Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 04/28/2020	**Proposed SN:** 012-0075	**Route:**	FAS 1707
Revised Date: 01/11/2021	**Existing SN:** 012-0021	**Section:**	(BXB)B-1
Geotechnical Engineer: Doris D. Gonzalez		**County:**	Clark
Structural Engineer: Justin T. Belue		**Contract:**	74360

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed structure will be replacing an existing bridge located on US 40 over East Mill Creek in Clark County. A Location Map is included in Appendix A. It consists of a three-span bridge with W33 beams supported on integral abutments and solid wall encased pile bent piers. The structure will have a back-to-back of abutment length of 166'-9 1/2" and out-to-out width of 38'-10" (42'-10" along a 25 degrees skew). The foundation locations are shown on the Type, Size and Location (TSL) drawing. The TSL drawing and the Plan and Profile are included in Appendix B. The preliminary factored loads on the substructures provided by the Bridge Planning Unit are 757.2 kips at the abutments and 1403 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): The subsurface investigation is based on two borings drilled on January 2019, Boring 1 (West Abutment) and Boring 2 (East Abutment), 80 ft and 85 ft deep, respectively. Boring 1 was continued with a 10 ft rock core. The soils consist predominantly of clays and silty/sandy loams followed by clay shale and shaley sandstone encountered at elevations of 461.3 ft and 467.2 ft in Borings 1 and 2, respectively. A 3.5 ft thick layer of loose sand was encountered on Boring 2 around the streambed elevation. This loose sand layer was also encountered in all historical borings at approximately the same elevation. Groundwater was encountered at an approximate elevation of 520 ft. The boring logs are included in Appendix C.

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, the grade will not be raised, consequently, no significant amount of settlement is expected.

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 existing plans and the preliminary TSL, new cuts of approximately 15 ft of depth are expected in front of the proposed abutments. Slope stability analyses were conducted for each proposed abutment and Factors of Safety of 2.9 and 1.7 were obtained for the East Abutment and West Abutment, respectively. Additionally, seismic slope stability analyses were conducted and Factors of Safety greater than 1.0 were obtained for both abutments. No further testing or ground improvement appears to be necessary. The slope stability analyses results are shown on Appendix D.

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: Since the proposed structure will be supported by integral abutments, the 100-year scour and 200-year Design Scour Elevations will be set at the bottom of abutment cap for each abutment. The 100-year and 200-year total scour depths at the piers are 13.5 ft and 14.7 ft, respectively, per the approved Hydraulic Report. The proposed Streambed Elevation is 519.8. The Design Scour Elevation Table is shown in Appendix E. Since the soil encountered near the streambed elevation and the scour depths is mainly granular or soft sandy clays and loams, no scour depth reduction was applied.

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: Using Boring 1 and Boring 2, the calculated seismic soil site class is D. The 0.2 second and 1.0 second Design Spectral Accelerations for Site Class D are 0.365g and 0.175g, respectively; and the value for the Site-Adjusted Peak Ground Acceleration (As) is 0.17. The project corresponding Seismic Performance Zone is SPZ 2. Liquefaction analyses were conducted for both abutments and even though some liquefiable layers of soil are present on site, the combination of earthquake magnitude and source-to-site distance that produced the largest Peak Ground Acceleration (PGA), did not produce liquefaction during the analyses. The Design Spectral Accelerations as well as the Liquefaction Spreadsheets are included in Appendix F.

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: Due to proximity to rock, we recommend that H-piles driven to rock be used at the abutments and the piers. Since only two borings (one at each abutment) were drilled, and rock was not encountered in the historical boring logs near the existing piers locations, the Estimated Top of Rock Elevations at the piers were estimated using the rock elevations from Boring 1 and Boring 2. Pile Design Tables are included in Appendix G. Losses due to scour were considered for the pile factored resistances at the Piers. We recommend two test piles, one at the West Abutment and other at Pier 2. Pile shoes are not required.

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 521.6 ft, per the approved Hydraulic Report. Due to both the uncertainty of where the top of excavation will be in relation to the EWSE for both piers during their construction and the close proximity of the proposed piers to the existing ones, we recommend that Type 1 Cofferdams be used at both piers. Sealcoats will not be required.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: According to the Structure Report, the District recommends that traffic during construction be maintained using a road closure and detour; therefore, temporary retention of soil will not be required for traffic maintenance. To construct the proposed structure, excavations of approximately 20 feet, from the existing roadway to the bottom the proposed riprap (at the abutments), is required. Should stage construction be implemented, a Temporary Soil Retention System (TSRS) will be required.

Attachments

Appendix A: Site Location Map

Project Location Map [1]

[1] From USGS Quadrangle Maps

Appendix B: TSL Drawing and Plan and Profile

Benchmark: Permanent marker stamped L211 on northeast wingwall of SN 012-0021; Station 301+30, 20' LT, Elevation 542.463

Existing Structure: Structure No. 012-0021 was originally constructed in 1952 as Route FA 12 Section B-XB. The original structure was a three span reinforced concrete deck girder with reinforced concrete deck supported on solid concrete piers and open abutments with channel realignment. Back-to-back abutment length is 131'-3" and out-to-out width of deck is 35'-8". The structure has a 30° skew. In 1993, the bridge railing was replaced under Section (C-X, B-X) RS & (X-1) RS-1. In 2011, a new bituminous wearing surface was installed on the bridge deck and approach slabs. Existing structure will be removed and replaced while traffic is detoured.

No Salvage

Note: All Structural Steel Shall Be Galvanized

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 Concrete)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

HIGHWAY CLASSIFICATION

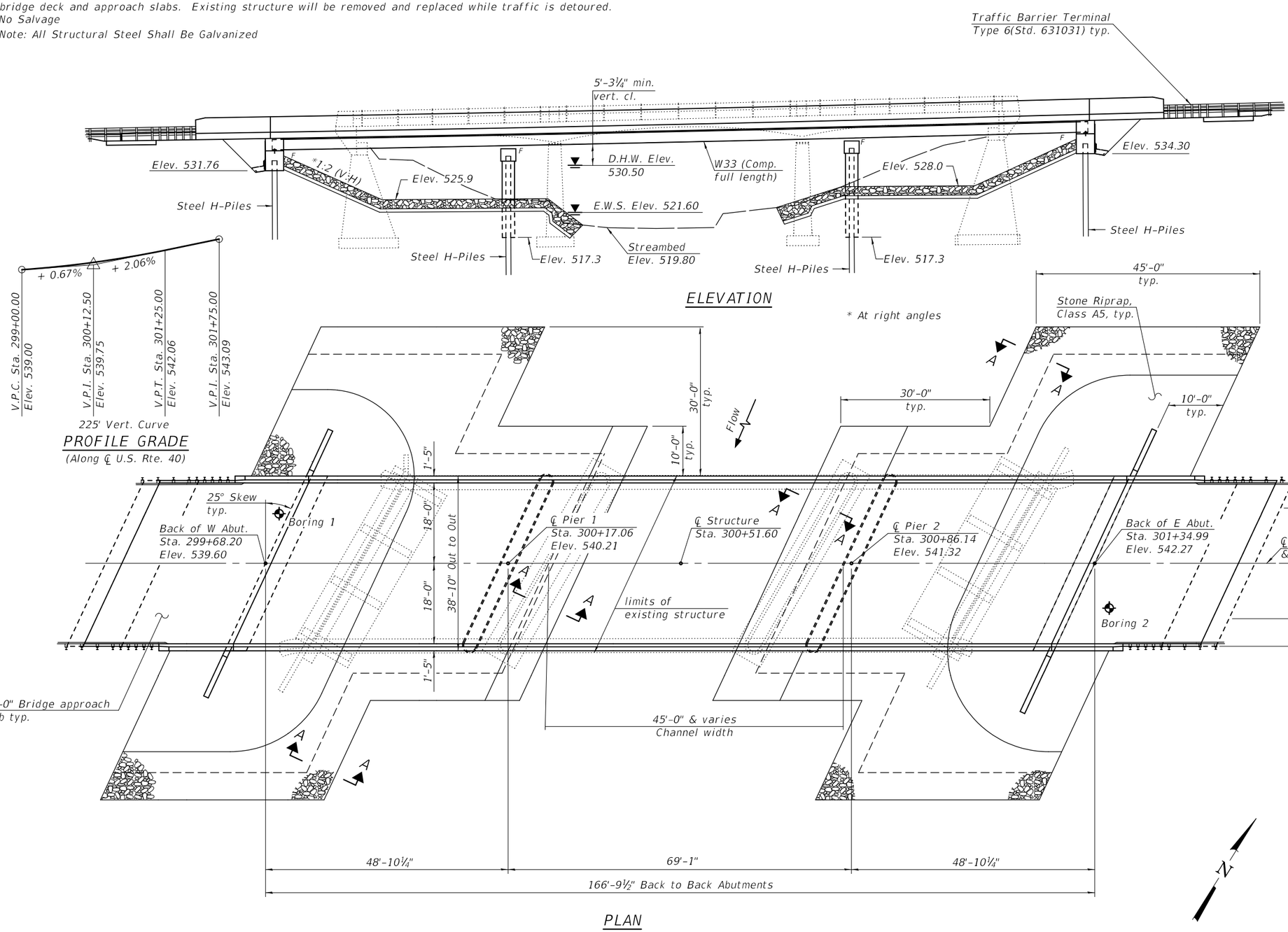
US RTE. 40 over East Mill Creek
Functional Class: Major Collector
ADT: 3550 (2021); 4400 (2041)
ADTT: 270 (2021); 335 (2041)
DHV: 528 (2041)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 51:49

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) = 0.175g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.365g
Soil Site Class = D



GENERAL PLAN & ELEVATION
U.S. 40 OVER EAST MILL CREEK
F.A.S. RTE. 1707 - SECTION (BXB)B-1
CLARK COUNTY
STA. 300+51.60
STRUCTURE NO. 012-0075

DESIGNED	JUSTIN T. BELUE
CHECKED	JOSUE D. ORTIZ-VARELA
DRAWN	GLENN W. STOVER
CHECKED	RICHARD J. CHAPUT

9/23/2020 - 10:31:08 AM

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1707	(BXB) B-1	CLARK	_	_
		CONTRACT NO. 74360		
	ILLINOIS	FED. AID PROJECT		

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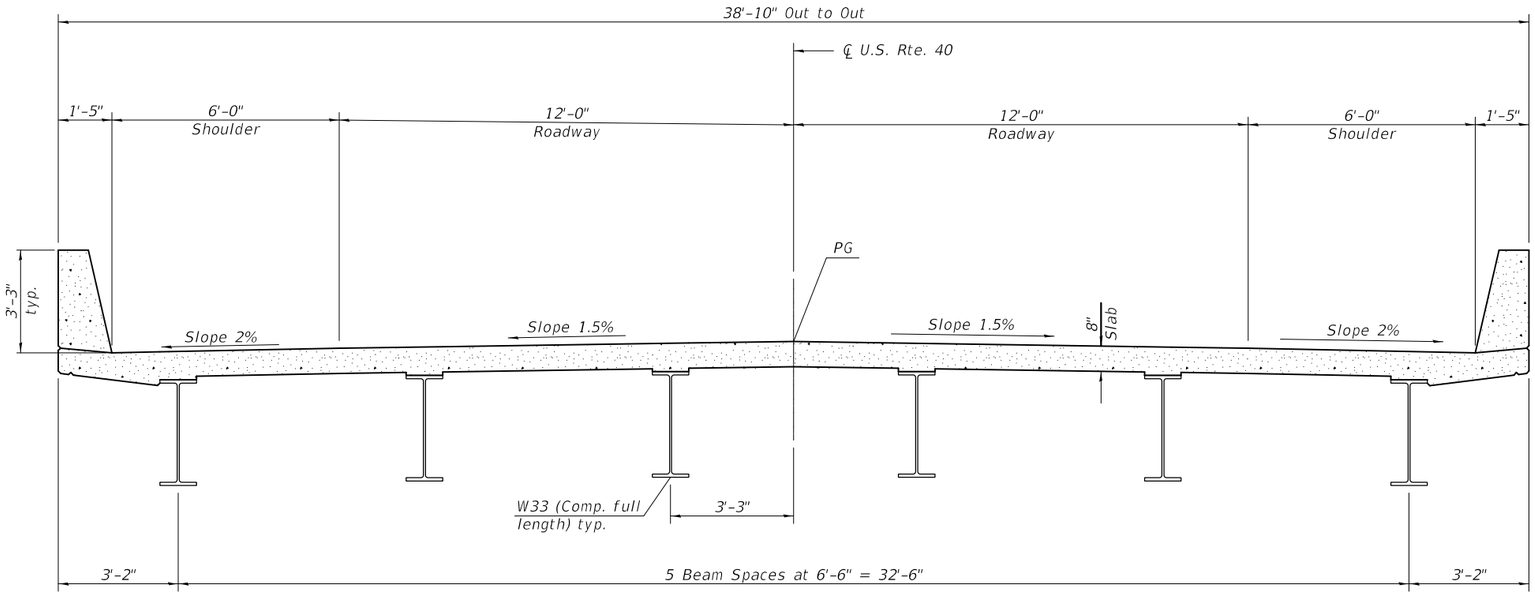

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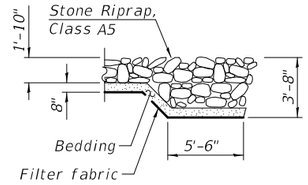
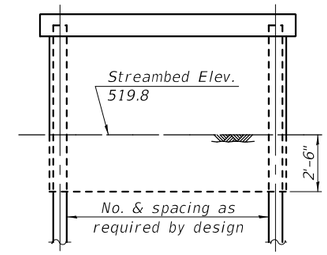
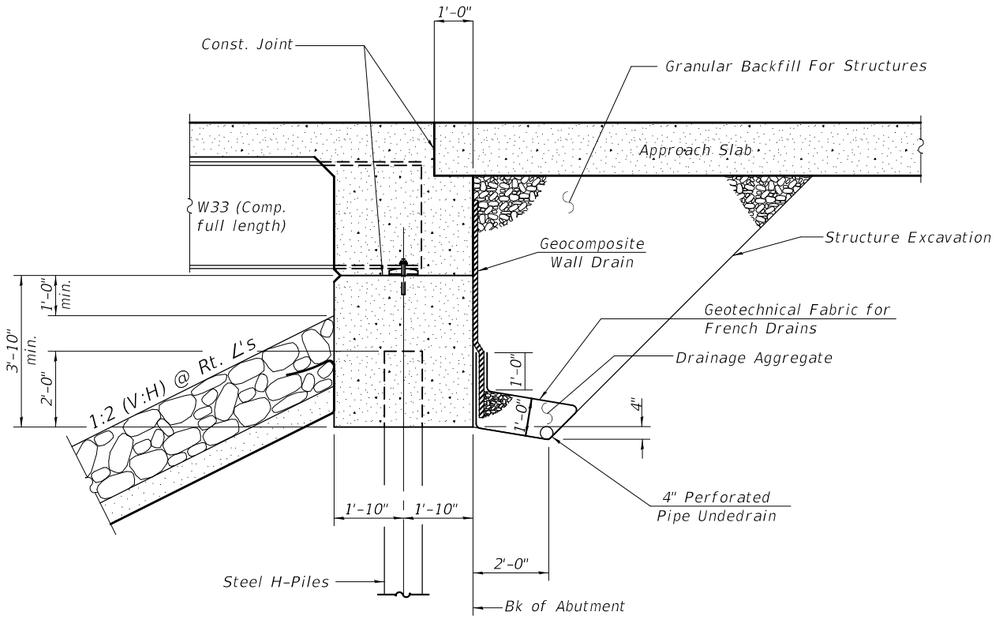


SECTION A-A



PIER SKETCH



SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. L's)

WATERWAY INFORMATION

Drainage Area = 16.0 sq. mi.

Existing Overtopping Elev. = 538.50 at Sta. 3298+22

Proposed Overtopping Elev. = 538.50 at Sta 3298+22

Flood Event	Freq Yr.	Discharge Ft^3/s	Waterway Opening - ft^2		Natural H.W.E. ft.	Head - ft.		Headwater Elevation ft.	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	3440	390	521	529.4	1.6	1.2	531.0	530.6
Design	50	5670	460	648	530.5	2.9	1.6	533.4	532.1
Base	100	6680	493	707	531.0	3.5	1.8	534.5	532.8
Scour Design Check	200	7747	513	743	531.3	4.2	2.1	535.5	533.4
Overtop Existing	–	–	–	–	–	–	–	–	–
Overtop Proposed	–	–	–	–	–	–	–	–	–
Max Calc.	500	9230	548	798	531.8	5.1	2.5	536.9	534.3

10 year velocity through existing bridge = 7.8 ft./sec

10 year velocity through proposed bridge = 5.6 ft./sec

DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.)				
	W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	531.76	506.3	506.3	534.3	5
Q200	531.76	505.1	505.1	534.3	
Design	531.76	506.3	506.3	534.3	
Check	531.76	505.1	505.1	534.3	

DETAILS
U.S. 40 OVER EAST MILL CREEK
F.A.S. RTE. 1707 - SECTION (BXB)B-1
CLARK COUNTY
STA. 300+51.60
STRUCTURE NO. 012-0075

DESIGNED	-	JUSTIN T. BELUE
CHECKED	-	JOSUE D. ORTIZ-VARELA
DRAWN	-	GLENN W. STOVER
CHECKED	-	RICHARD J. CHAPUT

9/23/2020 - 10:30:17 AM

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1707	(BXB) B-1	CLARK	_	_
		CONTRACT NO. 74360		
	ILLINOIS FED. AID PROJECT			

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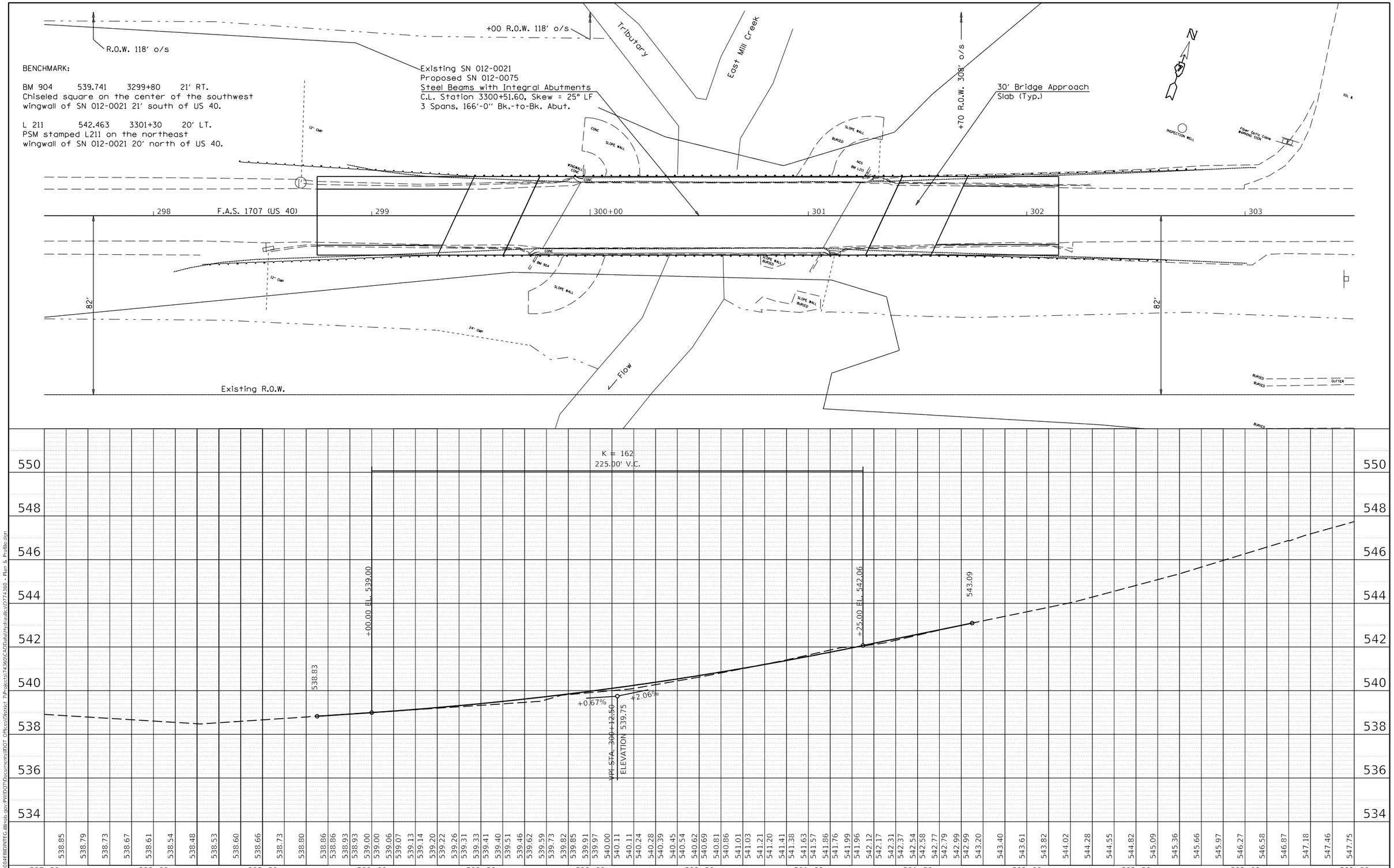

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
R.M. NOTED
STRUCTURE NOTATIONS CHKD
NOTE BOOK
NO.

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	DRAWN - RW	REVISED -
PLOT SCALE = 40.0000 ' / in.	CHECKED - DPM	REVISED -
PLOT DATE = 1/9/2019	DATE - 1/9/2019	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PLAN & PROFILE
EX. SN 012–0021 & PR. SN 012–0075

SCALE: 20 Scale | SHEET 1 OF 1 SHEETS | STA. 297+50 | TO STA. 303+50

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1707	(BXB)B-1	CLARK		
		CONTRACT NO. 74360		
	ILLINOIS FED. AID PROJECT			

Appendix C: Boring Logs

Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 1/8/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

BORING NO. 1 West Abutment
Station 3299+71
Offset 10.0ft North
Ground Surface Elev. 539.31 ft

Surface Water Elev. 521.02 ft
Stream Bed Elev. 519.52 ft

Groundwater Elev.:
▽ **First Encounter** 519.8 ft
▼ **Upon Completion** 522.8 ft
▼ **After** 48 **Hrs.** 522.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
5" Asphalt over 10" Concrete				Very soft, wet, gray, SANDY LOAM	3 3	0.23 S	21
538.06							
Brown, Sandy LOAM							
Soft, moist.	3				0		
	2 2	0.5 P	14		1 2	0.15 S	25
534.81							
-5 Very stiff, moist, brown, CLAY LOAM	1			514.31 -25	1		
	4 5	2.27 B	13	Medium, moist, gray CLAY	1 2	0.82 B	28
532.31							
Stiff, moist, brown, SILTY CLAY LOAM	3			*Stiff*	1		
	4 5	1.32 B	17		1 1	1.15 B	28
529.81							
-10 Stiff, moist, brown, CLAY LOAM	3			-30 *Medium*	1		
	3 4	1.03 B	15		2 3	0.82 B	24
Hard.	4						
	7 10	4.33 BS	9				
Stiff.							
-15	2			-35 *Stiff*	1		
523.81	4 6	1.65 BS	10		2 3	1.40 B	19
Gray, SILTY LOAM							
Soft, moist.	2						
	2 6	0.49 B	28				
▽ 519.31 -20	1			499.81 Soft, moist, gray, SILTY LOAM -40	5		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, Form 137 (Rev. 8-99)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\CLARK CO (012)\012-0021 SOIL ROCK 2019.GPJ Data Template D6TEMPLT.GDT Date Printed 4/22/19
Latitude N 39.379571 Longitude W 87.736120 Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 1/8/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

BORING NO. 1 West Abutment
Station 3299+71
Offset 10.0ft North
Ground Surface Elev. 539.31 ft

Surface Water Elev. 521.02 ft
Stream Bed Elev. 519.52 ft

Groundwater Elev.:
First Encounter 519.8 ft
Upon Completion 522.8 ft
After 48 **Hrs.** 522.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	3 4	0.49 B	24	Soft, moist, gray, SILTY LOAM *(continued)*
494.81				
-45	2			Medium, moist, gray, SANDY LOAM
	2 3	0.74 B	18	
489.81				
-50	13			Stiff, moist gray, SILTY LOAM with fine-graded SAND
	6 7	1.65 B	18	
-55				
479.81				
-60	6			
	14 16	4.12 B	18	Hard, moist, gray, CLAY LOAM TILL *(continued)*
-65				
469.81				
-70	6			Hard, moist, gray, CLAY TILL
	10 15	4.53 B	18	
-75				
461.31				
	50			Very dense, moist, gray SANDY CLAY SHALE
	1-1/2" 50	NT	8	
459.31 -80	1/2"			

Borehole continued with rock

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, Form 137 (Rev. 8-99)

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Latitude N 39.379571 Longitude W 87.736120 Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

ROCK CORE LOG

Date 1/8/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

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

Core Diameter 2.06 in
Top of Rock Elev. 459.31 ft
Begin Core Elev. 459.31 ft

BORING NO. 1 West Abutment
Station 3299+71
Offset 10.0ft North
Ground Surface Elev. 539.31 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray, weathered, shaley SANDSTONE	459.31		B1C1	87	48	2.2	
Rock Core B1C1 at depth 82.4' to 83.0' - Qu = 342 tsf							
No recovery at bottom 0.6' of core run.	454.31	-85					
Gray, weathered, shaley SANDSTONE			B1C2	100	58	2.4	
Rock Core B1C2 at depth 86.8' to 87.3' - Qu = 122 tsf	449.31	-90					
Extent of Exploration							
Benchmark: PSM Stamped L211 on NE Wingwall of Str No. 012-0021, Sta. 3301+30, 20' LT.		-95					
		-100					

Color pictures of the cores Available on Request
Cores will be stored for examination until 01/09/24
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 012-0021 SOIL ROCK 2019.GPJ D6TEMPLT.GDT 4/22/19

Field Rock Core Log a.xls

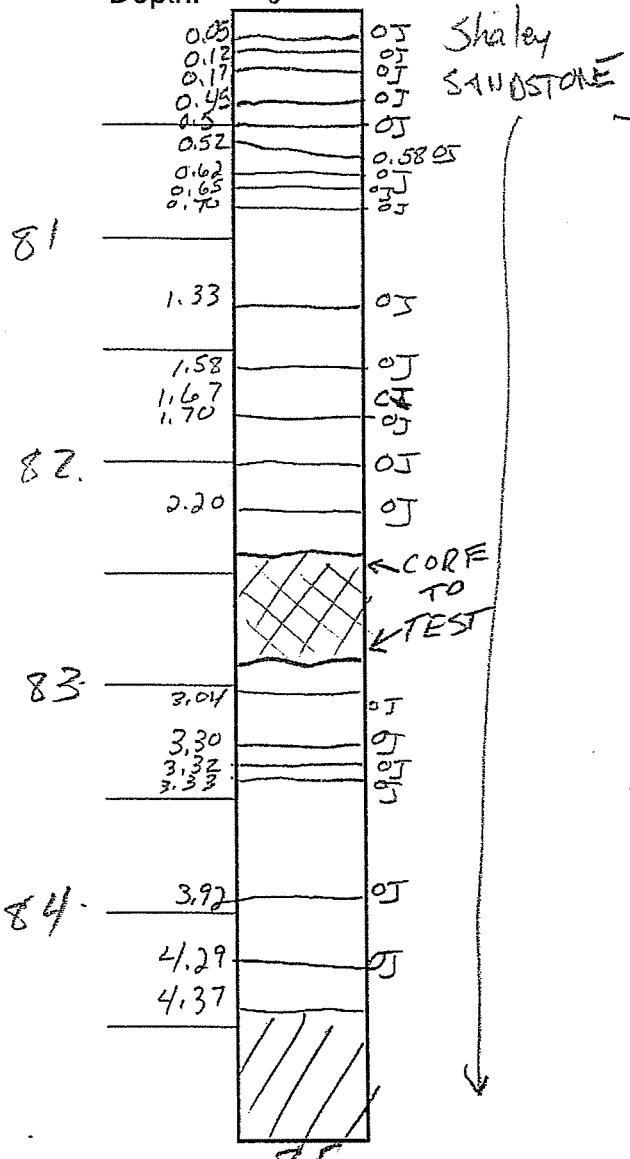
Field Rock Core Log

Date: 1-08-19

Structure #: 013-0021 Boring #: 1 WABUT

Rock Core #: 1

Depth: 80



RQD
7.5
10.0
6.5
4.5
29.5

Depth: 85

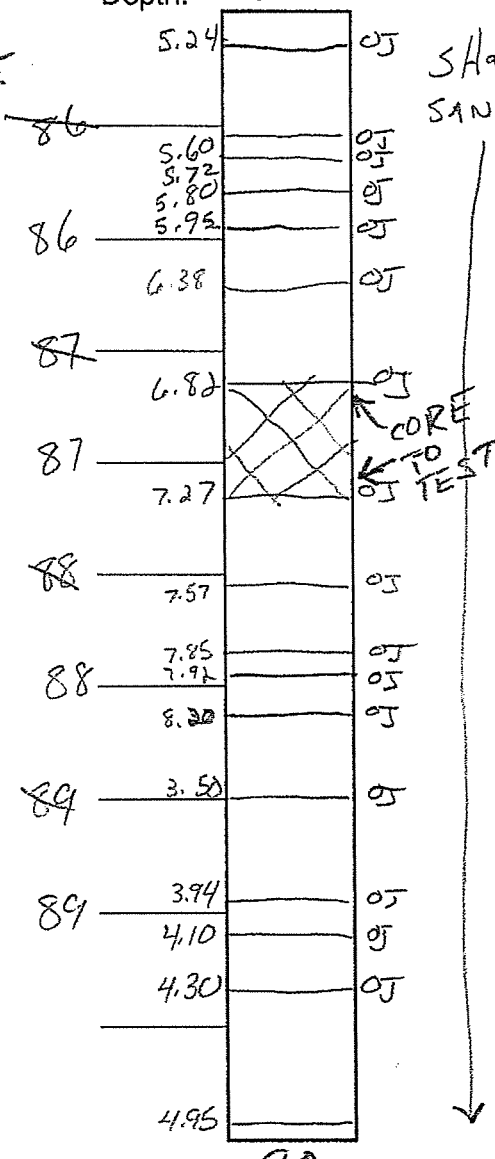
Core Time: 11:10

Recovery: 87%

RQD: 47.5

Rock Core #: 2

Depth: 85



RQD
5.5
5.0
5.0
5.25
5.5
7.75
34.5

Depth: 90

Core Time: 12:04

Recovery: 100%

RQD: 57.5

Logged By: Eric Sandschafer

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 3/12/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

BORING NO. 2 East Abutment
Station 3301+38
Offset 9.0ft South
Ground Surface Elev. 542.17 ft

Surface Water Elev. 521.02 ft
Stream Bed Elev. 519.52 ft

Groundwater Elev.:
▽ **First Encounter** 520.2 ft
▼ **Upon Completion** 523.2 ft
▼ **After** 48 **Hrs.** 523.7 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				3" Asphalt over 8-1/4" Concrete
				541.17
				Brown, SANDY CLAY
	4			*Medium, moist*
	4	0.87	12	
	3	S		
-5	1			
	3	0.87	12	
	3	S		
				535.17
	4			Soft, moist, brown, CLAY LOAM
	3	0.49	9	
	3	B		
-10	2			
	2	0.41	13	
	2	B		
	2			*Medium.*
	2	0.82	12	
	3	B		
-15	2			*Very stiff, brown-gray marbled.*
	3	2.06	19	
	5	B		
	3			
				524.47
	5	1.75	17	Stiff, moist, gray, SILTY CLAY LOAM
	8	S		▼ ▼
				522.67
-20	8			Soft, moist, gray, SANDY LOAM
	7	0.41	18	Soft, moist, gray, SANDY LOAM *(continued)*
	5	S		
				▽ 520.17
	3			Loose, wet, gray, fine-graded SAND
	4	NT	NT	
	5			
-25	3			
				516.67
	1	0.82	30	Medium, moist, gray, SILTY CLAY
	1	B		
	2			
	2	0.91	25	
	2	B		
-30	2			
	2	0.70	25	
	2	B		
				507.67
-35	2			Soft, moist, gray, SILT
	1	0.45	21	
	1	B		
				502.17
-40	10			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, Form 137 (Rev. 8-99)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\CLARK CO (012)\012-0021 SOIL ROCK 2019.GPJ Data Template D6TEMPLT.GDT Date Printed 4/22/19
Latitude N 39.379649 Longitude W 87.735551 Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 3/12/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

BORING NO. 2 East Abutment
Station 3301+38
Offset 9.0ft South
Ground Surface Elev. 542.17 ft

Surface Water Elev. 521.02 ft
Stream Bed Elev. 519.52 ft

Groundwater Elev.:
First Encounter 520.2 ft
Upon Completion 523.2 ft
After 48 **Hrs.** 523.7 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	9 12	2.89 B	13	Very stiff, moist, gray, CLAY LOAM TILL
-45	6			
496.67	7 8	2.47 B	15	Very stiff, moist, gray, SANDY LOAM TILL
492.67				
-50	6			Hard, moist, dark gray, CLAY LOAM TILL
	7 14	4.53 B	17	
-55				
482.67				
-60	5			
-65	36 46	0.92 S	17	Very dense, moist, gray, very fine graded SANDY LOAM with SILT *(continued)*
-70	19			
	21 24	2.76 S	18	
467.17 -75				Brown chert and blue SANDY CLAY SHALE
-80	35			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, Form 137 (Rev. 8-99)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\CLARK CO (012)\012-0021 SOIL ROCK 2019.GPJ Data Template D6TEMPLT.GDT Date Printed 4/22/19
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SOIL BORING LOG

Date 3/12/19

ROUTE FAS 1707 (US 40) **DESCRIPTION** East Mill Creek, 2 Mile West of Marshall **LOGGED BY** E. Sandschafer

SECTION (BXB) B-1 **LOCATION** NE, **SEC.** 28, **TWP.** 11N, **RNG.** 12W, 3 **PM**

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

STRUCT. NO. 012-0021 (E) 012-0075 (P)
Station 3300+30

BORING NO. 2 East Abutment
Station 3301+38
Offset 9.0ft South
Ground Surface Elev. 542.17 ft

Surface Water Elev. 521.02 ft
Stream Bed Elev. 519.52 ft

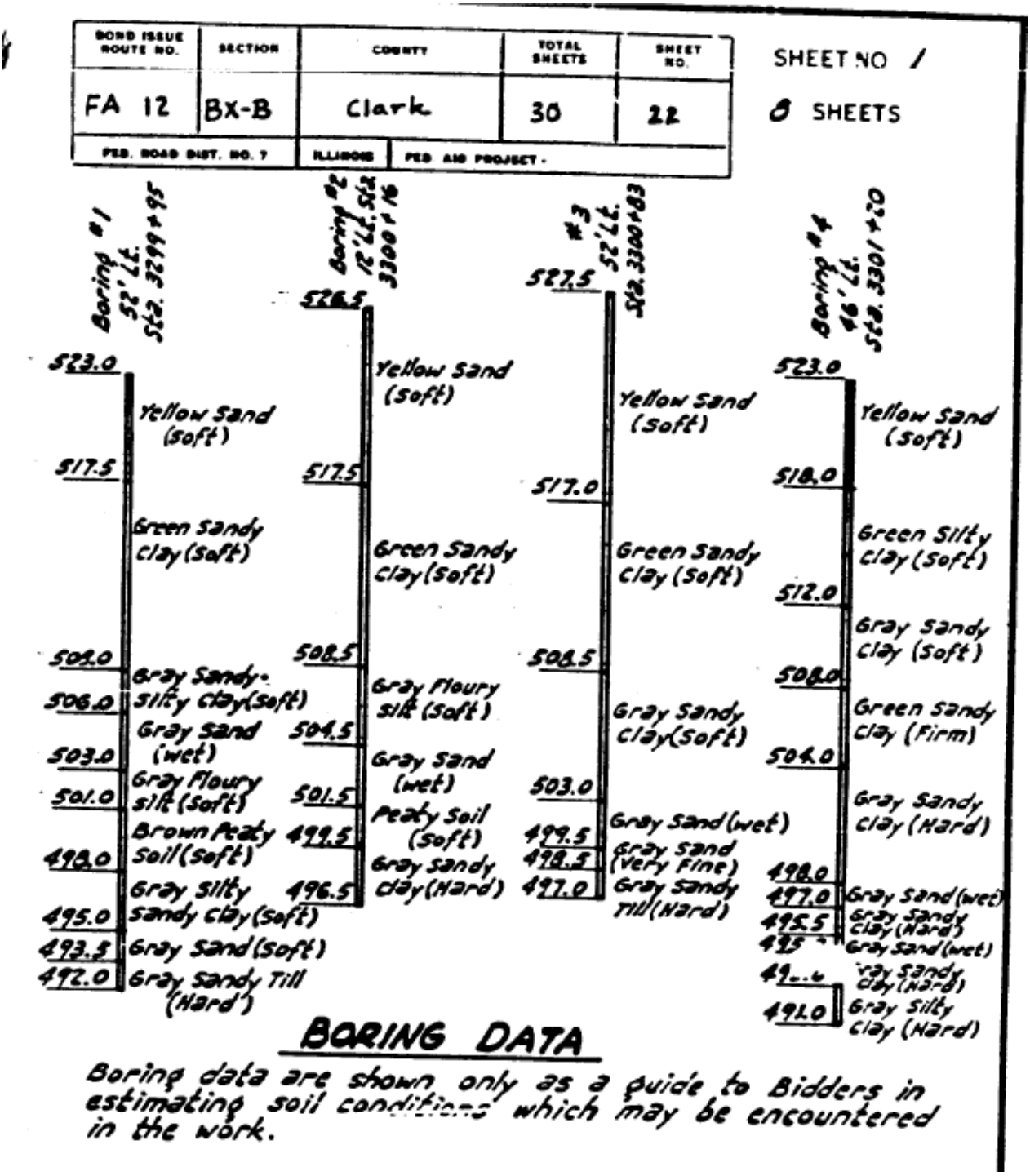
Groundwater Elev.:
First Encounter 520.2 ft
Upon Completion 523.2 ft
After 48 **Hrs.** 523.7 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Brown chert and blue SANDY CLAY SHALE *(continued)*		50 5" 43	NT	12
	457.67			
Very dense, moist, gray, CLAY SHALE	457.17 -85	50		
		7/16" 50	NT	14
Extent of Exploration		3/16" 50 3/16"		
Benchmark: PSM Stamped L211 on NE Wingwall of Str No. 012-0021, Sta. 3301+30, 20' LT.	-90			
	-95			
	-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, Form 137 (Rev. 8-99)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\CLARK CO (012)\012-0021 SOIL ROCK 2019.GPJ Data Template D6TEMPLT.GDT Date Printed 4/22/19
Latitude N 39.379649 Longitude W 87.735551 Datum Job Number

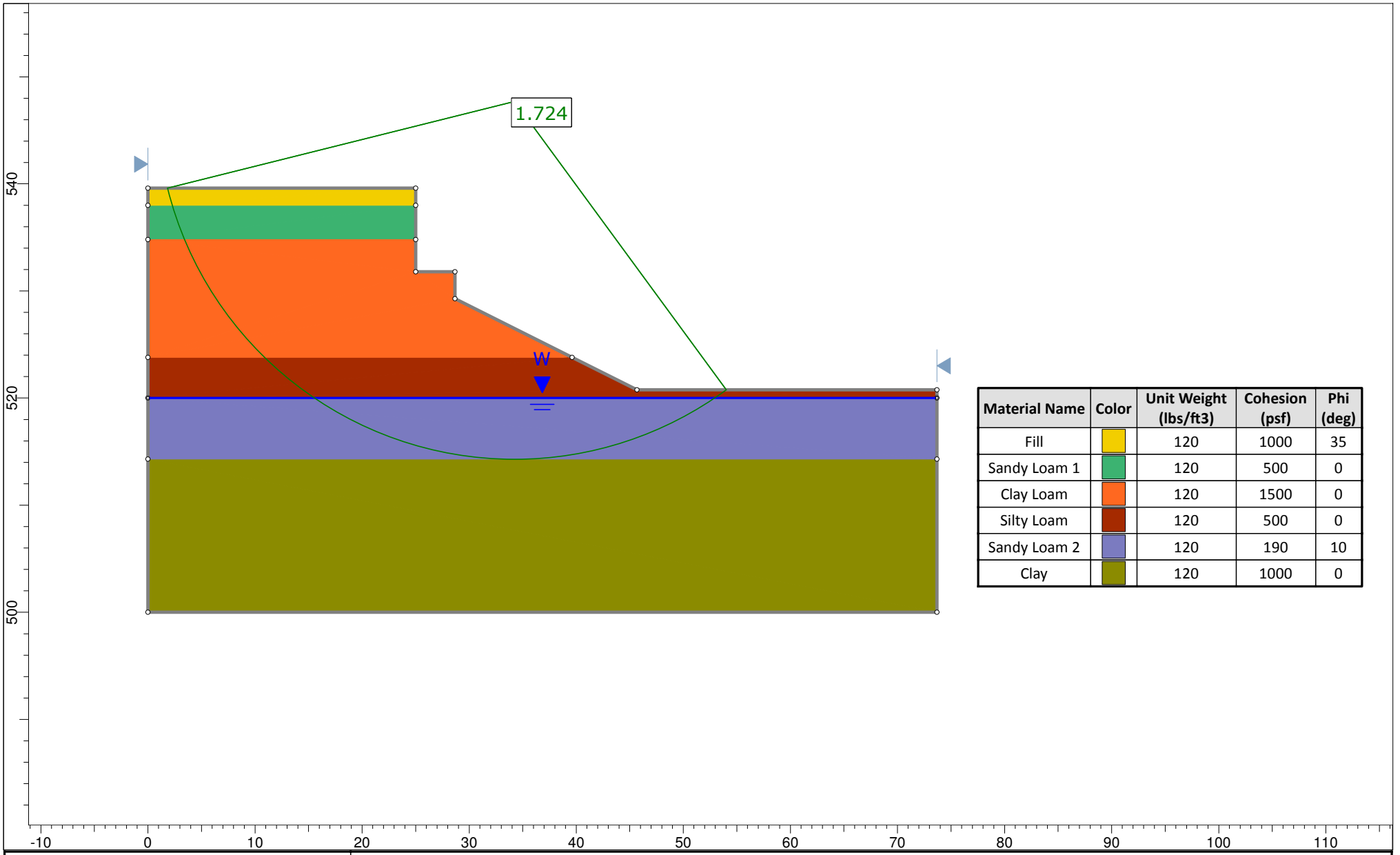
Historical Boring Logs (From Existing Structure 012-0021)



BORING DATA

Boring data are shown only as a guide to Bidders in estimating soil conditions which may be encountered in the work.

Appendix D: Slope Stability Analyses

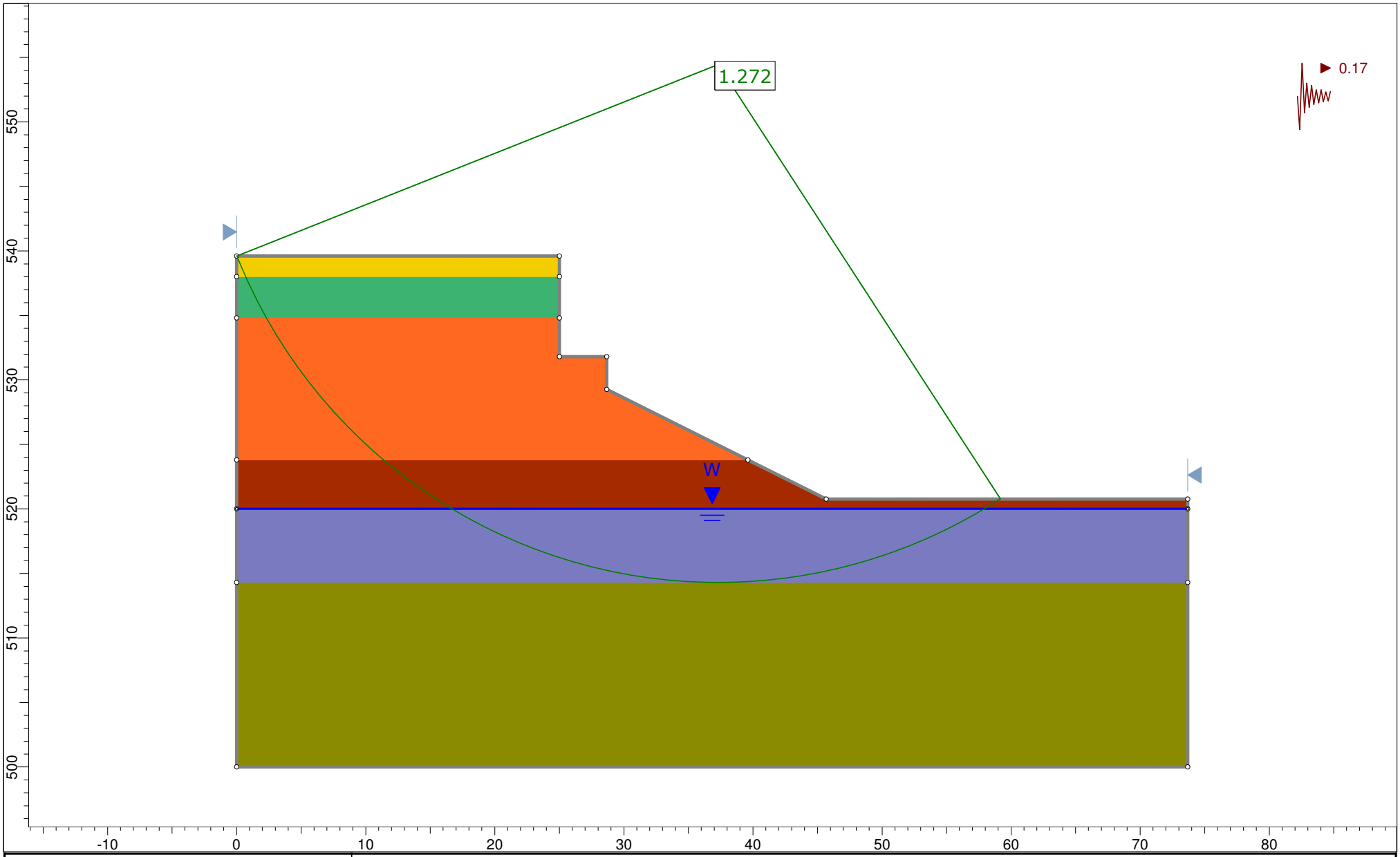


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1000	35
Sandy Loam 1		120	500	0
Clay Loam		120	1500	0
Silty Loam		120	500	0
Sandy Loam 2		120	190	10
Clay		120	1000	0

rocscience

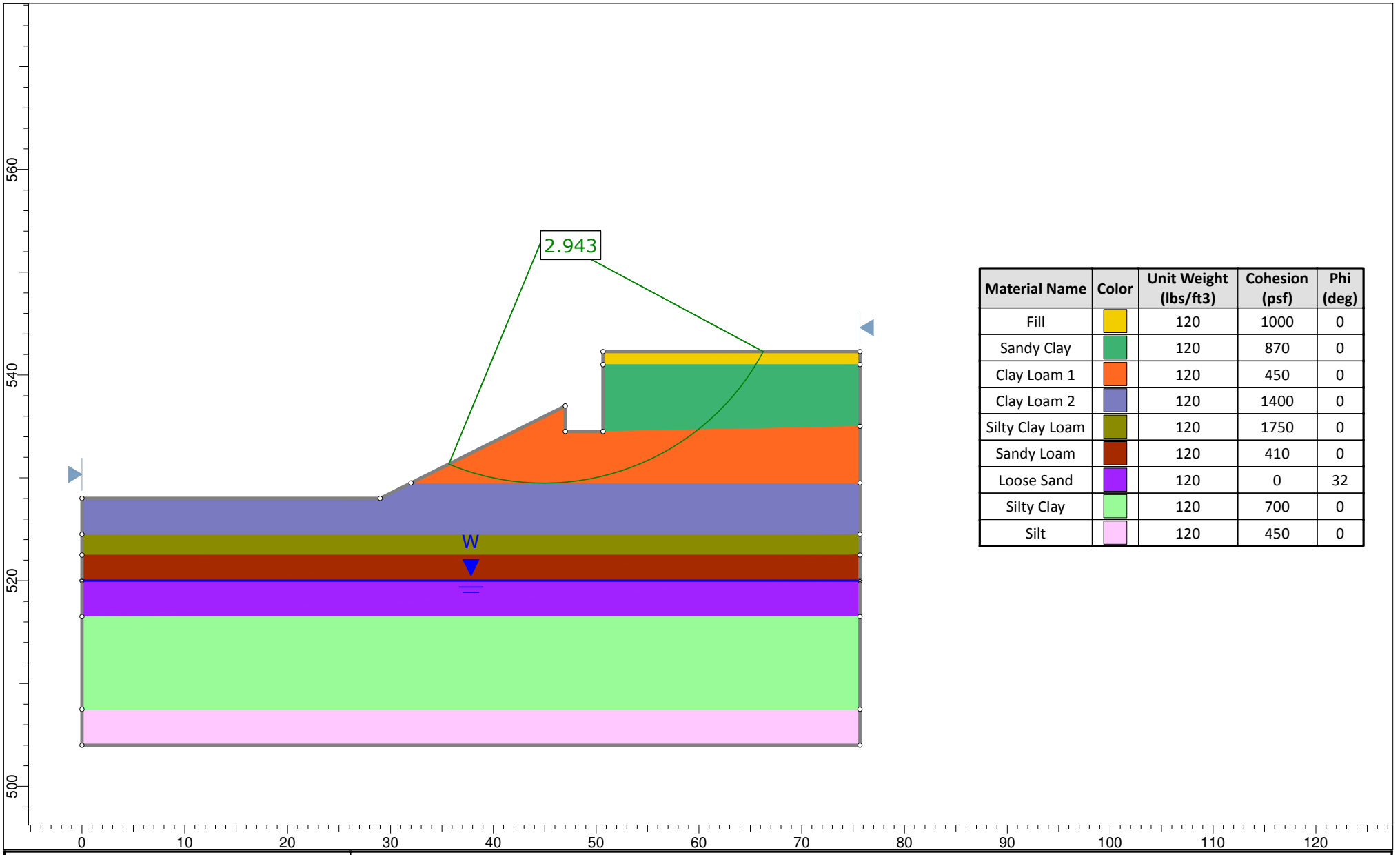
SLIDEINTERPRET 8.026

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		Scale 1:148	Company
Date	4/23/2020, 9:32:34 AM		File Name West Abutment.slmd



rocscience	Project: SLIDE - An Interactive Slope Stability Program		
	Analysis Description:		
	Drawn By:	Scale: 1:123	Company:
	Date: 4/23/2020, 9:32:34 AM		File Name: West Abutment_Seismic.slmd

SLIDEINTERPRET 8.026

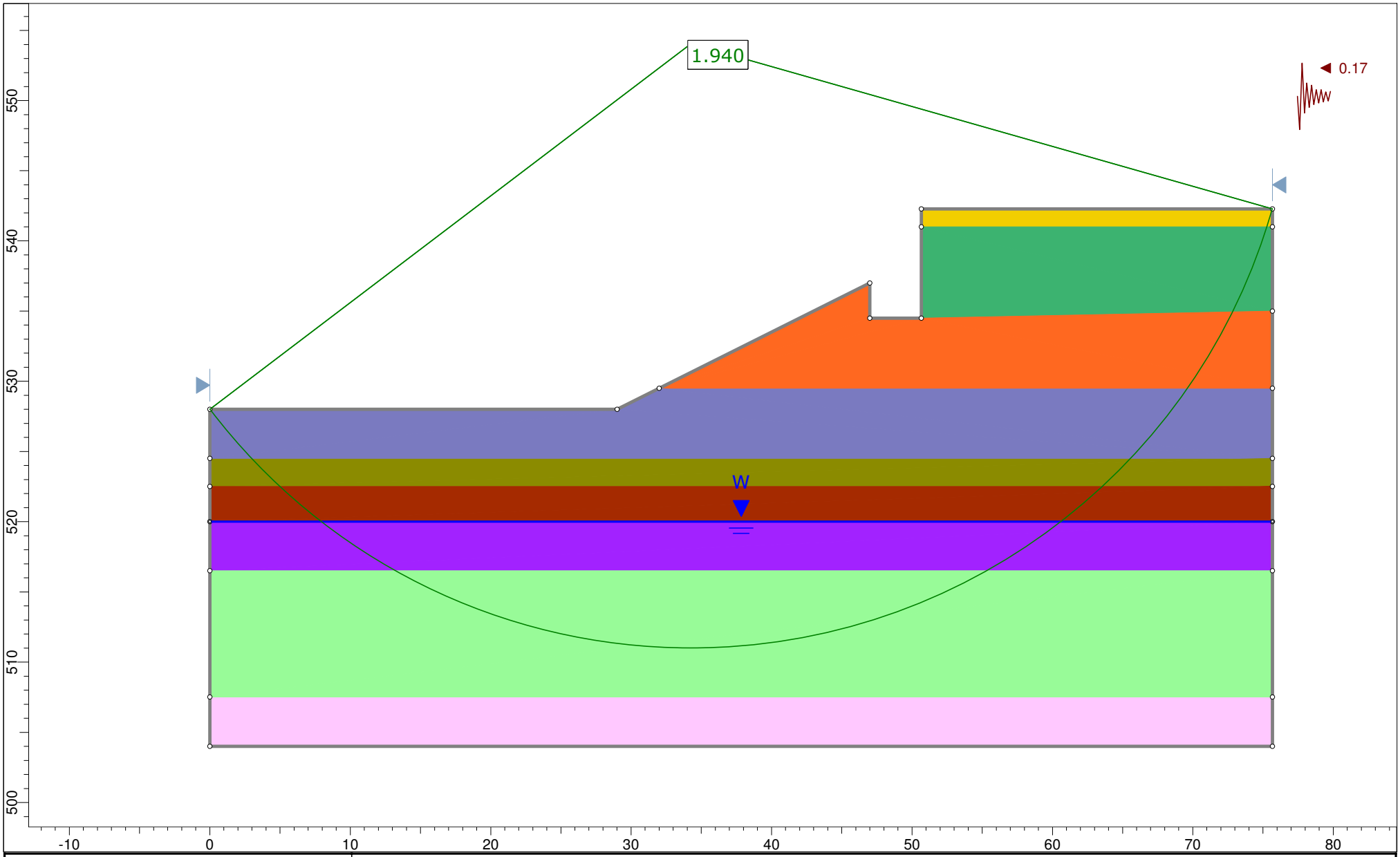


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Fill		120	1000	0
Sandy Clay		120	870	0
Clay Loam 1		120	450	0
Clay Loam 2		120	1400	0
Silty Clay Loam		120	1750	0
Sandy Loam		120	410	0
Loose Sand		120	0	32
Silty Clay		120	700	0
Silt		120	450	0

rocscience

SLIDEINTERPRET 8.026

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		*Scale* 1:154	*Company*
Date	4/22/2020, 4:54:07 PM		*File Name* East Abutment.slmd



rocscience	Project: SLIDE - An Interactive Slope Stability Program		
	Analysis Description:		
	Drawn By:	Scale: 1:113	Company:
	Date: 4/22/2020, 4:54:07 PM		File Name: East Abutment_Seismic.slmd

SLIDEINTERPRET 8.026

Appendix E: Design Scour Elevation Table

Design Scour Elevation Table

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	531.76	506.3	506.3	534.30	5
Q200	531.76	505.1	505.1	534.30	
Design	531.76	506.3	506.3	534.30	
Check	531.76	505.1	505.1	534.30	

Note: According to the All Bridge Designer Memo 14.2 – *Revised Scour Design Policy*, engineered scour countermeasures designed for the Q200 flood should be considered, since the Q100 scour is below the bottom of pile encasement and greater than 6 ft below the finished ground line at the proposed piers.

Appendix F: Design Spectral Accelerations and Liquefaction Analyses

Design Spectral Accelerations

Site-Adjusted Peak Ground Acceleration	0.170g
Design Spectral Acceleration at 1.0 sec. (SD1)	0.175g
Design Spectral Acceleration at 0.2 sec. (SDS)	0.365g

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== Boring 1 W Abut
ELEVATION OF BORING GROUND SURFACE ========== 539.31 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 19.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 10.21 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.041
EARTHQUAKE MOMENT MAGNITUDE ========== 7.8
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -7.60 FT. (Cut Depth)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.929**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **401** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.77
Source-To-Site Distance, R (km) = 351.44
Ground Motion Prediction Equations = NMSZ
PGA = **0.041**

	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
538.06	1.25	4	0.5				14	0.114	0.143	7.849	7.849	0.095								
535.06	4.25	4	0.5				14	0.114	0.485	7.111	7.111	0.089								
532.56	6.75	9	2.27				13	0.131	0.812	14.767	14.767	0.158								
530.06	9.25	9	1.32				17	0.125	1.125	14.250	14.250	0.153	0.125	0.206	0.206	1.500	**0.213**	0.983	**0.026**	**N.L. (1)**
527.56	11.75	7	1.03				15	0.122	1.430	10.721	10.721	0.120	0.122	0.511	0.511	1.399	**0.155**	0.954	**0.025**	**N.L. (1)**
525.06	14.25	17	4.33				9	0.140	1.780	26.849	26.849	0.334	0.140	0.861	0.861	1.354	**0.421**	0.921	**0.025**	**N.L. (1)**
522.56	16.75	10	1.65				10	0.127	2.097	14.094	14.094	0.151	0.127	1.179	1.179	1.163	**0.163**	0.885	**0.024**	**N.L. (1)**
520.06	19.25	8	0.49	20	11	40	28	0.114	2.382	10.841	15.317	0.163	0.052	1.309	1.399	1.136	**0.172**	0.847	**0.024**	**N.L. (2)**
517.56	21.75	6	0.23	20	11	40	21	0.043	2.490	8.075	12.331	0.134	0.043	1.416	1.662	1.104	**0.138**	0.807	**0.025**	**N.L. (2)**
515.06	24.25	3	0.15	20	11	40	25	0.039	2.587	4.002	7.935	0.095	0.039	1.514	1.916	1.076	**0.095**	0.767	**0.026**	**N.L. (2)**
512.56	26.75	3	0.82	80	12	41	28	0.057	2.730	3.923	9.708	0.111	0.057	1.656	2.214	1.058	**0.109**	0.729	**0.026**	**N.L. (2)**
510.06	29.25	2	1.15	80	12	41	28	0.061	2.882	2.556	8.068	0.096	0.061	1.809	2.523	1.035	**0.093**	0.693	**0.026**	**N.L. (2)**
506.31	33	5	0.82	80	12	41	24	0.057	3.096	6.188	12.425	0.135	0.057	2.023	2.970	1.012	**0.127**	0.646	**0.025**	**N.L. (2)**
501.31	38	5	1.4	80	12	41	19	0.063	3.411	5.900	12.079	0.132	0.063	2.338	3.597	0.976	**0.120**	0.596	**0.024**	**N.L. (2)**
496.31	43	7	0.49	20	11	40	24	0.051	3.666	7.967	12.214	0.133	0.051	2.593	4.164	0.952	**0.118**	0.561	**0.024**	**N.L. (2)**
491.31	48	5	0.74	20	11	40	24	0.056	3.946	5.473	9.523	0.109	0.056	2.873	4.756	0.933	**0.094**	0.538	**0.024**	**N.L. (2)**
483.81	55.5	13	1.65	20	11	40	18	0.065	4.433	13.309	17.981	0.192	0.065	3.360	5.712	0.878	**0.156**	0.518	**0.023**	**N.L. (2)**
473.81	65.5	30	4.12				18	0.077	5.203	29.756	29.756	0.451	0.077	4.130	7.106	0.789	**0.331**	0.507	**0.023**	**N.L. (3)**
463.81	75.5	25	4.53	80	12	41	18	0.078	5.983	21.708	31.050	0.564	0.078	4.910	8.510	0.737	**0.387**	0.497	**0.023**	**N.L. (2)**
453.81	85.5	100	20				8	0.099	6.973	89.137	89.137	0.637	0.099	5.900	10.124	0.664	**0.393**	0.483	**0.022**	**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 ========== Boring 2 E Abut
ELEVATION OF BORING GROUND SURFACE ========== 542.17 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 22.17 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 12.80 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.041
EARTHQUAKE MOMENT MAGNITUDE ========== 7.8
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -7.87 FT. (Cut Depth)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.929**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **412** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.77
Source-To-Site Distance, R (km) = 351.44
Ground Motion Prediction Equations = NMSZ
PGA = **0.041**

	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
537.92	4.25	7	0.87					0.120	0.510	12.417	12.417	0.135								
535.42	6.75	6	0.87					0.120	0.810	9.631	9.631	0.110								
532.92	9.25	6	0.49					0.114	1.095	9.453	9.453	0.108	0.114	0.157	0.157	1.500	**0.151**	0.987	**0.026**	**N.L. (1)**
530.42	11.75	4	0.41					0.112	1.375	6.212	6.212	0.081	0.112	0.437	0.437	1.388	**0.105**	0.961	**0.026**	**N.L. (1)**
527.92	14.25	5	0.82					0.119	1.673	7.527	7.527	0.092	0.119	0.735	0.735	1.257	**0.107**	0.931	**0.025**	**N.L. (1)**
525.42	16.75	8	2.06					0.130	1.998	11.517	11.517	0.127	0.130	1.060	1.060	1.182	**0.139**	0.897	**0.024**	**N.L. (1)**
522.92	19.25	13	1.75					0.128	2.318	18.252	18.252	0.195	0.128	1.380	1.380	1.129	**0.204**	0.861	**0.023**	**N.L. (1)**
520.42	21.75	12	0.41	10	10	30	18	0.112	2.598	15.938	17.152	0.182	0.050	1.505	1.572	1.099	**0.186**	0.822	**0.023**	**N.L. (2)**
517.92	24.25	9						0.060	2.748	11.642	11.642	0.128	0.060	1.655	1.878	1.062	**0.126**	0.784	**0.024**	**5.250 (D)**
515.42	26.75	2	0.82	40	11	40	30	0.057	2.890	2.538	8.046	0.096	0.057	1.797	2.177	1.037	**0.093**	0.746	**0.024**	**N.L. (2)**
512.92	29.25	4	0.91	40	11	40	25	0.058	3.035	4.972	10.967	0.122	0.058	1.942	2.478	1.021	**0.116**	0.710	**0.024**	**N.L. (2)**
509.17	33	4	0.7	40	11	40	25	0.055	3.241	4.826	10.791	0.120	0.055	2.149	2.918	0.997	**0.111**	0.661	**0.024**	**N.L. (2)**
504.17	38	2	0.45	10	8	30	21	0.050	3.491	2.328	3.248	0.060	0.050	2.399	3.480	0.976	**0.054**	0.609	**0.024**	**N.L. (2)**
499.17	43	21	2.89	30	10	41	13	0.072	3.851	24.329	32.789	1.064	0.072	2.759	4.152	0.906	**0.896**	0.573	**0.023**	**N.L. (2)**
494.17	48	15	2.47	20	10	40	15	0.070	4.201	15.851	20.725	0.225	0.070	3.109	4.814	0.892	**0.186**	0.548	**0.023**	**N.L. (2)**
486.67	55.5	21	4.53	30	10	41	17	0.078	4.786	21.089	29.049	0.413	0.078	3.694	5.867	0.823	**0.316**	0.527	**0.022**	**N.L. (2)**
476.67	65.5	82	0.92				17	0.058	5.366	87.713	87.713	0.626	0.058	4.274	7.071	0.755	**0.440**	0.514	**0.023**	**N.L. (3)**
467.17	75	45	2.76				18	0.071	6.041	42.487	42.487	0.192	0.071	4.948	8.338	0.712	**0.127**	0.504	**0.023**	**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

Appendix G: Pile Design Tables

Pile Design Tables

Table 1: West Abutment

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (ft.)
HP 12 X 53	418	230	73
HP 12 X 74	589	324	76
HP 12 X 84	664	365	76
HP 14 X 73	578	318	74
HP 14 X 89	705	388	76

Table 2: East Abutment

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (ft.)
HP 12 X 53	418	230	70
HP 12 X 74	589	324	73
HP 12 X 84	664	365	74
HP 14 X 73	578	318	71
HP 14 X 89	705	388	73

Table 3: Pier 1

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (ft.)
HP 12 X 53	418	210	71
HP 12 X 74	589	303	75
HP 12 X 84	664	345	75
HP 14 X 73	578	294	72
HP 14 X 89	705	364	74

Table 4: Pier 2

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (ft.)
HP 12 X 53	418	207	71
HP 12 X 74	589	300	74
HP 12 X 84	664	341	75
HP 14 X 73	578	290	72
HP 14 X 89	705	360	74