.1	682.4	2.50	19	5.10	B
44.6	679.9	2.50	37		
47.1	677.4	2.50	39		
49.6	674.9	2.50	49		B
52.6	671.9	3.00	42		
55.6	668.9	3.00	42		
58.6	665.9	3.00	42		
61.6	662.9	3.00	42		
64.6	659.9	3.00	42		
67.6	656.9	3.00	42		
70.6	653.9	3.00	42		
73.6	650.9	3.00	42		
76.6	647.9	3.00	42		
79.6	644.9	3.00	42		
82.6	641.9	3.00	42		
85.6	638.9	3.00	42		
89.1	635.4	3.50	42		
92.6	631.9	3.50	42		
96.1	628.4	3.50	42		
100.0	624.5	3.90	42		B

Global Site Class Definition: Substructures 1 through 4

N (bar): 25 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 43 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 4.24 (ksf) Soil Site Class C

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE====

Substructure 5

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 (ft)	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 6

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 (ft)	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 7

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 (ft)	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 8

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 (ft)	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

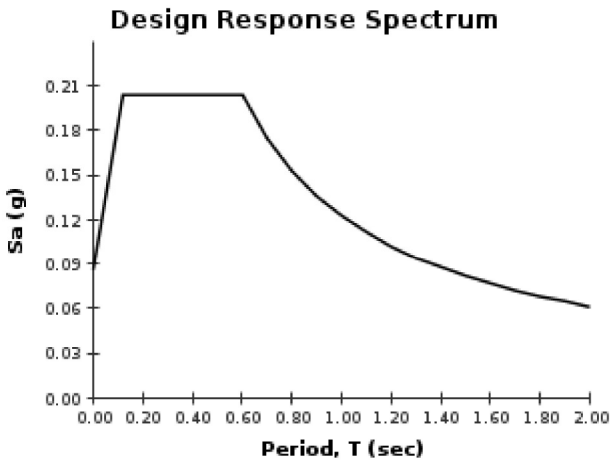
USGS Design Maps Summary Report

User–Specified Input

Report Title	SN 027-0104 Wed January 4, 2017 19:07:00 UTC
Building Code Reference Document	2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (which utilizes USGS hazard data available in 2002)
Site Coordinates	40.41817°N, 88.11345°W
Site Soil Classification	Site Class D – "Stiff Soil"

USGS–Provided Output

PGA =	0.054 g	**A_s =**	0.086 g
S_s =	0.128 g	**S_{DS} =**	0.204 g
S_1 =	0.051 g	**S_{D1} =**	0.123 g



[External] US 45 over Big Four Ditch Hide

From: Lori Sommer
Sent: 12/19/2016 2:24 PM
To: Short, Michael A; Ferguson, Steven P
Cc: Deborah Zroka

Message PTSL US 45 over Big Four Ditch.pdf (1.9 MB)

Mike,

I have attached the preliminary TSL for the bridge carrying US 45 over the Big Four Ditch.

These are the preliminary substructure loads:

- Abutments
  - Service Dead Load=305k
  - Service Live Load plus Impact =255k
  - Total Service Load= 560k
  - Factored Dead Load=390k
  - Factored Live Load plus Impact= 440k
  - Total Factored Load = 830k
- Piers
  - Service Dead Load=975k
  - Service Live Load =305k
  - Total Service Load= 1280k
  - Factored Dead Load=1250k
  - Factored Live Load = 535k
  - Total Factored Load = 1785k

Please let me know if you need any other information.

Lori Sommer SE, PE| Senior Structural Engineer
Milhouse Engineering & Construction, Inc.
60 E. Van Buren St., STE 1501 | Chicago, IL 60605
D: 847.968.4312 | O: 312.987.0061 | F: 312.987.0071
Email: lsommer@milhouseinc.com
Web: www.milhouseinc.com
"Improving communities around the world through innovative engineering."

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

STRUCTURE NUMBER==========	SN 027-0104	
STRUCTURE TYPE ==========	MULTI-SPAN	
STRUCTURE SKEW==========	14	DEGREES
TOTAL STRUCTURE LENGTH==========	192.94	FT
LONGEST END SPAN LENGTH ==========	59.14	FT

ABUTMENT #1 DATA

ABUTMENT NAME ==========	South Abutment	
ABUTMENT REFERENCE BORING==========	Boring 01	
BOTTOM OF ABUTMENT ELEVATION==========	731.6	FT
ESTIMATED NUMBER OF PILES AT ABUT.=======	8	

ABUTMENT #2 DATA

ABUTMENT NAME ==========	North Abutment	
ABUTMENT REFERENCE BORING==========	Boring 02	
BOTTOM OF ABUTMENT ELEVATION==========	730.5	FT
ESTIMATED NUMBER OF PILES AT ABUT.=======	8	

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
729.10	2.50	3.5		
726.60	2.50	2.7		
724.10	2.50	2.0		
721.60	2.50	2.5		

10.00 FT = TOTAL DEPTH ENTERED

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #2

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
729.90	0.60	1.5		
727.40	2.50	1.5		
724.90	2.50	2.0		
722.40	2.50	2.00		
720.50	1.90	2.50		

10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1======= 2.68 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #1
= 1/(1.45-[0.3*2.68])========== 1.54

WEIGHTED AVERAGE Qu FOR ABUTMENT #2======= 1.94 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #2
= 1/(1.45-[0.3*1.94])========== 1.15

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.54*8*0+1.15*8*192.94]/[1.54*8+1.15*8]======== 82.43 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.15*8*0+1.54*8*192.94]/[1.15*8+1.54*8]======== 110.51 FT

EFFECTIVE EXPANSION LENGTH (EEL) CALCULATION

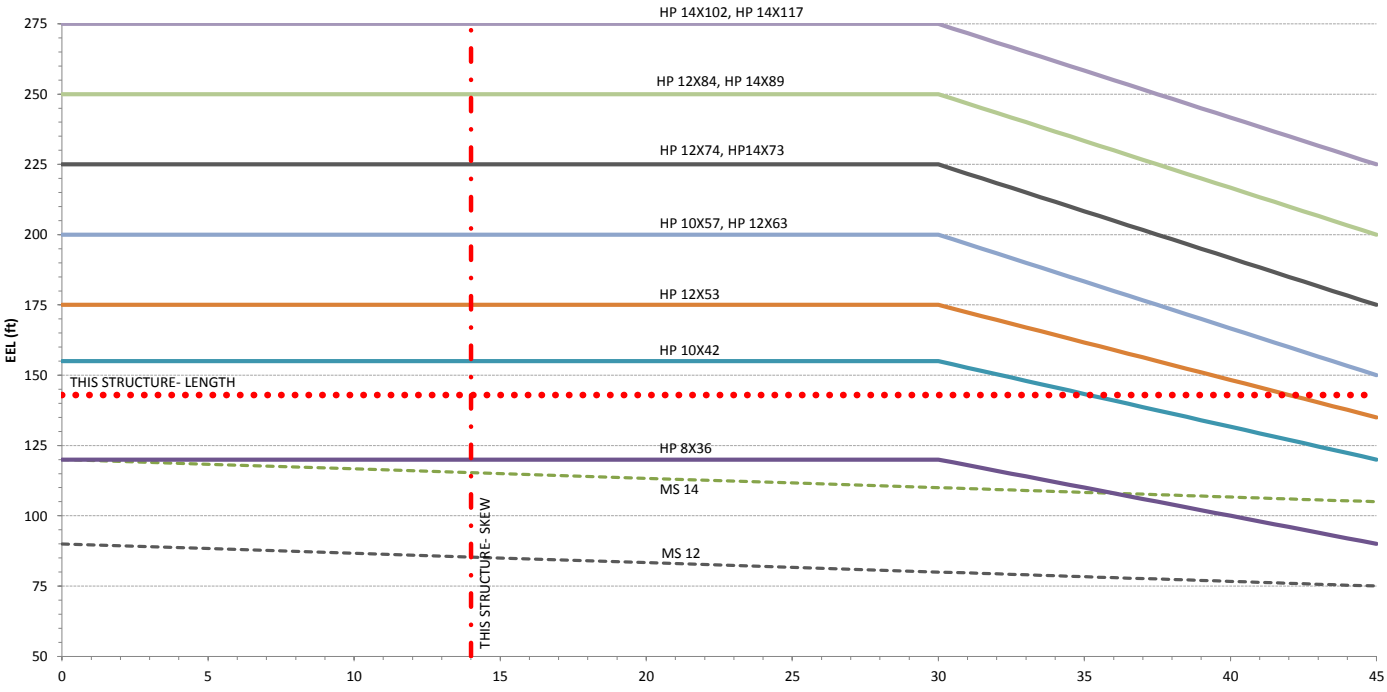
CONTROLLING ABUTMENT==========	ABUT. #2 North Abutment	
CONTROLLING EXPANSION LENGTH (DISTANCE TO CENTROID OF STIFFNESS FROM CONTROLLING ABUTMENT) ==========	110.51	FT
WEIGHTED AVE. Qu FOR CONTROLLING ABUTMENT ==========	1.94	TSF
Qu CORRECTION FACTOR ========== 1.94/1.5 ==========	1.29	
EFFECTIVE EXPANSION LENGTH (EEL) ========== EEL = 110.51*1.29 ==========	142.92	FT

FEASIBLE PILE TYPES PER CHART IN ABD MEMO 12.3 BASED ON SKEW AND EEL OR MODIFIED EEL:

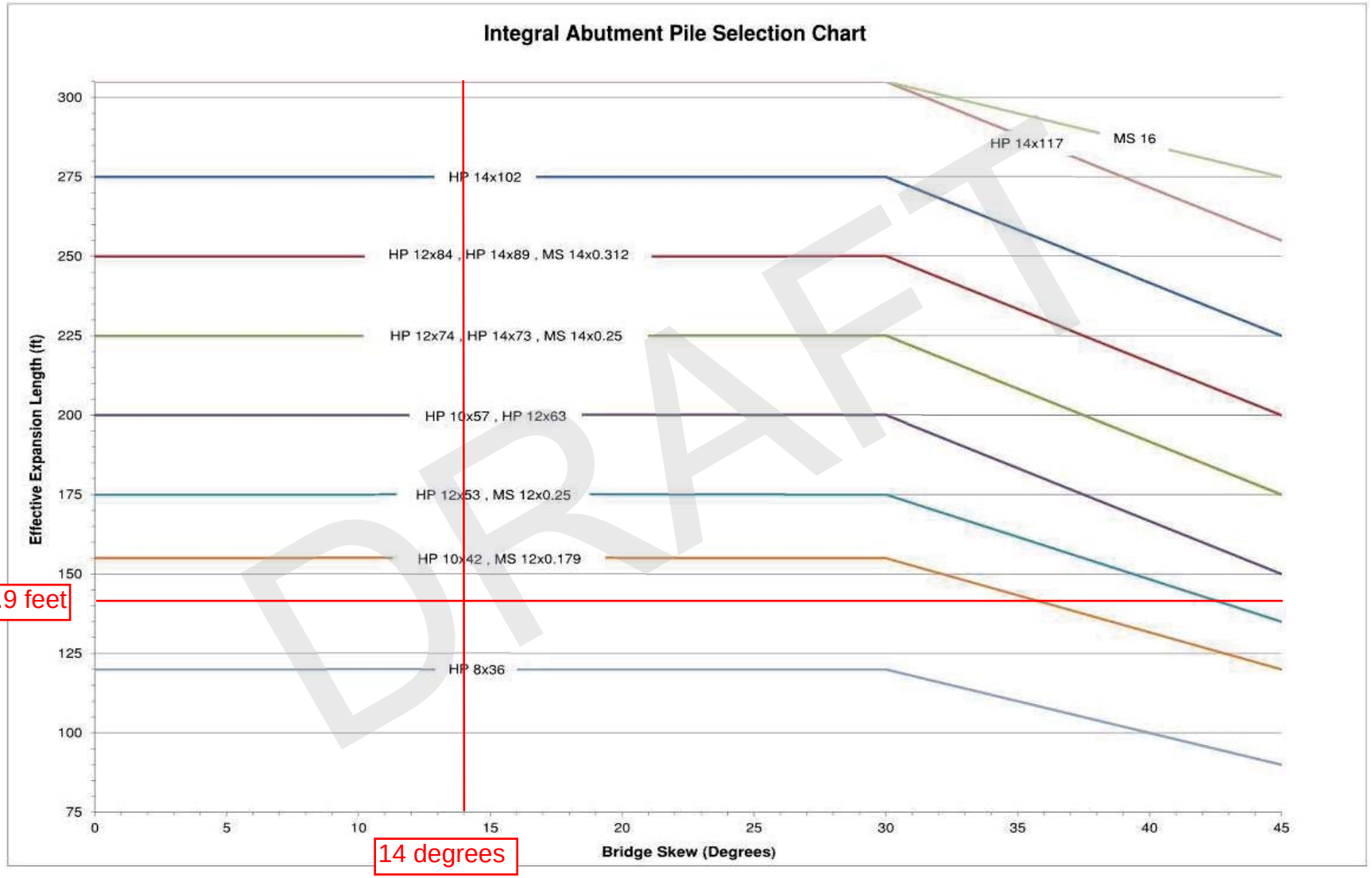
PILE SIZES AT OR ABOVE THE LENGTH LINE AT THE INTERSECTION WITH THE SKEW LINE ARE ALLOWED FOR USE WITH THIS INTEGRAL ABUTMENT STRUCTURE

AVAILABLE PILE SIZES:

HP 10X42, HP 12X53, HP 10X57, HP 12X63, HP 12X74, HP 14X73, HP 12X84, HP 14X89, HP 14X102, HP 14X117



SN 027-0104 Proposed Integral Abutment Policy Pile Selection Chart
Structure Skew = 14 degrees
Effective Expansion Length = 142.9 feet



Allowable pile sizes:
MS 12X0.179, MS 12X0.25, MS 14X0.25, MS 14X0.312, MS 16
HP 10X42, HP 10X57, HP 12X53, HP 12X63, HP 12X74, HP 12X84
HP 14X73, HP 14X89, HP 14X102, HP 14X117

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== South Abutment
REFERENCE BORING ========== 1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 733.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 731.60 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 ========== 830 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 37.10 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 178.98 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 67.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 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
588 KIPS	**377** KIPS	**207** KIPS	**31** 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.)
729.10	2.50	3.50	9		28.1		***69.4***				69	0	0	38	5
726.60	2.50	2.70	9		23.3	41.4	***82.0***				82	0	0	45	7
724.10	2.50	2.00	4		19.1	30.6	***108.7***				109	0	0	60	10
721.60	2.50	2.50	6		22.1	38.3	***115.5***				115	0	0	64	12
719.10	2.50	1.50	2		15.8	23.0	***123.6***				124	0	0	68	15
716.60	2.50	1.00	2		11.6	15.3	***286.9***				287	0	0	158	17
714.10	2.50		19	Sandy Gravel	23.5	167.0	***244.5***				245	0	0	134	20
711.60	2.50	6.60	22		34.1	101.1	***281.6***				282	0	0	155	22
709.10	2.50	6.80	19		34.1	104.1	***306.5***				307	0	0	169	25
706.60	2.50	6.20	18		34.1	95.0	***337.5***				338	0	0	186	27
704.10	2.50	6.00	19		34.1	91.9	***356.3***				356	0	0	196	30
702.60	1.50	5.00	16		20.4	76.6	***376.8***				377	0	0	207	31
701.10	1.50	5.00	16		20.4	76.6	***1094.1***				~~1094~~	~~0~~	~~0~~	~~602~~	~~33~~
698.60	2.50		88	Fine Sand	156.9	773.5	***1119.2***				~~1119~~	~~0~~	~~0~~	~~616~~	~~35~~
696.60	2.00		73	Medium Sand	111.3	641.6	***645.5***				~~646~~	~~0~~	~~0~~	~~355~~	~~37~~
694.10	2.50	3.70	18		29.3	56.7	***680.9***				~~681~~	~~0~~	~~0~~	~~375~~	~~40~~
691.60	2.50	4.10	22		31.7	62.8	***746.3***				~~746~~	~~0~~	~~0~~	~~410~~	~~42~~
689.60	2.00	6.30	27		27.3	96.5	***746.0***				~~746~~	~~0~~	~~0~~	~~410~~	~~44~~
687.10	2.50	4.50	27		34.1	68.9	***780.1***				~~780~~	~~0~~	~~0~~	~~429~~	~~47~~
684.60	2.50	4.50	27		34.1	68.9	***814.2***				~~814~~	~~0~~	~~0~~	~~448~~	~~49~~
683.60	1.00	4.50	27		13.6	68.9	***956.6***				~~957~~	~~0~~	~~0~~	~~526~~	~~50~~
681.10	2.50		30	Hard Till	17.2	197.8	***973.8***				~~974~~	~~0~~	~~0~~	~~536~~	~~53~~
678.60	2.50		30	Hard Till	17.2	197.8	***846.9***				~~847~~	~~0~~	~~0~~	~~466~~	~~55~~
677.10	1.50	3.50	13			53.6									

Pile Design Table for South Abutment utilizing Boring #1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls		
115	64	12
124	68	15
245	134	20
282	155	22
307	169	25
338	186	27
356	196	30
377	207	31
Metal Shell 16"Φ w/.375" walls		
115	64	12
124	68	15
245	134	20
282	155	22
307	169	25
338	186	27
356	196	30
377	207	31
Metal Shell 14"Φ w/.25" walls		
106	59	15
203	112	20
235	129	22
258	142	25
285	157	27
303	167	30
321	177	31
Metal Shell 14"Φ w/.312" walls		
106	59	15
203	112	20
235	129	22
258	142	25
285	157	27
303	167	30
321	177	31
Steel HP 8 X 36		
120	66	25
132	73	27
140	77	30
149	82	31
183	101	37
197	109	40
224	123	44
238	131	47
252	139	49
255	140	50
256	141	55
Steel HP 10 X 42		
102	56	20
128	70	22
152	84	25
173	95	27
180	99	30
191	105	31
230	127	37
249	137	40
282	155	44
299	165	47
317	174	49
319	175	50
319	176	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
106	58	20
131	72	22
156	86	25
177	97	27
185	102	30
195	107	31
236	130	37
255	140	40
289	159	44
306	168	47
324	178	49
326	179	50
326	179	55
Steel HP 12 X 53		
111	61	17
122	67	20
153	84	22
182	100	25
212	117	27
228	126	30
241	132	31
285	157	37
309	170	40
350	192	44
370	204	47
391	215	49
392	216	55
Steel HP 12 X 63		
114	63	17
126	69	20
157	86	22
186	103	25
217	119	27
231	127	30
243	134	31
288	159	37
312	171	40
353	194	44
374	206	47
395	217	49
396	218	55
Steel HP 12 X 74		
115	63	17
129	71	20
160	88	22
189	104	25
219	121	27
235	129	30
247	136	31
292	161	37
316	174	40
358	197	44
380	209	47
401	220	49
401	221	55
Steel HP 12 X 84		
117	64	17
131	72	20
162	89	22
192	106	25
222	122	27
238	131	30
251	138	31
297	163	37
321	177	40
364	200	44
385	212	47
406	223	49
407	224	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
97	53	15
135	74	17
149	82	20
186	102	22
221	121	25
257	141	27
286	157	30
300	165	31
349	192	37
378	208	40
428	235	44
452	249	47
475	261	55
Steel HP 14 X 89		
98	54	15
137	75	17
153	84	20
190	105	22
225	124	25
261	144	27
290	159	30
304	167	31
354	195	37
383	211	40
433	238	44
458	252	47
481	264	55
Steel HP 14 X 102		
99	55	15
139	76	17
156	86	20
193	106	22
228	126	25
264	145	27
294	162	30
309	170	31
358	197	37
388	213	40
439	241	44
464	255	47
486	268	55
Steel HP 14 X 117		
101	55	15
141	78	17
160	88	20
198	109	22
233	128	25
269	148	27
298	164	30
313	172	31
363	200	37
393	216	40
445	244	44
470	258	47
492	271	55
Precast 14"x 14"		
116	64	10
125	69	12
136	75	15
Timber Pile		
111	61	15
152	84	17

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== 1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 733.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 709.90 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 709.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1785 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 37.10 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 384.91 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 144.34 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 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
588 KIPS	**579** KIPS	**319** KIPS	**47** 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.)
707.00	2.90	6.20	18		39.5		***39.5***				40	0	0	22	27
704.10	2.90	6.00	19		39.5		***79.1***				79	0	0	43	30
703.35	0.75	5.00	16		10.2		***89.3***				89	0	0	49	30
702.60	0.75	5.00	16		10.2		***99.5***				100	0	0	55	31
701.85	0.75	5.00	16		10.2		***109.7***				110	0	0	60	32
701.60	0.25	5.00	16		3.4		***113.1***				113	0	0	62	32
701.35	0.25	5.00	16		3.4		***116.5***				117	0	0	64	32
701.10	0.25	5.00	16		3.4		***120.0***				120	0	0	66	33
700.85	0.25		88	Fine Sand	15.7		***135.6***				136	0	0	75	33
700.60	0.25		88	Fine Sand	15.7		***151.3***				151	0	0	83	33
700.10	0.50		88	Fine Sand	31.4		***182.7***				183	0	0	100	34
698.60	1.50		88	Fine Sand	94.2		***276.9***				277	0	0	152	35
697.60	1.00		73	Medium Sand	55.7		***332.5***				333	0	0	183	36
697.10	0.50		73	Medium Sand	27.8		***360.4***				360	0	0	198	37
696.60	0.50		73	Medium Sand	27.8		***444.9***				445	0	0	245	37
694.10	2.50	3.70	18		29.3	56.7	***480.3***				480	0	0	264	40
691.60	2.50	4.10	22		31.7	62.8	***545.6***				546	0	0	300	42
689.60	2.00	6.30	27		27.3	96.5	***545.3***				545	0	0	300	44
687.10	2.50	4.50	27		34.1	68.9	***579.4***				579	0	0	319	47
684.60	2.50	4.50	27		34.1	68.9	***613.5***				~~613~~	~~0~~	~~0~~	~~337~~	~~49~~
683.60	1.00	4.50	27		13.6	68.9	***756.0***				~~756~~	~~0~~	~~0~~	~~416~~	~~50~~
681.10	2.50		30	Hard Till	17.2	197.8	***773.2***				~~773~~	~~0~~	~~0~~	~~425~~	~~53~~
678.60	2.50		30	Hard Till	17.2	197.8	***646.2***				~~646~~	~~0~~	~~0~~	~~355~~	~~55~~
677.10	1.50	3.50	13		16.8	53.6	***663.1***				~~663~~	~~0~~	~~0~~	~~365~~	~~57~~
674.60	2.50	3.50	13		28.1	53.6	***691.1***				~~691~~	~~0~~	~~0~~	~~380~~	~~59~~
672.10	2.50	3.50	13		28.1	53.6	***719.2***				~~719~~	~~0~~	~~0~~	~~396~~	~~62~~
669.60	2.50	3.50	13			53.6									

Pile Design Table for Pier 1 utilizing Boring #1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls		
183	100	34
277	152	35
333	183	36
360	198	37
445	245	37
480	264	40
545	300	44
579	319	47
Metal Shell 16"Φ w/.375" walls		
183	100	34
277	152	35
333	183	36
360	198	37
445	245	37
480	264	40
545	300	44
579	319	47
613	337	49
Metal Shell 14"Φ w/.25" walls		
242	133	35
291	160	36
315	173	37
383	211	37
Metal Shell 14"Φ w/.312" walls		
242	133	35
291	160	36
315	173	37
383	211	37
413	227	40
467	257	42
470	258	44
499	275	47
Steel HP 8 X 36		
210	115	62
Steel HP 10 X 42		
249	137	59
263	145	62

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
255	140	59
269	148	62
Steel HP 12 X 53		
259	142	47
279	154	49
280	154	55
291	160	57
308	169	59
325	178	62
Steel HP 12 X 63		
262	144	47
282	155	49
283	156	55
293	161	57
311	171	59
328	180	62
Steel HP 12 X 74		
245	135	44
266	146	47
287	158	49
287	158	55
298	164	57
315	173	59
332	183	62
Steel HP 12 X 84		
248	137	44
270	148	47
291	160	49
291	160	55
302	166	57
320	176	59
337	185	62

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
246	135	40
294	162	42
296	163	44
320	176	47
343	188	55
355	195	57
375	206	59
395	217	62
Steel HP 14 X 89		
249	137	40
299	165	42
300	165	44
325	178	47
347	191	55
359	198	57
380	209	59
400	220	62
Steel HP 14 X 102		
253	139	40
303	166	42
304	167	44
329	181	47
351	193	55
364	200	57
384	211	59
405	223	62
Steel HP 14 X 117		
256	141	40
308	169	42
308	169	44
333	183	47
356	196	55
368	203	57
389	214	59
410	225	62
Precast 14"x 14"		
204	112	34
Timber Pile		
151	83	33

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 732.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 709.90 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 709.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1785 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 37.10 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 384.91 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 144.34 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.375" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 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
704 KIPS	**561** KIPS	**309** KIPS	**50** 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.)
707.40	2.50	5.30	17		34.1		***104.5***				105	0	0	57	25
704.90	2.50	4.60	14		34.1	70.5	***130.9***				131	0	0	72	28
702.40	2.50	4.10	21		31.7	62.8	***469.0***				469	0	0	258	30
699.90	2.50		56	Sandy Gravel	153.3	369.2	***317.4***				317	0	0	175	33
697.40	2.50	4.20	13		32.3	64.3	***378.8***				379	0	0	208	35
694.90	2.50	6.10	9		34.1	93.4	***412.9***				413	0	0	227	38
692.40	2.50	6.10	13		34.1	93.4	***447.0***				447	0	0	246	40
689.90	2.50	6.10	18		34.1	93.4	***470.3***				470	0	0	259	43
687.40	2.50	5.40	15		34.1	82.7	***502.9***				503	0	0	277	45
684.90	2.50	5.30	14		34.1	81.2	***533.9***				534	0	0	294	48
683.90	1.00	5.10	16		13.6	78.1	***547.5***				548	0	0	301	49
683.40	0.50	5.10	16		6.8	78.1	***554.3***				554	0	0	305	49
682.90	0.50	5.10	16		6.8	78.1	***561.1***				561	0	0	309	50
682.40	0.50	5.10	16		6.8	78.1	***815.1***				~~815~~	~~0~~	~~0~~	~~448~~	~~50~~
679.90	2.50		37	Sandy Gravel	63.2	325.2	***895.8***				~~896~~	~~0~~	~~0~~	~~493~~	~~53~~
677.90	2.00		39	Sandy Gravel	56.3	342.8	***1040.1***				~~1040~~	~~0~~	~~0~~	~~572~~	~~55~~
675.40	2.50		49	Sandy Gravel		430.7									

Pile Design Table for Pier 2 utilizing Boring #2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls		
131	72	28
317	175	33
379	208	35
413	227	38
447	246	40
470	259	43
503	277	45
534	294	48
548	301	49
554	305	49
561	309	50
Metal Shell 16"Φ w/.375" walls		
131	72	28
317	175	33
379	208	35
413	227	38
447	246	40
470	259	43
503	277	45
534	294	48
548	301	49
554	305	49
561	309	50
Metal Shell 14"Φ w/.25" walls		
108	59	28
271	149	33
321	177	35
351	193	38
381	209	40
402	221	43
Metal Shell 14"Φ w/.312" walls		
108	59	28
271	149	33
321	177	35
351	193	38
381	209	40
402	221	43
431	237	45
459	252	48
471	259	49
476	262	49
482	265	50
Steel HP 8 X 36		
228	126	55
Steel HP 10 X 42		
256	141	50
269	148	53
295	162	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
262	144	50
276	152	53
302	166	55
Steel HP 12 X 53		
245	135	43
264	145	45
282	155	48
290	160	49
294	162	49
298	164	50
323	178	50
340	187	53
375	206	55
Steel HP 12 X 63		
248	136	43
267	147	45
285	157	48
293	161	49
297	164	49
302	166	50
326	180	50
343	189	53
379	208	55
Steel HP 12 X 74		
252	138	43
271	149	45
289	159	48
298	164	49
302	166	49
306	168	50
332	182	50
349	192	53
385	212	55
Steel HP 12 X 84		
256	141	43
276	152	45
294	162	48
302	166	49
307	169	49
311	171	50
337	185	50
354	195	53
392	215	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
240	132	38
276	152	40
306	168	43
329	181	45
349	192	48
359	198	49
364	200	49
369	203	50
402	221	50
423	233	53
466	256	55
Steel HP 14 X 89		
245	135	38
281	155	40
311	171	43
333	183	45
354	195	48
364	200	49
369	203	49
374	206	50
408	224	50
429	236	53
474	261	55
Steel HP 14 X 102		
248	136	38
284	156	40
315	173	43
338	186	45
359	197	48
369	203	49
374	206	49
379	208	50
414	228	50
435	239	53
479	263	55
Steel HP 14 X 117		
252	139	38
289	159	40
320	176	43
343	189	45
364	200	48
374	206	49
379	208	49
384	211	50
420	231	50
441	243	53
486	267	55
Precast 14"x 14"		
137	75	28
Timber Pile		
80	44	28

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== North Abutment
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 732.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 730.50 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 ========== 830 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 37.10 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 178.98 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 67.12 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 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
588 KIPS	**331** KIPS	**182** KIPS	**28** 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.)
729.90	0.60	1.50	4		3.8		***26.8***				27	0	0	15	3
727.40	2.50	1.50	4		15.8	23.0	***50.2***				50	0	0	28	5
724.90	2.50	2.00	5		19.1	30.6	***69.3***				69	0	0	38	8
722.40	2.50	2.00	7		19.1	30.6	***96.0***				96	0	0	53	10
719.90	2.50	2.50	8		22.1	38.3	***170.2***				170	0	0	94	13
717.40	2.50	5.90	20		34.1	90.4	***242.5***				243	0	0	133	15
714.40	3.00	8.40	27		40.9	128.6	***365.7***				366	0	0	201	18
711.90	2.50		32	Hard Till	18.4	211.0	***295.7***				296	0	0	163	21
709.40	2.50	8.00	24		34.1	122.5	***288.5***				288	0	0	159	23
707.40	2.00	5.30	20		27.3	81.2	***305.0***				305	0	0	168	25
704.90	2.50	4.60	19		34.1	70.5	***331.4***				331	0	0	182	28
702.40	2.50	4.10	19		31.7	62.8	***792.5***				~~793~~	~~0~~	~~0~~	~~436~~	~~30~~
699.90	2.50		56	Sandy Gravel	153.3	492.2	***517.9***				518	0	0	285	33
697.40	2.50	4.20	20		32.3	64.3	***579.3***				579	0	0	319	35
694.90	2.50	6.10	24		34.1	93.4	***613.4***				~~613~~	~~0~~	~~0~~	~~337~~	~~38~~
692.40	2.50	6.10	25		34.1	93.4	***647.4***				~~647~~	~~0~~	~~0~~	~~356~~	~~40~~
689.90	2.50	6.10	25		34.1	93.4	***670.8***				~~671~~	~~0~~	~~0~~	~~369~~	~~43~~
687.40	2.50	5.40	21		34.1	82.7	***703.3***				~~703~~	~~0~~	~~0~~	~~387~~	~~45~~
684.90	2.50	5.30	15		34.1	81.2	***734.4***				~~734~~	~~0~~	~~0~~	~~404~~	~~48~~
682.40	2.50	5.10	19		34.1	78.1	***1015.5***				~~1016~~	~~0~~	~~0~~	~~559~~	~~50~~
679.90	2.50		37	Sandy Gravel	63.2	325.2	***1096.3***				~~1096~~	~~0~~	~~0~~	~~603~~	~~53~~
677.40	2.50		39	Sandy Gravel	70.4	342.8	***1254.6***				~~1255~~	~~0~~	~~0~~	~~690~~	~~55~~
675.40	2.00		49	Sandy Gravel		430.7									

Pile Design Table for North Abutment utilizing Boring #2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls		
96	53	10
170	94	13
243	133	15
288	159	23
305	168	25
331	182	28
Metal Shell 16"Φ w/.375" walls		
96	53	10
170	94	13
243	133	15
288	159	23
305	168	25
331	182	28
Metal Shell 14"Φ w/.25" walls		
80	44	10
139	76	13
198	109	15
244	134	23
259	143	25
283	156	28
Metal Shell 14"Φ w/.312" walls		
80	44	10
139	76	13
198	109	15
244	134	23
259	143	25
283	156	28
Steel HP 8 X 36		
120	66	25
131	72	28
164	90	33
190	104	35
204	112	38
218	120	40
227	125	43
241	132	45
253	139	48
277	152	50
Steel HP 10 X 42		
119	65	18
129	71	21
148	82	23
155	86	25
168	92	28
209	115	33
243	134	35
260	143	38
277	153	40
288	158	43
304	167	45
319	176	48

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
122	67	18
133	73	21
152	84	23
159	88	25
172	95	28
214	117	33
249	137	35
266	147	38
284	156	40
295	162	43
311	171	45
327	180	48
359	197	50
372	205	53
401	221	55
Steel HP 12 X 53		
113	62	15
143	79	18
154	85	21
180	99	23
198	109	25
211	116	28
261	143	33
306	168	35
327	180	38
348	191	40
358	197	43
378	208	45
396	218	48
Steel HP 12 X 63		
117	64	15
147	81	18
158	87	21
184	101	23
200	110	25
214	117	28
263	145	33
310	170	35
330	182	38
351	193	40
362	199	43
381	210	45
399	220	48
441	243	50
458	252	53
496	273	55
Steel HP 12 X 74		
120	66	15
149	82	18
162	89	21
187	103	23
203	112	25
217	119	28
267	147	33
315	173	35
336	185	38
357	196	40
368	202	43
387	213	45
405	223	48
448	246	50
465	256	53
504	277	55
Steel HP 12 X 84		
86	48	13
123	68	15
150	83	18
165	91	21
189	104	23
206	114	25
220	121	28
271	149	33
319	176	35
341	187	38
362	199	40
373	205	43
393	216	45
411	226	48
454	250	50
472	260	53
512	281	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
97	53	13
139	76	15
174	95	18
187	103	21
218	120	23
246	135	25
263	144	28
321	177	33
381	210	35
406	223	38
430	237	40
441	243	43
463	255	45
484	266	48
537	295	50
558	307	53
Steel HP 14 X 89		
101	55	13
143	79	15
177	97	18
192	106	21
222	122	23
250	137	25
266	146	28
326	179	33
387	213	35
411	226	38
436	240	40
447	246	43
469	258	45
490	270	48
544	299	50
565	311	53
616	339	55
Steel HP 14 X 102		
103	57	13
147	81	15
179	98	18
196	108	21
225	124	23
252	139	25
270	148	28
330	181	33
392	216	35
417	229	38
442	243	40
453	249	43
476	262	45
496	273	48
551	303	50
573	315	53
625	343	55
Steel HP 14 X 117		
106	58	13
152	83	15
182	100	18
201	111	21
229	126	23
256	141	25
274	151	28
334	184	33
397	219	35
423	232	38
448	246	40
459	252	43
482	265	45
503	277	48
558	307	50
580	319	53
633	348	55
Precast 14"x 14"		
102	56	10
177	97	13
252	139	15
Timber Pile		
97	53	13
138	76	15