



## Abbreviated Structure Geotechnical Report

**Original Report Date:** 6/7/2022      **Proposed SN:** 012-0076      **Route:** FAS 1707  
**Revised Date:** 11/1/22      **Existing SN:** 012-0018      **Section:** (CX-B)B  
**Geotechnical Engineer:** BBS Foundations & Geotech Unit Bill Kramer      **County:** Clark  
**Structural Engineer:** BBS Bridge Planning Unit Nick Barnett      **Contract:** \_\_\_\_\_

**Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing):** *The proposed structure consists of a 3-span reinforced concrete deck on steel plate girders supported by integral abutments and pile bent piers. The proposed out-to-out width is 34'-10" and the back-to-back of abutments is 294'-0". The skew should be 25 degrees ahead left and the low beam elevation should be 575.4.*

**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):** *Existing Structure 012-0018 was originally constructed in 1954 as a 3-span reinforced concrete haunch T-beam superstructure with a reinforced concrete deck supported by open, counterfort abutments and solid wall piers on pile supported footings.*

**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:** *No significant fill is being placed so settlement is not a concern.*

**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:** *No significant fill is being placed so 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:** *The scour calculations in the Hydraulic report indicated 13.9 and 14.45 at the left bank (pier 1) and 12.46 and 12.93 on the right bank (pier 2) for the 100yr and 200yr flows respectively. The bottom of the pier encasement is at El. 564.70.*

*We attached scour adjustment calculations which reflect some reductions due to the cohesive soils at the surface. However, we recommend no reduction since the borings are not close, and the hydraulic and adjusted scour depths extend either into or very close to a thick granular layer, which make our adjustment calculation less reliable and thus we recommend no reductions which is reflected in the table below.*

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	West Abut.	Pier 1	Pier 2	East Abut.	
100 yr.	572.16	553.6	555.0	572.39	8
200 yr	572.16	553.1	554.6	572.39	
Design	572.16	553.6	555.0	572.39	
Check	572.16	553.1	554.6	572.39	

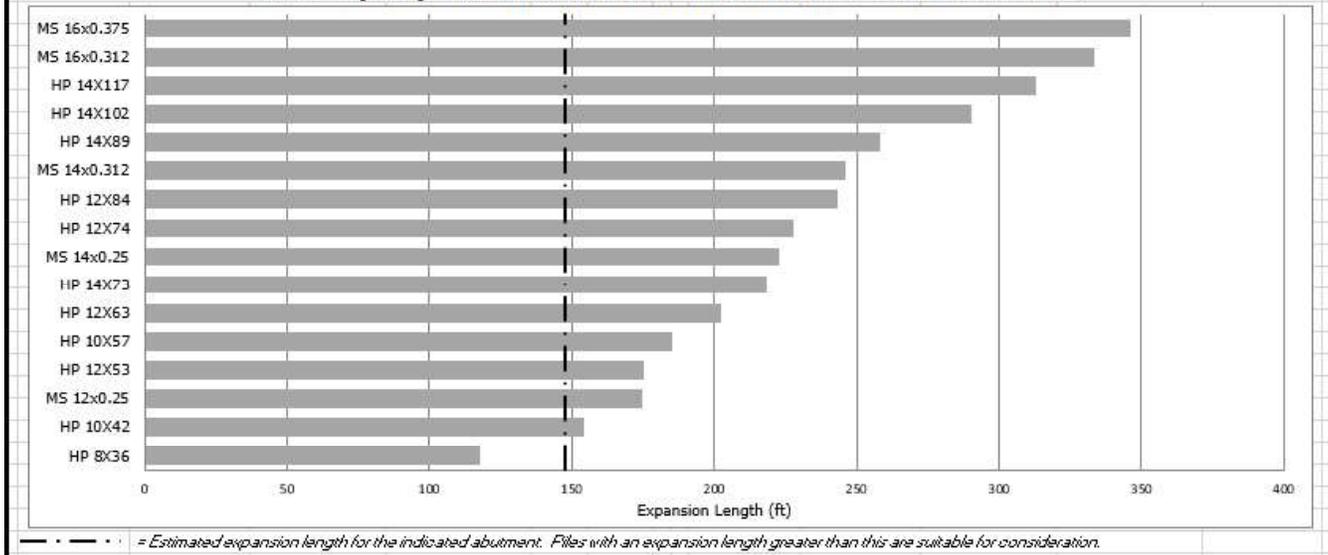
**Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable:** *Liquefaction is not an issue at this location and the seismic data run is attached and shown below:*

*Seismic Performance Zone 2  
 Design Spectral Acceleration at 1.0 sec (SD1) 0.181g  
 Design Spectral Acceleration at 0.2 sec (SDS) 0.385g  
 Soil Site Class D*

**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: Per ABD Memo 19.8 the Integral Abutment Pile Selection chart indicates, integral abutments are feasible. To see the piles are believed to work, see the table below:**

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1					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)	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)
568.50	1.50	1.8			563.00	1.00	3.1		
566.00	2.50	0.4			566.50	2.50	2.3		
563.50	2.50	1.4			564.00	2.50	1.6		
560.00	3.50	2.3			561.50	2.50	0.40		
					560.00	1.50	0.80		
10.00 FT = TOTAL DEPTH ENTERED					10.00 FT = TOTAL DEPTH ENTERED				
WEIGHTED AVERAGE Qu FOR ABUTMENT #1=====			153	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2=====			151	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1					PILE STIFFNESS MODIFIER FOR ABUTMENT #2				
= 1/(1.45-[0.3*1.53])=====			1.01		= 1/(1.45-[0.3*1.51])=====			1.00	
DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.01*6*0+1*6*294]/(1.01*6+1*6)=====					146.56	FT			
DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1*6*0+1.01*6*294]/(1*6+1.01*6)=====					147.44	FT			

**ABUT 2 (East) - EXPANSION LENGTH LIMIT CHART - 25.0 DEG. SKEW**



We recommend using 14" metal shell piles (min) at all substructures based on the deep distance to rock and shorter estimated lengths (see attached bearing vs. est. length tables, which are based on a pile cutoff elevation of 574.3). We also recommend conical tips at all substructures due to the stiff soils at depth.

The estimated pile lengths at the piers are shown in the attachments which assumes a pile cutoff elevation of 574.3. If pile bent is not feasible, we can use a solid wall pier stem on a pile supported footing, but the pile lengths would need to be reduced based on the reduction in the new pile cut off change. The pier pile lengths have accounted for scour and test piles are recommended at pier 1 and the east abutment.

**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 560.89 according to the Hydraulic Report dated 3/12/21 and confirmed by bridge planning. Cofferdams will not be necessary since the bottom of the substructures concrete is above the EWSE.

**Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns:** The retained height and soils below the abutment excavation indicate temporary sheet piling is feasible using an embedment of 10 ft .and a minimum section modulus of 15in3/ft. However after reviewing the final TSL, we see that construction will be completed using a road closure so no soil retention should be required. We recommend construction slopes be sloped and 1:1 per OSHA and see no problem with temporary slope stability.

Benchmark D211, Brass disk on wingwall at northwest corner of SN 012-0018, station 810+84, 19.01' left of C. Elevation 581.16.

Existing structure: SN 012-0018 was originally constructed in 1954 as a 3-span reinforced concrete haunch T-beam superstructure with a reinforced concrete deck supported by open, counterfort abutments and solid wall piers on untreated timber pile supported footings. The superstructure is composed of 5 concrete T-Beams integrated with a 7-inch thick reinforced concrete slab. The structure is 239'-6" long from back-to-back of abutment, and 35'-8" wide out-to-out of the deck, with a left forward 25 degree skew. The structure will be removed and replaced under road closure. No Salvage.

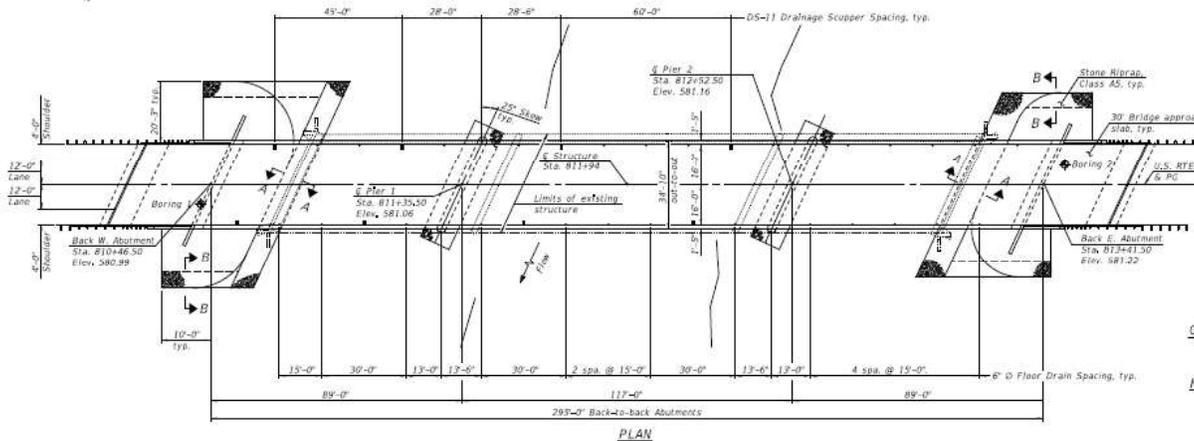
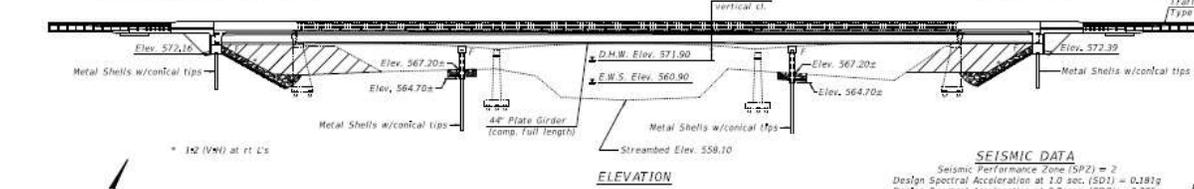
**DESIGN SPECIFICATIONS**

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

**LOADING HL-93**  
Allow 50k/sg, 11' Future wearing surface

Note: The profile grade shows the final elevations after grinding.

Note: See roadway plans for channel excavation.



**DESIGN STRESSES**

**FIELD UNITS**  
 F<sub>c</sub> = 4,000 psi (Superstructure)  
 F<sub>c</sub> = 3,500 psi (Substructure)  
 F<sub>y</sub> = 60,000 psi (Reinforcement)  
 F<sub>y</sub> = 50,000 psi (M270 Grade 50)  
 All structural steel shall be metallized

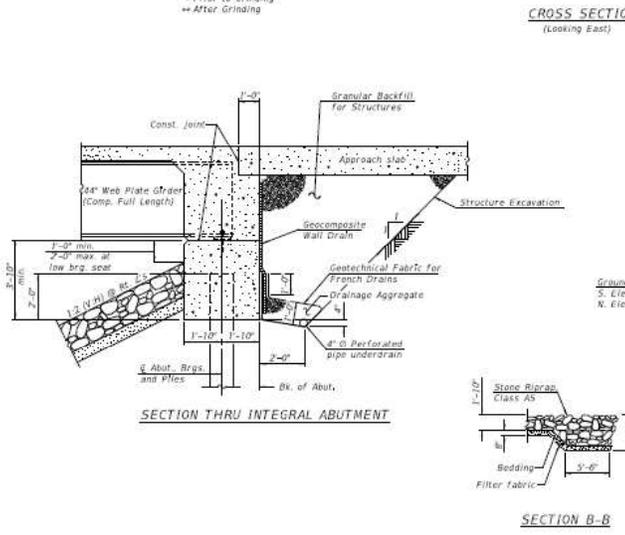
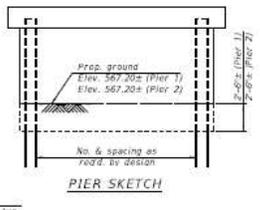
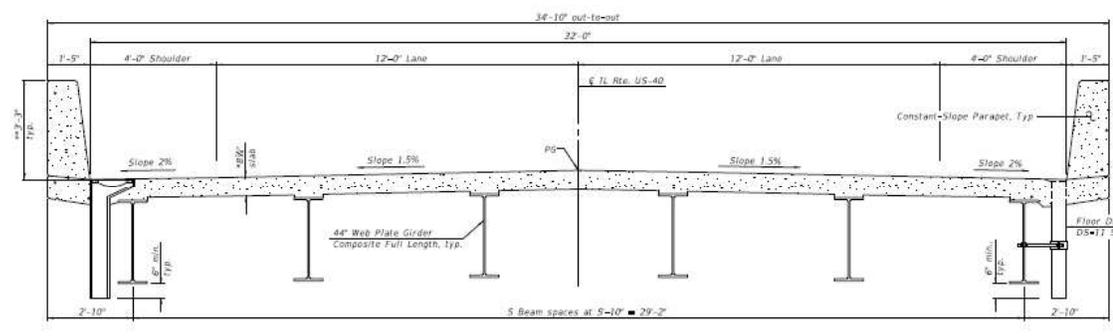
**HIGHWAY CLASSIFICATION**

FAS 1707  
 Functional Class: Major Collector  
 ADT: 2350 (2024), 2800 (2044)  
 ADTT: 350 (2024), 417 (2044)  
 DWT: 282 (2024), 336 (2044)  
 Design Speed: 60 m.p.h.  
 Posted Speed: 55 m.p.h.  
 2-Way Traffic  
 Directional Distribution: 51:49

DESIGNED BY	MICHAEL S. BARNETT
CHECKED BY	NEPHTEL PERA MARTINEZ
DRAWN BY	ALAN JOHNSTON
CHECKED BY	NARAYANAK

STATE OF ILLINOIS  
DEPARTMENT OF TRANSPORTATION

TAXI	SECTION	COUNTY	TOTAL SHEETS
100	0207B	CLARK	30
CONTRACT NO. 1450			11-118



**WATERWAY INFORMATION TABLE**

Flood Event	Freq. Yr.	Discharge CFS	Waterway Opening-Ft.		Natural H.W.E. Ft.		Head-ft.	Headwater Elev. Ft.	
			Existing	Proposed	Existing	Proposed		Existing	Proposed
Design	10	8,040	1,544	1,871	576.2	0.8	QW	571.5	571.4
Base	50	12,800	1,745	2,137	571.9	1.6	Q	573.3	573.1
Scour Design FH	100	14,900	1,819	2,231	572.2	1.7	1.4	573.9	573.6
100 Yr. Calc.	500	16,250	1,882	2,286	572.3	1.9	1.6	574.4	574.1
100 Yr. Calc.	500	20,100	1,979	2,435	573.0	2.6	2.8	575.6	575.0

10 Year velocity through existing bridge = 5.2 ft/s  
 10 Year velocity through proposed bridge = 4.3 ft/s

**DESIGN SCOUR TABLE**

Event / Limit	Design Scour Elevations (ft.)				
	State	W. Abut.	Pier 1	Pier 2	E. Abut.
0.00	572.16	553.6	553.6	572.39	
0.00	572.16	553.1	554.6	572.39	
Design	572.16	553.6	555.0	572.39	
Check	572.16	553.1	554.6	572.39	

**DETAILS**  
 U.S. RTE. 40 OVER NORTH  
 FORK EMBARRAS RIVER  
 F.A.S. RTE.1707 - SEC. (CX)-BIB  
 CLARK COUNTY  
 STATION 811+94.00  
 STRUCTURE NO. 012-0076

DESIGNED BY	MICHAEL S. BARNETT
CHECKED BY	NEPHTEL PERA MARTINEZ
DRAWN BY	ALAN JOHNSTON
CHECKED BY	NARAYANAK

STATE OF ILLINOIS  
DEPARTMENT OF TRANSPORTATION

TAXI	SECTION	COUNTY	TOTAL SHEETS
100	0207B	CLARK	30
CONTRACT NO. 1450			11-118



**Illinois Department  
of Transportation**

Route	FAS 1707	Sheet	
Section	(C-XB)B	Comp By	NRB 5/2/2022
County	Clark	Chkd By	
Structure Number	012-0076		

**Substructure Loads for Foundation Design**

Loads applied: superstructure DL, substructure DL, live loads, approach slab load

**Dead Loads (Strength 1) - ABUTMENTS**

			Rxn	beams	Load	
Superstructure Reaction	DC1	(MDX Output)	31	6	186	k
Parapets	DC2	(MDX Output)	7	6	42	k
Future Wearing Surface	DW	(MDX Output)	14	6	84	k
Approach Slab	DC1	=1.25 (3.4k/')(34.8333')			148	k

		Length	Width	Height	Factor	
Diaphragm	DC1	38.43396	3.667	4.177	1.25	110
Cap	DC1	38.43396	3.667	3.5	1.25	92

**Live Load (Strength 1) - ABUTMENTS**

Live Load	LL	(see LL spreadsheet)				380	k
-----------	----	----------------------	--	--	--	-----	---

**ABUTMENT TOTAL 1043 k**

**Dead Loads (Strength 1) - PIERS**

			Rxn	beams	Load	
Superstructure Reaction	DC1	(MDX Output)	115	6	690	k
Parapets	DC2	(MDX Output)	25	6	150	k
Future Wearing Surface	DW	(MDX Output)	50	6	300	k

		Length	Width	Height	Factor	
Cap	DC1	42.833	2.5	2.5	1.25	50
Wall	DC1	42.5	2	16.060	1.25	256

*wall ht = bot of bm ele at P1 - 565 from Misc Info*

**Live Load (Strength 1) - PIERS**

Live Load	LL	(see LL spreadsheet)				592	k
-----------	----	----------------------	--	--	--	-----	---

**PIER TOTAL 2039 k**



**Illinois Department  
of Transportation**

Route	FAS 1707	Sheet	
Section	(C-XB)B	Comp By	NRB 4/22/2022
County	Clark	Chkd By	
Structure Number	012-0076		

**EWSE**

**Water Surface Adjustment in feet**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	3	4	5	6	7	8	9	10	11	12
1.5	1.5	0.75	0	0.75	1.5	2.25	3	3.75	3	2.25	1.5

Existing Water Surface Elevation 559.39 *File*

Top of Bank Elevation 564.89 *File*

Streambed Elevation 557.4 *File*

Month of Survey 12 *File*

Adjustment 1.5 *ft*

April High Water Elevation 560.89 *Existing water elevation + adjustment*

Check Max Water Elevation

Assumed September Elevation 557.14 *April high water elevation - Sept. adjustment*

One foot above streambed 558.4

September Elevation 558.40 *Max of Assumed Sept. Elevation and One Foot above streambed*

75% Difference between Sept. Elevation and Top of Bank Elevation

563.27 = 0.75(Top of Bank Ele - Sept Ele) + Sept Ele

**Estimated Water Surface Elevation 560.89** *Minimum between April High Water and 75% Difference elevation*

ESTIMATED WATER SURFACE ELEVATION COMPUTATIONS  
KASKASKIA ENGINEERING GROUP, LLC  
12-Mar-21

Survey Date	12/30/2014		
Water Surface Elevation	559.39		<u>(Station 1+35)</u>
Correction for December	+1.5'		
EWSE	560.89		<u>METHOD 1</u>
Assumed September Elevation	$560.89 - 3.75 =$	557.14	
One foot above streambed elevation	$557.40 + 1.0 =$	558.40	<u>(Station 1954)</u>
558.40 > 557.14, therefore use 558.40			
Top of Bank Elevation	564.89		<u>(Station 1954)</u>
75% of (564.89-558.40) + 558.40	563.27		<u>METHOD 2</u>
560.89 < 563.27 therefore use 560.89	<b>560.89</b>		EWSE

### Input Data and Parameter Calculations

Select Geographic Region

Contermineous 48 States

Guidelines Edition

2007 AASHTO Bridge Design Guidelines

Specify Site Location by Latitude-Longitude or Zip Code

Latitude-Longitude : Recommended  Zip Code

Latitude (50.0 to 24.6):  Longitude (-125.0 to -65.0):

Calculate Basic Design Parameters

Probability of Exceedance:

Calculate Response Spectra

### Output Calculations and Ground Motion Maps

**Spectral Response Accelerations SDs and SD1**

Latitude = 39.339040  
Longitude = -087.897800

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1  
Site Class C - Fpga = 1.20, Fa = 1.20, Fv = 1.70

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.135	As - Site Class C
0.2	0.209	SDs - Site Class C
1.0	0.128	SD1 - Site Class C

**Contermineous 48 States**

2007 AASHTO Bridge Design Guidelines

**Spectral Response Accelerations SDs and SD1**

Latitude = 39.339040  
Longitude = -087.897800

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1  
Site Class D - Fpga = 1.57, Fa = 1.60, Fv = 2.40

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.181	As - Site Class D
0.2	0.385	SDs - Site Class D
1.0	0.181	SD1 - Site Class D

**Illinois Department of Transportation**

PROJECT TITLE=====

Substructure 1					Substructure 2				
Base of Substruct. Elev. (or ground surf for bent) 572 ft.					Base of Substruct. Elev. (or ground surf for bent) 572 ft.				
Pile or Shaft Dia. 12 inches					Pile or Shaft Dia. 12 inches				
Boring Number B-1					Boring Number B-2				
Top of Boring Elev. 580.7 ft.					Top of Boring Elev. 580 ft.				
Approximate Fixity Elev. 566 ft.					Approximate Fixity Elev. 566 ft.				
<b>Individual Site Class Definition:</b>					<b>Individual Site Class Definition:</b>				
N (bar): 20 (Blows/ft. Soil Site Class D <----Controls)					N (bar): 27 (Blows/ft. Soil Site Class D				
N <sub>u</sub> (bar): 43 (Blows/ft. Soil Site Class D					N <sub>u</sub> (bar): (Blows/ft. NA				
s <sub>v</sub> (bar): 0.59 (ksf) Soil Site Class E					s <sub>v</sub> (bar): 2.59 (ksf) Soil Site Class C <----Controls				
Seismic Soil Column	Bot. Of Sample	Sample	Layer Description		Seismic Soil Column	Bot. Of Sample	Sample	Layer Description	
Depth (ft)	Elevation (ft)	Thick. (ft)	N (tsf)	Qu (tsf)	Depth (ft)	Elevation (ft)	Thick. (ft)	N (tsf)	Qu (tsf)
	574.2	6.50	3	0.60		573.0	7.00	4	1.20
	571.7	2.50	5	1.80		570.5	2.50	7	3.10
	569.2	2.50	2	0.40	B	568.0	2.50	5	2.30
	566.7	2.50	2	1.40		565.5	2.50	2	1.60
1.8	564.2	2.50	3	2.30		563.0	2.50	2	0.40
4.3	561.7	2.50	8	2.30		560.5	2.50	6	0.80
6.8	559.2	2.50	2	0.30	B	558.0	2.50	3	2.50
9.3	556.7	2.50	7			555.5	2.50	3	0.40
11.8	554.2	2.50	3			553.0	2.50	3	0.20
14.3	551.7	2.50	9			550.5	2.50	4	
19.3	546.7	5.00	14			545.5	5.00	3	
24.3	541.7	5.00	17	0.20		540.5	5.00	11	
29.3	536.7	5.00	24		B	535.5	5.00	10	
34.3	531.7	5.00	46	4.10		530.5	5.00	14	
39.3	526.7	5.00	72	6.60		525.5	5.00	15	5.40
44.3	521.7	5.00	100	8.50	B	520.5	5.00	30	6.90
49.3	516.7	5.00	29			515.5	5.00	54	6.10
54.3	511.7	5.00	50			510.5	5.00	52	
59.3	506.7	5.00	50			505.5	5.00	54	
64.3	501.7	5.00	37			500.5	5.00	38	
69.3	496.7	5.00	50		B	495.5	5.00	30	
100.0	466.0	30.70	45	4.50		490.5	5.00	26	5.80
						80.5	485.5	5.00	100
						100.0	466.0	19.50	100

**Global Site Class Definition: Substructures 1 through 2**

N (bar): 24 (Blows/ft. Soil Site Class D

N<sub>u</sub> (bar): 43 (Blows/ft. Soil Site Class D

s<sub>v</sub> (bar): 1.73 (ksf) Soil Site Class D <----Controls

## SCOUR ANALYSIS FOR NON-GRANULAR CONDITIONS

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

Modified 5/28/2015

STRUCTURE NUMBER ===== 012-0076 boring 1

SUBSTRUCTURE UNIT ===== PIER 1 left bank

BORING LOCATION RELATIVE TO SUBSTRUCTURE UNIT ===== NEAR

BOTTOM OF SUBSTRUCTURE ELEVATION ===== 565.0

GROUND SURFACE ELEVATION AT SUBSTRUCTURE ===== 567.5

Q100 SCOUR DEPTH AT SUBSTRUCTURE PER APPROVED HYDRAULIC REPORT (HR Q100) ===== 13.90 FT

Q200 SCOUR DEPTH AT SUBSTRUCTURE PER APPROVED HYDRAULIC REPORT (HR Q200) ===== 14.45 FT

LAYER NO.	BOTTOM OF LAYER ELEV. (FT)	DEPTH BELOW SURFACE (FT)	LAYER THICK. (FT)	Qu VALUE (TSF) IF APPLICABLE	ROCK TYPE	SCOUR REDUCTION (%)	SCOUR RESISTANCE OF LAYER (FT)	REMAINING Q100 SCOUR BELOW LAYER (FT)	REMAINING Q200 SCOUR BELOW LAYER (FT)
1	565.5	2.0	2.00	0.4		0%	2.00	11.90	12.45
2	564.3	3.3	1.25	0.4		0%	1.25	10.65	11.20
3	563.0	4.5	1.25	0.8		25%	1.67	8.98	9.53
4	561.8	5.8	1.25	0.8		25%	1.67	7.32	7.87
5	560.5	7.0	1.25	2.5		50%	2.50	4.82	5.37
6	559.3	8.3	1.25	2.5		50%	2.50	2.32	2.87
7	558.0	9.5	1.25	0.4		0%	1.25	1.07	1.62
8	556.8	10.8	1.25	0.4		0%	1.25	0.00	0.37
9	555.5	12.0	1.25	0.2		0%	1.25		0.00
10	554.3	13.3	1.25	0		0%	1.25		
11	553.0	14.5	1.25	0		0%	1.25		
12	551.8	15.8	1.25	0		0%	1.25		
13	550.5	17.0	1.25	0		0%	1.25		
14	549.3	18.3	1.25	0		0%	1.25		
15	548.0	19.5	1.25	0		0%	1.25		

*\* Warning: Granular soil layers exist between the Adjusted and Hydraulic Report scour depths. The soil profile for the site should be evaluated to assess potential fluctuations in the vertical limits of soil layers between the boring log used for the analysis and the substructure location. Engineering judgment should be used in determining an adjusted scour depth.*

**STRENGTH LIMIT STATE ADJUSTED SCOUR (ADJ. Q100)**

UNADJUSTED Q100 SCOUR DEPTH ===== 553.6 FT

LAYER IN WHICH ADJUSTED Q100 SCOUR STOPS ===== LAYER 8

DEPTH INTO LAYER 8 AT WHICH SCOUR STOPS ===== 1.1 FT

DEPTH BELOW GROUND SURFACE TO ADJUSTED Q100 ===== 10.6 FT

TOTAL % ADJUSTMENT OF Q100 SCOUR =  $(1 - (10.57/13.9))$  = 24.0%

Q100 SCOUR ELEVATION ===== 556.9 FT

**EXTREME EVENT II ADJUSTED SCOUR (ADJ. Q200)**

UNADJUSTED Q200 SCOUR DEPTH ===== 553.1 FT

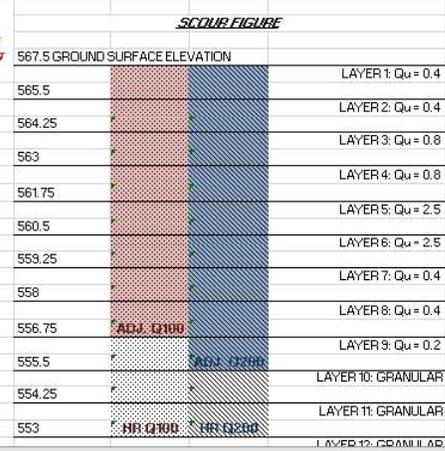
LAYER IN WHICH ADJUSTED Q200 SCOUR STOPS ===== LAYER 9

DEPTH INTO LAYER 9 AT WHICH SCOUR STOPS ===== 0.4 FT

DEPTH BELOW GROUND SURFACE OF ADJUSTED Q200 ===== 11.1 FT

TOTAL % ADJUSTMENT OF Q200 SCOUR =  $(1 - (11.12/14.45))$  = 23.1%

Q200 SCOUR ELEVATION ===== 556.4 FT



## SCOUR ANALYSIS FOR NON-GRANULAR CONDITIONS

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

Modified 5/28/2015

STRUCTURE NUMBER ===== 012-0076 boring 2

SUBSTRUCTURE UNIT ===== PIER 2 right bank

BORING LOCATION RELATIVE TO SUBSTRUCTURE UNIT ===== NEAR

BOTTOM OF SUBSTRUCTURE ELEVATION ===== 565.0

GROUND SURFACE ELEVATION AT SUBSTRUCTURE ===== 567.5

Q100 SCOUR DEPTH AT SUBSTRUCTURE PER APPROVED HYDRAULIC REPORT (HR Q100) ===== 12.46 FT

Q200 SCOUR DEPTH AT SUBSTRUCTURE PER APPROVED HYDRAULIC REPORT (HR Q200) ===== 12.93 FT

LAYER NO.	BOTTOM OF LAYER ELEV. (FT)	DEPTH BELOW SURFACE (FT)	LAYER THICK. (FT)	Qu VALUE (TSF) IF APPLICABLE	ROCK TYPE	SCOUR REDUCTION (%)	SCOUR RESISTANCE OF LAYER (FT)	REMAINING Q100 SCOUR BELOW LAYER (FT)	REMAINING Q200 SCOUR BELOW LAYER (FT)
1	566.3	1.3	1.25	2.30		50%	2.50	9.96	10.43
2	565.0	2.5	1.25	2.30		50%	2.50	7.46	7.93
3	563.8	3.8	1.25	2.30		50%	2.50	4.96	5.43
4	562.5	5.0	1.25	0.30		0%	1.25	3.71	4.18
5	561.3	6.3	1.25	0.30		0%	1.25	2.46	2.93
6	560.0	7.5	1.25	0.30		0%	1.25	1.21	1.68
7	558.8	8.8	1.25	0.00		0%	1.25	0.00	0.43
8	557.5	10.0	1.25	0.00		0%	1.25		0.00
9	556.3	11.3	1.25	0.00		0%	1.25		
10	555.0	12.5	1.25	0.00		0%	1.25		
11	553.8	13.8	1.25	0.00		0%	1.25		
12	552.5	15.0	1.25	0.00		0%	1.25		
13	551.3	16.3	1.25	0.00		0%	1.25		
14	550.0	17.5	1.25	0.00		0%	1.25		
15	548.8	18.8	1.25	0.00		0%	1.25		

*\* Warning: Granular soil layers exist between the Adjusted and Hydraulic Report scour depths. The soil profile for the site should be evaluated to assess potential fluctuations in the vertical limits of soil layers between the boring log used for the analysis and the substructure location. Engineering judgment should be used in determining an adjusted scour depth.*

**STRENGTH LIMIT STATE ADJUSTED SCOUR (ADJ. Q100)**

UNADJUSTED Q100 SCOUR DEPTH ===== 555.0 FT

LAYER IN WHICH ADJUSTED Q100 SCOUR STOPS ===== LAYER 7

DEPTH INTO LAYER 7 AT WHICH SCOUR STOPS ===== 1.2 FT

DEPTH BELOW GROUND SURFACE TO ADJUSTED Q100 ===== 8.7 FT

TOTAL % ADJUSTMENT OF Q100 SCOUR =  $(1 - (8.7/12.46))$  = 30.1%

Q100 SCOUR ELEVATION ===== 559.7 FT

**EXTREME EVENT II ADJUSTED SCOUR (ADJ. Q200)**

UNADJUSTED Q200 SCOUR DEPTH ===== 554.6 FT

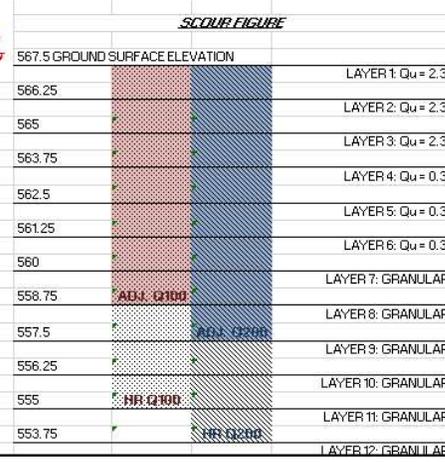
LAYER IN WHICH ADJUSTED Q200 SCOUR STOPS ===== LAYER 8

DEPTH INTO LAYER 8 AT WHICH SCOUR STOPS ===== 0.4 FT

DEPTH BELOW GROUND SURFACE OF ADJUSTED Q200 ===== 9.2 FT

TOTAL % ADJUSTMENT OF Q200 SCOUR =  $(1 - (9.18/12.93))$  = 29.0%

Q200 SCOUR ELEVATION ===== 559.7 FT



Pile Design Table for w Abutment utilizing Boring #B1								
Nominal			Factored			Estimated		
Required	Resistance	Pile	Required	Resistance	Pile	Required	Resistance	Pile
Bearing	Available	Length	Bearing	Available	Length	Bearing	Available	Length
(Kips)	(Kips)	(Ft.)	(Kips)	(Kips)	(Ft.)	(Kips)	(Kips)	(Ft.)
<b>Metal Shell 14"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
91	50	27	124	68	50	137	75	45
253	139	30	144	79	52	145	80	47
273	150	32	163	90	55	160	88	50
364	200	35	183	101	57	184	101	52
390	214	37	193	106	60	208	114	55
459	252	40	200	110	62	232	127	57
<b>Metal Shell 14"Φ w/.312" walls</b>			225	124	65	250	137	60
91	50	27	243	134	67	264	145	62
253	139	30	248	136	70	283	156	65
273	150	32	267	147	72	307	169	67
364	200	35	272	150	75	328	181	70
390	214	37	283	156	77	350	192	72
436	240	40	302	166	80	361	198	75
466	256	42	307	169	82	374	206	77
475	261	45	<b>Steel HP 10 X 57</b>			401	220	80
570	314	47	129	71	50	404	222	82
<b>Metal Shell 16"Φ w/.312" walls</b>			148	82	52	<b>Steel HP 14 X 73</b>		
105	58	27	168	92	55	135	75	40
315	173	30	188	103	57	147	81	42
339	186	32	198	109	60	157	86	45
454	250	35	206	113	62	166	91	47
484	266	37	229	126	65	182	100	50
540	297	40	249	137	67	210	115	52
573	315	42	254	140	70	238	131	55
581	319	45	274	151	72	266	146	57
654	359	47	279	153	75	289	159	60
<b>Metal Shell 16"Φ w/.375" walls</b>			290	159	77	305	168	62
105	58	27	310	170	80	325	179	65
315	173	30	314	173	82	353	194	67
339	186	32	<b>Steel HP 12 X 53</b>			379	209	70
454	250	35	137	75	47	404	222	72
484	266	37	149	82	50	430	237	75
540	297	40	172	95	52	449	247	77
573	315	42	196	108	55	478	263	80
581	319	45	219	120	57	483	266	82
610	336	47	239	131	60	<b>Steel HP 14 X 89</b>		
782	430	50	252	139	62	140	77	40

Pile Design Table for w pier 1 utilizing Boring #B1								
Nominal			Factored			Estimated		
Required	Resistance	Pile	Required	Resistance	Pile	Required	Resistance	Pile
Bearing	Available	Length	Bearing	Available	Length	Bearing	Available	Length
(Kips)	(Kips)	(Ft.)	(Kips)	(Kips)	(Ft.)	(Kips)	(Kips)	(Ft.)
<b>Metal Shell 14"Φ w/.25" walls</b>			<b>Steel HP 10 X 42</b>			<b>Steel HP 12 X 84</b>		
77	19	32	191	91	67	191	88	60
238	107	35	210	102	70	214	101	62
259	118	37	230	113	72	233	111	65
349	168	40	238	117	75	246	118	67
375	183	42	258	128	77	265	129	70
401	197	45	262	131	80	289	142	72
427	211	47	273	137	82	311	154	75
459	252	50	292	147	85	332	166	77
<b>Metal Shell 14"Φ w/.312" walls</b>			297	150	87	349	175	80
77	19	32	<b>Steel HP 10 X 57</b>			362	182	82
238	107	35	196	94	67	389	197	85
259	118	37	215	104	70	392	199	87
349	168	40	235	115	72	<b>Steel HP 14 X 73</b>		
375	183	42	245	121	75	189	85	57
401	197	45	264	131	77	217	100	60
427	211	47	269	134	80	245	115	62
453	226	50	280	140	82	268	128	65
570	314	52	300	151	85	284	137	67
<b>Metal Shell 16"Φ w/.312" walls</b>			304	154	87	305	148	70
88	21	32	<b>Steel HP 12 X 53</b>			333	164	72
299	137	35	202	95	62	359	178	75
322	150	37	222	105	65	304	192	77
437	213	40	235	113	67	410	206	80
467	230	42	252	122	70	433	219	82
497	246	45	275	135	72	457	232	85
526	262	47	297	147	75	469	239	87
556	279	50	317	158	77	<b>Steel HP 14 X 89</b>		
653	359	52	334	167	80	195	88	57
<b>Metal Shell 16"Φ w/.375" walls</b>			347	174	82	223	103	60
88	21	32	372	188	85	251	118	62
299	137	35	376	190	87	273	131	65
322	150	37	<b>Steel HP 12 X 63</b>			290	140	67
437	213	40	207	97	62	312	152	70
467	230	42	227	108	65	340	167	72
497	246	45	240	115	67	366	181	75
526	262	47	258	125	70	391	195	77
556	279	50	281	138	72	417	210	80
586	295	52	303	150	75	440	222	82
782	430	55	324	162	77	465	236	85

Pile Design Table for E pier 2 utilizing Boring #B2											
	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 14"Ø w/.25" walls</b>				<b>Steel HP 10 X 42</b>				<b>Steel HP 12 X 84</b>			
	184	83	42		198	99	62		201	98	55
	232	109	45		222	111	65		227	112	57
	459	252	47		241	122	67		246	122	60
<b>Metal Shell 14"Ø w/.312" walls</b>					246	125	70		260	130	62
	184	83	42		265	135	72		279	140	65
	232	109	45		270	138	75		303	153	67
	453	231	47	<b>Steel HP 10 X 57</b>					325	165	70
	486	249	50		196	97	60		346	177	72
	570	314	52		204	101	62		358	184	75
<b>Metal Shell 16"Ø w/.312" walls</b>					226	114	65	<b>Steel HP 14 X 73</b>			
	187	82	40		246	125	67		200	95	50
	221	101	42		252	128	70		213	102	52
	278	132	45		272	139	72		230	111	55
	562	288	47		277	141	75		260	128	57
	600	309	50	<b>Steel HP 12 X 53</b>					284	141	60
	653	359	52		189	91	55		300	150	62
<b>Metal Shell 16"Ø w/.375" walls</b>					214	105	57		321	162	65
	187	82	40		235	117	60		349	177	67
	221	101	42		248	124	62		375	191	70
	278	132	45		265	133	65		400	205	72
	562	288	47		288	146	67		426	219	75
	600	309	50		310	158	70	<b>Steel HP 14 X 89</b>			
	638	330	52		330	169	72		205	98	50
	782	430	55		343	176	75		218	105	52
<b>Steel HP 8 X 36</b>				<b>Steel HP 12 X 63</b>					236	115	55
	189	96	70		194	94	55		266	131	57
	204	104	72		219	108	57		290	144	60
	209	106	75		240	119	60		306	153	62
					254	127	62		328	165	65

Pile Design Table for E Abutment utilizing Boring #B2											
	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 14"Ø w/.25" walls</b>				<b>Steel HP 10 X 42</b>				<b>Steel HP 12 X 84</b>			
	96	53	22		134	74	45		136	75	42
	152	84	25		160	88	47		171	94	45
	161	89	27		169	93	50		202	111	47
	164	90	30		177	98	52		213	117	50
	172	95	32		189	104	55		224	123	52
	184	101	35		209	115	57		239	132	55
	191	105	40		212	116	60		265	146	57
	221	121	42		219	121	62		282	155	60
	459	252	45		249	137	65		291	160	62
<b>Metal Shell 14"Ø w/.312" walls</b>					262	144	67		317	174	65
	96	53	22		267	147	70		340	187	67
	152	84	25	<b>Steel HP 10 X 57</b>					354	195	70
	161	89	27		138	76	45	<b>Steel HP 14 X 73</b>			
	164	90	30		164	90	47		120	66	40
	172	95	32		173	95	50		156	86	42
	184	101	35		181	100	52		195	107	45
	191	105	40		193	106	55		232	128	47
	221	121	42		214	118	57		245	135	50
	268	147	45		217	119	60		257	141	52
	489	269	47		225	124	62		274	151	55
	523	287	50		255	141	65		304	167	57
	570	314	52		269	148	67		328	181	60
<b>Metal Shell 16"Ø w/.312" walls</b>					274	150	70		345	189	62
	112	62	22	<b>Steel HP 12 X 53</b>					365	201	65
	186	102	25		128	71	42		393	216	67
	196	108	27		161	88	45		419	231	70
	198	109	30		191	105	47	<b>Steel HP 14 X 89</b>			
	208	114	32		202	111	50		123	68	40
	222	122	35		212	117	52		160	88	42
	228	126	40		226	124	55		200	110	45
	262	144	42		251	138	57		237	130	47
	319	176	45		270	148	60		250	137	50
	604	332	47		279	153	62		262	144	52
	653	359	50		302	166	65		280	154	55
<b>Metal Shell 16"Ø w/.375" walls</b>					325	179	67		311	171	57
	112	62	22		339	187	70		334	184	60
	186	102	25	<b>Steel HP 12 X 63</b>					350	193	62
	196	108	27		132	72	42		372	205	65
	198	109	30		165	91	45		400	220	67
	208	114	32		196	108	47		426	234	70
	222	122	35		207	114	50	<b>Steel HP 14 X 102</b>			
	228	126	40		217	119	52		125	69	40
	262	144	42		231	127	55		162	89	42
	319	176	45		257	141	57		203	112	45
	604	332	47		273	150	60		241	132	47
	693	381	50		282	155	62		253	139	50
	782	430	52		308	170	65		266	146	52

		B#1				
	N Value	Qu	% Moist	Description		
590						
580				Pavement C Embankment		
	3	0.6 B	18			
	5	1.8 B	16			
570	2	0.4 B	19	CL Embankment		
	2	1.4 B	22			
	3	2.3 B	22			
	8	2.3 B	21	SaC		
560	2	0.3 B	24	SaL		
	7	NT NT	21	SaL		
	3	NT NT	NT	Sa		
	9	NT NT	21			
550	14	NT NT	NT			
	17	0.2 S	14	SaL		
540	24	NT NT	13	Sa		
				Sa		
	46	4.1 B	8	CL Till		
530	72	6.6 B	7			
	46	8.5 S	8			
520	29	NT NT	8	Sa		
				Sa		
	50	NT NT	8	Sa		
510	50	NT NT	NT			
	37	NT NT	12			
500	50	NT NT	10	Sa		
	45	4.5 B	11	CL Till		
490						

2810+43  
7.0ft South

		B#2				
	N Value	Qu	% Moist	Description		
590						
580				Pavement C Embankment		
	4	1.2 B	16			
	7	3.1 B	11			
570	5	2.3 B	13			
	2	1.8 B	18	SIC Embankment		
	2	0.4 B	25			
	6	0.8 B	21			
560	3	2.5 B	19	C		
	3	0.4 B	19	C		
	3	0.2 S	18	SaL		
	4	NT NT	20	Sa		
550	3	NT NT	17			
	11	NT NT	NT			
540	10	NT NT	NT	Sa		
	14	NT NT	13			
530	15	5.4 B	10	CL Till		
	30	6.9 S	9	SaCL Till		
520	54	6.1 S	10	Sa		
	52	NT NT	12			
510	54	NT NT	5			
	38	NT NT	11			
500	30	NT NT	11	Sa		
	26	5.8 B	8	CL Till		
490	NT NT	NT	17	Sa		
	NT NT	NT	11	Si		

2813+49  
7.0ft North





# SOIL BORING LOG

ROUTE FAS 1707 (US 40) DESCRIPTION US 40 over North Fork of Embarras River LOGGED BY Sandschafer

SECTION (CX-B)B LOCATION SW, SEC. 6, TWP. 10N, RNG. 13W, 2<sup>nd</sup> PM  
Latitude N 39.338838, Longitude W 87.898492

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

STRUCT. NO. 012-0018 (Existing)  
012-0076 (Proposed)  
Station 2811+94.00

BORING NO. 1 West Abutment  
Station 2810+43  
Offset 7.0 ft SOUTH  
Ground Surface Elev. 580.70 ft

D E P T H S H	B L O W S H S	U C S Qu	M U S T	Surface Water Elev.		D E P T H S H	B L O W S H S	U C S Qu	M U S T
				Elev.	ft				
				555.50	ft				
				554.30	ft				
				Groundwater Elev.:					
				556.7	ft				
				574.7	ft				
				565.7	ft				

Soil Description	ft	(ft)	(/6")	(tsf)	(%)	Soil Description	ft	(ft)	(/6")	(tsf)	(%)
Medium, wet, grey, fine-grained SAND with 1/4 to 1/2" angular gravel 16.4% passing #200 Sieve	536.20		11 13	NT NT	13	Medium, wet, grey, coarse, gravelly, SAND 70.9% passing #200 Sieve	516.20		13 16	NT NT	8
Hard, moist, grey, CLAY LOAM Till	-45		8 20 26		8	Dense, wet, medium, SAND with 1/2" to 1-1/2" angular gravel 12.8% passing #200 Sieve	-65		26 24 26	NT NT	8
	-50		16 33 39	6.6 B	7		-70		12 24 26	NT NT	NT
	-55		29 46 50 5"	8.5 S	8	10.8% passing #200 Sieve	-75		19 17 20	NT NT	12
	521.20										
	520.70	-60	10				500.70	-80	19		

SOIL BORING 012-0018 SCB1 2021.GPJ IL DOT.GDT 8/5/21

The Unclassified Compressive Strength (UCS) Failure Mode is indicated by (D-Dulge, 3-3linear, F-Permeometer, 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.









# SOIL BORING LOG

ROUTE FAS 1707 (US 40) DESCRIPTION US 40 over North Fork of Embarras River LOGGED BY Sandschafer

SECTION (CX-B)B LOCATION SW, SEC. 6, TWP. 10N, RNG. 13W, 3<sup>rd</sup> PM

Latitude N 39.339211, Longitude W 87.897544

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

STRUCT. NO. 012-0018 (Existing)  
012-0076 (Proposed)  
 Station 2811+94.00

BORING NO. 2 East Abutment  
 Station 2813+49  
 Offset 7.0 ft North  
 Ground Surface Elev. 580.72 ft

D E P T H	B L O W S	U C S	M O I S T
(ft)	(/6")	(tsf)	(%)

Surface Water Elev.	<u>555.50</u>	ft
Stream Bed Elev.	<u>554.30</u>	ft
Groundwater Elev.:		
First Encounter	<u>556.2</u>	ft $\nabla$
Upon Completion	<u>575.7</u>	ft $\nabla$
After <u>96</u> Hrs.	<u>566.7</u>	ft $\nabla$

With 1/2" to 1" gravel  
 12.6% passing #200 Sieve

	15	NT	11
	15	NT	

496.22

Hard, moist, grey, CLAY LOAM  
 Till

	6		
	8	5.8	8
	18	B	

491.22

Very dense, wet, grey,  
 fine-grained, SAND

	40		
	50	NT	17
	3-3/4"	NT	
	50		
	3-3/4"		

486.22

Very dense, moist, grey, very  
 fine-grained, SILTY SAND

	22		
	50	NT	11
	5-3/8"	NT	

484.72

Benchmark: National Geodetic  
 Survey Marker D 211 1959 -  
 Brass Disk set in top of the South  
 End Back Wall at the  
 West-Northwest Corner of SN  
 012-0018, 19 feet North of  
 Centerline.  
 End of Boring

	50		
	4-1/8"		