Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 3/7/2023	**Proposed SN:** 051-0077	**Route:**	FAP 327
Revised Date:	**Existing SN:** 051-0009	**Section:**	(3,2B) B-1
Geotechnical Engineer: BBS FGU / Doris D. Gonzalez		**County:**	Lawrence
Structural Engineer: Justin T. Belue		**Contract:**	74443

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The existing structure is a continuous three-span reinforced concrete haunch T-beam bridge, with stub abutments and pile bent piers, supported by precast concrete piles. The existing structure will be removed and replaced by a three-span bridge using W33 beams, with integral abutments and solid wall bent piers, both supported by driven H-piles. Traffic is to be maintained utilizing stage construction. The estimated factored loads at the substructures are 858 kips at the Abutments and 1535 kips at the Piers.

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): Borings B-1 and B-2 were advanced at the proposed East and West Abutments locations, respectively. Boring B-3 was advanced close to Pier 2, in November 2022. Based on the information gathered in the borings, as well as using linear interpolation at Pier 1, the estimated top of rock elevations at the Piers are equal to 399.8 and 400.8 at Piers 1 and 2, respectively.

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: According to the Plan and Profile sheet, less than 1 ft of fill is expected. The expected settlement is negligible. No further testing or ground improvement will be necessary.

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: According to the Bridge Condition Report (BCR) dated January 5, 2021, no rotation or movement was observed at the abutments and wingwalls of the existing bridge. Also, no significant fills or cuts are expected; therefore, we can conclude that slope stability is not a concern.

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: Based on the soils encountered, the soil profile consists mainly of silty and sandy loams with some interbedded layers of silty clay; therefore, we recommend no reductions be applied to the scour depths.

Event / Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	446.07	409.9	410.0	444.77	5
Q200	446.07	408.3	408.4	444.77	
Design	446.07	409.9	410.0	444.77	
Check	446.07	408.3	408.4	444.77	

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:
Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.235
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.544
Soil Site Class = D

The boring logs show some layers of potentially liquefiable soil layers at the Abutments and the Piers. Liquefaction losses have been applied to the Abutments' estimated pile capacities (for the Seismic case). No losses were applied at the Piers since no liquefaction induced downdrag is expected at these locations and the axial and lateral resistances will be provided by the rock sockets. See attached pile tables.

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: The proposed integral abutments supported by H-piles are feasible. Pile tables are included in the attachment section. Due to the large scour depths and estimated top of rock elevations, driven piles at the piers would have very little embedment above rock. For this reason, we recommend H-piles socketed into rock. If these are not structurally feasible, drilled shafts, are also a geotechnically feasible alternative. The estimated nominal unit side and tip resistances are shown in the table below. The corresponding resistance factors are 0.50 for tip and 0.55 for side. We recommend a minimum socket depth of 6 ft and a socket diameter of 24 in for pile sections HP12 and HP14. Socket depths, diameters and pile sections will be determined during final design. We recommend one test pile at each abutment and that abutment piles be driven with pile shoes.

Rock Socket / Drilled Shaft Nominal Unit Resistances	
Side (ksf)	Tip (ksf)
27	325

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: The Estimated Water Surface Elevation is equal to 436.8 ft, which indicates water is expected above the bottom of encasement; however, EWSE is below the existing groundline. Based on this, there is no need for cofferdams at the piers.

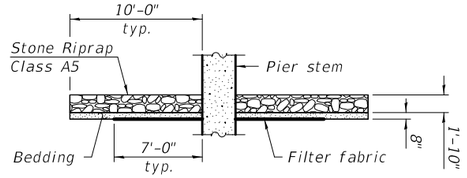
Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: Traffic will be maintained by utilizing stage construction and due to the soft soils, anticipated retained heights, and proximity to rock, Temporary Sheet Piling is not feasible. Temporary Soil Retention System should be used at the abutments instead.

Attachments

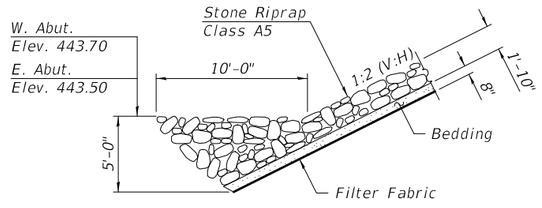
Benchmarks: BM 391: Chiseled square on wingwall at southwest corner of S.N. 051-0009
Station 1071+05, 18.0' Right of ℄ F.A.P. 327, Elevation = 453.87

Existing Structure: S.N. 051-0009 was originally constructed in 1946 under F.A. Route 13, Section 3-2-B. In 1986, structural repairs were made under F.A. 99 (US 50), Section 3-2B-1. The structure is a continuous three-span reinforced concrete haunch T-beam bridge with reinforced concrete stub abutments and reinforced concrete pile bent piers, both supported on precast concrete piles. The structure has no skew. Existing structure will be removed and replaced. Traffic is to be maintained utilizing stage construction.

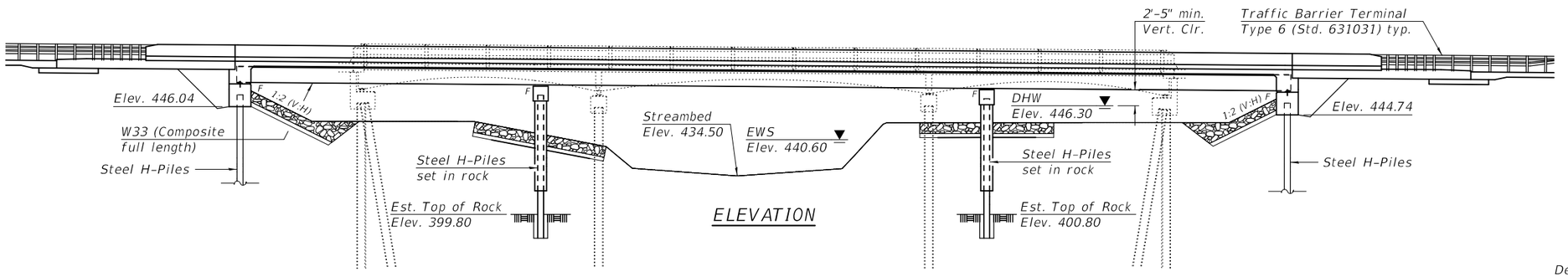
No salvage.



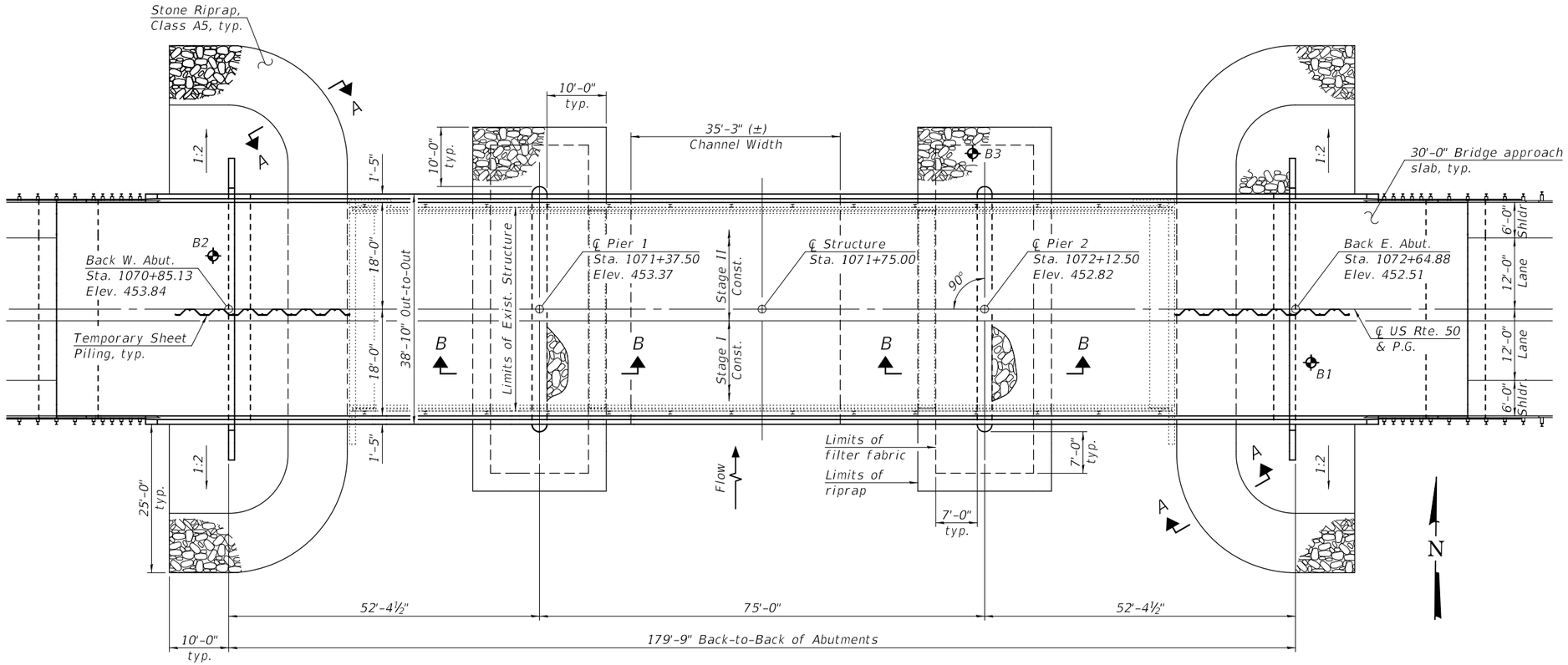
SECTION B-B



SECTION A-A



ELEVATION



PLAN

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

DESIGN STRESSES

FIELD UNITS

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

HIGHWAY CLASSIFICATION

F.A.P. Rte. 327 - US 50
Functional Class: Other Principal Arterial
ADT: 4500 (2024); 5400 (2044)
ADTT: 725 (2024); 870 (2044)
DHV: 568 (2044)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 51:49

LOADING HL-93

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

SEISMIC DATA

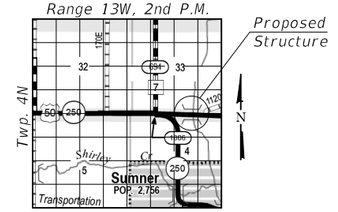
Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.235g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.544g
Soil Site Class = D

Note:
All structural steel shall be galvanized.

APPROVED

MARCH 02, 2023

AS A BASIS FOR
PREPARATION OF DETAILED PLANS



LOCATION SKETCH

GENERAL PLAN & ELEVATION
U.S 50 OVER MUDDY CREEK
F.A.P. ROUTE 327 - SEC. (3,2B)B-1
LAWRENCE COUNTY
STA. 1071+75
STRUCTURE NO. 051-0077

DESIGNED	-	JUSTIN T. BELUE	
CHECKED	-	JOSUE ORTIZ-VARELA	
DRAWN	-	ANTHONY J. NOVELLO	
CHECKED	-	JTB / JOV / RJC	

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
327	(3,2B)B-1	LAWRENCE	__	---
		CONTRACT NO. 74443		
		ILLINOIS	FED. AID PROJECT	

MODEL: 051007-74443-TSL-001
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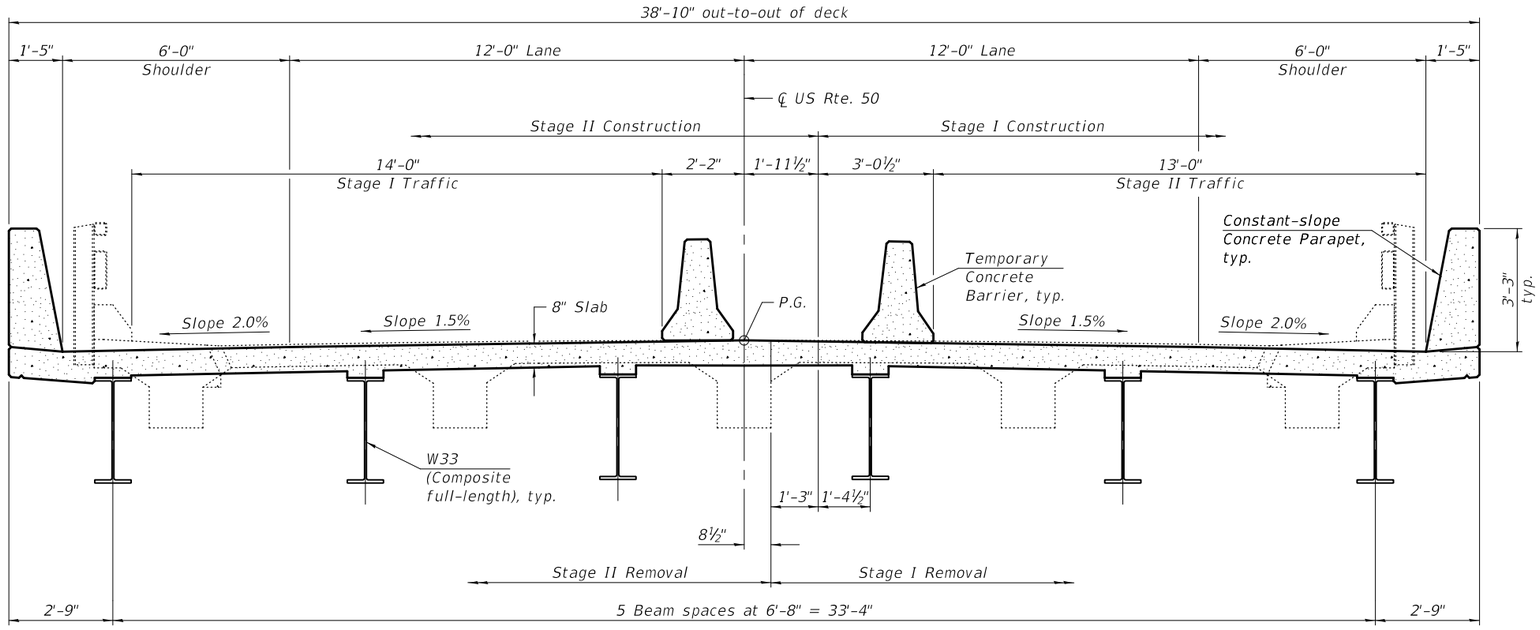
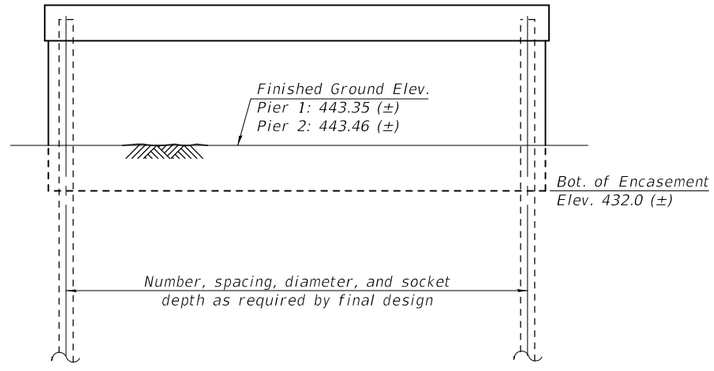
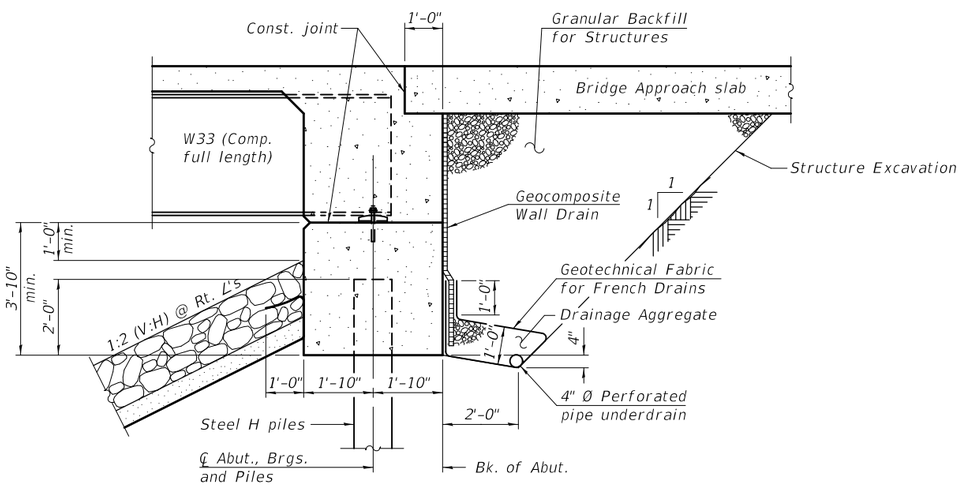


CROSS SECTION
(Looking East)



PIER SKETCH



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

WATERWAY INFORMATION TABLE

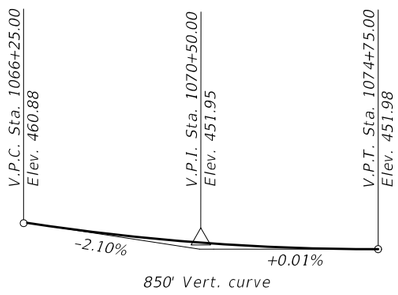
Existing Overtopping Elev. = 451.28 @ Sta. 75+08.75
Drainage Area = 19.97 sq. mi. Proposed Overtopping Elev. = 451.30 @ Sta. 75+50.00

Flood Event	Freq. Yr.	Q C.F.S.	Opening Ft² Exist.	Opening Ft² Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	3550	533	657	445.4	1.9	0.8	447.3	446.2
Design	50	5750	619	792	446.3	2.5	1.4	448.8	447.7
Base	100	6740	662	855	446.7	2.8	1.6	449.5	448.3
Scour Design Check	200	7400	676	874	446.8	3.0	1.8	449.8	448.6
Max. Calc.	500	9190	741	964	447.3	3.6	2.3	450.9	449.6

10 Year Velocity through Existing Bridge = 5.50 fps
10 Year Velocity through Proposed Bridge = 4.14 fps

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	446.04	409.9	410.0	444.74	
Q200	446.04	408.3	408.4	444.74	5
Design	446.04	409.9	410.0	444.74	
Check	446.04	408.3	408.4	444.74	



PROFILE GRADE
(along ℄ of FAP 327 (US 50))

APPROVED

MARCH 02, 2023

AS A BASIS FOR PREPARATION OF DETAILED PLANS

DETAILS
U.S 50 OVER MUDDY CREEK
F.A.P. ROUTE 327 - SEC. (3,2B)B-1
LAWRENCE COUNTY
STA. 1071+75
STRUCTURE NO. 051-0077

DESIGNED -	JUSTIN T. BELUE
CHECKED -	JOSUE ORTIZ-VARELA
DRAWN -	ANTHONY J. NOVELLO
CHECKED -	JTB / JOV / RJC

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
327	(3,2B)B-1	LAWRENCE	__	---
		CONTRACT NO. 74443		
	ILLINOIS FED. AID PROJECT			

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Pile Design Tables

East Abutment

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	335	184	35
Steel HP 10 X 57			
	454	250	37
Steel HP 12 X 53			
	418	230	35
Steel HP 12 X 63			
	497	273	36
Steel HP 12 X 74			
	589	324	37
Steel HP 12 X 84			
	664	365	37
Steel HP 14 X 73			
	578	318	36
Steel HP 14 X 89			
	705	388	37
Steel HP 14 X 102			
	810	446	37
Steel HP 14 X 117			
	929	511	38

West Abutment

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	335	184	54
Steel HP 10 X 57			
	454	250	56
Steel HP 12 X 53			
	418	230	53
Steel HP 12 X 63			
	497	273	55
Steel HP 12 X 74			
	589	324	57
Steel HP 12 X 84			
	664	365	58
Steel HP 14 X 73			
	578	318	54
Steel HP 14 X 89			
	705	388	56
Steel HP 14 X 102			
	810	446	58
Steel HP 14 X 117			
	929	511	59

Pile Design Tables (Liquefaction)

East Abutment

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	335	293	35
Steel HP 10 X 57			
	454	411	37
Steel HP 12 X 53			
	418	368	35
Steel HP 12 X 63			
	497	446	36
Steel HP 12 X 74			
	589	538	37
Steel HP 12 X 84			
	664	612	37
Steel HP 14 X 73			
	578	518	36
Steel HP 14 X 89			
	705	645	37
Steel HP 14 X 102			
	810	749	37
Steel HP 14 X 117			
	929	868	38

West Abutment

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	335	214	54
Steel HP 10 X 57			
	454	331	56
Steel HP 12 X 53			
	418	273	53
Steel HP 12 X 63			
	497	351	55
Steel HP 12 X 74			
	589	441	57
Steel HP 12 X 84			
	664	514	58
Steel HP 14 X 73			
	578	406	54
Steel HP 14 X 89			
	705	531	56
Steel HP 14 X 102			
	810	634	58
Steel HP 14 X 117			
	929	751	59

Illinois Department of Transportation
Division of Highways
IDOT D7

SOIL BORING LOG

Date 8/3/21

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731897, **Longitude** W 87.858881

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 1 East Abutment
Station 72+67.5
Offset 9.0 ft RT
Ground Surface Elev. 452.25 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft
Groundwater Elev.:
First Encounter 435.3 ft
Upon Completion Washed ft
After 72 **Hrs.** 440.3 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				5-1/2" Asphalt over 10" Concrete over 6" Aggregate
450.25				
				Grey, SILTY CLAY
				Stiff, moist
-5	WH			
	1 3	1.7 B	16	
445.25				
	2			Medium, moist, grey, SILTY LOAM
	8 7	0.5 B	17	
				Very soft
-10	1			
	1 1	0.3 B	22	
	WH			
	1 1	0.1 B	24	
				Wet
-15	WH			
	WH 1	0.0 B	17	
	WH			
	WH 1	0.0 B	14	
-20	WH			
431.75				
	1 2	1.7 B	20	Stiff, moist, brown and grey, SILTY CLAY
	WH			
	1 2	1.3 B	16	*Grey mottled brown*
427.25 -25	1			
	1 2	0.2 B	31	Very soft, wet, grey, SILTY LOAM
	1			
	3 2	0.2 B	30	
-30	1			
421.55	2 4	0.1 B	16	
				Very soft, wet, grey, SANDY LOAM
417.75				
-35	WH			Medium, moist, grey, fine-grained, SAND
	3 9		22	*With 3/4" angular gravel*
				14.2% passing #200 Sieve
414.25				
				Very dense, moist, grey, SANDSTONE
412.25 -40	50 6"			

SOIL BORING 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 9/21/21

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
IDOT D7

SOIL BORING LOG

Date 8/3/21

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731897, **Longitude** W 87.858881

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 1 East Abutment
Station 72+67.5
Offset 9.0 ft RT
Ground Surface Elev. 452.25 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft

Groundwater Elev.:
First Encounter 435.3 ft ▼
Upon Completion Washed ft
After 72 **Hrs.** 440.3 ft ▽

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very dense, moist, grey, SANDSTONE	411.25	50 1-9/16"		21
Borehole continued with rock coring.		50 7/16"		
	-45			
	-50			
	-55			
	-60			

SOIL BORING 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 9/21/21

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
IDOT D7

ROCK CORE LOG

Date 8/3/21

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731897, **Longitude** W 87.858881

COUNTY Lawrence **CORING METHOD** Rotary, surf set diamond bit

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner
Core Diameter 2.1 **in**
Top of Rock Elev. 414.25 **ft**
Begin Core Elev. 411.25 **ft**

BORING NO. 1 East Abutment
Station 72+67.5
Offset 9.0 ft RT
Ground Surface Elev. 452.25 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Soft, grey, SANDSTONE	411.25		1	15	15	1	
	407.25	-45					
Soft, grey, SANDSTONE			2	63	12	3	135.8
	403.60						
Grey, SHALE							
	402.25	-50					
Benchmark: BM 391 Chiseled square on the Southwest wingwall of SN 051-0009, Sta. 70+90, 18' RT, Elevation 453.873 ft. End of Boring		-55					
		-60					

ROCK CORE 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 9/21/21

Color pictures of the cores Available on request
Cores will be stored for examination until 8/4/2026
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation
Division of Highways
IDOT D7

SOIL BORING LOG

Date 8/2/21

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731897, **Longitude** W 87.858881

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 2 West Abutment
Station 70+82.5
Offset 9.0 ft LT
Ground Surface Elev. 453.50 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft
Groundwater Elev.:
First Encounter 438.5 ft ▼
Upon Completion Washed ft
After 96 **Hrs.** 441.8 ft ▽

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
5-1/2" Asphalt over 10" Concrete over 6" Aggregate				
451.70				
Brown, CLAY				
Stiff, moist	-5	1		
		1 1	1.9 B	11
Brown and grey marbled		2		
		2 2	1.2 B	14
444.00				
Stiff, moist, grey, SANDY CLAY	-10	2		
442.90		2 2	1.1 B	10
Stiff, moist, grey, SANDY LOAM				
441.50 ▽				
Medium, moist, grey, SILTY CLAY		WH		
		1 1	0.7 B	16
439.00				
Soft, wet, grey, SANDY LOAM	-15 ▼	WH		
		1 1	0.3 B	23
Very soft		WH		
		WH 1	0.2 B	11
434.00				
Stiff, moist, grey, SILTY LOAM	-20	WH		
433.50				
431.50				
Stiff, moist, grey, SILTY CLAY		WH		
		1 1	1.4 B	18
	-25	WH		
		1 2	1.0 B	9
Medium		WH		
		1 2	0.7 B	18
424.00				
Stiff, moist, grey, LOAM	-30	WH		
		2 3	1.7 B	19
419.00				
Very soft, wet, grey, SANDY LOAM	-35	WH		
11.3% passing #200 Sieve		WH 1	0.1 B	24
414.00				
413.50	-40	5		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
IDOT D7

SOIL BORING LOG

Date 8/2/21

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731897, **Longitude** W 87.858881

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 2 West Abutment
Station 70+82.5
Offset 9.0 ft LT
Ground Surface Elev. 453.50 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft

Groundwater Elev.:
First Encounter 438.5 ft ▼
Upon Completion Washed ft
After 96 **Hrs.** 441.8 ft ▽

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium, moist, grey, fine grained, SAND *24.6% passing #200 Sieve*		7 7		19
	-45	5		
		9 11		23
404.00				
Stiff, moist, dark brown, CLAY with Shale fragments	-50	5		
		10 20	1.4 S	16
399.00				
Hard, moist, grey, CLAY SHALE	-55			
				5
397.50				
Benchmark: BM 391 Chiseled square on the Southwest wingwall of SN 051-0009, Sta. 70+90, 18' RT, Elevation 453.873 ft. End of Boring				
	-60			

SOIL BORING 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 9/21/21

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/10/22

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731941, **Longitude** W 87.859084

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 3 East Pier
Station 72+11.5
Offset 27.0 ft LT
Ground Surface Elev. 445.27 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft

Groundwater Elev.:
First Encounter 435.8 ft ▼
Upon Completion Washed ft
After 96 **Hrs.** 436.3 ft ▽

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Brown, SANDY LOAM
	1			*Very soft, moist*
	2 3	0.2 P	13	
-5	1			
	3 2	0.2 P	18	
438.27				
	1			Very soft, moist, brown, SILTY LOAM
	1 2	0.2 P	24	
-10	WH			*Wet, grey*
	WH 1	0.3 B	27	
	WH			*With sand*
	1 1	0.2 B	24	
-15	WH			
	WH 1	0.3 B	33	
	WH			
	WH 1	0.3 B	26	
425.27 -20	WH			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	WH 1	0.6 B	27	Medium, moist, grey, SILTY LOAM
	WH			
	2 3	0.8 B	16	
-25	WH			
	1 2	0.7 B	25	
	WH			
	WH 1	0.6 B	26	
				Very soft, wet
-30	WH			
	WH 1	0.2 B	28	
-35	WH			
	WH 1	0.2 B	25	
405.27 -40	WH			

SOIL BORING 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 12/7/22

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/10/22

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731941, **Longitude** W 87.859084

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER** Auto ETR = 91.8% @ 57.4 bpm

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 3 East Pier
Station 72+11.5
Offset 27.0 ft LT
Ground Surface Elev. 445.27 ft

Surface Water Elev. 436.46 ft
Stream Bed Elev. 433.81 ft

Groundwater Elev.:
First Encounter 435.8 ft ▼
Upon Completion Washed ft
After 96 **Hrs.** 436.3 ft ▽

Material	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Loose, wet, grey, fine grain, SAND		1 5	0.2 B	23
	400.77			
Very dense, moist, grey, SHALE	-45	50/3-1/4"		
		50/1-3/8"	NT	6
	399.27	50/0-3/4"	NT	
Borehole continued with rock coring.	-50			
	-55			
	-60			

SOIL BORING 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 12/7/22

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated) The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206), WH-Weight of Hammer, NT-Not Tested.

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 11/10/22

ROUTE FAP 327 (US 50) **DESCRIPTION** US 50 over Muddy Creek **LOGGED BY** E. Sandschafer

SECTION (3,2B)B-1 **LOCATION** SW 1/4 of SE1/4, **SEC.** 33, **TWP.** 4N, **RNG.** 13W, 2nd **PM**,
Latitude N 38.731941, **Longitude** W 87.859084

COUNTY Lawrence **CORING METHOD** Rotary, surf set diamond bit

STRUCT. NO. 051-0009 (Existing) 051-0077 (Proposed)
Station 71+75

BORING NO. 3 East Pier
Station 72+11.5
Offset 27.0 ft LT
Ground Surface Elev. 445.27 ft

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner
Core Diameter 2.1 in
Top of Rock Elev. 399.27 ft
Begin Core Elev. 399.27 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Grey, Sandy Clay SHALE	399.27		1	64	53	1.7	43.7 tsf 87.4 ksf
	395.27	-50					
Grey, Sandy Clay SHALE			2	97	72	1.9	430.9 tsf 861.7 ksf
	390.27	-55					
Grey, Sandy Clay SHALE			3	92	75	2.4	204.2 tsf 408.4 ksf
	385.27	-60					
Benchmark: BM 391 Chiseled square on the Southwest wingwall of SN 051-0009, Sta. 70+90, 18' RT, Elevation 453.873 ft. End of Boring		-65					

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

BBS, form 138 (Rev. 8-99)

ROCK CORE 051-0077 SOIL ROCK 2021.GPJ IL_DOT.GDT 12/7/22

Field Rock Core Log a.xls

Field Rock Core Log

Date: 11-10-22

Structure # : 051-0009

Boring # : B3

Rock Core # : B3 C1

Depth: 45'

GREY SANDY CLAY Shale

0.27' OJ
0.44 OJ
0.90' OJ
1.46' OJ
1.70' OJ
2.20 OJ
2.65 OJ
CORE TO TEST
3.20'

RQD
48
55'
10
15
25
1.63

Depth: 50'

Core Time: 8:37

Recovery: 6.1/8

RQD: 52.6%

Rock Core # : B3 C2

Depth: 50'

0.26 OJ
0.71
0.81
1.00 OJ
1.20 OJ
1.30 OJ
2.93 OJ
3.35 OJ
3.83 OJ
4.35' CORE TO TEST
4.84'

Grey SANDY CLAY Shale

RQD.
0.55'
1.65
0.41
0.95
3.56

Depth: 55'

Core Time: 9:40

Recovery: 96.8%

RQD: 71.2%

Logged By: Eric Sandschafer

Field Rock Core Log a.xls

Field Rock Core Log

Date: 11-10-22

Structure # : 051-0009

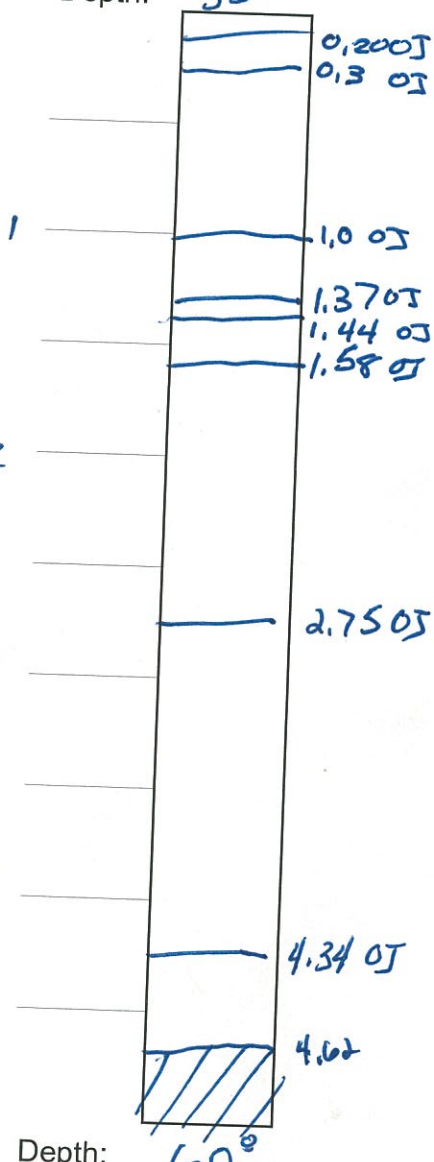
Boring # : B3 E. PIER

Rock Core # : C3

Rock Core # :

Depth: 55'

Depth: 60'



Grey Sandy Clay Shale

RQD

8.25
4.0
14.0
10.25
8.25
44.75

Depth: 60'

Depth: 65'

Core Time: 12:00

Core Time:

Recovery: 92%

Recovery:

RQD: 74.6

RQD:

Logged By: Eric Sandschafer

Illinois Department of Transportation

Memorandum

To:	Terry Stephenson	Attn:	Scott Kassel
From:	Heather Shoup	By:	Kurt Schmuck (CBM)
Subject:	Rock Core Compression Testing		
Date:	December 12, 2022		

County: Lawrence
Route: US-50
SN: 051-0009 over Muddy Creek
Loc. 0.5 mile N. of Sumner
Section: (3-2-B)
Job # : D-97-023-10
CN: 74443
Date: 12/12/2022

Unconfined Compressive Strength of Intact Rock Cores
ASTM D-7012 Method C

All samples trimmed to maintain a length-to-diameter ratio of 2.0 to 2.5. ASTM D-4543

Stress Rate @ 20 psi/sec. (unless otherwise noted)
* Denotes a Strain Rate of 1% per minute for soft materials.

Boring: B-3 E. Pier
Station: 33 ft. W of E. Abut.

Sample	Depth (ft.)	Dia. (in.)	Area (in^2.)	Length (in.)	Weight (grams)	As Tested Moist. %	Unit Weight (lbs / ft^3) Wet	Unit Weight (lbs / ft^3) Dry	Compressive Strength Data: Load (lbs)	Stress (psi)	Stress (tsf)	Stress (ksf)	Deflec. (in.)
---	---	---	---	---	---	---	---	---	---	---	---	---	---
B3C1*	47.6 - 4802	2.053	3.310	4.052	531.6	5.32	151.0	143.4	2010	607	43.7	87.4	n/a
B3C2	54.4 - 54.8	2.053	3.310	3.993	549.2	2.72	158.3	154.1	19810	5984	430.9	861.7	n/a
B3C3	58-6 - 59.2	2.052	3.307	4.204	568.2	4.95	155.7	148.3	9380	2836	204.2	408.4	n/a

EXHIBIT 15

SCOUR SUMMARY

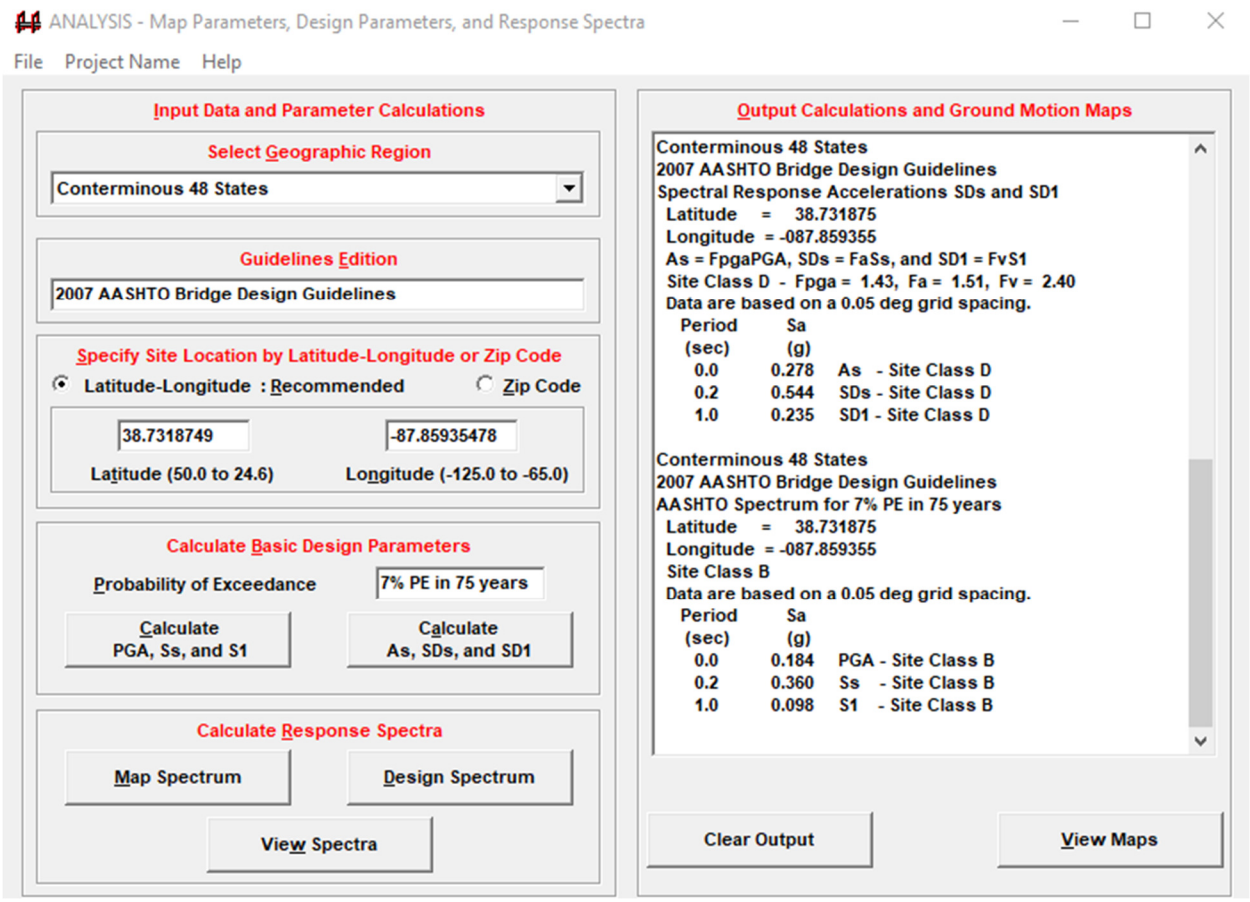
HEC-18 Hand Calculations

A. EXISTING CONDITION

Storm Frequency (Year)	Contraction Scour (CS)	Pier #1 Scour (PS)	Pier #2 Scour (PS)	Abutment Scour (AS) using HIRE or Froelich's Method		Total Pier #1 Scour (TPS) (=CS + PS)	Total Pier #2 Scour (TPS) (=CS + PS)	Total Abutment Scour (TAS) HIRE or Froelich Method	
				Left (ASL)	Right (ASR)			Left (TAS_R) (= CS + ASR)	Right (TAS_R) (= CS + ASR)
10	19.32	3.01	2.59	9.44	7.79	22.34	21.92	28.76	27.11
50	29.05	3.58	3.22	13.73	11.83	32.64	32.27	42.78	40.89
100	33.04	3.78	3.46	15.42	13.38	36.82	36.50	48.47	46.42
200	35.69	3.90	3.60	16.59	14.30	39.59	39.29	52.28	49.99
500	46.66	4.18	3.95	19.51	16.46	50.84	50.62	66.17	63.12

B. PROPOSED CONDITION

Storm Frequency (Year)	Contraction Scour (CS)	Pier #1 Scour (PS)	Pier #2 Scour (PS)	Abutment Scour (AS) using HIRE or Froelich's Method		Total Pier #1 Scour (TPS) (=CS + PS)	Total Pier #2 Scour (TPS) (=CS + PS)	Total Abutment Scour (TAS) HIRE or Froelich Method	
				Left (ASL)	Right (ASR)			Left (TAS_R) (= CS + ASR)	Right (TAS_R) (= CS + ASR)
10	10.27	3.11	3.03	6.16	6.77	13.38	13.30	16.43	17.04
50	18.95	3.89	3.80	9.88	10.52	22.84	22.75	28.83	29.47
100	20.40	4.16	4.08	11.46	12.10	24.56	24.48	31.85	32.49
200	21.90	4.32	4.24	12.37	13.02	26.22	26.14	34.27	34.92
500	26.20	4.70	4.62	14.71	15.39	30.91	30.83	40.91	41.59


ANALYSIS - Map Parameters, Design Parameters, and Response Spectra
File
Project Name
Help
Input Data and Parameter Calculations
Select Geographic Region
Conterminous 48 States
Guidelines Edition
2007 AASHTO Bridge Design Guidelines
Specify Site Location by Latitude-Longitude or Zip Code
Latitude-Longitude : Recommended
Zip Code
38.7318749
-87.85935478
Latitude (50.0 to 24.6)
Longitude (-125.0 to -65.0)
Calculate Basic Design Parameters
Probability of Exceedance
7% PE in 75 years
Calculate PGA, Ss, and S1
Calculate As, SDs, and SD1
Calculate Response Spectra
Map Spectrum
Design Spectrum
View Spectra
Output Calculations and Ground Motion Maps
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 38.731875
Longitude = -087.859355
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.43, Fa = 1.51, Fv = 2.40
Data are based on a 0.05 deg grid spacing.
Period (sec) Sa (g)
0.0 0.278 As - Site Class D
0.2 0.544 SDs - Site Class D
1.0 0.235 SD1 - Site Class D
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
Latitude = 38.731875
Longitude = -087.859355
Site Class B
Data are based on a 0.05 deg grid spacing.
Period (sec) Sa (g)
0.0 0.184 PGA - Site Class B
0.2 0.360 Ss - Site Class B
1.0 0.098 S1 - Site Class B
Clear Output
View Maps

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====SN 051-0077

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	446.07	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B2	
Top of Boring Elev.	453.5	ft.
Approximate Fixity Elev.	440.07	ft.

Individual Site Class Definition:

N (bar):	7	(Blows/ft.)	Soil Site Class E
N_{ch} (bar):	59	(Blows/ft.)	Soil Site Class C
s_u (bar):	0.9	(ksf)	Soil Site Class E <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	451.7	1.80	3		B
	446.8	4.95	2	1.90	
	444.0	2.75	4	1.20	
	441.5	2.50	4	1.10	
1.1	439.0	2.50	2	0.70	B
3.6	436.5	2.50	2	0.30	
6.1	434.0	2.50	1	0.20	B
8.6	431.5	2.50	2	1.00	
11.1	429.0	2.50	2	1.40	
13.6	426.5	2.50	3	1.00	
16.1	424.0	2.50	3	0.70	B
21.1	419.0	5.00	5	1.70	B
26.1	414.0	5.00	1	0.10	B
29.6	410.5	3.50	14		B
36.1	404.0	6.50	20		B
41.1	399.0	5.00	30	1.40	B
100.0	340.1	58.93	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents	444.77	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B1	
Top of Boring Elev.	452.25	ft.
Approximate Fixity Elev.	438.77	ft.

Individual Site Class Definition:

N (bar):	10	(Blows/ft.)	Soil Site Class E <----Controls
N_{ch} (bar):	NA	(Blows/ft.)	NA
s_u (bar):	0.47	(ksf)	Soil Site Class E

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	450.3	2.00	3		B
	445.3	5.00	4	1.70	B
	443.0	2.25	15	0.50	B
	440.5	2.50	2	0.30	
0.8	438.0	2.50	2	0.10	
3.3	435.5	2.50	1	0.01	
5.8	433.0	2.50	1	0.01	B
7.0	431.8	1.25	3	1.70	B
11.5	427.3	4.50	3	1.30	B
13.3	425.5	1.75	3	0.20	
15.8	423.0	2.50	5	0.20	
17.0	421.8	1.25	6	0.10	B
21.0	417.8	4.00	6		B
24.5	414.3	3.50	12		B
100.0	338.8	75.48	100	5.00	B

Substructure 3

Base of Substruct. Elev. (or ground surf for bents	434.5	ft.
Pile or Shaft Dia.	24	inches
Boring Number	B2	
Top of Boring Elev.	453.5	ft.
Approximate Fixity Elev.	422.5	ft.

Individual Site Class Definition:

N (bar):	14	(Blows/ft.)	Soil Site Class E
N_{ch} (bar):	64	(Blows/ft.)	Soil Site Class C
s_u (bar):	1.27	(ksf)	Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	451.7	1.80	3		B
	446.8	4.95	2	1.90	
	444.0	2.75	4	1.20	
	441.5	2.50	4	1.10	
	439.0	2.50	2	0.70	B
	436.5	2.50	2	0.30	
	434.0	2.50	1	0.20	B
	431.5	2.50	2	1.00	
	429.0	2.50	2	1.40	
	426.5	2.50	3	1.00	
	424.0	2.50	3	0.70	B
3.5	419.0	5.00	5	1.70	B
8.5	414.0	5.00	1	0.10	B
12.0	410.5	3.50	14		B
18.5	404.0	6.50	20		B
23.5	399.0	5.00	30	1.40	B
100.0	322.5	76.50	100	5.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents	434.5	ft.
Pile or Shaft Dia.	24	inches
Boring Number	B1	
Top of Boring Elev.	452.25	ft.
Approximate Fixity Elev.	422.5	ft.

Individual Site Class Definition:

N (bar):	45	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	50	(Blows/ft.)	Soil Site Class D <----Controls
s_u (bar):	2.01	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	450.3	2.00	3		B
	445.3	5.00	4	1.70	B
	443.0	2.25	15	0.50	B
	440.5	2.50	2	0.30	
	438.0	2.50	2	0.10	
	435.5	2.50	1	0.01	
	433.0	2.50	1	0.01	B
	431.8	1.25	3	1.70	B
	427.3	4.50	3	1.30	B
	425.5	1.75	3	0.20	
	423.0	2.50	5	0.20	
0.8	421.8	1.25	6	0.10	B
4.8	417.8	4.00	6		B
8.3	414.3	3.50	12		B
18.3	404.3	10.00	30	1.40	B
100.0	322.5	81.75	100	5.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar):	19	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	56	(Blows/ft.)	Soil Site Class C
s_u (bar):	1.16	(ksf)	Soil Site Class D <----Controls

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== B2 W. Abut.
ELEVATION OF BORING GROUND SURFACE ========== 453.50 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 15.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 6.57 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.510
EARTHQUAKE MOMENT MAGNITUDE ========== 5.3
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -7.43 FT. (Cut Depth)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.169**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **287** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.3
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.357**

	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
446.75	6.75	2	1.9					0.129	0.871	3.153	3.153	0.059								
444	9.5	4	1.2					0.124	1.212	6.149	6.149	0.081	0.124	0.257	0.257	1.500	**0.263**	0.931	**0.308**	**N.L. (1)**
441.5	12	4	1.1					0.123	1.519	6.021	6.021	0.080	0.123	0.564	0.564	1.315	**0.228**	0.844	**0.280**	**N.L. (1)**
439	14.5	2	0.7		12	16	16	0.117	1.812	2.924	2.924	0.058	0.055	0.702	0.733	1.247	**0.157**	0.757	**0.262**	**N.L. (2)**
436.5	17	2	0.3		10	23	23	0.046	1.927	2.932	2.932	0.058	0.046	0.817	1.004	1.210	**0.152**	0.671	**0.274**	**0.555 (C)**
434	19.5	1	0.2		10	11	11	0.042	2.032	1.461	1.461	0.051	0.042	0.922	1.265	1.181	**0.130**	0.591	**0.269**	**0.483 (C)**
431.5	22	2	1		12	19	19	0.059	2.179	2.872	2.872	0.058	0.059	1.069	1.568	1.147	**0.143**	0.517	**0.252**	**N.L. (2)**
429	24.5	2	1.4		12	18	18	0.063	2.337	2.807	2.807	0.057	0.063	1.227	1.882	1.116	**0.138**	0.452	**0.230**	**N.L. (2)**
426.5	27	3	1		12	9	9	0.059	2.484	4.117	4.117	0.066	0.059	1.374	2.185	1.091	**0.155**	0.395	**0.208**	**N.L. (2)**
424	29.5	3	0.7		12	18	18	0.055	2.622	4.030	4.030	0.065	0.055	1.512	2.479	1.070	**0.151**	0.347	**0.189**	**N.L. (2)**
421.5	32	5	1.7		10	19	19	0.065	2.784	6.539	6.539	0.084	0.065	1.674	2.797	1.051	**0.191**	0.307	**0.170**	**1.124 (C)**
419	34.5	5	1.7		10	19	19	0.065	2.947	6.369	6.369	0.083	0.065	1.837	3.116	1.030	**0.185**	0.275	**0.154**	**1.201 (C)**
416.5	37	1	0.1	11.3	10	24	24	0.035	3.034	1.258	2.606	0.056	0.035	1.924	3.359	1.020	**0.124**	0.248	**0.144**	**0.861 (C)**
414	39.5	1	0.1	11.3	10	24	24	0.035	3.122	1.242	2.590	0.056	0.035	2.012	3.603	1.011	**0.123**	0.227	**0.135**	**0.911 (C)**
410.5	43	14		24.6			19	0.064	3.346	16.965	23.112	0.259	0.064	2.236	4.045	0.983	**0.552**	0.204	**0.122**	**4.525 (D)**
408	45.5	20		24.6			23	0.067	3.513	24.547	31.543	0.636	0.067	2.403	4.369	0.955	**1.317**	0.192	**0.116**	**11.353 (D)**
404	49.5	20		24.6			23	0.067	3.781	23.463	30.337	0.493	0.067	2.671	4.886	0.920	**0.985**	0.178	**0.108**	**9.120 (D)**
401.5	52	30	1.4					0.063	3.939	36.457	36.457	-0.142	0.063	2.829	5.200	0.892	**-0.274**	0.171	**0.104**	**N.L. (3)**
399	54.5	30	1.4					0.063	4.096	35.500	35.500	-0.408	0.063	2.986	5.513	0.875	**-0.775**	0.166	**0.102**	**N.L. (3)**

* 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

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== B1 E. Abut.
ELEVATION OF BORING GROUND SURFACE ========== 452.25 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 16.95 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 6.57 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.510
EARTHQUAKE MOMENT MAGNITUDE ========== 5.3
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -7.48 FT. (Cut Depth)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.169**

AVG. SHEAR WAVE VELOCITY (top 40')
$V_{s,40'}$ = **298** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.3
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.357**

	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
445.25	7	4	1.7		12		16	0.128	0.896	6.260	6.260	0.082								
443	9.25	15	0.5				17	0.114	1.153	25.153	25.153	0.295	0.114	0.202	0.202	1.500	**0.960**	0.945	**0.313**	**N.L. (1)**
440.5	11.75	2	0.3				22	0.108	1.423	3.069	3.069	0.059	0.108	0.472	0.472	1.351	**0.172**	0.863	**0.286**	**N.L. (1)**
438	14.25	2	0.1		11	24	24	0.098	1.668	3.014	3.014	0.058	0.036	0.562	0.574	1.304	**0.165**	0.779	**0.264**	**0.625 (C)**
435.5	16.75	1					17	0.095	1.905	1.470	1.470	0.051	0.033	0.644	0.813	1.269	**0.139**	0.697	**0.291**	**0.478 (C)**
433	19.25	1					14	0.043	2.013	1.465	1.465	0.051	0.043	0.752	1.076	1.230	**0.135**	0.617	**0.293**	**0.461 (C)**
431.75	20.5	3	1.7		11	20	20	0.065	2.094	4.353	4.353	0.067	0.065	0.833	1.236	1.205	**0.176**	0.580	**0.285**	**0.618 (C)**
430.5	21.75	3	1.7		12	20	20	0.065	2.175	4.307	4.307	0.067	0.065	0.914	1.395	1.183	**0.172**	0.544	**0.275**	**N.L. (2)**
427.25	25	3	1.3		12	16	16	0.062	2.377	4.184	4.184	0.066	0.062	1.116	1.799	1.137	**0.163**	0.459	**0.245**	**N.L. (2)**
425.5	26.75	3	0.2		10	31	31	0.042	2.450	4.143	4.143	0.066	0.042	1.189	1.982	1.123	**0.160**	0.420	**0.232**	**0.690 (C)**
423	29.25	5	0.2		10	30	30	0.042	2.555	6.801	6.801	0.086	0.042	1.294	2.243	1.110	**0.207**	0.370	**0.212**	**0.976 (C)**
421.75	30.5	6	0.1		10	16	16	0.035	2.599	8.110	8.110	0.097	0.035	1.338	2.365	1.106	**0.232**	0.348	**0.204**	**1.137 (C)**
417.75	34.5	6					16	0.057	2.827	7.814	7.814	0.094	0.057	1.566	2.842	1.068	**0.219**	0.291	**0.175**	**1.251 (C)**
414.25	38	12					22	0.063	3.047	15.081	15.081	0.161	0.063	1.787	3.281	1.046	**0.365**	0.254	**0.154**	**2.370 (D)**

* 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

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== B3 Piers
ELEVATION OF BORING GROUND SURFACE ========== 445.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 6.80 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 6.82 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.510
EARTHQUAKE MOMENT MAGNITUDE ========== 5.3
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -1.84 FT. (Cut Depth)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.169**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **221** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.3
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.357**

	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
441.05	4.25	5	0.2				13	0.104	0.442	9.015	9.015	0.105	0.104	0.251	0.251	1.500	**0.340**	0.884	**0.293**	**N.L. (1)**
438.55	6.75	5	0.2				18	0.104	0.702	8.293	8.293	0.098	0.104	0.511	0.511	1.369	**0.292**	0.767	**0.254**	**N.L. (1)**
436.05	9.25	3	0.2		11	24	24	0.042	0.807	5.133	5.133	0.073	0.042	0.616	0.652	1.282	**0.203**	0.658	**0.231**	**0.879 (C)**
433.55	11.75	1	0.3		11	27	27	0.046	0.922	1.756	1.756	0.052	0.046	0.731	0.923	1.237	**0.139**	0.558	**0.234**	**0.594 (C)**
431.05	14.25	2	0.2		11	24	24	0.042	1.027	3.555	3.555	0.062	0.042	0.836	1.184	1.205	**0.162**	0.470	**0.221**	**0.733 (C)**
428.55	16.75	1	0.3		11	33	33	0.046	1.142	1.774	1.774	0.052	0.046	0.951	1.455	1.174	**0.132**	0.394	**0.200**	**0.660 (C)**
426.05	19.25	1	0.3		11	26	26	0.046	1.257	1.756	1.756	0.052	0.046	1.066	1.726	1.147	**0.129**	0.330	**0.177**	**0.729 (C)**
423.55	21.75	1	0.6		11	27	27	0.053	1.390	1.722	1.722	0.052	0.053	1.198	2.015	1.121	**0.126**	0.277	**0.154**	**0.818 (C)**
421.05	24.25	5	0.8		11	16	16	0.057	1.532	8.397	8.397	0.099	0.057	1.341	2.313	1.107	**0.238**	0.233	**0.133**	**1.789 (C)**
418.55	26.75	3	0.7		11	25	25	0.055	1.670	4.910	4.910	0.071	0.055	1.478	2.607	1.075	**0.166**	0.198	**0.116**	**1.431 (C)**
416.05	29.25	1	0.6		11	26	26	0.053	1.802	1.596	1.596	0.051	0.053	1.611	2.895	1.056	**0.117**	0.170	**0.101**	**1.158 (C)**
412.3	33	1	0.2		11	28	28	0.042	1.960	1.550	1.550	0.051	0.042	1.768	3.287	1.037	**0.115**	0.138	**0.085**	**1.353 (C)**
407.3	38	1	0.2		11	25	25	0.042	2.170	1.491	1.491	0.051	0.042	1.978	3.809	1.014	**0.112**	0.110	**0.070**	**1.600 (C)**
400.8	44.5	6	0.2		11	23	23	0.042	2.443	8.518	8.518	0.100	0.042	2.251	4.488	0.987	**0.215**	0.090	**0.059**	**3.644 (C)**

* 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

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 446.77 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 444.77 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 423.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== 427.25 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 858 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 176.76 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.28 KIPS

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.

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	**403** KIPS	**221** KIPS	**35** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
443.00	1.77	0.50			2.7		6.9	4.0		***4.5***	4	0	0	2	4
440.50	2.50	0.30			2.4	4.1	***6.5***	3.5	0.5	7.7	7	0	0	4	6
438.00	2.50	0.10			0.8	1.4	***6.1***	1.2	0.2	8.7	6	0	0	3	9
435.50	2.50	0.01			0.1	0.1	***6.2***	0.1	0.0	8.9	6	0	0	3	11
433.00	2.50	0.01			0.1	0.1	***6.3***	0.1	0.0	9.0	6	0	0	3	14
431.75	1.25	0.01			0.0	0.1	29.6	0.1	0.0	***11.6***	12	0	0	6	15
430.50	1.25	1.70			5.2	23.4	29.3	7.6	2.6	***18.6***	19	0	0	10	16
427.25	3.25	1.30			11.2	17.9	***25.3***	16.4	2.0	33.3	25	0	0	14	20
425.50	1.75	0.20			1.1	2.8	***26.5***	1.7	0.3	35.0	26	0	0	15	21
423.00	2.50	0.20			1.6	2.8	***26.7***	2.4	0.3	37.2	27	0	0	15	24
421.75	1.25	0.10			0.4	1.4	***36.8***	0.6	0.2	38.9	37	0	0	20	25
419.75	2.00		6	Very Fine Silty Sand	0.7	11.0	***37.5***	1.1	1.2	40.0	38	0	0	21	27
417.75	2.00		6	Very Fine Silty Sand	0.7	11.0	49.3	1.1	1.2	***42.2***	42	0	0	23	29
414.25	3.50		12	Very Fine Silty Sand	2.6	22.0	228.9	3.8	2.4	***65.4***	65	0	0	36	33
414.05	0.20			Sandstone	16.5	199.1	245.4	24.1	21.8	***89.5***	89	0	0	49	32.7
413.85	0.20			Sandstone	16.5	199.1	261.8	24.1	21.8	***113.6***	114	0	0	62	32.9
413.65	0.20			Sandstone	16.5	199.1	278.3	24.1	21.8	***137.7***	138	0	0	76	33.1
413.45	0.20			Sandstone	16.5	199.1	294.8	24.1	21.8	***161.7***	162	0	0	89	33.3
413.25	0.20			Sandstone	16.5	199.1	311.2	24.1	21.8	***185.8***	186	0	0	102	33.5
413.05	0.20			Sandstone	16.5	199.1	327.7	24.1	21.8	***209.9***	210	0	0	115	33.7
412.85	0.20			Sandstone	16.5	199.1	344.2	24.1	21.8	***234.0***	234	0	0	129	33.9
412.65	0.20			Sandstone	16.5	199.1	360.7	24.1	21.8	***258.1***	258	0	0	142	34.1
412.45	0.20			Sandstone	16.5	199.1	377.1	24.1	21.8	***282.2***	282	0	0	155	34.3
412.25	0.20			Sandstone	16.5	199.1	393.6	24.1	21.8	***306.3***	306	0	0	168	34.5
412.05	0.20			Sandstone	16.5	199.1	410.1	24.1	21.8	***330.3***	330	0	0	182	34.7
411.85	0.20			Sandstone	16.5	199.1	426.5	24.1	21.8	***354.4***	354	0	0	195	34.9
411.65	0.20			Sandstone	16.5	199.1	443.0	24.1	21.8	***378.5***	379	0	0	208	35.1
411.45	0.20			Sandstone	16.5	199.1	459.5	24.1	21.8	***402.6***	403	0	0	221	35.3
411.25	0.20			Sandstone	16.5	199.1	476.0	24.1	21.8	***426.7***	~~427~~	~~0~~	~~0~~	~~235~~	~~35.5~~
411.05	0.20			Sandstone	16.5	199.1	492.4	24.1	21.8	***450.8***	~~451~~	~~0~~	~~0~~	~~248~~	~~35.7~~
410.85	0.20			Sandstone	16.5	199.1	508.9	24.1	21.8	***474.8***	~~475~~	~~0~~	~~0~~	~~261~~	~~35.9~~
410.65	0.20			Sandstone	16.5	199.1	525.4	24.1	21.8	***498.9***	~~499~~	~~0~~	~~0~~	~~274~~	~~36.1~~
410.45	0.20			Sandstone	16.5	199.1	541.8	24.1	21.8	***523.0***	~~523~~	~~0~~	~~0~~	~~288~~	~~36.3~~
410.25	0.20			Sandstone	16.5	199.1	558.3	24.1	21.8	***547.1***	~~547~~	~~0~~	~~0~~	~~301~~	~~36.5~~
410.05	0.20			Sandstone	16.5	199.1	574.8	24.1	21.8	***571.2***	~~571~~	~~0~~	~~0~~	~~314~~	~~36.7~~
409.85	0.20			Sandstone		199.1			21.8						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== B-2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 448.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 446.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 414.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== 419.00 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 858 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 176.76 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.28 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	**418** KIPS	**230** KIPS	**53** 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.)
444.00	2.00	1.20			6.5		21.7	9.5		***11.2***	11	0	0	6	4
443.00	1.00	1.10			3.0	15.2	***14.0***	4.4	1.7	14.4	14	0	0	8	5
441.50	1.50		4	Very Fine Silty Sand	0.4	4.4	19.6	0.5	0.5	***15.5***	16	0	0	9	7
439.00	2.50	0.70			5.2	9.6	***19.3***	7.6	1.1	22.6	19	0	0	11	9
436.75	2.25	0.30			2.2	4.1	***20.0***	3.2	0.5	25.6	20	0	0	11	11
434.00	2.75	0.20			1.8	2.8	32.9	2.6	0.3	***29.4***	29	0	0	16	14
431.50	2.50	1.00			7.0	13.8	45.4	10.3	1.5	***40.3***	40	0	0	22	17
429.00	2.50	1.40			9.1	19.3	***49.0***	13.3	2.1	53.0	49	0	0	27	19
426.50	2.50	1.00			7.0	13.8	***51.9***	10.3	1.5	62.9	52	0	0	29	22
424.00	2.50	0.70			5.2	9.6	***70.9***	7.6	1.1	72.0	71	0	0	39	24
421.50	2.50	1.70			10.4	23.4	***81.3***	15.2	2.6	87.2	81	0	0	45	27
419.00	2.50	1.70			10.4	23.4	***69.6***	15.2	2.6	100.0	70	0	0	38	29
416.50	2.50	0.10			0.8	1.4	***70.5***	1.2	0.2	101.2	70	0	0	39	32
414.00	2.50	0.10			0.8	1.4	***104.2***	1.2	0.2	106.0	104	0	0	57	34
411.00	3.00		14	Medium Sand	3.0	34.3	121.9	4.4	3.8	***112.0***	112	0	0	62	37
408.00	3.00		20	Medium Sand	4.3	49.0	126.3	6.3	5.4	***118.4***	118	0	0	65	40
404.00	4.00		20	Medium Sand	5.8	49.0	***102.4***	8.5	5.4	123.6	102	0	0	56	44
401.50	2.50	1.40			9.1	19.3	***111.5***	13.3	2.1	136.9	111	0	0	61	47
399.00	2.50	1.40			9.1	19.3	223.8	13.3	2.1	***161.5***	161	0	0	89	49
398.00	1.00			Shale	49.4	122.5	273.2	72.3	13.4	***233.7***	234	0	0	129	50
397.00	1.00			Shale	49.4	122.5	322.6	72.3	13.4	***306.0***	306	0	0	168	51
396.00	1.00			Shale	49.4	122.5	***372.0***	72.3	13.4	378.2	372	0	0	205	52
395.00	1.00			Shale	49.4	122.5	***421.4***	72.3	13.4	450.5	~~421~~	~~0~~	~~0~~	~~232~~	~~53~~
394.00	1.00			Shale	49.4	122.5	***470.8***	72.3	13.4	522.7	~~471~~	~~0~~	~~0~~	~~259~~	~~54~~
393.00	1.00			Shale	49.4	122.5	***520.2***	72.3	13.4	595.0	~~520~~	~~0~~	~~0~~	~~286~~	~~55~~
392.00	1.00			Shale	49.4	122.5	***569.6***	72.3	13.4	667.2	~~570~~	~~0~~	~~0~~	~~313~~	~~56~~
391.00	1.00			Shale	49.4	122.5	***619.1***	72.3	13.4	739.5	~~619~~	~~0~~	~~0~~	~~340~~	~~57~~
390.00	1.00			Shale	49.4	122.5	***668.5***	72.3	13.4	811.7	~~668~~	~~0~~	~~0~~	~~368~~	~~58~~
389.00	1.00			Shale		122.5			13.4						

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	SN 051-0077		TOTAL STRUCTURE LENGTH	179.75	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	52.38	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	75.00	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W33X141	
BEAM SPACING PERP. TO CL	6.67	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)

WIDE FLANGE	W33X141	
BEAM SPACING PERP. TO CL	6.67	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	West	
ABUTMENT REFERENCE BORING	B-2	
BOTTOM OF ABUTMENT ELEVATION	446	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	6.67	FT

ABUTMENT #2 DATA

ABUTMENT NAME	East	
ABUTMENT REFERENCE BORING	B-1	
BOTTOM OF ABUTMENT ELEVATION	444.8	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	6.67	FT

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)*
444.00	2.00	1.2		
441.50	2.50	1.1		
439.00	2.50	0.7		
436.50	2.50	0.3		
436.00	0.50	0.2		

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)*
443.05	1.75	0.5		
440.55	2.50	0.3		
438.05	2.50	0.1		
435.55	2.50		1	0.7
434.80	0.75		1	0.7

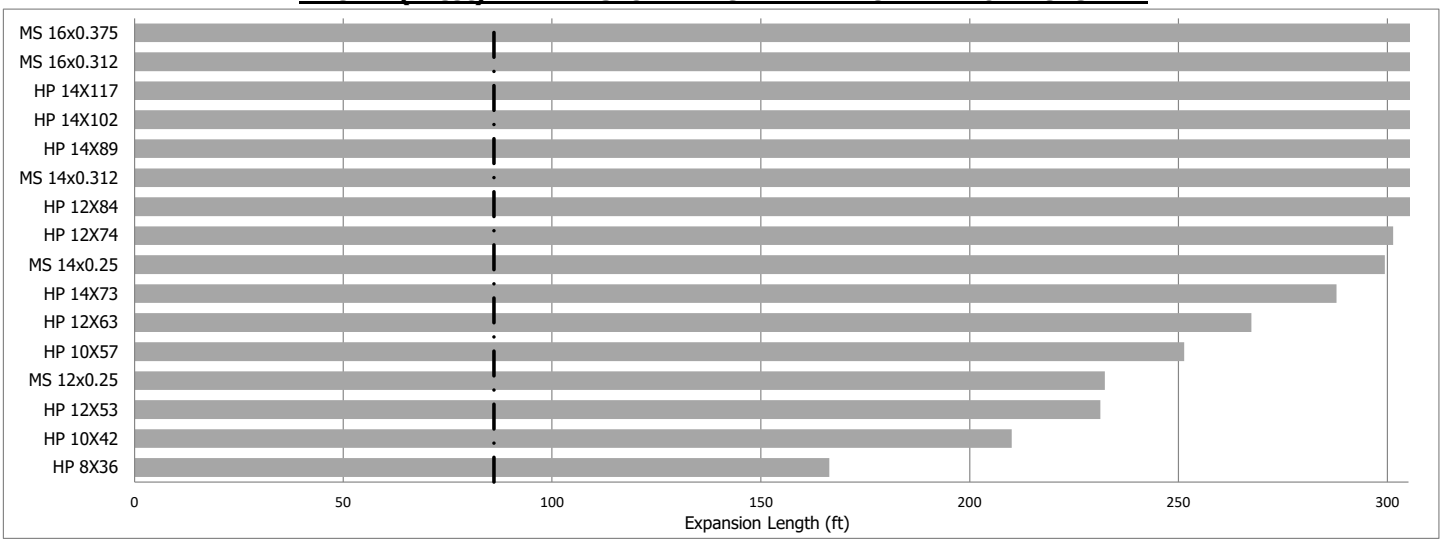
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	0.78	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	0.42	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*0.78])	0.82		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*0.42])	0.75	

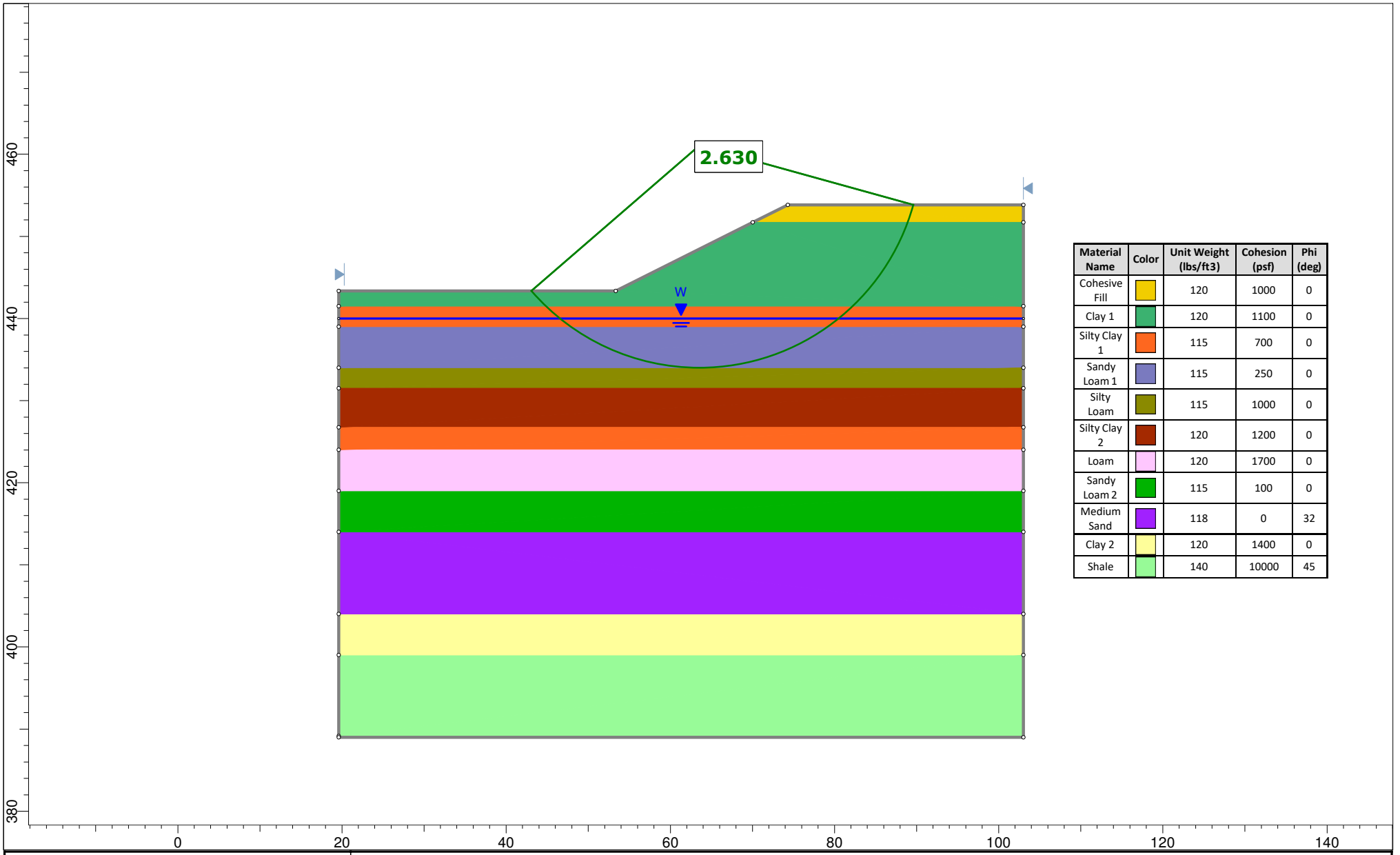
DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [0.82*6*0+0.75*6*179.75]/[0.82*6+0.75*6] = 86.06 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [0.75*6*0+0.82*6*179.75]/[0.75*6+0.82*6] = 93.69 FT

ABUT 1 (West) - EXPANSION LENGTH LIMIT CHART - 0 DEG. SKEW



= Estimated expansion length for the indicated abutment. Piles with an expansion length greater than this are suitable for consideration.
(Note: The same size pile should be used at both abutments.)



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Cohesive Fill		120	1000	0
Clay 1		120	1100	0
Silty Clay 1		115	700	0
Sandy Loam 1		115	250	0
Silty Loam		115	1000	0
Silty Clay 2		120	1200	0
Loam		120	1700	0
Sandy Loam 2		115	100	0
Medium Sand		118	0	32
Clay 2		120	1400	0
Shale		140	10000	45

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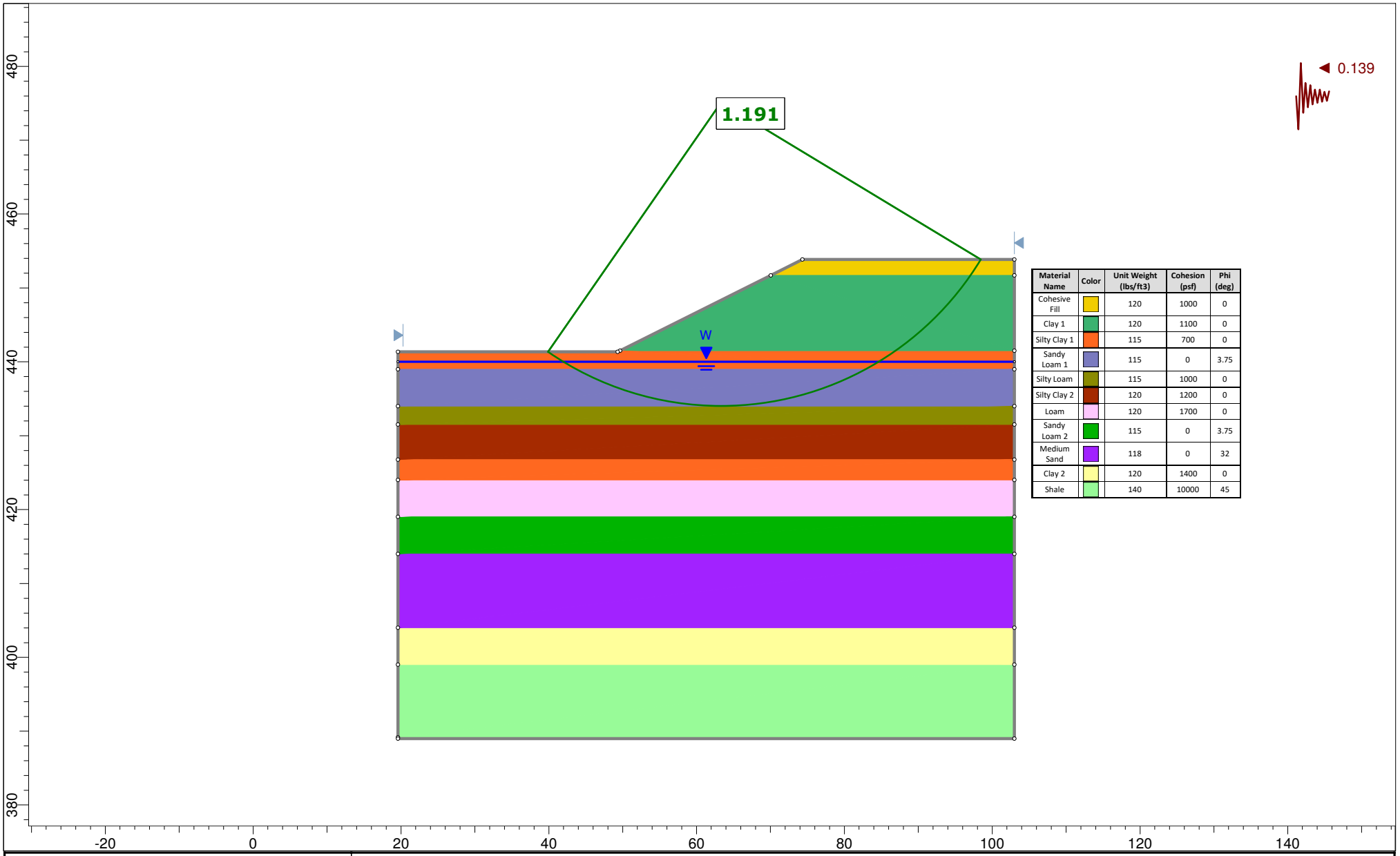
SLIDEINTERPRET 9.024

Project	051-0077 West Abutment Static		
Group	Group 1	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	4/7/2023, 9:05:20 AM	*File Name*	Slide2 B2 Static.slmd

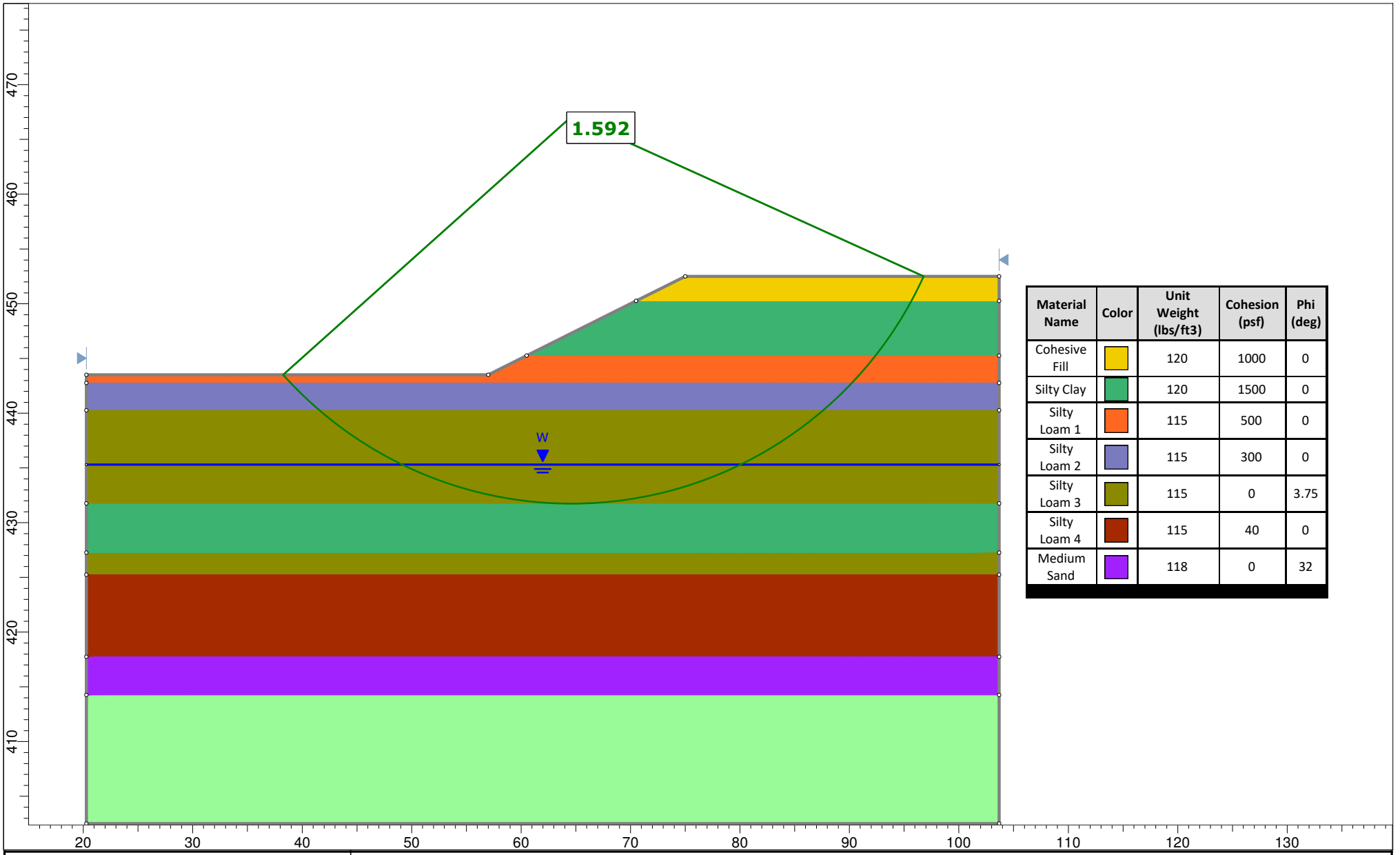


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Cohesive Fill		120	1000	0
Clay 1		120	1100	0
Silty Clay 1		115	700	0
Sandy Loam 1		115	0	3.75
Silty Loam		115	1000	0
Silty Clay 2		120	1200	0
Loam		120	1700	0
Sandy Loam 2		115	0	3.75
Medium Sand		118	0	32
Clay 2		120	1400	0
Shale		140	10000	45

rocscience

SLIDEINTERPRET 9.024

Project	051-0077 West Abutment Seismic		
Group	Group 1	Scenario	Master Scenario
Drawn By		Company	
Date	4/7/2023, 9:05:20 AM	File Name	Slide2 B2 Seismic.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Cohesive Fill		120	1000	0
Silty Clay		120	1500	0
Silty Loam 1		115	500	0
Silty Loam 2		115	300	0
Silty Loam 3		115	0	3.75
Silty Loam 4		115	40	0
Medium Sand		118	0	32

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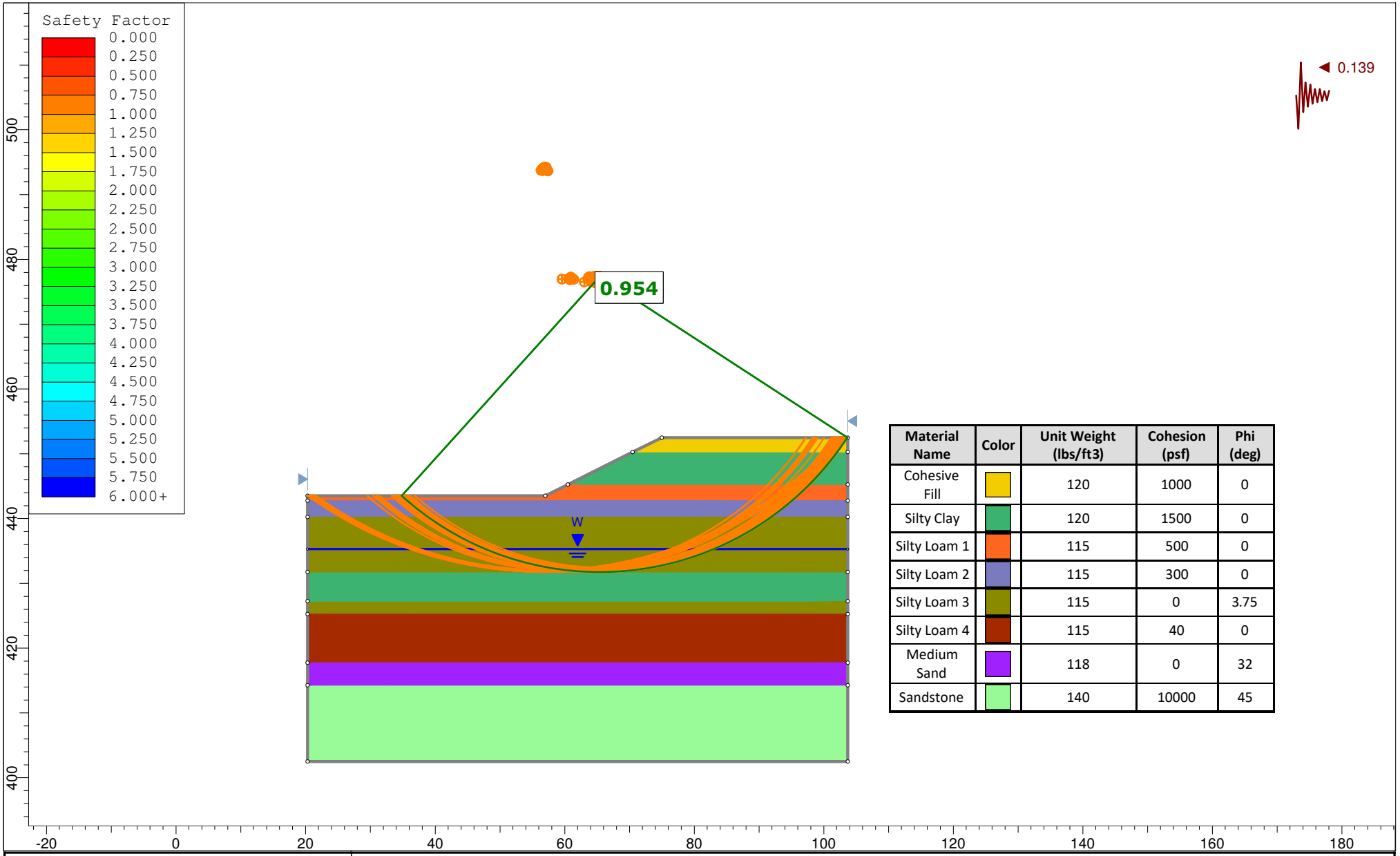
SLIDEINTERPRET 9.024

Project	051-0077 East Abutment Static		
Group	Group 1	Scenario	Master Scenario
Drawn By		Company	
Date	4/7/2023, 9:05:20 AM	File Name	Slide2 Only B1 Static-Short.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Cohesive Fill		120	1000	0
Silty Clay		120	1500	0
Silty Loam 1		115	500	0
Silty Loam 2		115	300	0
Silty Loam 3		115	0	3.75
Silty Loam 4		115	40	0
Medium Sand		118	0	32
Sandstone		140	10000	45

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SLIDEINTERPRET 9.024

Project	051-0077 East Abutment Seismic		
Group	Group 1	Scenario	Master Scenario
Drawn By		Company	
Date	4/7/2023, 9:05:20 AM	File Name	Slide2 Only B1 Seismic Kav-Short.slmd

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ==========SN 051-0077
SUBSTRUCTURE & REFERENCE BORING ====West Abut. B2

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICK-NESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
14.5	2.6		0.5
(ROUND TO NEAREST 0.25')	2.5		0.2
	2.5		1
	2.5		1.4
	2.5		1
	2.5		0.7

GRANULAR CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 0.00 FT

AND REQUIRES A SECTION MODULUS OF: 0.00 $IN.^3/FT$

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. ($IN.^3/FT$)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. ($IN.^3/FT$)	RATIO OF LOWER/ UPPER 1/3 Qu
0.65	0.65	5	0.5	5.00						0.50					
1.30	0.65	5	0.5	5.00						0.50					
1.95	0.65	5	0.5	5.00	5.00	27.18	5.00		1.00	0.50	0.50	########	0.50		1.00
2.60	0.65	5	0.5	5.00	5.00	27.18	5.00		1.00	0.50	0.50	########	0.50		1.00
2.91	0.3125	2	0.2	4.68	5.00	27.18	5.00		1.00	0.47	0.50	########	0.50		1.00
3.23	0.3125	2	0.2	4.42	5.00	27.79	5.00		1.00	0.44	0.50	########	0.50		1.00
3.54	0.3125	2	0.2	4.20	5.00	28.28	5.00		1.00	0.42	0.50	########	0.50		1.00
3.85	0.3125	2	0.2	4.03	5.00	28.69	5.00		1.00	0.40	0.50	########	0.50		1.00
4.16	0.3125	2	0.2	3.87	5.00	29.03	5.00		1.00	0.39	0.50	########	0.50		1.00
4.48	0.3125	2	0.2	3.74	5.00	########	5.00		1.00	0.37	0.50	########	0.50		1.00
4.79	0.3125	2	0.2	3.63	5.00	########	5.00		1.00	0.36	0.50	########	0.50		1.00
5.10	0.3125	2	0.2	3.53	5.00	########	5.00		1.00	0.35	0.50	########	0.50		1.00
5.41	0.3125	10	1	3.90	4.88	########	5.00		1.00	0.39	0.49	########	0.50		1.00
5.73	0.3125	10	1	4.24	4.72	########	5.00		1.00	0.42	0.47	########	0.50		1.00
6.04	0.3125	10	1	4.53	4.58	28.63	5.00		1.00	0.45	0.46	########	0.50		1.00
6.35	0.3125	10	1	4.80	4.46	28.06	5.00		1.00	0.48	0.45	########	0.50		1.00
6.66	0.3125	10	1	5.05	4.34	28.21	5.00		1.00	0.50	0.43	########	0.50		1.00
6.98	0.3125	10	1	5.27	4.24	28.43	5.00		1.00	0.53	0.42	########	0.50		1.00
7.29	0.3125	10	1	5.47	4.14	28.63	5.00		1.00	0.55	0.41	########	0.50		1.00
7.60	0.3125	10	1	5.66	4.05	28.81	5.00		1.00	0.57	0.41	########	0.50		1.00
7.91	0.3125	14	1.4	5.99	3.97	28.98	4.96		0.98	0.60	0.40	########	0.50		0.98
8.23	0.3125	14	1.4	6.29	3.90	########	4.84		0.94	0.63	0.39	########	0.48		0.94
8.54	0.3125	14	1.4	6.57	3.83	########	4.74		0.90	0.66	0.38	########	0.47		0.90
8.85	0.3125	14	1.4	6.84	3.76	########	4.64		0.86	0.68	0.38	########	0.46		0.86
9.16	0.3125	14	1.4	7.08	3.70	########	4.55		0.82	0.71	0.37	########	0.46		0.82
9.48	0.3125	14	1.4	7.31	3.65	########	4.47		0.79	0.73	0.36	########	0.45		0.79
9.79	0.3125	14	1.4	7.52	3.59	########	4.39		0.76	0.75	0.36	########	0.44		0.76
10.10	0.3125	14	1.4	7.72	3.54	########	4.32		0.73	0.77	0.35	########	0.43		0.73
10.41	0.3125	10	1	7.79	3.66	########	4.25		0.70	0.78	0.37	########	0.42		0.70
10.73	0.3125	10	1	7.86	3.85	########	4.18		0.67	0.79	0.38	########	0.42		0.67
11.04	0.3125	10	1	7.92	4.02	########	4.12		0.65	0.79	0.40	########	0.41		0.65
11.35	0.3125	10	1	7.97	4.19	29.04	4.06		0.62	0.80	0.42	########	0.41		0.62
11.66	0.3125	10	1	8.03	4.34	28.73	4.01		0.60	0.80	0.43	########	0.40		0.60
11.98	0.3125	10	1	8.08	4.49	28.43	3.95		0.58	0.81	0.45	########	0.40		0.58
12.29	0.3125	10	1	8.13	4.63	28.15	3.90		0.56	0.81	0.46	########	0.39		0.56
12.60	0.3125	10	1	8.17	4.76	27.88	3.86		0.54	0.82	0.48	########	0.39		0.54
12.91	0.3125	7	0.7	8.15	4.89	27.63	3.81		0.52	0.81	0.49	########	0.38		0.52
13.23	0.3125	7	0.7	8.12	5.01	27.39	3.77		0.51	0.81	0.50	########	0.38		0.51
13.54	0.3125	7	0.7	8.09	5.12	27.17	3.73		0.49	0.81	0.51	########	0.37		0.49
13.85	0.3125	7	0.7	8.07	5.23	27.00	3.69		0.48	0.81	0.52	########	0.37		0.48
14.16	0.3125	7	0.7	8.05	5.34	26.83	3.65		0.46	0.80	0.53	########	0.37		0.46
14.48	0.3125	7	0.7	8.02	5.44	26.68	3.62		0.45	0.80	0.54	########	0.36		0.45
14.79	0.3125	7	0.7	8.00	5.54	26.53	3.58		0.43	0.80	0.55	########	0.36		0.43
15.10	0.3125	7	0.7	7.98	5.63	26.39	3.55		0.42	0.80	0.56	########	0.35		0.42

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ==========SN 051-0077
SUBSTRUCTURE & REFERENCE BORING ====East Abut. B1

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICK-NESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
13.25	1.4		0.1
(ROUND TO NEAREST 0.25')	2.5	1	
	3.75	1	
	1.25		1.7
	4.5		1.3
	5.5		0.2
	5	6	
	5	12	

GRANULAR CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 24.37 FT

AND REQUIRES A SECTION MODULUS OF: 53.69 IN.^{3}/FT

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. (IN.^{3}/FT)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. (IN.^{3}/FT)	RATIO OF LOWER/ UPPER 1/3 Qu
0.35	0.35	1	0.1	1.00						0.10					
0.70	0.35	1	0.1	1.00						0.10					
1.05	0.35	1	0.1	1.00	1.00	#######	1.00		1.00	0.10	0.10	########	0.10		1.00
1.40	0.35	1	0.1	1.00	1.00	#######	1.00		1.00	0.10	0.10	########	0.10		1.00
1.71	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.08	0.10		0.10		1.00
2.03	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.07	0.10		0.10		1.00
2.34	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.06	0.10		0.10		1.00
2.65	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.05	0.10		0.10		1.00
2.96	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.05	0.09		0.10		1.00
3.28	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.04	0.09		0.10		1.00
3.59	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.04	0.08		0.10		1.00
3.90	0.3125	1	0	1.00	1.00	#######	1.00		1.00	0.04	0.07		0.10		1.00
4.37	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.03	0.06		0.10		0.92
4.84	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.03	0.06		0.09		0.74
5.31	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.03	0.05		0.08		0.58
5.78	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.02	0.05		0.07		0.45
6.24	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.02	0.04		0.07		0.35
6.71	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.02	0.04		0.06		0.25
7.18	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.02	0.04		0.06		0.17
7.65	0.4688	1	0	1.00	1.00	#######	1.00		1.00	0.02	0.04		0.05		0.10
7.81	0.1563	17	1.7	1.32	1.00	#######	1.00		1.00	0.05	0.04		0.05		0.08
7.96	0.1563	17	1.7	1.63	1.00	#######	1.00		1.00	0.08	0.04		0.05		0.05
8.12	0.1563	17	1.7	1.92	1.00	#######	1.00		1.00	0.12	0.03		0.05		0.03
8.28	0.1563	17	1.7	2.21	1.00	#######	1.00		1.00	0.15	0.03		0.05		0.02
8.43	0.1563	17	1.7	2.48	1.00	#######	1.00		1.00	0.17	0.03		0.05		0.00
8.59	0.1563	17	1.7	2.75	1.00	#######	1.00		1.00	0.20	0.03		0.05		0.00
8.74	0.1563	17	1.7	3.00	1.00	#######	1.00		1.00	0.23	0.03		0.05		0.00
8.90	0.1563	17	1.7	3.25	1.00	#######	1.00		1.00	0.25	0.03		0.05		0.00
9.46	0.5625	13	1.3	3.83	1.00	#######	1.00		1.00	0.32	0.03		0.04		0.00
10.03	0.5625	13	1.3	4.34	1.00	#######	1.00		1.00	0.37	0.03		0.04		0.00
10.59	0.5625	13	1.3	4.80	1.00	#######	1.00		1.00	0.42	0.03		0.04		0.00
11.15	0.5625	13	1.3	5.22	1.00	#######	1.00		1.00	0.47	0.03		0.04		0.00
11.71	0.5625	13	1.3	5.59	1.00	#######	1.00		1.00	0.51	0.02		0.04		0.00
12.28	0.5625	13	1.3	5.93	1.00	#######	1.00		1.00	0.54	0.02		0.03		0.00
12.84	0.5625	13	1.3	6.24	1.00	#######	1.00		1.00	0.58	0.02		0.03		0.00
13.40	0.5625	13	1.3	6.52	1.00	#######	1.00		1.00	0.61	0.02		0.03		0.00
14.09	0.6875	2	0.2	6.30	1.00	#######	1.00		1.00	0.59	0.02		0.03		0.00
14.78	0.6875	2	0.2	6.10	1.00	#######	1.00		1.00	0.57	0.02		0.03		0.00
15.46	0.6875	2	0.2	5.92	1.17	#######	1.00		1.00	0.55	0.04		0.03		0.00
16.15	0.6875	2	0.2	5.75	1.84	#######	1.00		1.00	0.54	0.11		0.03		0.00
16.84	0.6875	2	0.2	5.60	2.46	#######	1.00		1.00	0.52	0.17		0.02		0.00
17.53	0.6875	2	0.2	5.46	3.03	#######	1.00		1.00	0.51	0.23		0.02		0.00
18.21	0.6875	2	0.2	5.33	3.47	#######	1.00		1.00	0.50	0.28		0.02		0.00
18.90	0.6875	2	0.2	5.21	3.81	#######	1.00		1.00	0.49	0.32		0.02		0.00
19.53	0.625	6	0	5.23	4.11	#######	1.00		1.00	0.47	0.35		0.02		0.00
20.15	0.625	6	0	5.26	4.38	26.67	1.00		1.00	0.46	0.38		0.02		0.00
20.78	0.625	6	0	5.28	4.64	26.18	1.00		1.00	0.44	0.40		0.02		0.00
21.40	0.625	6	0	5.30	4.89	25.73	1.00		1.00	0.43	0.43		0.02		0.00
22.03	0.625	6	0	5.32	5.12	25.30	1.00		1.00	0.42	0.46		0.02		0.00
22.65	0.625	6	0	5.34	5.34	24.94	1.00		1.00	0.41	0.48		0.02		0.00
23.28	0.625	6	0	5.36	5.54	24.65	1.22		1.45	0.40	0.50		0.04		1.32
23.90	0.625	6	0	5.37	5.74	24.62	1.64		2.27	0.39	0.52		0.09		3.85
24.53	0.625	12	0	5.54	5.92	24.60	2.03		3.06	0.38	0.54		0.13		6.37
25.15	0.625	12	0	5.70	6.10	24.37	2.40	53.69	3.80	0.37	0.56		0.17		8.90
25.78	0.625	12	0	5.85	6.26		2.75		4.51	0.36	0.58		0.20		11.43
26.40	0.625	12	0	6.00	6.42		3.09		5.18	0.35	0.60		0.24		13.96
27.03	0.625	12	0	6.14	6.48		3.36		5.73	0.34	0.60		0.27		16.18
27.65	0.625	12	0	6.27	6.38		3.58		6.16	0.33	0.59		0.29		18.12
28.28	0.625	12	0	6.40	6.29		3.79		6.58	0.33	0.58		0.31		20.05
28.90	0.625	12	0	6.52	6.19		3.99		6.98	0.32	0.58		0.33		21.99

Rock Sockets Capacity Calculations

Nominal Unit Resistances - Core B3							
Elevations (ft)	qu (ksf)	Shale Spreadsheet		Rock Spreadsheet		From Eqns 10-21 and 10-23 NHI 18-024	
		Side (ksf)	Tip (ksf)	Side (ksf)	Tip (ksf)	Side (ksf)	Tip (ksf)
400.8-395.3	87.4	27.1	324.7	-	-	-	-
395.3-390.3	504	-	-	32.6	2154.3	32.7	2154.3
390.3-385.3	408.4	-	-	29.4	1021.1	29.4	1021.0

Unit Resistances (Nominal) - Shale			
Elevations (ft)	qu (ksf)	From FGU Design Guide (Soft Shale)	
		Side (ksf)	Tip (ksf)
400.8-395.3	87.4	27.1	327.5
395.3-390.3	100	31	374.7
390.3-385.3	100	31	374.7

Assumptions:

Pier Load (k)	1535	D (in)	24
No. of piles	6	Area (sf)	3.14
Load/pile (k)	255.8	pa (ksf)	2.116

For soft shale, a maximum Qu=100 ksf was assumed.
Assumed Nc=2.5 for Normal Rock Condition

Capacity Check, neglecting side fricton
Min. Nominal Unit Tip Resistance:

162.9 ksf

162.9 ksf < 325 ksf, OK

Due to the low RQD values on the rock encountered at the East Abutment core and the fact that no rock cores were obtained for Pier 1, a Qu value equal to 87.4 ksf was utilized to calculate the rock socket capacity. This Qu corresponds to the minimum value obtained at core B3.

Minimum recommended socket length = 6 ft
Pile structural resistance factor for non-driven undamaged piles (AASHTO 6.5.4.2) = 0.7

Rock Socket / Drilled Shaft	
Side (ksf)	Tip (ksf)
27	325

Illinois Department of Transportation

Route:	FAP 327	Sheet		of	
Section:	(3,2B) B-1	Computed by:	JTB	Date:	07/28/22
County:	Lawrence	Checked by:		Date:	
Structure Number:	051-0077				

Planning Computations: Estimated Loads for FGU

Superstructure Loads: *(using Force Envelope)*

Service I Reactions:

	Unfactored Loads, (kips)			
	*DC1	*DC2	*DW	**LL
W. Abut.	14.2	3.0	5.6	71.1
Pier	59.9	12.4	23.7	117.4
E. Abut.	14.2	3.0	5.6	71.1

*per Beam

**per Lane

# Beams	# Lanes	m
6.00	3	0.85

(very conservative)

Table 3.6.1.1.2-1—Multiple Presence Factors, *m*

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

1	1.20
2	1.00
3	0.85
>3	0.65

W. Abut. = [(1.00)*(14.2k) + (1.00)*(3k) + (1.00)*(5.6k)]*(6 beams) + [(1.00)*(71.1k)]*(3 lanes)*(0.85)
= 318.1 k

Pier = [(1.00)*(59.9k) + (1.00)*(12.4k) + (1.00)*(23.7k)]*(6 beams) + [(1.00)*(117.4k)]*(3 lanes)*(0.85)
= 875.4 k

E. Abut. = [(1.00)*(14.2k) + (1.00)*(3k) + (1.00)*(5.6k)]*(6 beams) + [(1.00)*(71.1k)]*(3 lanes)*(0.85)
= 318.1 k

Strength I Reactions:

W. Abut. = [(1.25)*(14.2k) + (1.25)*(3k) + (1.50)*(5.6k)]*(6 beams) + [(1.75)*(71.1k)]*(3 lanes)*(0.85)
= 496.7 k

Pier = [(1.25)*(59.9k) + (1.25)*(12.4k) + (1.5)*(23.7k)]*(6 beams) + [(1.75)*(117.4k)]*(3 lanes)*(0.85)
= 1,279.4 k

E. Abut. = [(1.25)*(14.2k) + (1.25)*(3k) + (1.5)*(5.6k)]*(6 beams) + [(1.75)*(71.1k)]*(3 lanes)*(0.85)
= 496.7 k

Substructure Loads:

Service I Reactions:

West Abutment							
	Amount, (each)	γ_c, (kcf.)	Width, (ft.)	Length, (ft.)	Thick, (ft.)	Weight, (kips)	
Abutment Cap	1	0.150	3.67	38.83	3.83	81.9	
End Diaphragm	1	0.150	3.67	38.83	3.83	81.9	ESTIMATE - REVISE HEIGHT ACCORDINGLY
Approach Slab	1	0.150	38.83	15.00	1.25	109.2	
					Σ =	273.0	

West Abutment						
	Amount, (each)	γ_c, (kcf.)	Area, (sq.ft.)	Length, (ft.)	Weight, (kips)	
Appr. Parapets	2	0.150	3.50	15.00	15.8	
				Σ =	15.8	

**For simplicity, wingwalls were ignored.*

Service I (W.A.) = (1.00)*[273k + 15.8k]
= 288.7 k

Pier							
	Amount, (each)	γ_c, (kcf.)	Width, (ft.)	Length, (ft.)	Thick, (ft.)	Weight, (kips)	
Pier Cap	1	0.150	2.50	38.83	2.50	36.4	
Pier Wall	1	0.150	2.00	38.33	14.62	168.1	ESTIMATE - REVISE HEIGHT ACCORDINGLY
					Σ =	204.5	

Service I (Pier) = (1.00)*[204.5k]
= 204.5 k

East Abutment						
	Amount, (each)	γ_c, (kcf.)	Width, (ft.)	Length, (ft.)	Thick, (ft.)	Weight, (kips)
Abutment Cap	1	0.150	3.67	38.83	3.83	81.9
End Diphragm	1	0.150	3.67	38.83	3.83	81.9
Approach Slab	1	0.150	38.83	15.00	1.25	109.2
					Σ =	273.0

ESTIMATE - REVISE HEIGHT ACCORDINGLY

East Abutment					
	Amount, (each)	γ_c, (kcf.)	Area, (sq.ft.)	Length, (ft.)	Weight, (kips)
Appr. Parapets	2	0.150	3.5	15.00	15.8
				Σ =	15.8

**For simplicity, wingwalls were ignored.*

Service I (E.A.) = (1.00)*[273k + 15.8k]
= 288.7 k

Strength I Reactions:

Strength I (W.A.) = (1.25)*[273k + 15.8k]
= 360.9 k

Strength I (Pier) = (1.25)*[204.5k]
= 255.7 k

Strength I (E.A.) = (1.25)*[273k + 15.8k]
= 360.9 k

Summary: *(Estimated Total Loads at Bottom of Encasements)*

	Service I			Strength I		
	Super	Sub	Total	Super	Sub	Total
West Abutment	318.1	288.7	606.8	496.7	360.9	857.6
Pier	875.4	204.5	1,079.9	1,279.4	255.7	1,535.1
East Abutment	318.1	288.7	606.8	496.7	360.9	857.6

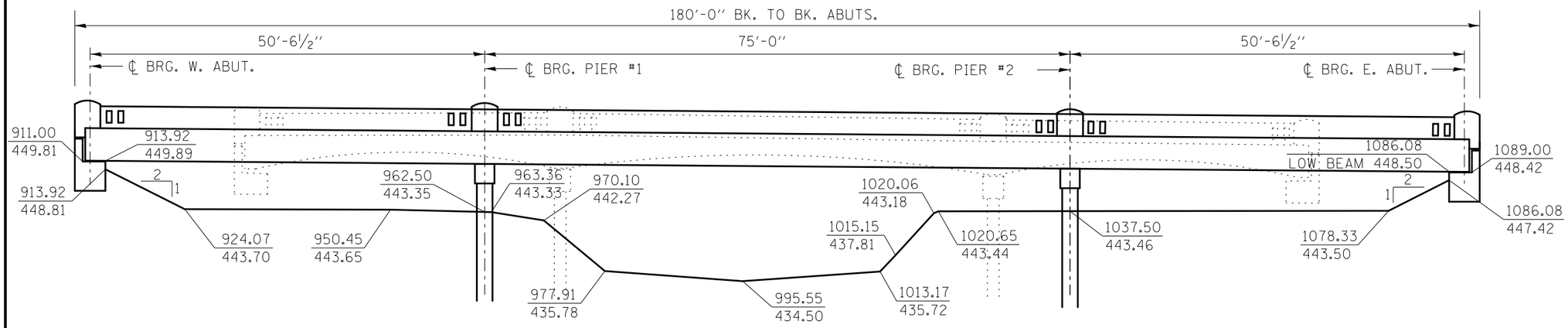
Note:

The Estimated Total Loads shown above reflect the loads before distribution to the proposed foundation type due to unknown foundation type at this time.

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
US RTE 50		LAWRENCE		
FED. ROAD DIST. NO. 7		ILLINOIS	FED. AID PROJECT-	

JTB 08/19/2022

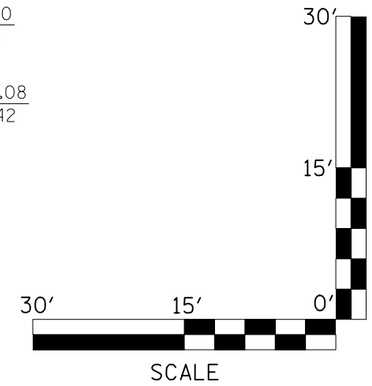
JOV 09/28/22

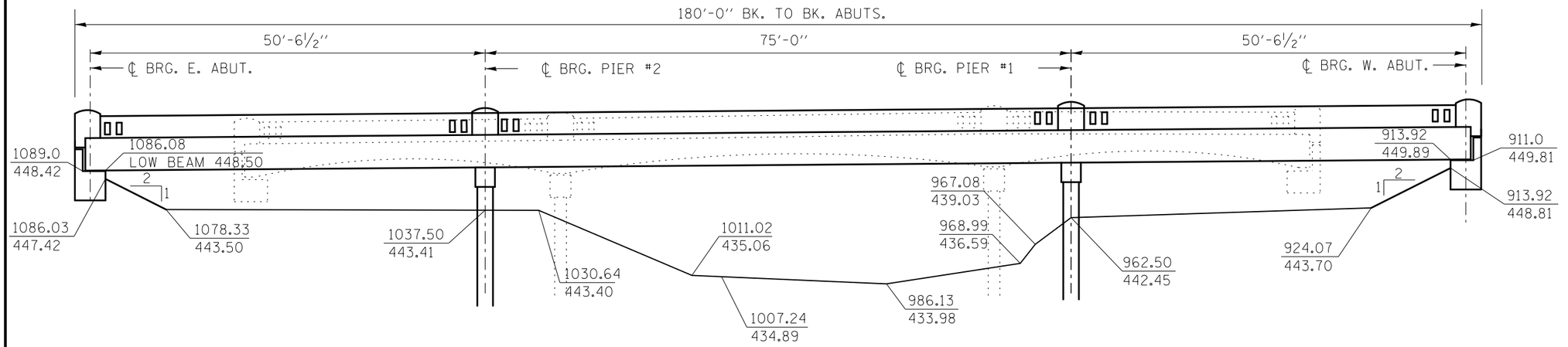


U/S FACE S.N. 051-0009 - TO BE REMOVED .....

PR U/S BRIDGE FACE XS STA. 1051.52 ———

UPSTREAM BRIDGE OPENING
(LOOKING DOWNSTREAM)





U/S FACE S.N. 051-0009 - TO BE REMOVED .....

PR D/S BRIDGE FACE XS STA. 1012.68 ———

DOWNSTREAM BRIDGE OPENING
(LOOKING UPSTREAM)

EXHIBIT 9B

PROPOSED BRIDGE OPENING U.S. ROUTE 50 OVER MUDDY CREEK S.N. 051-0077