Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 2/7/2024	**Proposed SN:** 101-2053	**Route:**	Bypass 20/I-39
Revised Date: 4/4/2024	**Existing SN:** 101-2025	**Section:**	(201-3)K and (4-1,5)R
Geotechnical Engineer: Matt D. Masterson, PE		**County:**	Winnebago
Structural Engineer: Matthew Hellenthal. PE, SE		**Contract:**	64C24

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed new structure carrying I-39/US Rte. 20 over Madigan Creek will be a triple barrel concrete box culvert. Each barrel has an interior cross section of 9' across by 9' high, with an approximate length of 313'-0". See Location Map - Exhibit A, and the TS&L drawing - Exhibit C for more details.

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): Three boring logs, labeled B-1d, B-2d, and B-3, were provided to Kaskaskia Engineering Group, LLC. by IDOT. Borings B-1d and Boring B-2d were drilled in April 2008. Boring B-3 was drilled in August 2020. Location of the borings are shown on the attached Boring Location Plan (Exhibit B). Boring B-3 was drilled in the roadway on top of the embankment. In general, the subsurface condition for B-3 can be stratified into three layers. The top layer consisted mostly of sandy loam and had N-values ranging from 12 to 25 blows per foot (bpf), Qu values ranging from 0.8 to 4.5 tsf, and moisture contents ranging from 8.0 to 23.0 percent. The bottom of the top layer is at approximately El. 743. The middle layer consists of sand and sandy gravel with a bottom at approximately El. 732. The middle layer N-values ranged from 32 to 76 bpf, and no moisture contents were recorded. A third lower layer, which consisted of very dense sandy loam till, was encountered before termination. The boring was terminated at El. 716.62. The N-values for the bottom layer ranged from 17 to 51 bpf, with Qu values between from 1.4 to 2.3 tsf, and moisture contents ranging from 9.0 to 26.0 percent. Borings B-1d and B-2d were drilled near the openings of the culvert, and were taken down to depths of 28.5 ft BGE and 26 ft BGE respectively. Both borings encountered loam/sandy loam/sand/silt down to approximately El 716.1. N-values of these soils ranged from 6 to 27 bpf, with Qu values between 0.4 to 4.6 tsf, and moisture contents between 8 and 22 percent. Boring B-1d encountered very dense limestone at El 715.5 to termination at El 711. Blow counts for the limestone ranged from 47 bpf to 100 blows per 5" of penetration. Boring B-2d encountered hard Loam Till from El 716.1 to termination at El 711.6. N-values for the Loam Till ranged from 35 to 37 bpf, with UCS values between 4.6 and 6.3 tsf, and moisture contents of 8 percent. Detailed information regarding the nature and thickness of the soils encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs - Exhibit D and Subsurface Profile - Exhibit E.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary: The soil encountered in the boring at the anticipated bearing elevation of the culvert consist of a very dense Sandy Gravel. The assumed bearing elevation at the bottom of the culvert is El. 735.18ft +/-. The soil characteristics of Boring B-3 at the bearing elevation has a N-Value of 43 and a UCS of 0 tsf. The allowable bearing pressure for support of the new culvert in underlying, sandy gravel is estimated to be in excess of 45 ksf, using an LRFD Factor of 0.5. Sliding resistance was estimated at 187.5 psf. Applied pressures are not anticipated to be exceeded with the new construction. See Exhibit F for calculations performed.

Settlement calculations were done for the western portion of the culvert where new fill is being added. Settlement was calculated to be an estimated 0.5 inches for this portion of the culvert. The rest of the culvert will apply less or similar loading than the current existing load that will be removed, so no settlement is expected for this portion of the culvert. Due to the low magnitude of total settlement in only the western portion of the culvert, and thus use of a 2 foot unsuitable removal and replacement platform for uniform support of the culvert, no additional improvement/treatment is necessary. See Settlement Calculations - Exhibit G for additional details.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary: The slope geometries were analyzed in SLOPE/W for the upstream and downstream sides of the culvert, with a slope inclination of the fill slope of 1V:3H. For the upstream and downstream slopes, Boring B-3 was used for the soil parameters. Two conditions were modeled: end-of-construction (Undrained) and long-term (Drained). A critical factor of safety (F.O.S.) was calculated for each condition. According to the current standard of practice, the target F.O.S. is 1.5 for end-of-construction and long-term slope stability. The analysis for the upstream side of the culvert resulted in an end-of-construction F.O.S. of 3.5 and a long-term F.O.S. of 1.9. The analysis of the downstream side of the culvert resulted in an end-of-construction F.O.S. of 3.7 and a long-term F.O.S of 2.3. The results indicate that an acceptable F.O.S. will exist under undrained and drained conditions. No additional ground improvement/treatments are necessary for

long term support of the proposed slopes. Results of the slope stability analysis are attached in Exhibit H - Slope Stability Analysis.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations: Q100 for the proposed culvert is El. 745.66 and the Q500 is El. 746.73. A Q200 was not estimated for this structure. The upstream invert elevation is 737.38 ft. and the downstream invert elevation is 735.49 ft.

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: As per Bridge Manual v. 2012, Section 2.3.10, seismic data is not required for buried structures.

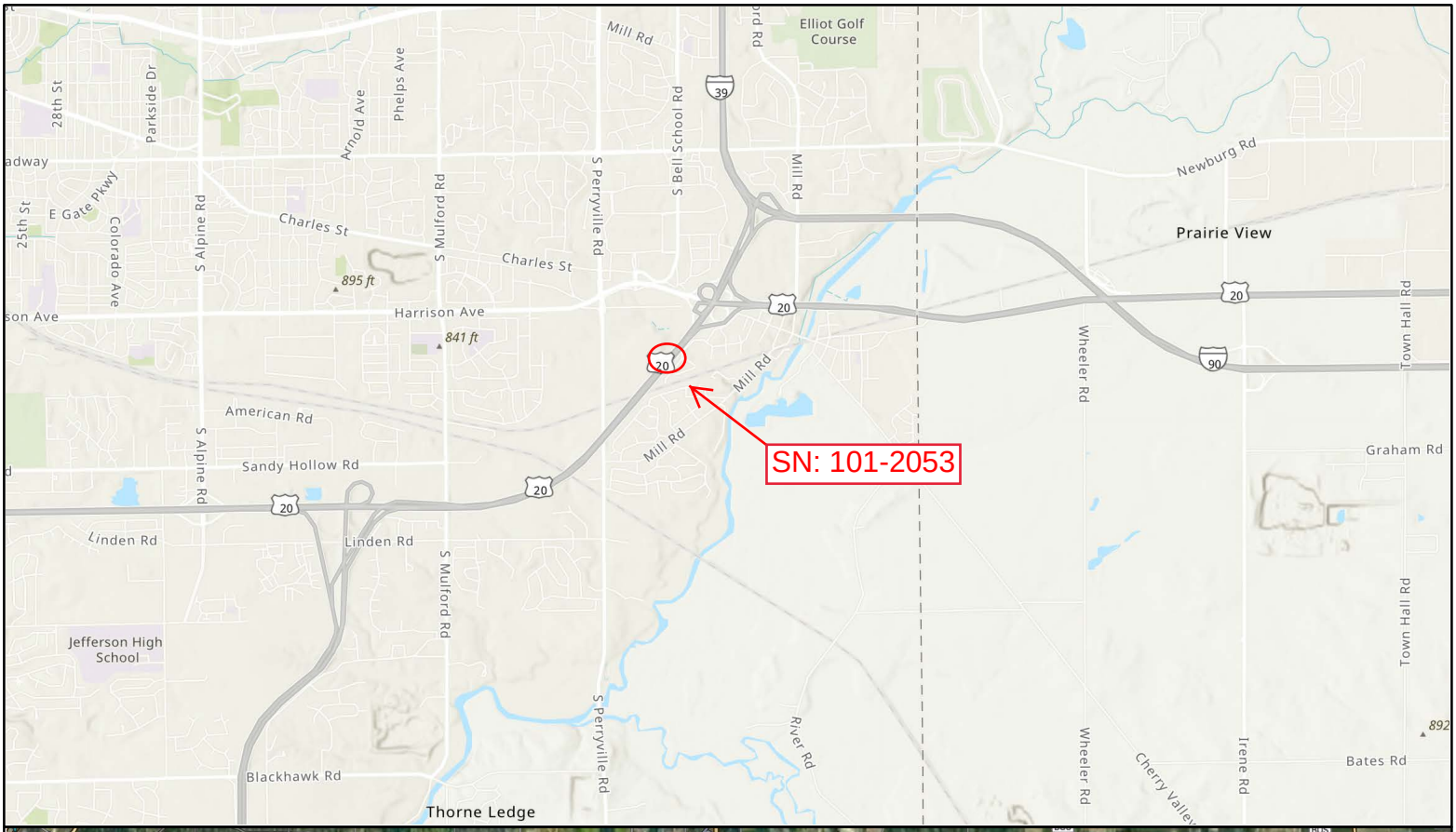
Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored 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 soils are sufficient for support of the proposed box culvert according to the analysis done for bearing capacity attached as Exhibit F.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: E.W.S.E: 737.9

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: Temporary Soil Retention Systems may be required for support of any required Stage construction for retained heights greater than 15 feet and should be designed in accordance with IDOT Design Guide 3.13.1 - Temporary Sheet Piling Design.

EXHIBIT A

LOCATION MAP



Kaskaskia Engineering Group, LLC

LOCATION MAP

I-39 over Madigan Creek
Section: (201-3)R & (4-1,5)R
Winnebago County, Illinois

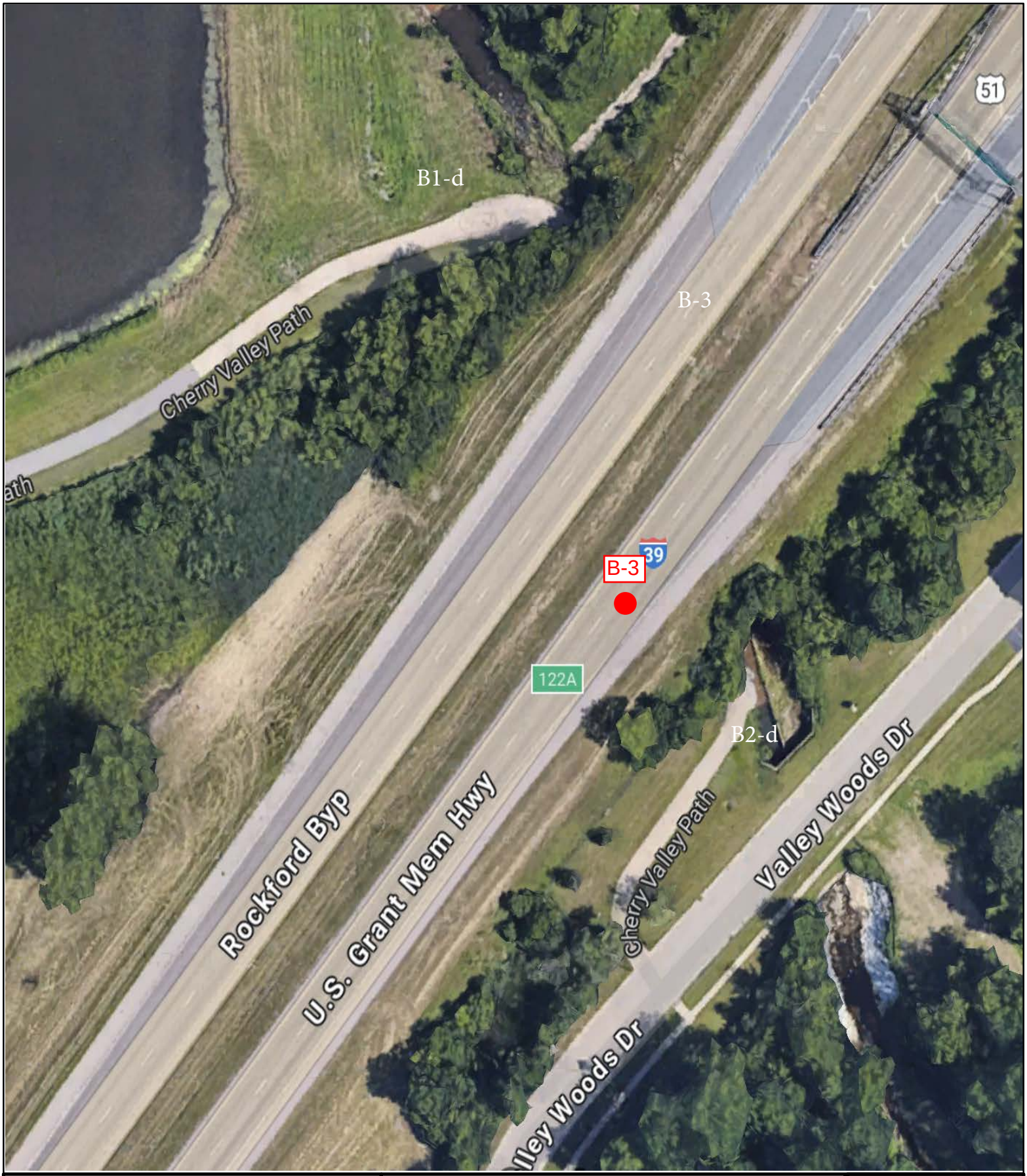
Exhibit No.

A

KEG JOB # 19-1138.00

EXHIBIT B

BORING PLAN



Kaskaskia Engineering Group, LLC

BORING PLAN

I-39 over Madigan Creek
Section: (201-3)R & (4-1,5)R
Winnebago County, Illinois

Exhibit No.

B

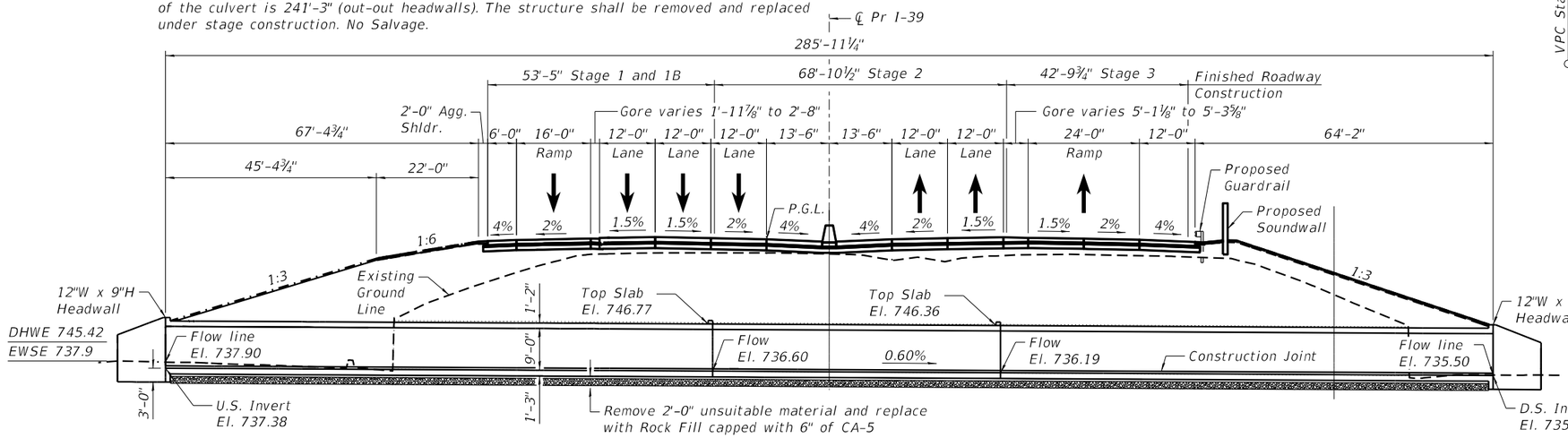
KEG JOB #19-1138.00

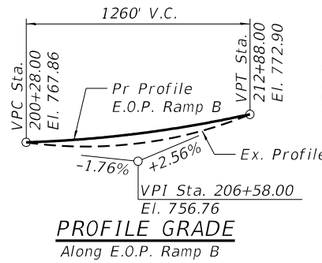
EXHIBIT C

TYPE, SIZE AND LOCATION PLAN

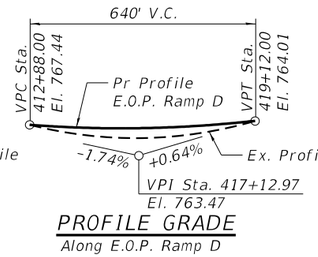
Existing Structure: *The existing culvert S.N. 101-2025 was constructed in 1963 as a 12'-0"x10'-0" (WxH) double barrel reinforced concrete box culvert at Sta. 2708+77. Skewed 25° Left Ahead. The culvert consists of a 12" thick top slab, 13" bottom slab, 10" sidewalls with horizontal cantilever wingwalls and maximum fill height of approximately 16 feet. The overall length of the culvert is 241'-3" (out-out headwalls). The structure shall be removed and replaced under stage construction. No Salvage.*

Bench Mark: #405 *Found cut "X" on the northwest bolt of east end of the overhead sign for "Belvidere Exit 122A" on exit ramp on I39 North. 42°14'10.2"N 88°58'06.7"W, El. 770.67*

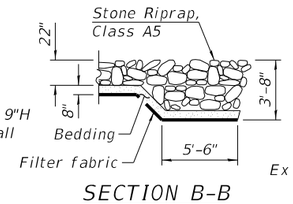




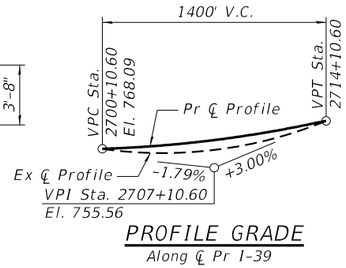
PROFILE GRADE
Along E.O.P. Ramp B



PROFILE GRADE
Along E.O.P. Ramp D



SECTION B-B



PROFILE GRADE
Along ℄ Pr I-39

PRECAST ALTERNATE IS NOT ALLOWED

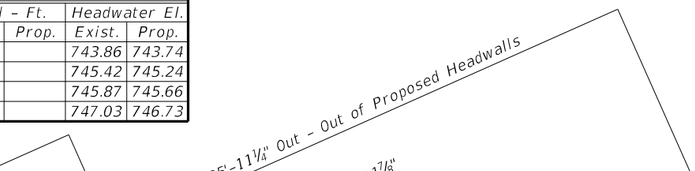
WATERWAY INFORMATION

Drainage Area = 5.8 Sq. Mi.
Exist. Overtopping El. = 756.6 at Sta. 2706+00
Prop. Overtopping El. = 756.6 at Sta. 2706+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	994	158	172				743.86	743.74
Design	50	1,382	196	212				745.42	745.24
Base	100	1,518	207	224				745.87	745.66
Max. Calc.	500	1,903	235	243				747.03	746.73

Existing 10-year outlet Velocity = 5.8 ft./s.
Proposed 10-year outlet Velocity = 5.1 ft./s.

LONGITUDINAL SECTION
Looking North
(Dimensions shown are at Right Angles to ℄ Pr. I-39)



PLAN VIEW

LEGEND:

- Soil Boring
- Limit of Rock Fill
- FO Ex. Fiber Optic
- Ex. Electrical Cable
- Pr. Storm Sewer
- Underground Watermain
- Pr. Access Control
- Ex. Access Control
- Stone Riprap
- Rock Fill

HIGHWAY CLASSIFICATION

F.A.I. Rte. 39 - I-39/U.S. 20
Functional Class: Interstate
ADT: 54,096 (2024) ; 77,290 (2044)
ADTT: 14,042 (2024); 20,063 (2044)
DHV: 7,290 (2044)
Design Speed: 70 m.p.h.
Posted Speed: 65 m.p.h.
2-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

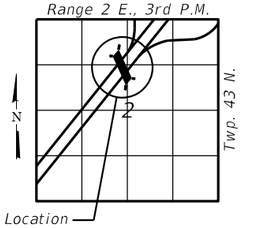
DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)
Precast Option Not Allowed

LOADING HL-93

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



LOCATION SKETCH

GENERAL PLAN & ELEVATION
I-39/U.S. 20 OVER MADIGAN CREEK
SEC. (201-3)R & (4-1,5)R
WINNEBAGO COUNTY
STATION 2708+77.50
STRUCTURE NO. 101-2053

MODEL: TSL
FILE NAME: S:\PROJECTS\2019\1390D19_IDOTD2\DESIGN\STRUCT\BG 01 SN 101-2053 - I-39 Over Madigan Creek\CAD SHEETS\D64C62-1012053_TSL.dgn

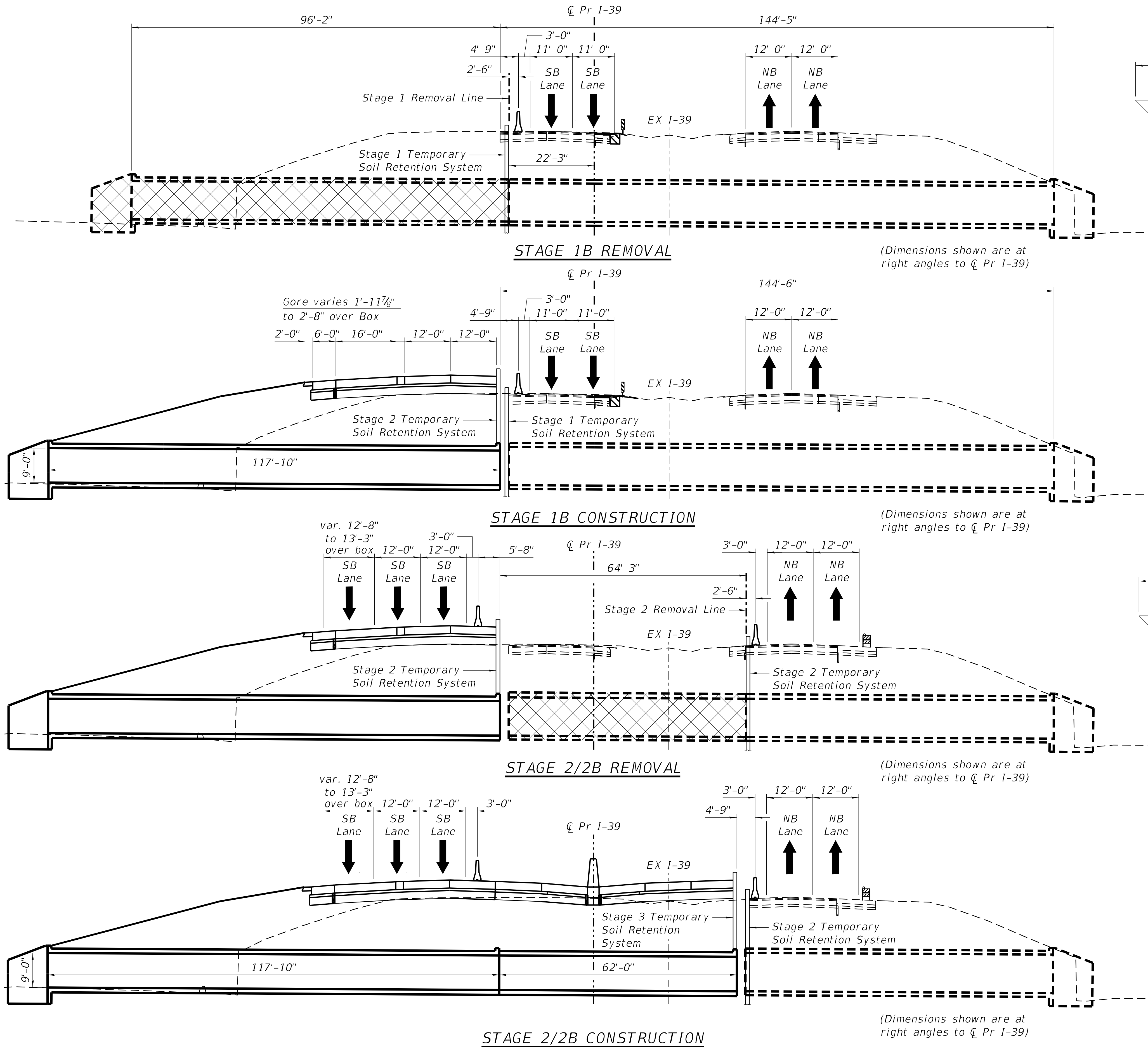
WILLETT HOFMANN & ASSOCIATES, INC
CONSULTING CIVIL, STRUCTURAL AND SURVEYING
809 EAST 2ND STREET, DIXON, IL 61021-0367
T 815-284-3351 LIVE-CHAT@WHA-HSR.COM

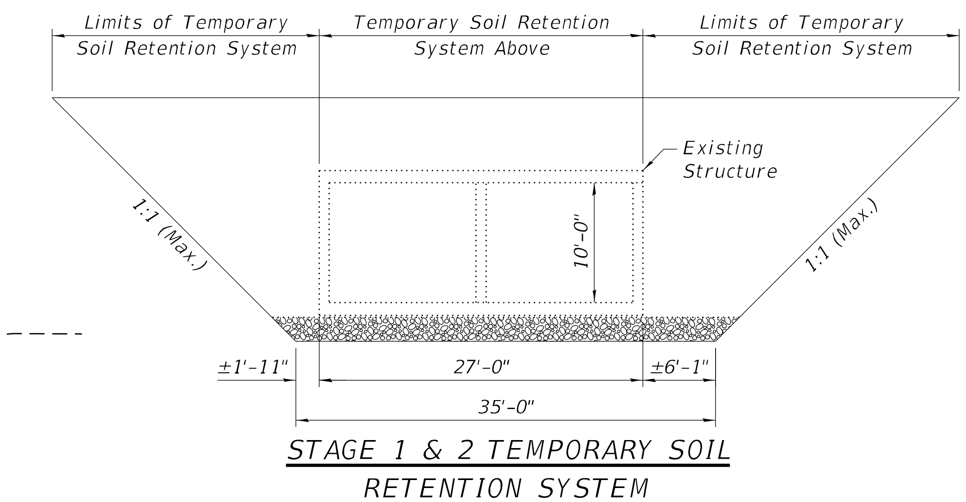
USER NAME = rona	DESIGNED - RB	REVISED -	
	CHECKED - ___	REVISED -	
PLOT SCALE =	DRAWN - RDA	REVISED -	
PLOT DATE = 4/5/2024	CHECKED - ___	REVISED -	

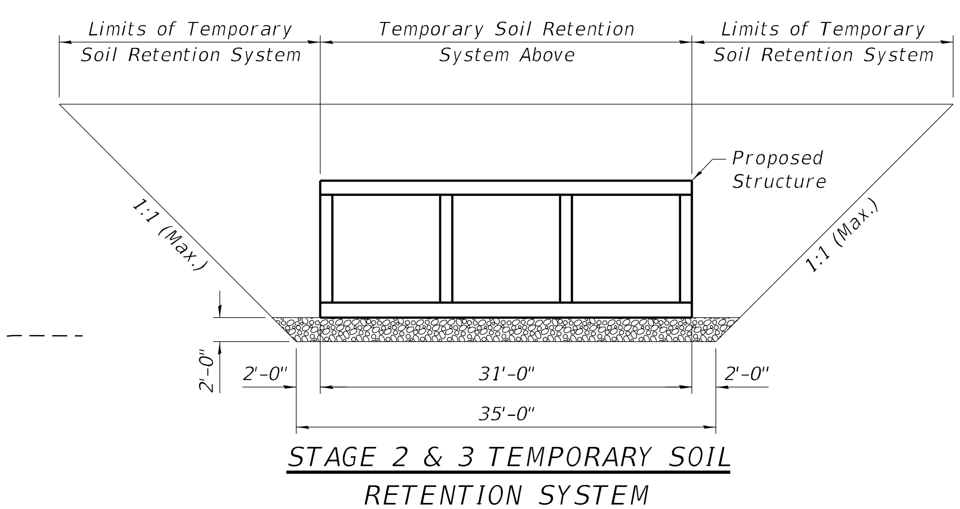
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NO. 101-2053
STRUCTURAL SHEET NO. 1 OF 4 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 39	(201-3)R & (4-1,5)R	WINNEBAGO	3	1
WHA # 1390D19		CONTRACT NO. 64C24		
	ILLINOIS	FED. AID PROJECT		







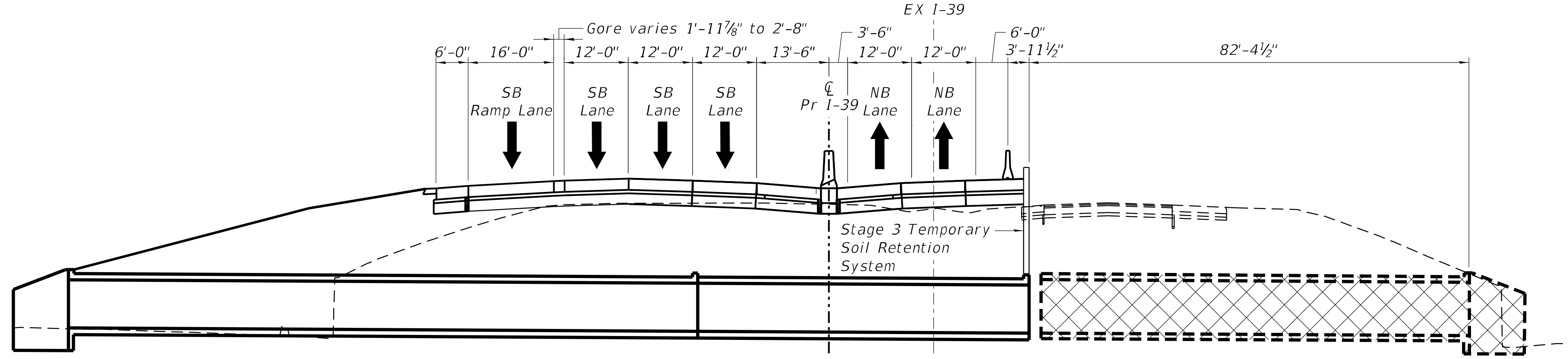
GENERAL PLAN & ELEVATION
I-39/U.S. 20 OVER MADIGAN CREEK
SEC. (201-3)R & (4-1,5)R
WINNEBAGO COUNTY
STATION 2708+77.50
STRUCTURE NO. 101-2053

MODEL: TSL
FILE NAME: S:\PROJECTS\2019\1390D19_IDOTD2\DESIGN\STRUCT\BG 01 SN 101-2053 - I-39 Over Madigan Creek\CAD SHEETS\D64C62-1012053_TSL.dgn

WILLETT HOFMANN & ASSOCIATES INC

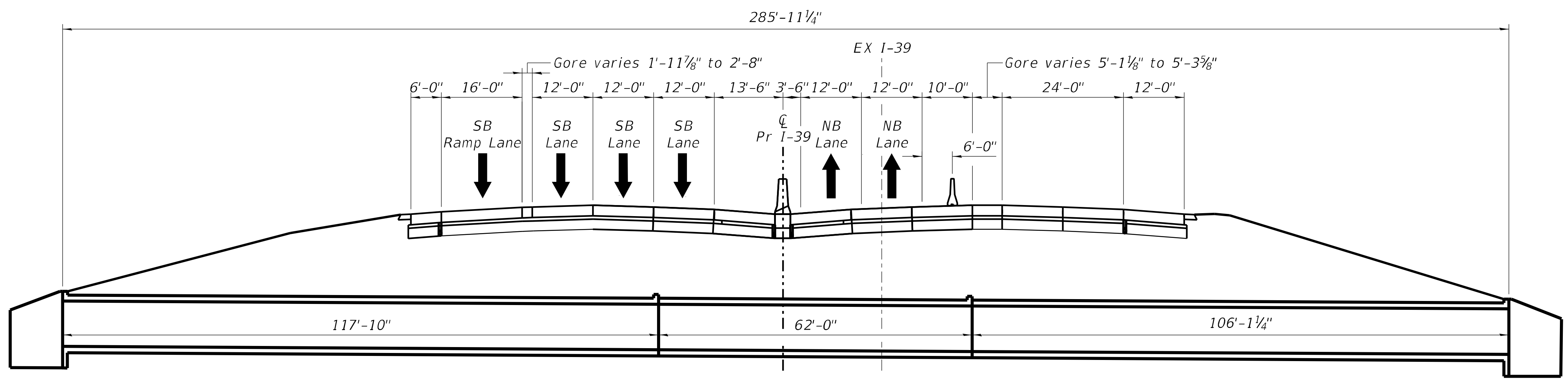
USER NAME = rona	DESIGNED - RB	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	DETAILS 1 STRUCTURE NO. 101-2053
	CHECKED - ___	REVISED -		
PLOT SCALE =	DRAWN - RDA	REVISED -		
PLOT DATE = 4/5/2024	CHECKED - ___	REVISED -		STRUCTURAL SHEET NO. 2 OF 4 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 39	(201-3)R & (4-1,5)R	WINNEBAGO	3	2
WHA # 1390D19		CONTRACT NO. 64C24		
		ILLINOIS	FED. AID PROJECT	



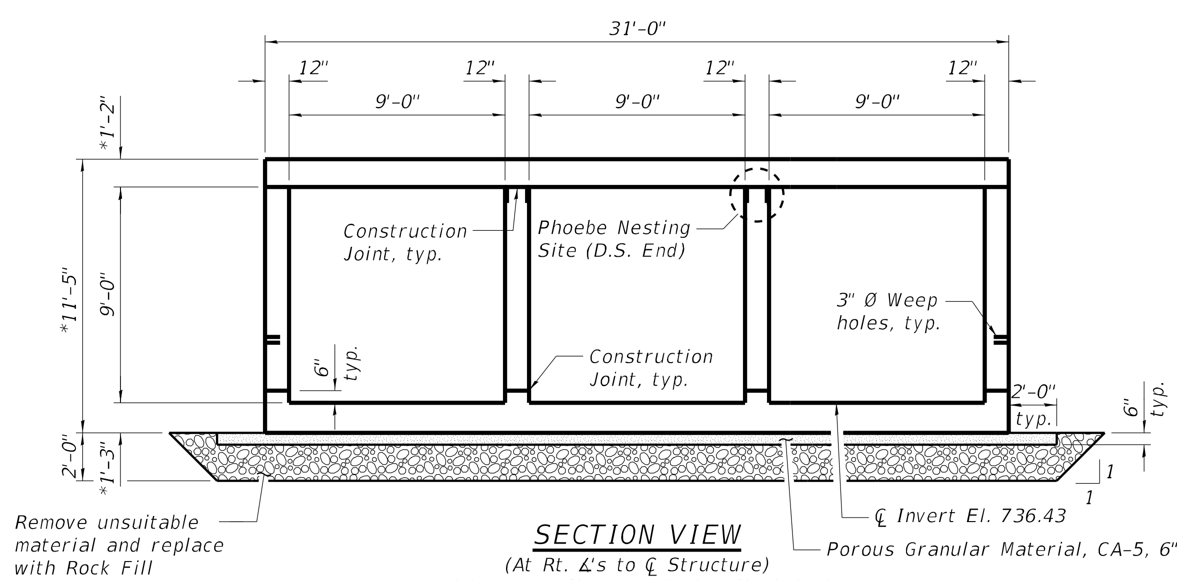
(Dimensions shown are at right angles to ℄ Pr I-39)

STAGE 3 REMOVAL



(Dimensions shown are at right angles to ℄ Pr I-39)

STAGE 3 CONSTRUCTION



SECTION VIEW

(At Rt. ∠'s to ℄ Structure)

*Subject to refinement during final design.

GENERAL PLAN & ELEVATION
I-39/U.S. 20 OVER MADIGAN CREEK
SEC. (201-3)R & (4-1,5)R
WINNEBAGO COUNTY
STATION 2708+77.50
STRUCTURE NO. 101-2053

MODEL: TSL
FILE NAME: S:\PROJECTS\2019\1390D19_IDOT D2\DESIGN\STRUCT\BG 01 SN 101-2053 - I-39 Over Madigan Creek\CAD SHEETS\D64C62-1012053_TSL.dgn

WILLETT HOFMANN & ASSOCIATES INC
809 EAST 2ND STREET, DIXON, IL 61021-3367

USER NAME = rona	DESIGNED - RB	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
	CHECKED - ___	REVISED -	
PLOT SCALE =	DRAWN - RDA	REVISED -	
PLOT DATE = 4/5/2024	CHECKED - ___	REVISED -	

DETAILS 2
STRUCTURE NO. 101-2053
STRUCTURAL SHEET NO. 3 OF 4 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 39	(201-3)R & (4-1,5)R	WINNEBAGO	3	3
WHA # 1390D19		CONTRACT NO. 64C24		
ILLINOIS	FED. AID PROJECT			

EXHIBIT D

BORING LOGS

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 4/23/08

ROUTE Bypass 20/I-39 **DESCRIPTION** P-92-111-06 Box Culvert over Madigan Creek on Bypass 20 **LOGGED BY** W. Garza

SECTION (201-3)K &(4-1,5)R **LOCATION** Cherry Valley, 2 NW. SEC., TWP. 43N RNG. 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO.
Station 857+18
BORING NO. B-1d
Station 2708+81
Offset 166.5 ft LT
Ground Surface Elev. 739.49 ft

Surface Water Elev. 2.50 ft
Stream Bed Elev. 4.00 ft
Groundwater Elev.:
First Encounter 735.0 ft ▼
Upon Completion Wash ft
After ____ **Hrs.** ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SOFT dark gray LOAM				
			0.4 P	22
737.5				
MEDIUM dark gray SANDY LOAM		2		
		2 4	0.6 P	20
735.5				
MEDIUM tan SAND with medium GRAVEL	▼ -5	5		
		9 8		
733.5				
LOOSE/MEDIUM tan SAND				
		5		
		6 4		
731.0				
Wash LOOSE tan dirty SAND	-10	3		
		4 8		
728.0				
STIFF tan/gray SILT		6		
		9 7	1.4 S	21
726.0				
MEDIUM gray SILT				
	-15	3		
		4 6	0.7 B	17
723.5				
MEDIUM gray SILT				
		3		
		4 5	0.6 B	16
721.0				
MEDIUM gray SILT with fine SAND lens	-20	2		
MEDIUM gray SILT with fine SAND lens *(continued)*		3 4	0.8 P	19
718.5				
STIFF gray SILTY CLAY TILL				
		13		
		11 8	1.1 P	18
715.5				
VERY DENSE tan weathered LIMESTONE	-25	21		
		25 22		
Wash VERY DENSE tan weathered LIMESTONE		100/5"		
711.0				
End of Boring	-30			
	-35			
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 4/23/08

ROUTE Bypass 20/I-39 **DESCRIPTION** P-92-111-06 Box Culvert over Madigan Creek on Bypass 20 **LOGGED BY** W. Garza

SECTION (201-3)K &(4-1,5)R **LOCATION** Cherry Valley, 2 NW. SEC., TWP. 43N RNG. 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO.
Station 857+18
BORING NO. B-2d
Station 2707+71
Offset 175.5 ft RT
Ground Surface Elev. 737.59 ft

Surface Water Elev. 2.50 ft
Stream Bed Elev. 4.00 ft
Groundwater Elev.:
First Encounter 733.1 ft ▼
Upon Completion Wash ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Stratum
				MEDIUM dark gray LOAM
		0.5 P	13	
735.6				
	2			MEDIUM dark gray dirt SAND & GRAVEL
	13			
	10			
733.6				
	2			STIFF tan SANDY LOAM TILL ▼
-5	9	1.4	10	
	6	P		
731.6				
				STIFF tan SANDY LOAM TILL
	6			
	11	1.0	9	
729.1	15	S		
				STIFF tan SANDY LOAM TILL
-10	5			
	7	1.7	8	
726.6	8	S		
				VERY STIFF gray LOAM TILL
	3			
	5	2.7	8	
724.1	9	B		
				STIFF gray LOAM TILL
-15	5			
	9	1.8	8	
721.6	11	S		
				HARD gray LOAM TILL
	8			
	10	4.6	8	
	17	S		
718.6				
				MEDIUM gray clean medium coarse SAND
-20	4			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Stratum
	10			MEDIUM gray clean medium coarse SAND *(continued)*
	12			
716.1				
				HARD gray LOAM TILL
	12			
	17	4.6	8	
	18	S		
-25	11			HARD gray LOAM TILL
	18	6.3	8	
711.6	19	S		
				End of Boring
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 8/3/20

ROUTE Bypass 20/I-39 **DESCRIPTION** P-92-111-06- Box Culvert carrying US Bypass 20 over Madigan Creek **LOGGED BY** W. Garza

SECTION (201-3)K &(4-1,5)R **LOCATION** Cherry Valley, 2 NW. SEC., TWP. 43N RNG. 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO. _____
Station _____

BORING NO. B-3
Station 2709+25
Offset 14.0 ft LT
Ground Surface Elev. 762.62 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 733.1 ft ▼
Upon Completion 722.6 ft ▽
After _____ **Hrs.** _____ ft

		DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM gray LOAM					
				0.8 P	13
	760.6				
HARD tan SANDY LOAM			7		
			7 9	4.5 P	10
	758.1				
VERY STIFF tan SANDY LOAM		-5	9		
			7 5	2.8 P	9
	755.6				
HARD tan SANDY LOAM			7		
			10 9	4.5 P	14
	753.1				
HARD tan SANDY LOAM		-10	9		
			11 14	4.5 P	10
	750.6				
HARD tan SANDY LOAM			10		
			8 8	4.0 P	8
	748.1				
VERY STIFF light brown CLAY LOAM		-15	6		
			6 9	3.5 B	23
	745.6				
MEDIUM gray SILTY CLAY LOAM with GRAVEL			4		
			4 9	0.8 P	23
	743.1				
DENSE tan FINE SAND		-20	15		
DENSE tan FINE SAND *(continued)*			16 16		
	740.6				
VERY DENSE tan moist SANDY GRAVEL			21		
			30 46		
	738.1				
DENSE tan moist SANDY GRAVEL 5' Run		-25	13		
			22 21		
	733.1 ▼				
VERY STIFF tan SANDY LOAM TILL top 6" SANDY GRAVEL 5' Run		-30	18		
			9 8	2.3 B	10
	728.1				
STIFF light gray SANDY LOAM TILL 5' Run		-35	3		
			8 14	1.4 S	26
	723.1				
		-40	26		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 8/3/20

ROUTE Bypass 20/I-39 **DESCRIPTION** P-92-111-06- Box Culvert carrying US Bypass 20 over Madigan Creek **LOGGED BY** W. Garza

SECTION (201-3)K &(4-1,5)R **LOCATION** Cherry Valley, 2 NW. SEC., TWP. 43N RNG. 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO. _____
Station _____

BORING NO. B-3
Station 2709+25
Offset 14.0 ft LT
Ground Surface Elev. 762.62 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 733.1 ft ▼
Upon Completion 722.6 ft ▽
After _____ **Hrs.** _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
VERY STIFF gray SANDY LOAM TILL		27 24		12
5' Run *(continued)*				
	718.1			
VERY STIFF light gray SANDY LOAM TILL	-45	7 10 13	2.1 P	9
	716.6			
End of Boring	-50 -55 -60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

EXHIBIT E

SUBSURFACE PROFILE

Elevation (ft)

765
760
755
750
745
740
735
730
725
720
715
710
705

B-1d
2708+81
166.5 ft LT

N	Qu	w%		
			739.49	
	0.4	22		SOFT dark gray LOAM
P				
6	0.6	20		MEDIUM dark gray SANDY LOAM
P				
17				MEDIUM tan SAND with medium GRAVEL
10				LOOSE/MEDIUM tan SAND
12				Wash LOOSE tan dirty SAND
16	1.4	21		STIFF tan/gray SILT
S				
10	0.7	17		MEDIUM gray SILT
B				
9	0.6	16		MEDIUM gray SILT
B				
7	0.8	19		MEDIUM gray SILT with fine SAND lens
P				
19	1.1	18		STIFF gray SILTY CLAY TILL
P				
47				VERY DENSE tan weathered LIMESTONE
			711.0	

B-3
2709+25
14.0 ft LT

N	Qu	w%		
			762.62	
	0.8	13		MEDIUM gray LOAM
P				
16	4.5	10		HARD tan SANDY LOAM
P				
12	2.8	9		VERY STIFF tan SANDY LOAM
P				
19	4.5	14		HARD tan SANDY LOAM
P				
25	4.5	10		HARD tan SANDY LOAM
P				
16	4.0	8		HARD tan SANDY LOAM
P				
15	3.5	23		VERY STIFF light brown CLAY LOAM
B				
13	0.8	23		MEDIUM gray SILTY CLAY LOAM with GRAVEL
P				
32				DENSE tan FINE SAND
76				VERY DENSE tan moist SANDY GRAVEL
43				DENSE tan moist SANDY GRAVEL
				5' Run
17	2.3	10		VERY STIFF tan SANDY LOAM TILL top 6" SANDY GRAVEL
B				
				5' Run
22	1.4	26		STIFF light gray SANDY LOAM TILL
S				
				5' Run
51		12		VERY STIFF gray SANDY LOAM TILL
				5' Run
23	2.1	9		VERY STIFF light gray SANDY LOAM TILL
P			**716.6**	

B-2d
2707+71
175.5 ft RT

N	Qu	w%		
			737.59	
	0.5	13		MEDIUM dark gray LOAM
P				
23				MEDIUM dark gray dirt SAND & GRAVEL
15	1.4	10		STIFF tan SANDY LOAM TILL
P				
26	1.0	9		STIFF tan SANDY LOAM TILL
S				
15	1.7	8		STIFF tan SANDY LOAM TILL
S				
14	2.7	8		VERY STIFF gray LOAM TILL
B				
20	1.8	8		STIFF gray LOAM TILL
S				
27	4.6	8		HARD gray LOAM TILL
S				
22				MEDIUM gray clean medium coarse SAND
35	4.6	8		HARD gray LOAM TILL
S				
37	6.3	8		
S				
			709.1	

PRINTERMOD2 11X17 19-1138.00 MADIGAN CREEK BORING LOGS.GPJ IL_DOT.GDT 4/1/24

Illinois Department of Transportation
Division of Highways

NOT TO HORIZONTAL SCALE

SUBSURFACE PROFILE

Route: Bypass 20/I-39
Section: (201-3)K &(4-1,5)R
County: Winnebago

EXHIBIT F

BEARING RESISTANCE CALCULATIONS

Kaskaskia Engineering Group, LLC
208 E. Main Street
Suite 100
Belleville, Illinois 62220
618.233.5877 *phone*
618.233.5977 *fax*
www.kaskaskiaeng.com

Project Title: Madigan Creek Culvert Sheet: 1 of 3
Project Number: 19-1138.00
Calculated By: CO Date: 4/1/24
Checked By: MDM Date: 4/4/2024
Comments:

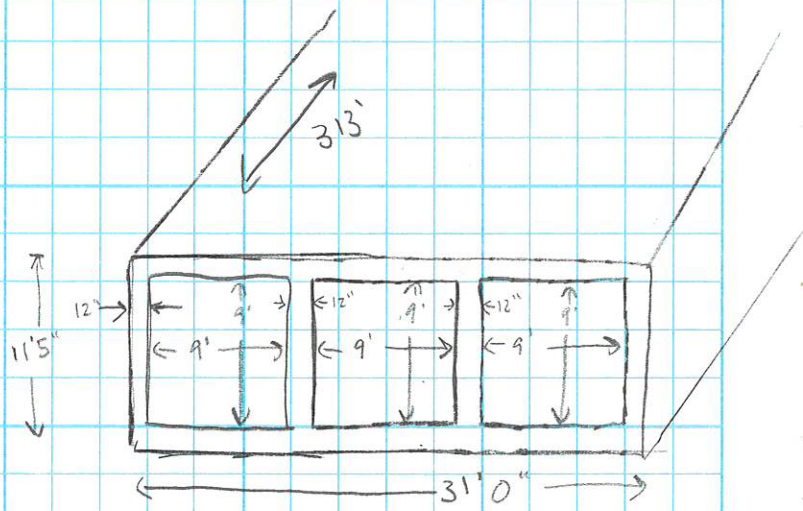
Weight of Culvert

Outer Volume: $(31')(11.4167')(313')$
$= 110,776\ ft^3$

Inner Volume: $3((9')(9')(313'))$
$= 76,059\ ft^3$

Final Volume: $110,776 - 76,059$
$= 34,717\ ft^3$

$W_{culvert} = 34,717\ ft^3 \cdot 150\ lb/ft^3$
$= 5,207,586\ lbs$



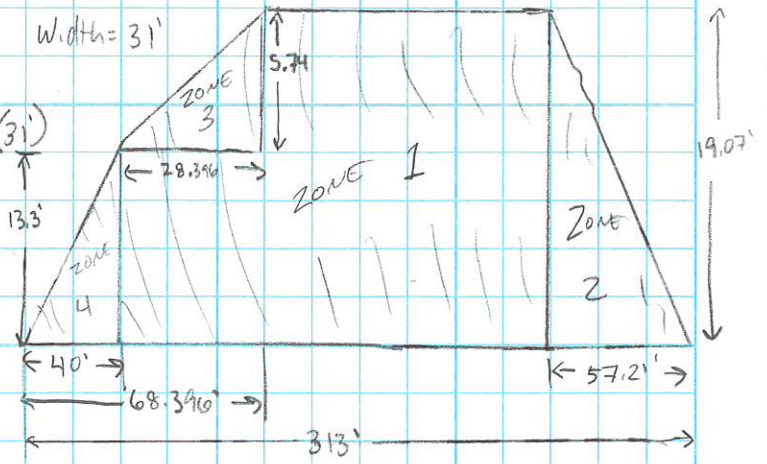
Weight of Fill:

$V_1 = (215.79')(13.3')(31') + (187.394')(5.74')(31')$
$= 122,315.1\ ft^3$

$V_2 = 1/2\ (57.21')(19.07')(31')$
$= 16,910.4\ ft^3$

$V_3 = 1/2\ (28.396')(5.74')(31')$
$= 2,526.39\ ft^3$

$V_4 = 1/2\ (40)(13.3)(31)$
$= 8,246\ ft^3$



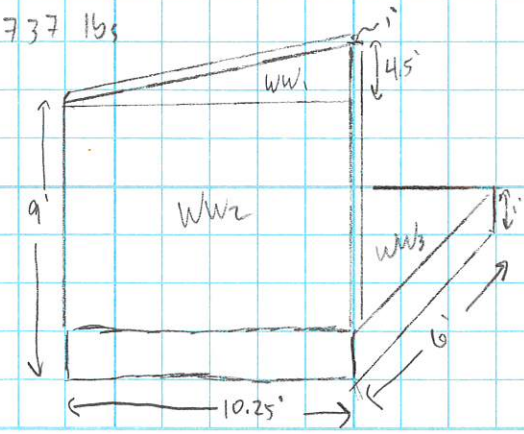
$V_{FILL} = 122,315.1 + 16910.4 + 2,526.39 + 8,246 = 149,998\ ft^3$

$W_{FILL} = 149,998\ ft^3 \left(\frac{125\ lb}{ft^3}\right) = 18,749,737\ lbs$

Weight of Wingwalls:

$V_{ww_1} = 4(1/2\ (10.25)(4.5)(1)) = 92.25\ ft^3$
$V_{ww_2} = 4((8)(10.25)(1)) = 328\ ft^3$
$V_{ww_3} = 4((10.25)(6)(1)) = 246\ ft^3$

Total $V_{ww} = 92.25 + 328 + 246 = 666.25\ ft^3$



Final $W_{ww} = 666.25\ ft^3 \left(\frac{150\ lb}{ft^3}\right) = 99,938\ lbs$

Kaskaskia
Engineering Group, LLC
208 E. Main Street
Suite 100
Belleville, Illinois 62220
618.233.5877 *phone*
618.233.5977 *fax*
www.kaskaskiaeng.com

Project Title: Madigan Creek Culvert Sheet: 2 of 3
Project Number: 19-1138.00
Calculated By: CO Date: 4/1/24
Checked By: _____ Date: _____
Comments: _____

Weight of Rock Fill:

$V_{RF} = (0.5')(313')(31') = 4,851.5\ ft^3$

$W_{RF} = (4,851.5\ ft^3)(125\ lb/ft^3) = 606,438\ lbs$

Weight of everything:

$W_c = 5,287,586\ lbs$
$W_{Fill} = 18,749,737\ lbs$
$W_{ww} = 99,938\ lbs$
$W_{RF} = 606,438\ lbs$

$W_{everything} = 24,743,699\ lbs$

BEARING PRESSURE = P/A

$= 24,743,699\ lbs / (31)(313') = \boxed{2,550\ psf}$

BEARING CAPACITY (CONTINUOUS FOUNDATION - TERZAGHI)

$q_{ult} = c'N_c + \theta_{2D}' N_q + 0.5\gamma' B N_\gamma$

$q_{ult} = 0 + (62.6\ pcf)(3.0)(61.5) + (0.5)(62.6\ pcf)(31)(82.3)$

$q_{ult} = \boxed{91,405.4\ psf}$

$q_{allowable} = q_{ult}/F_{OS} = 91,405/2 = \boxed{45,703\ psf}$

$q_{allowable} = 45,703\ psf > 2,550\ psf$

✓ OK

Bearing on sandy gravel:
Elevation 733.4 ft
$c' = 0$
$\Phi = 38°$
$\gamma' = 125\ pcf - 62.4 = 62.6\ pcf$
$D_f = 3\ ft$
$B = 31\ ft$
$N_c = 77.5$
$N_q = 61.5$
$N_\gamma = 82.3$
$D = 3\ ft$

Kaskaskia
Engineering Group, LLC
208 E. Main Street
Suite 100
Belleville, Illinois 62220
618.233.5877 *phone*
618.233.5977 *fax*
www.kaskaskiaeng.com

Project Title: Madison Creek Culvert Sheet: 3 of 3
Project Number: 19-1138.00
Calculated By: CO Date: 4/1/24
Checked By: _____ Date: _____
Comments: _____

SLIDING BEARING RESISTANCE

Sliding Bearing Resistance = $\frac{1}{2}\sigma_v$ or cohesion
Use lesser of two values

$\frac{1}{2}\sigma_v = \frac{1}{2}(125\ pcf)(3') = 187.5\ psf$

EXHIBIT G

SETTLEMENT CALCULATIONS

Settlement Calculations - I-39 over Madigan Creek

P (lb)=	5541092
γ (pcf)=	125
t (years)=	50

D(ft)=	3
B (ft)=	31
L (ft)=	71.484375

q (psf)=	2500.475
Iep=	0.574
σzp (psf)=	4250
σzd (psf)=	375

Correction Factor	
C1=	0.912
C2=	1.540
C3=	0.961

Layer	Soil Description	Soil Type	H (ft)	γ (pcf)	N	N60	zcl (ft)	βo (ksf)	β1 (ksf)	Es (psf)	p'o (psf)	Ies	Iec	Ie	Ieh*H/Es
1	Sandy Loam Till	2	2.76	125	17	19	1.38	50	12	278000	172.50	0.142	0.217	0.153	1.52E-06
2	Sandy Loam Till	2	5	125	22	25	5.26	50	12	350000	657.50	0.261	0.263	0.261	3.73E-06
3	Sandy Loam Till	2	5	125	51	59	10.26	50	12	758000	1282.50	0.414	0.324	0.401	2.64E-06
4	Sandy Loam Till	2	5	125	23	26	15.26	50	12	362000	1907.50	0.567	0.384	0.540	7.46E-06
5															
6															
7															
8															
9															
10															

Soil Type: 1. Clean Sands (SW and SP)
2. Silty Sands and Clayey Sands (SM and SC)

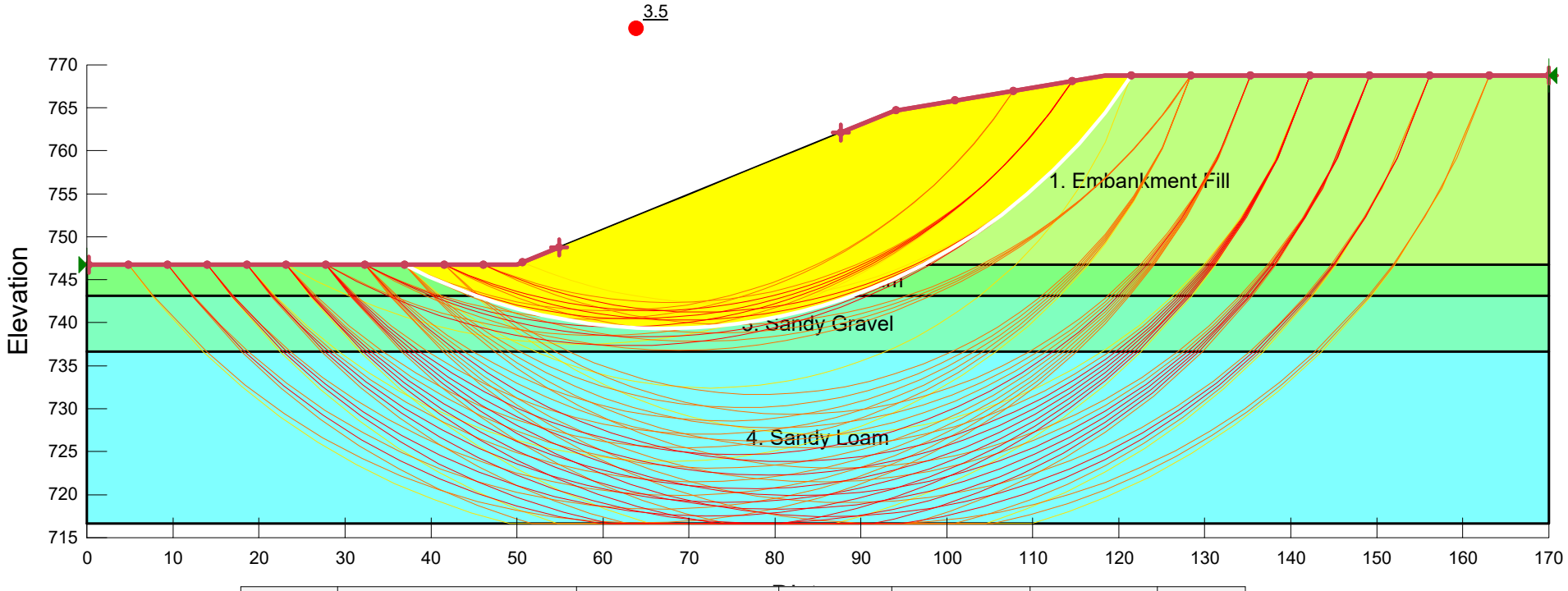
$$\delta = C_1 C_2 C_3 (q - \sigma'_{zD}) \sum \frac{I_\epsilon H}{E_s}$$

Σ=	1.54E-05
δ (ft)	4.40E-02
δ (in)	0.5283245

EXHIBIT H

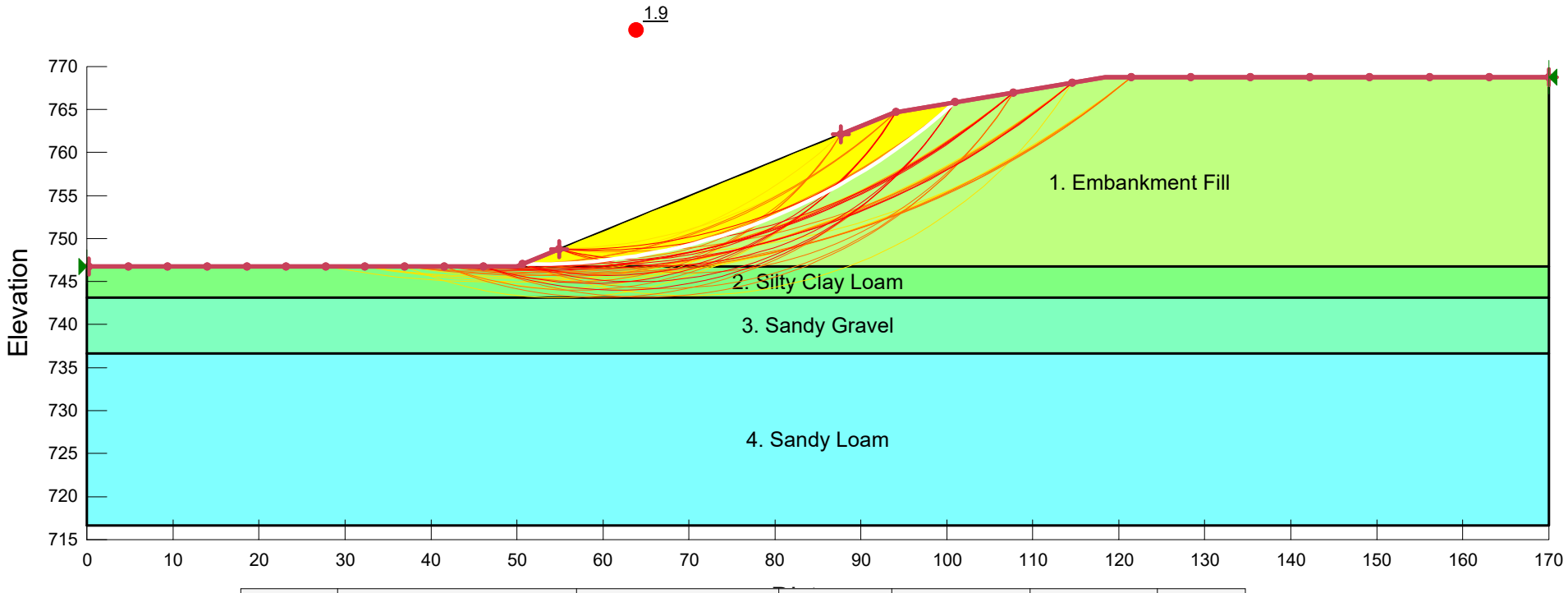
SLOPE/W SLOPE STABILITY ANALYSIS

I-39 over Madigan Creek Boring
B-3 - Upstream End
End-of-Construction
(Undrained Analysis)



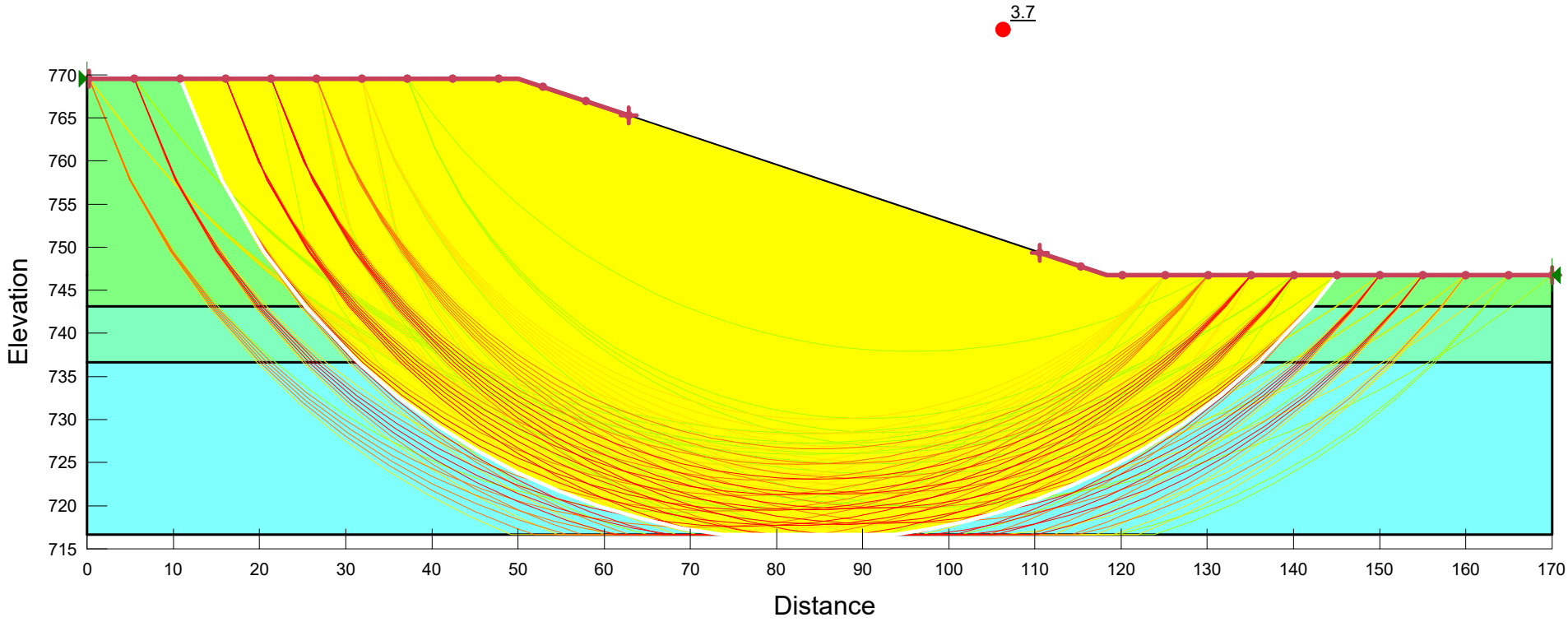
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Embankment Fill	Mohr-Coulomb	125	1,000	0	0
	2. Silty Clay Loam	Mohr-Coulomb	120	800	28	0
	3. Sandy Gravel	Mohr-Coulomb	120	0	38	0
	4. Sandy Loam	Mohr-Coulomb	120	1,750	0	0

I-39 over Madigan Creek
Boring B-3 - Upstream End
Long Term (Drained Analysis)



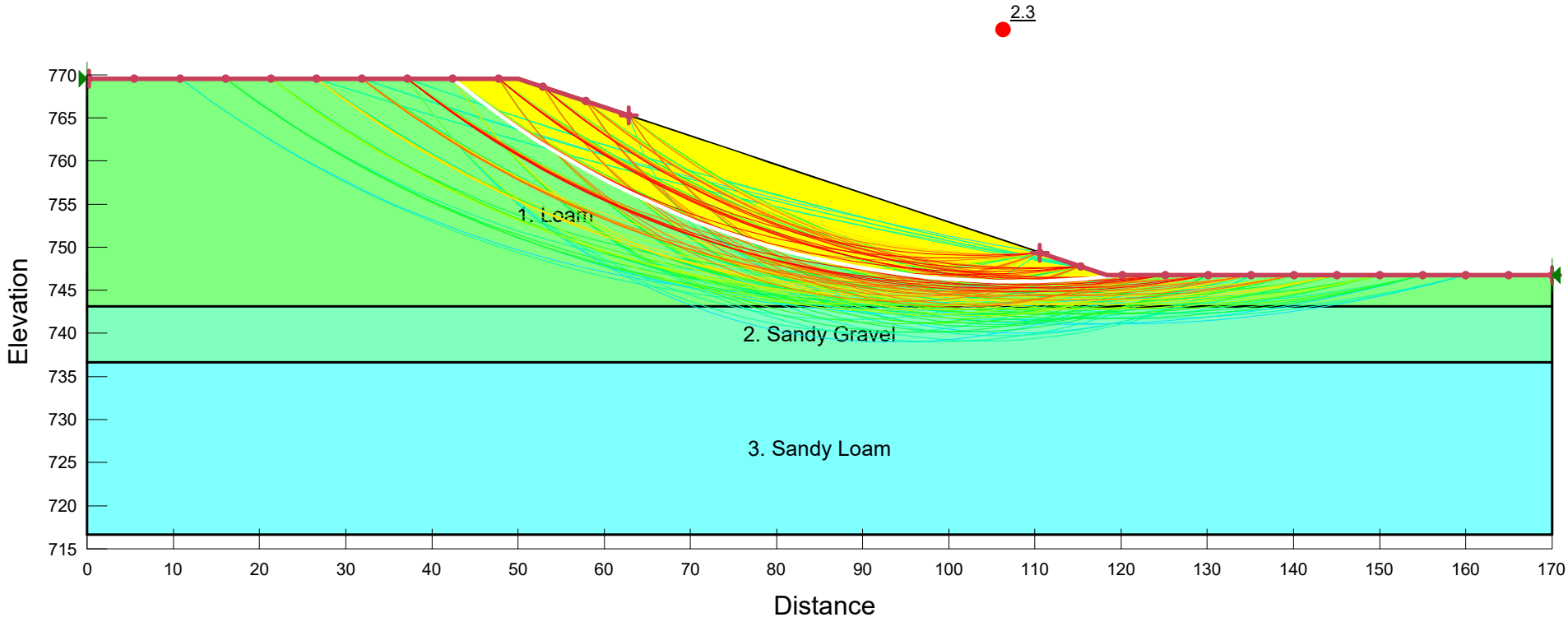
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Embankment Fill	Mohr-Coulomb	125	100	26	0
	2. Silty Clay Loam	Mohr-Coulomb	120	100	28	0
	3. Sandy Gravel	Mohr-Coulomb	120	0	38	0
	4. Sandy Loam	Mohr-Coulomb	120	0	30	0

I-39 over Madigan Creek Boring
B-3 - Downstream End
End-of-Construction
(Undrained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Loam	Mohr-Coulomb	120	800	28	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0
	3. Sandy Loam	Mohr-Coulomb	120	1,750	0	0

I-39 over Madigan Creek
Boring B-3 - Downstream End
Long Term (Drained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Loam	Mohr-Coulomb	120	100	28	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0
	3. Sandy Loam	Mohr-Coulomb	120	0	30	0