STRUCTURE GEOTECHNICAL REPORT
STRUCTURE NO. 049-0567
BOX CULVERT
IL 60 OVER MANITOU CREEK
LAKE COUNTY, ILLINOIS

10/10/2022

Revised 11/15/2022

Prepared for:

Bowman Consulting Group Ltd.

1001 Warrenville Road, Ste. 110

Lisle, Illinois 60532

Prepared by:

INTERRA, INC.

600 Territorial Drive, Suite G, Bolingbrook, IL 60440

Phone: (630) 754-8700, Fax: (630) 754-8705

www.interraservices.com

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LAKE COUNTY, ILLINOIS

1.0 INTRODUCTION

Interra, Inc. (INTERRA) was tasked by Bowman Consulting Group Ltd. based in Lisle, Illinois to conduct subsurface soil investigation and prepare the Structural Geotechnical Report (SGR) for the improvement of the culvert structure located under IL 60, west of South Arden Lane in Lake County, Illinois. The proposed improvement consists of removal and replacement of head walls and wingwalls of the existing 6'X4' box culvert at both ends. It is our understating that approximately, six feet of each end of the box culvert will be removed and replaced with new cast in place culvert section and horizontal cantilever wing walls.

2.0 PROJECT SCOPE

INTERRA's scope of work included drilling two (2) structure geotechnical borings to a depth of 30 feet each; performing associated laboratory tests on collected soil samples; preparation of Structure Geotechnical Report in accordance with IDOT Geotechnical Manual 2020.

3.0 SITE DESCRIPTION

The project section is in Fremont Township, Lake County and defined as Section 8, T44N, R10E Third Meridian. The subject area is located on IL 60, approximately 200 feet west of S. Arden Lane. The surface elevations of the boreholes are between 784.6 feet and 784.8 feet. The invert elevation of the Box Culvert structure is at approximately 774.5 feet.

3.1 Mining Activity

From the Illinois State Geological Survey (ISGS, 2021), Lake County is not identified as coal producing area. Therefore, no past coal mining activities may have taken place at

the project site.

3.2 Seismic Considerations

USGS National Seismic Hazard Maps (AASHTO LRFD, Figure 3.10.2.1-1) indicate a Peak Ground Acceleration (PGA) of 4% of gravity, with a 7% probability of exceedance in 75 years. The project area has no active, major faults (Kolata, 2005).

4.0 FIELD INVESTIGATION

The Borehole Location Plan is presented in Appendix A. The Boreholes were marked in the field by INTERRA. Prior to drilling, the drilling sub-contractor Geocon Professional Services (GEOCON) contacted the local one-call utility clearance service (JULIE) to clear underground utilities. The borings were drilled with a truck mounted drill rig Diedrich D-50. INTERRA's engineer was present during the drilling to collect and log the soil samples. The borings were drilled, and samples were collected in general accordance with the guidelines in the IDOT Geotechnical Manual. Soil sampling was performed per AASHTO T-206, "Penetration Test and Split Barrel Sampling of Soils". Soil sampling was performed at 2.5-foot intervals up to a depth of 30 feet. The soil samples were taken in conjunction with the Standard Penetration Test where a driving resistance to a standard 2" split-spoon samples indicate relative density of granular materials and consistency of cohesive soils. Soil specimens from the borings were visually identified in accordance with the AASHTO and IDOT textural classification systems. Also, unconfined compressive strength tests were performed on cohesive samples using an Illinois modified RIMAC tester. Cohesive samples that could not be tested with a RIMAC tester were tested with a pocket penetrometer to estimate the unconfined compressive strength. Shelby tube samples were also collected at selected boring locations for performing laboratory tests. Water level readings were taken during drilling.

5.0 LABORATORY TESTING

All laboratory testing was performed in accordance with IDOT and/or AASHTO standard methods for testing. Moisture content tests (AASHTO T 265) were performed for all soil samples. Shelby Tube samples were tested for Unconfined Compressive Strength (ASTM

D 2166), Grainsize Analysis (AASHTO T 88) and Atterberg Limits (AASHTO T 89, 90). Laboratory test reports are presented in Appendix B.

Soil boring logs indicating the blow counts, moisture content and soil description have been prepared and included in Appendix A of this report.

6.0 SUBSURFACE CONDITIONS

Boring IL-60-BCB-01 encountered 12.0 inches of asphalt and 5.0 inches of aggregate at the surface. This was underlain by dense sand and gravel up to 3.0 feet. Below this was stiff to hard clay layers up to 30.0 feet depth. Boring was terminated at 30.0 feet.

Boring IL-60-BCB-02 encountered 14.0 inches of asphalt at the surface. This was underlain by layers of medium stiff, stiff and very stiff clay up to 29.0 feet. Dense sand and gravel were encountered between 29.0 feet and 30.0 feet. Boring was terminated at 30.0 feet.

For detailed stratification, please refer to boring logs presented as Appendix A.

Groundwater Information

Groundwater elevations were recorded during drilling at both boring locations. Boring IL-60-BCB-01 encountered ground water at 16.0 feet depth during drilling. Boring IL-60-BCB-02 did not encountered ground water during drilling. Since the boreholes were backfilled immediately after drilling, the water levels reported may not represent the long-term groundwater levels. Changes in water levels should be expected due to seasonal variations and precipitation.

7.0 ANALYSIS AND RECOMMENDATIONS

The following recommendations are developed based on the field investigation and laboratory testing, project information provided to INTERRA, IDOT Culvert Manual, Standard Specifications and the AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.

It is our understanding that the headwalls, wingwalls and approximately a section of the box on the north and south ends of the existing box culvert will be removed and replaced with new culvert and horizontal cantilever wingwalls. We also understand that the replacement culvert will be the minimum length of 6 feet or half the length of the wingwalls.

BEARING CAPACITY AND SETTLEMENT

Design loads for the proposed construction were not provided. However, for analyses purposes, it is estimated that the approximate bearing pressure applied to the foundation soils will be less 1500 psf at an approximate depth of 11 feet below the existing roadway grade. Foundation soils at this elevation consist of very stiff to hard clayey soils. Based on soils encountered below the bottom of the bedding material for the culvert, an undercut of 12 inches is recommended. Foundation soils can be designed for a factored bearing resistance of 3000psf, which includes an LRFD Resistance Factor of 0.45. Although the roadway grade will not be changing, some additional fill is anticipated on the replacement sections. Settlements are expected to be no greater than one (1) inch due to minimal additional fill.

The actual need for undercut below the bottom of the bedding material should be evaluated in the field at the time of construction. If unsuitable soils are encountered during construction, the engineer should be contacted to determine the lateral and vertical extent of undercuts needed. The unsuitable soil may need to be removed and replaced with suitable material. We recommend undercutting any unsuitable soils and replacing with Rockfill. A woven geotextile fabric should be used below the aggregate improvement for ground stabilization (IDOT Section 1080.02). The aggregate shall be capped with six inches of CA7 and satisfy the Standard Specifications unless otherwise indicated in the Special Provisions. If the foundation soils become unstable due to construction equipment loadings during excavation or construction, a working platform may be needed. The need for such platform is dependent on the type, thickness and strength of the soils encountered, the method of water diversion selected by the Contractor, precipitation, construction sequence, and the time of the year the box culvert is

constructed. The Engineer should make the determination that a working platform is required during excavation based on the field conditions.

WINGWALLS

Plans indicate that existing wingwalls are horizontal. IDOT Culvert Manual requires that a portion of the barrel equal to the minimum of half the wingwall length or six (6) feet shall be poured monolithically with the wingwalls. Horizontal cantilever wingwalls are proposed.

The Wing walls at the box culvert should be designed for the lateral earth pressures and lateral pressures from live loads. In accordance with the culvert manual, Table 4.1.1.2-1, the earth pressure in horizontal (P_H) is estimated to be 65 psf for a horizontal cantilever wingwall. Live load surcharge from traffic and other surcharges can be estimated using a surcharge equivalent to 2 feet of soil for wingwalls. IDOT Standard Specifications and details should be followed for drains and limits of free draining material behind the wall.

STABILITY ANALYSES

Global slope stability analyses were conducted for the critical cross-section assuming wall height of 15 feet and a 3H:1V backfill. The LRFD resistance factor considered is 0.65, which is equivalent to slope stability factor of safety of 1.54. Slope stability analyses were conducted using SLIDE V7.0. Analyses indicated that the global slope stability factor of safety exceeded the minimum required value of 1.54 for both short and long-term loading conditions. Appendix C contains the results of the slope stability analyses.

CHANNEL PROTECTION

Channel protection at culvert outlets can be achieved by providing a riprapped transition or apron from the culvert outlet to the natural channel. The riprap should have bedding and/or filter fabric under it and should be of sufficient size and depth for the anticipated flow. A length of protection of three times the anticipated velocity in feet per second is commonly used as a rule of thumb.

SCOUR

As per All Bridge Designers Memo 14.2, design scour elevations for box culverts are no longer needed.

8.0 CONSTRUCTION CONSIDERATIONS

The contractor can consider temporary ditches, sumps, granular drainage blankets and other methods to control surface water infiltration and ground water and provide a dry condition for construction.

The proposed construction will be in stages and Temporary Soil Retention System (TSRS) may be required to facilitate the removal of the existing wingwalls and construction of the new headwall and wingwalls. It is anticipated that temporary shoring, will be required during the stage construction. At Boring BCB-01, a layer of hard clay with Qu value of 5.6tsf is present near the top of the required embedment depth. This value exceeds the 4.5tsf specified by IDOT's Temporary Sheet Piling Design Guide. Contractor-designed temporary soil retention system is recommended to accommodate stage construction. All Temporary Soil Retention Systems (TSRS) should consider surcharge loads from construction equipment, excavated material and trucks. The soil retention system should be designed by an Illinois Licensed Structural Engineer in accordance with IDOT standard specifications 522.07. Table 1 lists suggested lateral earth pressure and soil resistance parameters assuming a level backfill. All excavations must be performed in accordance with local and federal regulations.

Table 1 - Recommended Soil Parameters for Temporary Soil Retention Systems

Elevation (Depth below roadway surface)	**Soil Type**	**Saturated Unit Weight (pcf)**	**Shear Strength (psf)**		**Friction Angle (deg)**		**Active Earth Pr. Coeff, Ka**	**At-Rest Earth Pr. Coeff, K_0**	**Passive Earth Pr. Coeff., Kp**	**Soil Modulus, k (pci)**	**Epsilon 50 Strain**
			Undrained	**Drained**	**Undrained**	**Drained**					
0-11’	Stiff Cohesive Soil	130	1500	75	0	27	0.38	0.53	2.7	250	0.010
11’-30’	Very Stiff Cohesive Soil	130	2500	100	0	28	0.36	0.53	2.8	1500	0.006

Note: Earth pressure parameters provided assume a level backfill behind wall.

9.0 CLOSURE

The analysis and recommendations submitted in this report are based upon the data obtained from two (2) soil borings performed at the locations indicated on the Borehole Location Plan, project information provided to INTERRA and from any other information discussed in this report. This report does not reflect any variations that may occur between these boreholes. In performing subsurface explorations, specific information is obtained at specific locations at specific times. It is a well-known fact that variations in soil and rock conditions exist on most sites between borehole locations. Also, groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If project characteristics change or if variations in the subsurface conditions appear evident, it will be necessary for a re-evaluation of the recommendations of this report.

We appreciate the opportunity to be of service to you. Should you need additional information or clarifications, please call us at (630) 754-8700.

Yours truly,

INTERRA, INC.

Ashok Guntaka, EI
Project Manager

Reshma Chirakkara, Ph.D.
Staff Engineer

Sanjeev Bandi, Ph.D., PE
Principal Engineer

LICENSED PROFESSIONAL ENGINEER
SANJEEVREDDY
BANDI
062-051187
OF ILLINOIS
11/30/23

Sudhakar "Rao" Doppalapudi, PE
QC/QA Reviewer

REFERENCES

AASHTO 2020, LRFD Bridge Design Specifications, 9th Edition 2020, American Association of State Highway and Transportation Officials, Washington, DC.

IDOT 2020, Geotechnical Manual, Illinois Department of Transportation.

IDOT 2016, Culvert Manual, Illinois Department of Transportation.

IDOT 2016, Standard Specifications for Road and Bridge Construction. Illinois Department of Transportation.

IDOT 2012, Bridge Manual, Bureau of Bridges and Structures, Illinois Department of Transportation.

Kolata, D. R., 2005, Bedrock Geology of Illinois, Illinois Map 14, Illinois State Geological Survey.

U.S.G.S. 2014, National Seismic Hazard Maps. http://earthquake.usgs.gov/research/hazmaps/

Coduto, Donald P., 1994, Foundation Design, Prentice Hall, Inc.

Appendix A

Site Location Map

Borehole Location Plan and Profiles

Soil Boring Logs

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SITE LOCATION MAP
IL 60 BOX CULVERT
STRUCTURE NO: 049-0567
LAKE COUNTY, ILLINOIS
INTERRA Project No. 9243

N

BOREHOLE LOCATION PLAN
IL 60 BOX CULVERT
STRUCTURE NO: 049-0567
LAKE COUNTY, ILLINOIS
INTERRA Project No. 9243

Interra, Inc.
600 Territorial Drive, Suite G
Bolingbrook, IL 60440
www.interraservices.com

SOIL BORING LOG

Date 8/23/22

ROUTE IL-60 **DESCRIPTION** IL-60 Box Culvert **LOGGED BY** A. Boland

SECTION _____ **LOCATION** 2056151.735, 1049951.536

COUNTY Lake **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 049-0567
Station 195+94

BORING NO. IL-60-BCB-01
Station _____
Offset _____
Ground Surface Elev. 784.64 ft

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

Groundwater Elev.:
First Encounter 768.6 ft ▼
Upon Completion Not Taken ft
After _____ **Hrs.** Not Taken ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
783.64 ASPHALT (12")			
783.24 STONE (5")	37		
Dense gray SAND and GRAVEL, dry	25		8.6
	5		
781.64 Stiff dark brown CLAY, trace gravel, moist	2		
	1		35.0
-5	3	1.3 B	
779.14 Dark gray CLAY, moist			
Medium stiff	1		
Organic content= 5.6%	1		41.7
	2	0.7 B	
Very stiff, little gravel	5		
	4		19.1
-10	3	2.0 P	
Hard, trace gravel	4		
	5		17.0
	7	5.6 B	
Very stiff, trace gravel Shelby tube @ 13.5'-15.5' LL=32%,PI=16%			17.8
-15		4.0 B	
▼ Very stiff, trace gravel	4		
	5		19.0
	7	3.6 B	
Stiff, trace gravel	4		
	4		18.8
-20	5	1.6	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dark gray CLAY, moist *(continued)*		B	
Very stiff, trace gravel	5		
	4		21.2
	7	2.4 B	
Very stiff, trace gravel	5		
	5		20.6
-25	6	2.7 B	
Very stiff, trace gravel	2		
	4		21.6
	6	2.4 B	
Very stiff, trace gravel	5		
	4		22.3
754.64 -30	4	2.5 B	
End of boring at 30'			
-35			
-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)

Interra, Inc.
600 Territorial Drive, Suite G
Bolingbrook, IL 60440
www.interraservices.com

SOIL BORING LOG

Date 8/23/22

ROUTE IL-60 **DESCRIPTION** IL-60 Box Culvert **LOGGED BY** A. Boland

SECTION _____ **LOCATION** 2056186.901,1049939.856

COUNTY Lake **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 049-0567
Station 195+94

BORING NO. IL-60-BCB-02
Station _____
Offset _____
Ground Surface Elev. 784.86 ft

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

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After _____ **Hrs.** Not Taken ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				ASPHALT (14")
				783.66
	5			Dark brown CLAY, some sand, some gravel
	3		18.0	Very stiff
	3	2.3 P		
				Stiff
	2			
	2		24.9	
-5	2	1.0 P		
				Stiff
	2			
	1		18.1	
	1	1.8 P		
				776.86
				Medium stiff, gray CLAY, some sand, some gravel
	1			
	1		25.3	
-10	2	0.5 P		
				774.36
				Dark gray CLAY
	3			Very stiff
	5		17.6	
	7	3.5 B		
				Very stiff
	3			
	5		17.6	
-15	7	2.3 B		
				Very stiff
				Shelby tube taken @ 16'-18'
			19.6	LL=33%, PI=16%
		3.0 B		
				Very stiff, trace gravel
	2			
	3		22.1	
-20	4	2.1		
				Dark gray CLAY *(continued)*
			B	
				Very stiff, trace gravel
	2			
	4		21.9	
	4	3.0 B		
				Very stiff, trace gravel
	2			
	3		21.6	
-25	5	2.4 B		
				Stiff, trace gravel
	4			
	4		21.0	
	5	1.8 B		
	5			
				Stiff 755.86
	20		15.4	
	15	2.0 B		Dense, gray SAND and GRAVEL, moisture=7.6%
-30				754.86
				End of boring at 30'
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)

Appendix B

Laboratory Test Reports

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Organic Content
AASHTO T267

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 01-SS-03	**Date Tested**	9/2/2022	**Tested By**	BKP
						Qc By	AB

Date Sample Received	8/25/2022
Sample Location	6' - 7.5'
Sample Description	Dark gray clay

Moisture Content Determination

Can Number :	M-47	
Can Weight :	31.80	gm
Can + Wet Sample Weight :	55.94	gm
Can + Dry Sample Weight :	48.83	gm
Moisture Content :	**41.75**	%

Organic Content Determination

Dish Number :	A	
Dish Weight :	95.56	gm
Dish + Initial Sample Weight :	130.00	gm
Dish + Final Sample Weight :	128.06	gm
Oven-dried test specimen mass, B:	34.44	gm
Mass of ash, C:	32.50	gm
Ash Content, D:	94.37	%
Organic Content, (100-D):	**5.6**	**%**

Remarks

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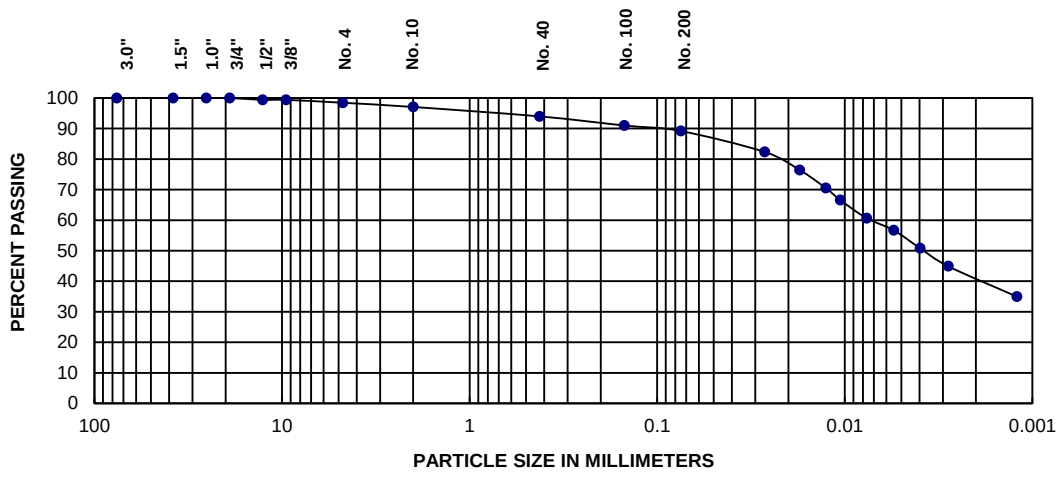
GRAIN SIZE ANALYSIS
AASHTO T 88

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 01-ST-06	**Date Tested**	9/1/2022	**Tested by**	BKP
						Qc by	AB

Date Sample Received:	8/25/2022
Sample Location	13.5' - 15.5'
Sample Description	Dark gray clay, trace gravel



			Fines	
% + 3"	**% Gravel**	**% Sand**	**% Silt**	**% Clay**
0.0	2.9	7.9	47.4	41.8

For coarse-grained soils with <12% Fines	D60(mm)	D30(mm)	D10(mm)	Cu	Cc

Sieve Size	**Percent Passing**
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	100.0
1/2"	99.4
3/8"	99.4
No. 4	98.5
No. 10	97.1
No. 40	94.0
No. 100	91.0
No. 200	89.2

Liquid Limit, L_L	**Plastic Limit, PL**	**Plasticity Index, PI**
32	16	16

AASHTO Classification:	A-6(14)
IDH Classification:	Clay

Remarks:	

Test ID	69541

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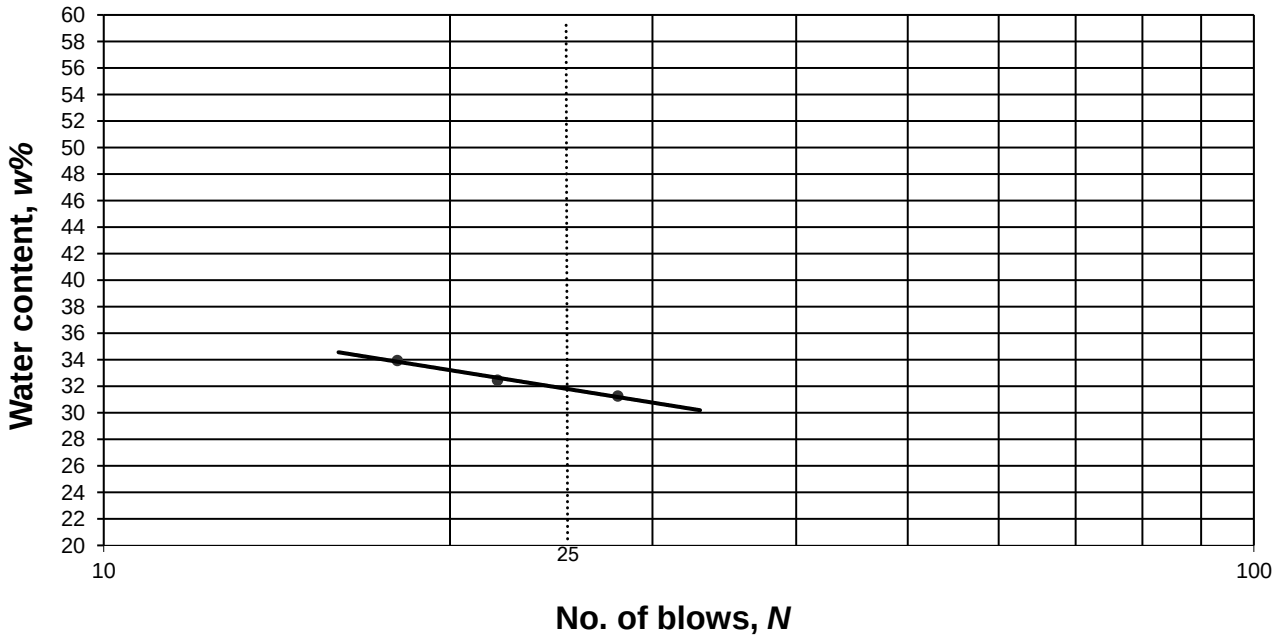
Atterberg Limits

AAASHTO T 89,90

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 01-ST-06	**Date Tested**	9/1/2022	**Tested By**	BKP
						Qc By	AB

Date Sample Recd.	8/25/2022
Sample Location	13.5' - 15.5'
Sample Description	Dark gray clay, trace gravel

LIQUID LIMIT DETERMINATION



Results

Liquid Limit, LL	**32**	**Plastic Limit, PL**	**16**	**Plasticity Index, PI**	**16**

Remarks

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Moisture Content
AASHTO T265

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 01-ST-06	**Date Tested**	8/30/2022	**Tested By**	BKP
						Qc By	RC

Date Sample Received	8/25/2022
Sample Location	13.5' - 15.5'
Sample Description	Dark gray clay, trace gravel

Can Number :	15-C	
Can Weight :	31.24	gm
Can + Wet Sample Weight :	156.69	gm
Can + Dry Sample Weight :	137.71	gm
Moisture Content :	**17.83**	%

Remarks

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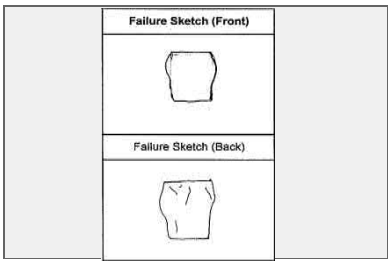
UNCONFINED COMPRESSIVE STRENGTH (ASTM D 2166)

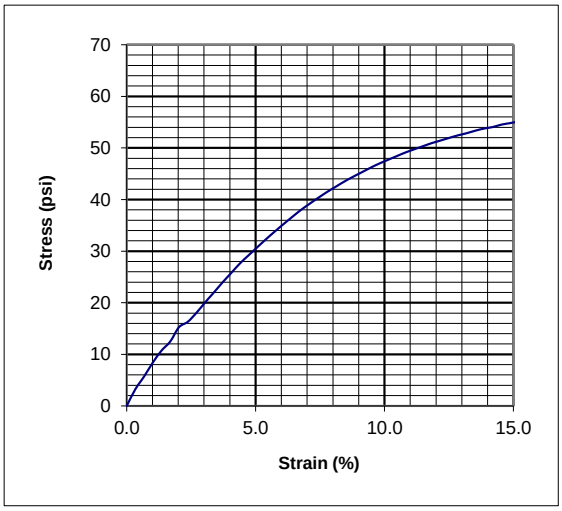
Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample No.**	BCB 01-ST-06	**Date Tested**	8/30/22	**Tested By**	AB
						QC By	RC

Date Sample Received	8/25/22
Description of Soil	Dark gray clay, trace gravel
Location	13.5' - 15.5'

Type of Sample	ST	
Average Height =	15.03	cm
Average Diameter =	7.43	cm
Height/Diameter Ratio =	2.02	
Wet Sample Weight=	1325.32	g
Wet Density =	2.03	g/cc
Moisture Content =	17.4	%
Dry Density =	1.73	g/cc
Strain Rate =	1.00	%/min



Failure Image



Unconfined Compressive Strength =	55.15	psi
	3.97	**tsf**
Shear Strength =	27.57	psi
	1.99	tsf
Strain at Failure =	15.2	%

Remarks:

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Test ID	69539

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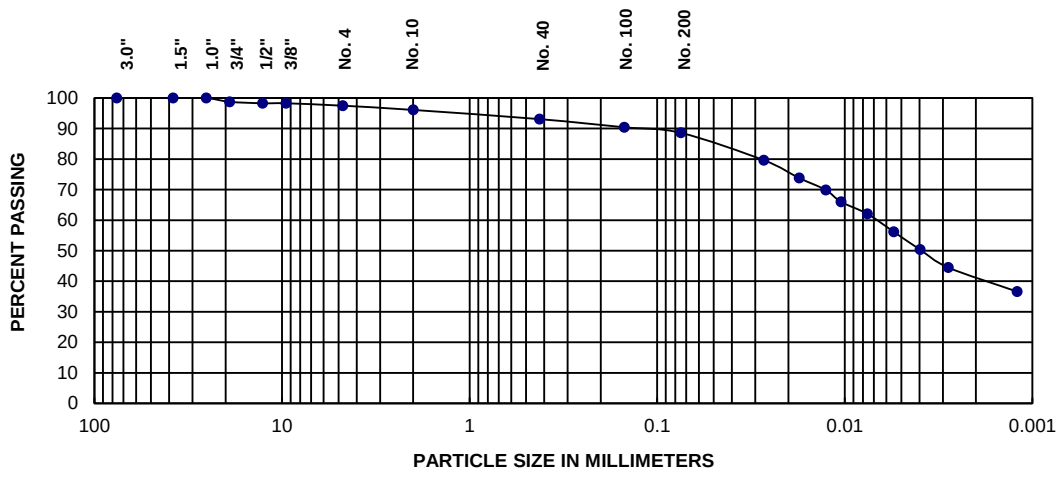
GRAIN SIZE ANALYSIS
AASHTO T 88

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 02-ST-07	**Date Tested**	9/1/2022	**Tested by**	BKP
						Qc by	AB

Date Sample Received:	8/25/2022
Sample Location	16' - 18'
Sample Description	Dark gray clay, trace gravel



			Fines	
% + 3"	**% Gravel**	**% Sand**	**% Silt**	**% Clay**
0.0	3.9	7.5	46.3	42.3

For coarse-grained soils with <12% Fines	D60(mm)	D30(mm)	D10(mm)	Cu	Cc

Sieve Size	**Percent Passing**
3.0"	100.0
1.5"	100.0
1.0"	100.0
3/4"	98.8
1/2"	98.3
3/8"	98.3
No. 4	97.5
No. 10	96.1
No. 40	93.1
No. 100	90.4
No. 200	88.6

Liquid Limit, L_L	**Plastic Limit, PL**	**Plasticity Index, PI**
33	17	16

AASHTO Classification:	A-6(14)
IDH Classification:	Clay

Remarks:	

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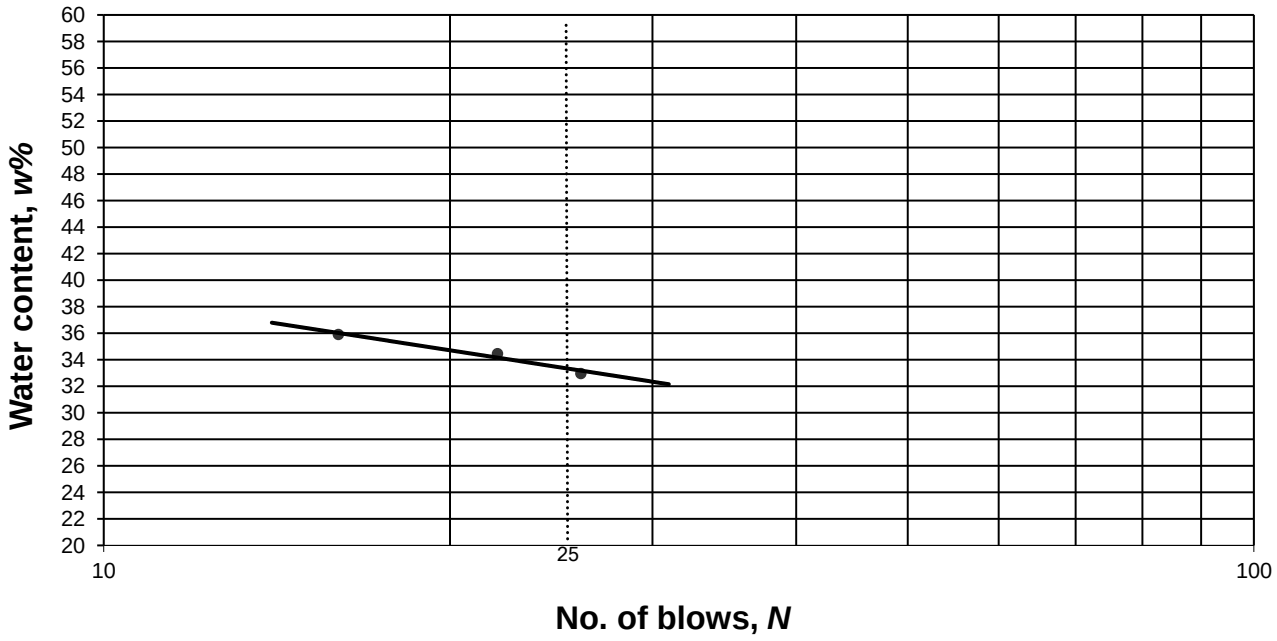
Atterberg Limits

AAASHTO T 89,90

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 02-ST-07	**Date Tested**	9/1/2022	**Tested By**	BKP
						Qc By	AB

Date Sample Recd.	8/25/2022
Sample Location	16' - 18'
Sample Description	Dark gray clay, trace gravel

LIQUID LIMIT DETERMINATION



Results

Liquid Limit, LL	**33**	**Plastic Limit, PL**	**17**	**Plasticity Index, PI**	**16**

Remarks

INTERRA
Engineering • Inspection • Testing

Moisture Content
AASHTO T265

Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample #**	BCB 02-ST-07	**Date Tested**	8/30/2022	**Tested By**	AB
						Qc By	RC

Date Sample Received	8/25/2022
Sample Location	16' - 18'
Sample Description	Dark gray clay, trace gravel

Can Number :	M-33	
Can Weight :	31.90	gm
Can + Wet Sample Weight :	143.07	gm
Can + Dry Sample Weight :	124.82	gm
Moisture Content :	**19.64**	%

Remarks

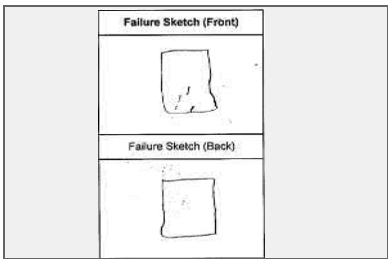
INTERRA Engineering • Inspection • Testing

UNCONFINED COMPRESSIVE STRENGTH (ASTM D 2166)

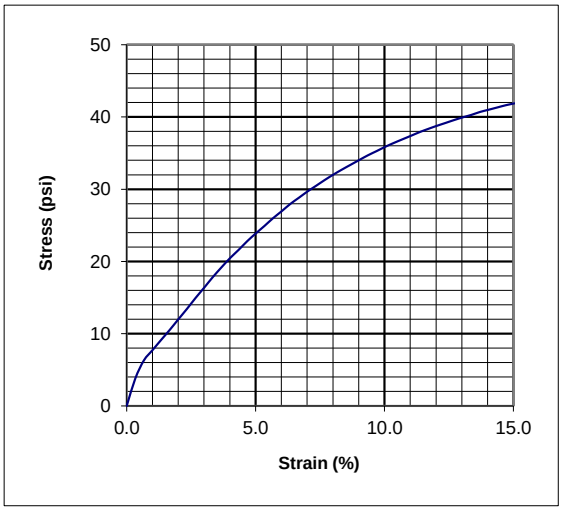
Project	Geotechnical Investigation, Box Culvert at IL 60 over dtich, PTB 195-016-WO 23, Lake County, IL						
Client	Bowman Consulting, 1001 Warrenville Road, Ste. 110, Lisle, IL 60532						
File No.	9243	**Sample No.**	BCB 02-ST-07	**Date Tested**	8/30/22	**Tested By**	AB
						QC By	RC

Date Sample Received	8/25/22
Description of Soil	Dark gray clay, trace gravel
Location	16' - 18'

Type of Sample	ST	
Average Height =	15.20	cm
Average Diameter =	7.20	cm
Height/Diameter Ratio =	2.11	
Wet Sample Weight=	1313.68	g
Wet Density =	2.12	g/cc
Moisture Content =	19.3	%
Dry Density =	1.78	g/cc
Strain Rate =	1.00	%/min



Failure Image

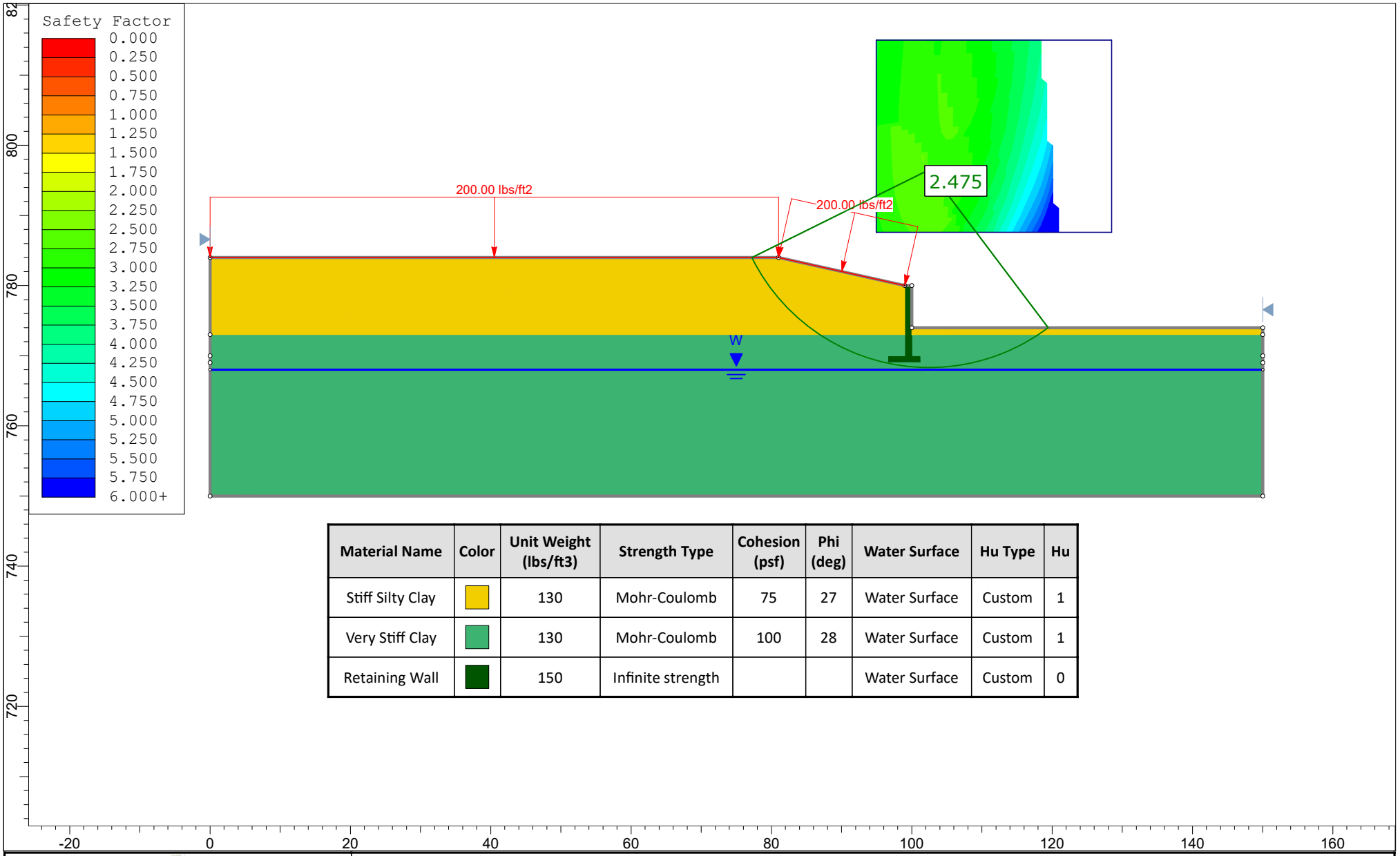


Unconfined Compressive Strength =	41.88	psi
	3.02	**tsf**
Shear Strength =	20.94	psi
	1.51	tsf
Strain at Failure =	15.0	%

Remarks:

Appendix C

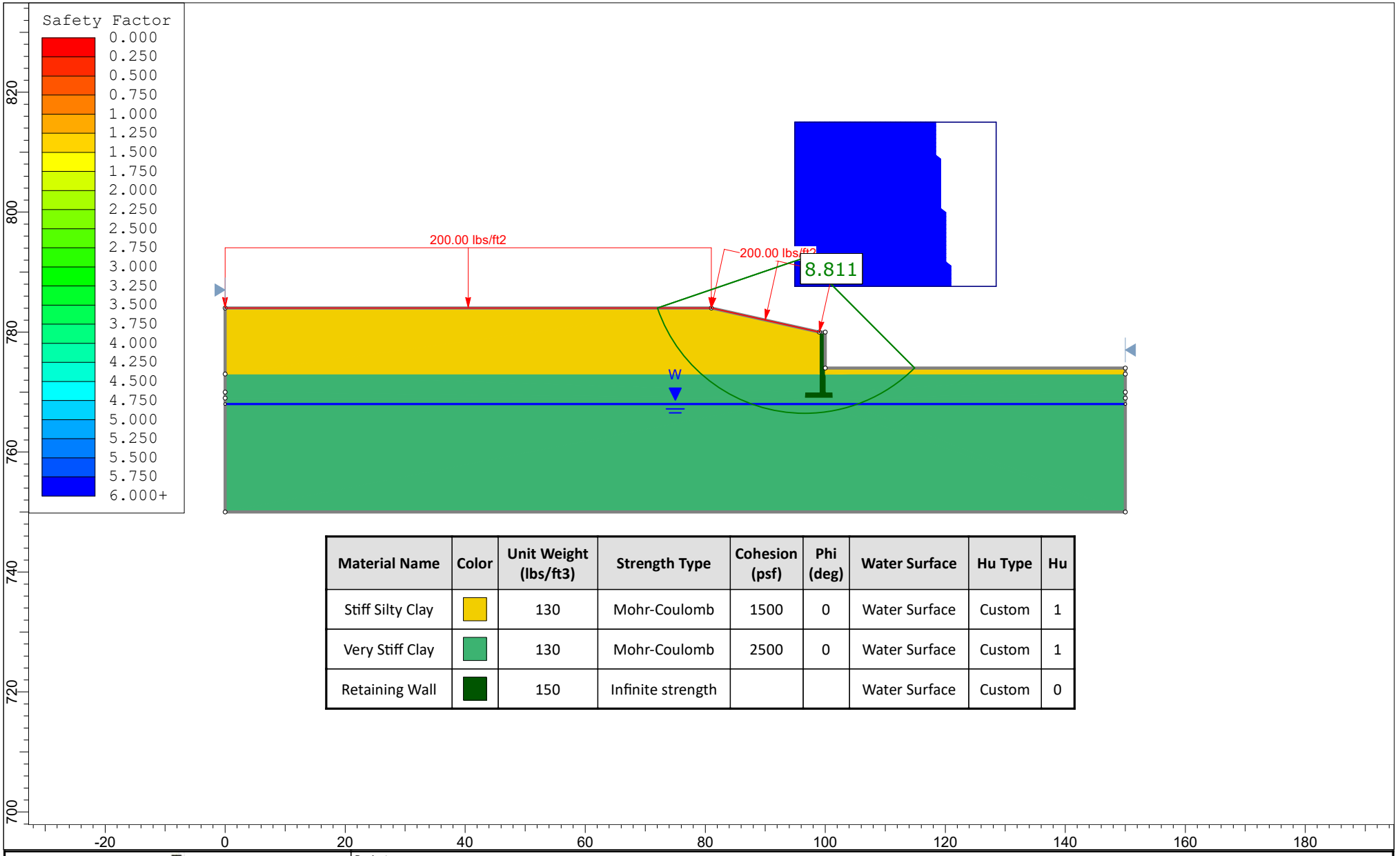
Slope Stability Analyses



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Stiff Silty Clay		130	Mohr-Coulomb	75	27	Water Surface	Custom	1
Very Stiff Clay		130	Mohr-Coulomb	100	28	Water Surface	Custom	1
Retaining Wall		150	Infinite strength			Water Surface	Custom	0

SLIDEINTERPRET 7.038

Project	Box Culvert Wing Wall-IL 60 over M anutou Creek		
Analysis Description	Global Stability Analysis-Long Term		
Drawn By		Scale 1:227	Company INTERRA, INC.
Date	9/30/22		.



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Stiff Silty Clay		130	Mohr-Coulomb	1500	0	Water Surface	Custom	1
Very Stiff Clay		130	Mohr-Coulomb	2500	0	Water Surface	Custom	1
Retaining Wall		150	Infinite strength			Water Surface	Custom	0

SLIDEINTERPRET 7.038

Project	Box Culvert Wing Wall-IL 60 over M anitou Creek		
Analysis Description	Global Stability Analysis-Short Term		
Drawn By		Scale 1:265	Company INTERRA, INC.
Date	9/30/22		.