STRUCTURE GEOTECHNICAL REPORT

US 45 over Lost Creek

Existing S.N. 097-0023
Proposed S.N. 097-0083

SECTION 105B-3
WHITE COUNTY, ILLINOIS
PTB 196 Item 062 WO #8
IDOT Job No. P-99-016-20/D-99-061-20
KEG NO. 20-1109.05

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March 21, 2023

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062-074390
OF ILLINOIS

Kaskaskia Engineering Group, LLC

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EXHIBITS

1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Introduction

The geotechnical study summarized in this report was performed by Kaskaskia Engineering Group, LLC (KEG) for a proposed bridge carrying US 45 over Lost Creek in White County, Illinois. The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of replacing a single-span bridge (existing SN 097-0023) over Lost Creek in White County, Illinois. The general location of the proposed structure is shown on a Location Map, Exhibit A. The project is located approximately 1.5 miles north of Enfield, Illinois. The site lies within the limits of the Mt. Vernon Hill County of the Till Plains Section from the Central Lowland Province. The area is part of the Mattoon Formation, from the Pennsylvanian geologic age. The bedrock consists primarily of shale, with beds of coal, limestone and sandstone.

1.3 Proposed Structure Information

The proposed structure will consist of a single span with rolled steel beams, which will be built on a 0-degree skew and will provide two 12 ft.-wide driving lanes and 4 ft.-wide shoulders with a total width of 34 ft.-10 in. out-to-out. The proposed bridge centerline station will be at 954+52.00 on US 45. The bridge will measure 74 ft. back-to-back abutments. A Type, Size & Location Plan (TS&L) is included in Exhibit C.

Further substructure details will be based on the findings of this SGR.

2.0 FIELD EXPLORATION

2.1 Subsurface Exploration and Testing

The site exploration plan was developed by IDOT. Two borings designated 1-S and 2-S were drilled from March 30th - April 2nd, 2021. The boring locations are shown on Exhibit B – Boring Location Plan. 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. The soil profile for the boring can be found in Subsurface Profile, Exhibit E.

2.2 Subsurface Conditions

Table 2.2.1 shows the depth below the ground surface elevation (GSE) where each boring was terminated and the estimated GSE.

Table 2.2.1 – Borings Depths and GSE

Boring	Depth (ft.)	Ground Surface Elevation (ft.)
1-S	59.9	387.7
2-S	69.0	387.2

In general, the borings included a mix of the following soil types: clays, silts, sands, and loams. Bedrock was encountered in both borings consisting of shale. Rock coring was performed in Boring 2-S and consisted of hard, gray clayey shale. A summary of the general condition of the subsurface is described in Table 2.2.2.

Table 2.2.2 – Subsurface Profile Summary

Soil Type	N-Values (bpf)	Q_u (tsf)	WC (%)	Boring
Clay/Clay Loam	2 to 27	0.5 to 5.1	14 to 28	1-S, 2-S
Silty Clay/Silty Clay Loam	3 to 17	0.3 to 3.5	17 to 32	1-S, 2-S
Sandy Loam	3 to 8	0.2	17 to 24	1-S, 2-S
Sand	4	-	17	1-S
Clayey Shale (Soil Boring)	36 to 100/4”	3.7 to 9.2	12 to 17	1-S, 2-S
Clayey Shale (Rock Core)	-	26.6 to 101.9	-	2-S

Groundwater was encountered in Boring 1-S at 32.5 ft. below GSE at an elevation of 355.2 ft. It should be noted that the groundwater level is subject to seasonal and climatic variations. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

Since no significant grading or changes to the existing embankments are expected at the proposed structure, it is estimated that the existing embankments will experience no settlement. Therefore, no settlement calculations were performed for the proposed structure.

3.2 Slope Stability

A stability analysis using SLOPE/W was performed using the proposed roadway and bridge geometry on the TS&L and soil characteristics from Boring 1-S and Boring 2-S. Three conditions were modeled for each scenario: end-of-construction, pseudo-static seismic for the undrained condition, and long-term stability. A critical factor of safety (FOS) was calculated for each condition.

In order to model the end-of-construction condition, full cohesion, and a friction angle of 0 degrees were assumed. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were between 50 and 100 psf for the cohesive soils, with friction angles between 26 and 38 degrees.

The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is shown in Table 3.2. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit F.

Table 3.2 – Slope Stability Critical FOS

Structure	Critical FOS		
	End-of Construction	Seismic Load	Long Term
North Abutment (1V:2H)	3.3	2.0	2.4
South Abutment (1V:2H)	2.2	1.4	2.4

According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.0 for the pseudo-static seismic analysis. The slope stability analysis indicated that the required minimum FOS for all conditions were met.

3.3 Scour

The design scour elevations for the proposed structure are shown in Table 3.3. Class A5 stone riprap will be placed on the surface of the proposed abutment end slopes to reduce the potential for future scour.

Table 3.3 - Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)		Item 113
	North Abutment	South Abutment	
Q_{100}	380.3	380.3	8
Q_{200}	380.3	380.3	
Design	380.3	380.3	
Check	380.3	380.3	

3.4 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 - Seismic Site Class Definition and the IDOT provided spreadsheet titled: '*Seismic Site Class Determination*.' Using these resources, the controlling global site class for this project is Soil Site Class D.

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. Published information and mapping from the USGS, including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to develop the parameters for the bridge location. The values, based on Soil Site Class D, are summarized below.

Table 3.4 - Summary of Seismic Parameters

Parameter	Value
Soil Site Class	D
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.72g
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.30g
Seismic Performance Zone	2

*S_{DS} and S_{D1} values shown as provided by IDOT

As indicated in the table above, the Seismic Performance Zone is 2, based on S_{D1} and Table 3.15.2 in the IDOT Bridge Manual, the Soil Site Class D, and Figure 2.3.10-3 in the IDOT Bridge Manual.

3.5 Liquefaction

A liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis.

The PGA and Mw to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website: https://earthquake.usgs.gov/hazards/interactive/ for both NMSZ (far source-site) and CEUS (near source-site) models. The deaggregation data indicated two near source-sites contributing at least 5.7% to the hazard for this site; hence, PGA maximums from the CEUS Model were necessary. Only the larger of the two magnitudes, in this case 5.1, was used in the analysis. The Peak Horizontal Ground Surface Acceleration value was set to the PGA calculated in the IDOT Liquefaction Analysis Spreadsheet.

The results from the analysis for the soil profiles encountered in Boring 1-S and Boring 2-S showed no potential for liquefaction from any source contributing at least 5% to the hazard for the site. Therefore, no reduction for liquefaction was considered for the pile design capacity or other foundation considerations. A summary of the liquefaction analysis including each specific run is included in Exhibit G, Liquefaction Analyses.

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 Driven Piles

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads. The IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit H).

The factored reactions and the preliminary design loads, as provided by ESCA Consultants are provided in Table 4.1.

Table 4.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
North Abutment	1050
South Abutment	1050

The estimated pile lengths for applicable H-pile types are shown in Tables 4.1.1 through 4.1.6 below. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 4.1.1 - Estimated Pile Lengths for HP 10x42 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	335	184	56	382.34
South Abutment (2-S)	335	184	52	382.34

Table 4.1.2 - Estimated Pile Lengths for HP 12x53 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	418	230	56	382.34
South Abutment (2-S)	418	230	52	382.34

Table 4.1.3 - Estimated Pile Lengths for HP 12x63 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	497	273	57	382.34
South Abutment (2-S)	497	273	54	382.34

Table 4.1.4 - Estimated Pile Lengths for HP 14x73 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	578	318	57	382.34
South Abutment (2-S)	578	318	53	382.34

Table 4.1.5 – Estimated Pile Lengths for HP 14x89 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	705	388	59	382.34
South Abutment (2-S)	705	388	55	382.34

Table 4.1.6 - Estimated Pile Lengths for HP 14x117 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	929	511	62	382.34
South Abutment (2-S)	929	511	59	382.34

As shown in the Tables above and in Pile Length/Pile Type, Exhibit H, downdrag and liquefaction have not been included at the substructure locations.

KEG recommends one test pile be performed, at a minimum. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to determine pile driving requirements for the project. This is also the manner in which the contractor’s proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

The piles are expected to be driven into penetrable shale and weathered sandstone and pre-coring should not be required to reach estimated embedment depths. Therefore, KEG recommends using pile shoes to facilitate driving and protect piles from damage.

4.2 Lateral Pile Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program, or other approved software, can be used for the lateral or displacement analysis of the foundations. Table 4.2.1 and Table 4.2.2 are included for the structural engineer's use in determining lateral pile response.

Table 4.2.1 - Soil Parameters for Lateral Pile Load Analysis

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N (ave.)	Assumed % fines < #200	K (pci)	ε50
			c (psf)	Φ (deg.)	c (psf)	Φ (deg.)				
1-S	373.2	120	860	0	100	26	4	65	100	0.01
	358.2	120	1300	0	100	26	5	85	500	0.007
	355.7	120	200	0	-	30	8	0	25	-
	353.2	115	-	34	-	34	4	3	20	-
	338.2	120	4100	0	100	26	19	85	2000	0.004
	339.2	125	1800	0	100	26	13	65	500	0.007
2-S	370.2	120	800	0	100	26	5	65	100	0.01
	367.7	120	1400	0	100	26	6	85	500	0.007
	365.2	120	700	0	50	26	3	65	100	0.01
	362.7	120	200	0	50	26	3	85	100	0.004
	360.2	120	600	0	-	30	4	0	25	-
	357.7	120	900	0	100	26	5	65	100	0.01
	342.7	120	2740	28	100	28	17	65	1000	0.005

Table 4.2.2 - Rock Parameters for Lateral Pile Load Analysis

Rock Type	Weak Rock			Strong Rock	
	y (psf)	RQD	Qu (tsf)	y (psf)	Qu (tsf)
Shale	135	17	26	145	102

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Construction Activities

Construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction and any pertinent Special Provisions or Policies.

Should any design considerations assumed by KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply.

5.2 Temporary Sheeting and Soil Retention

Temporary shoring may be required at various stages of this project due to the proposed staged-construction layout shown in the TS&L. Temporary Soil Retention Systems may be required versus Temporary Shoring, depending upon the surcharge loading and retained heights required to be supported during construction. An Illinois-licensed Structural Engineer is required to seal the design of Temporary Soil Retention Systems, if deemed necessary.

5.3 Site and Soil Conditions

Provisions of the Standard Specifications should adequately address site and soil conditions.

6.0 COMPUTATIONS

Computations and analyses for special circumstances, if any, are included as exhibits. Please refer to each section of the report for reference to the exhibit containing any such calculations or analysis used.

7.0 GEOTECHNICAL DATA

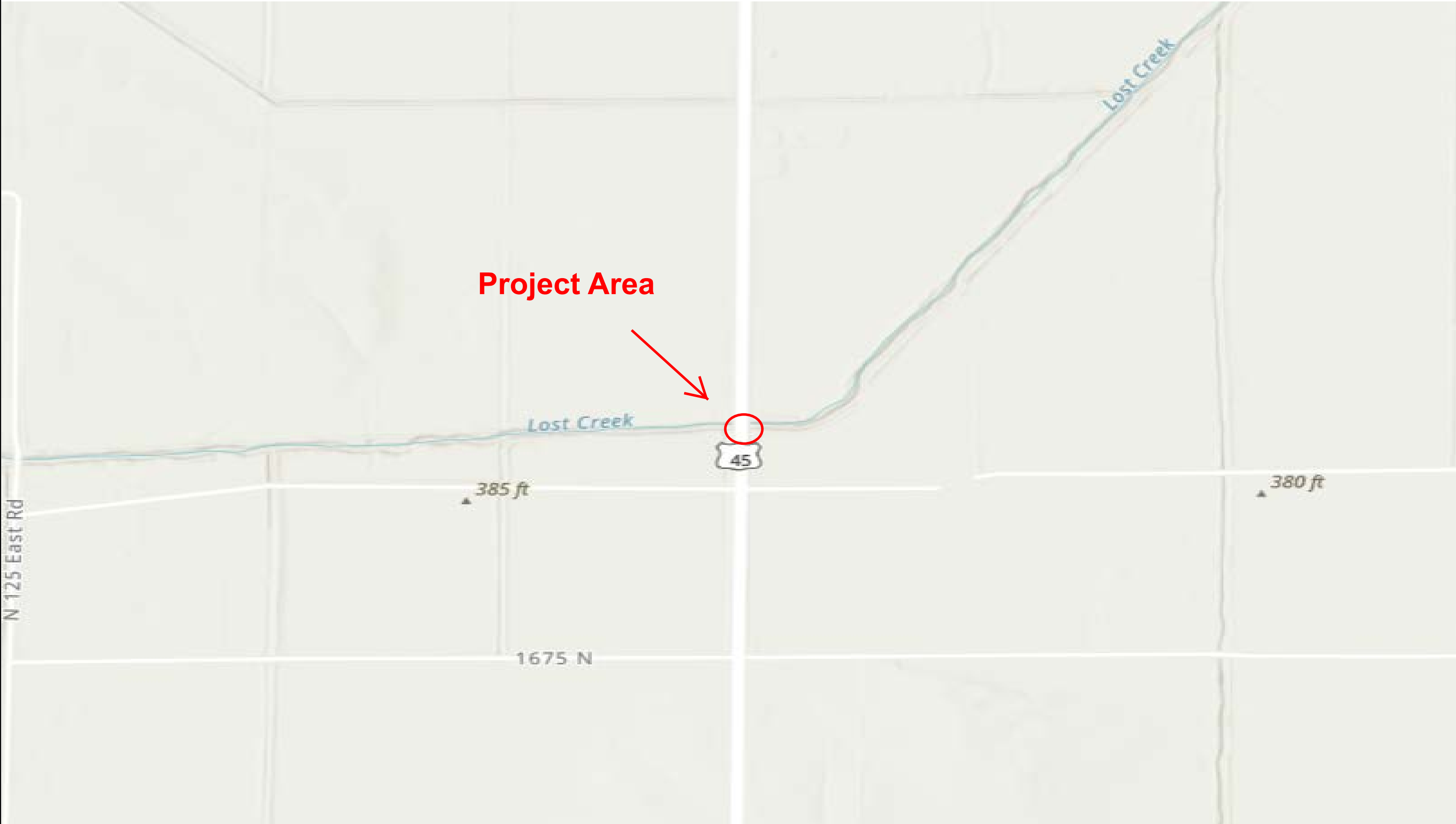
Soil boring logs can be found in Exhibit D. The Subsurface Profile can be found in Exhibit E.

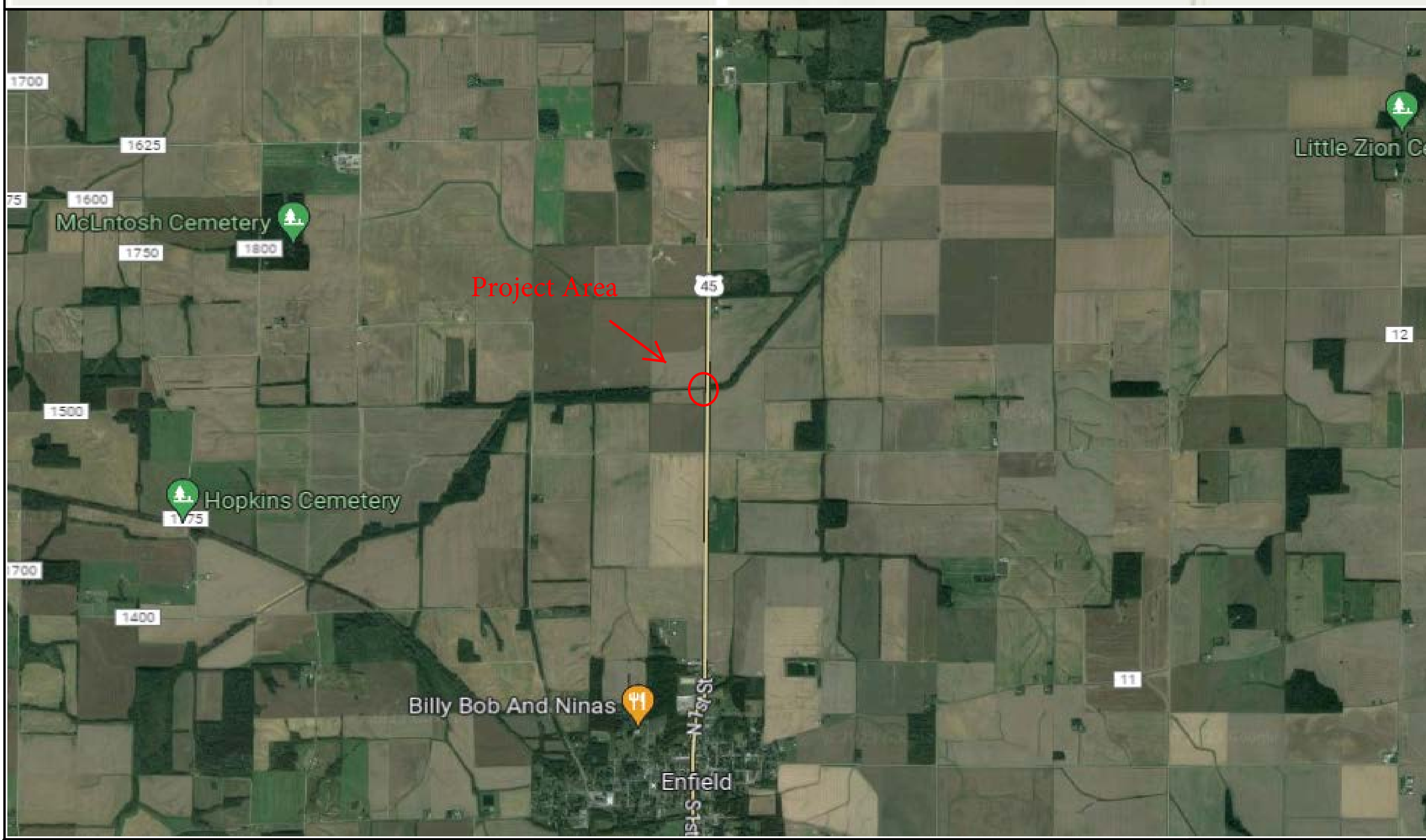
8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of ESCA Consultants, Inc., and the Illinois Department of Transportation (IDOT) District 9. They are specific only to the project described and are based on the subsurface information obtained by IDOT at two boring locations within the structure area. KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

EXHIBIT A

LOCATION MAP





Kaskaskia Engineering Group, LLC

LOCATION MAP

US 45 over Lost Creek
Section: 105B-3
White County, Illinois

Exhibit No.

A

KEG JOB # 20-1109.05

EXHIBIT B

BORING LOCATION PLAN

Kaskaskia Engineering Group, LLC

BORING PLAN

US 45 over Lost Creek
White County, Illinois

Exhibit No.

B

KEG JOB #20-1109.05

EXHIBIT C

TYPE, SIZE, AND LOCATION PLAN (TS&L)

BENCHMARK:
BM45-4 - A "□" cut on top of the southeast wingwall of SN 097-0063, elev. 384.996 (NAVD88).

EXISTING STRUCTURE:
SN 097-0023 was originally constructed in 1928 as SBI Route 140, Section 105B. It was widened with precast prestressed concrete beams in 1978. The bridge is a single-span with reinforced concrete T-beams and deck beams supported by closed abutments on untreated timber piles. The bridge is 48'-0" long back-to-back abutments. The clear width between bridge rails is 32'-7½". The bridge is not skewed. Traffic will be maintained using stage construction.

No salvage.

Excavation behind existing abutment walls shall be performed to balance front and back soil pressure before removing the existing superstructure.

HIGHWAY CLASSIFICATION

FAP 328 (US 45)
Functional Class: Minor Arterial
ADT: 1890 (2024) / 2310 (2044)
ADTT: 445 (2024) / 545 (2044)
DHV: 210 (2044)
Design Speed: 55 mph
Posted Speed: 55 mph
Two-Way Traffic
Directional Distribution: 50:50

SEISMIC DATA

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.302 g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.720 g
Soil Site Class = D

LOADING HL-93

Allow 50 psf for future wearing surface

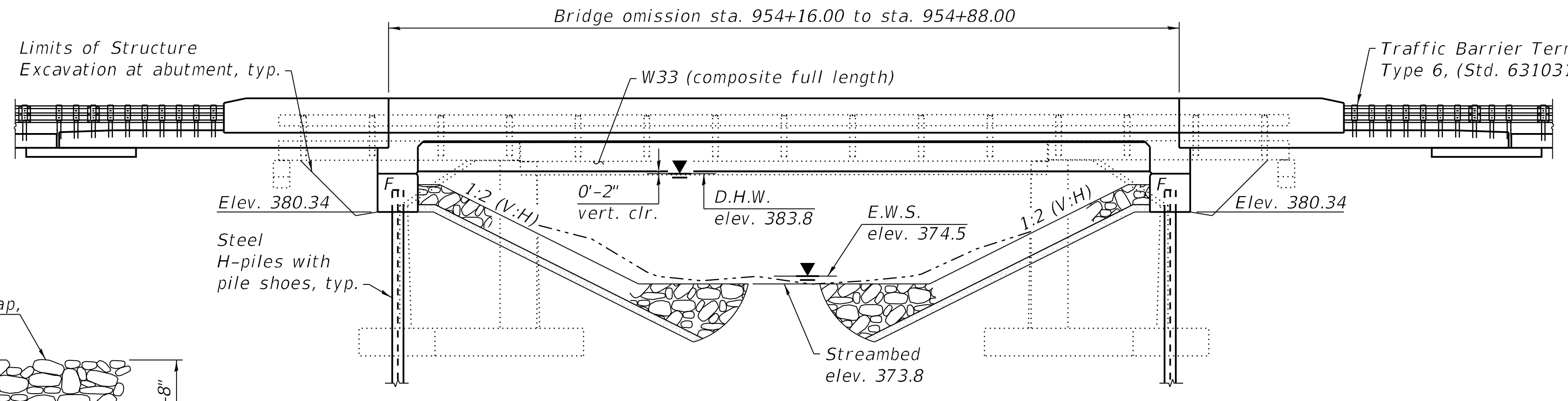
DESIGN STRESSES
FIELD UNITS

f'c = 3,500 psi (substructure concrete)
f'c = 4,000 psi (superstructure concrete)
fy = 50,000 psi (AASHTO M270, Grade 50) ①
fy = 60,000 psi (reinforcement)

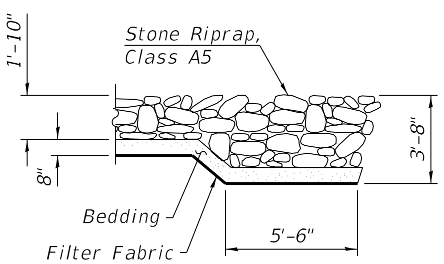
① All structural steel shall be painted.

DESIGN SPECIFICATIONS

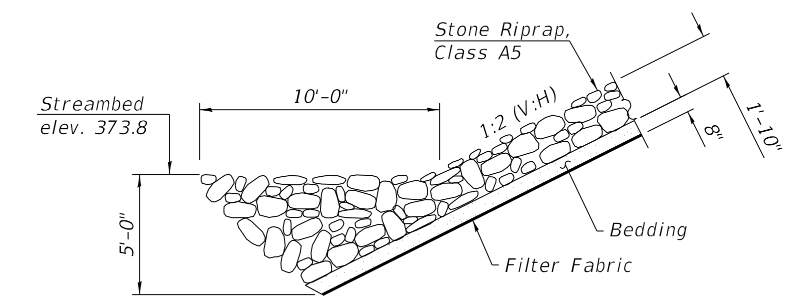
2020 AASHTO LRFD Bridge Design Specifications, 9th Edition



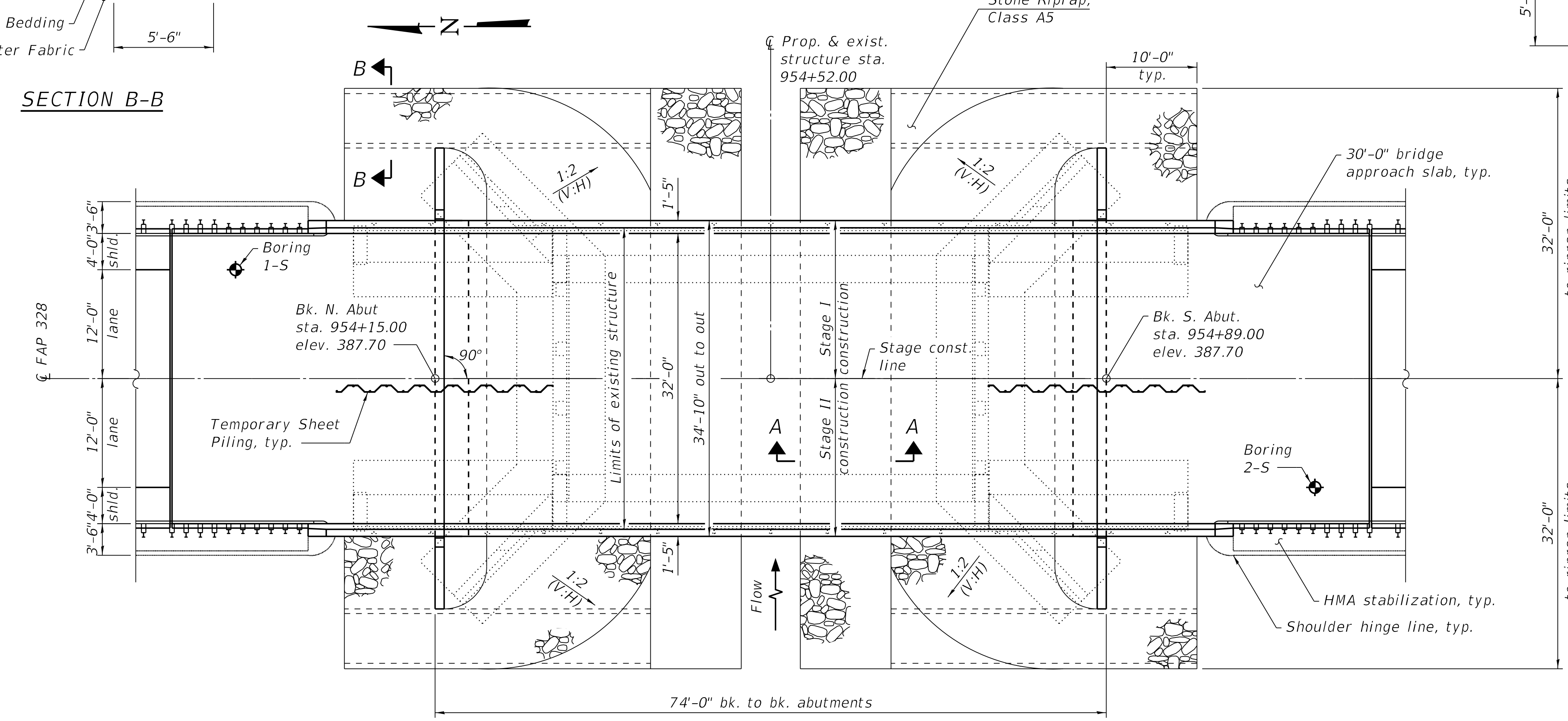
ELEVATION



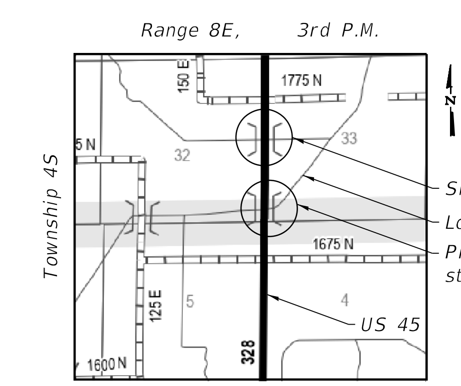
SECTION B-B



SECTION A-A



PLAN



LOCATION SKETCH

GENERAL PLAN & ELEVATION
US 45 OVER LOST CREEK
FAP ROUTE 328 - SECTION 105B-3
WHITE COUNTY
STATION 954+52.00
STRUCTURE NO. 097-0083

ESCA CONSULTANTS, INC.

USER NAME = shl	DESIGNED - SHL 01/23	REVISED -
ESCA PROJECT NO. 1359.08	CHECKED - ELH 01/23	REVISED -
PLOT SCALE = 0.167 ' / in.	DRAWN - ZTC 03/23	REVISED -
PLOT DATE = 3/27/2023	CHECKED - SHL 03/23	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
328	105B-3	WHITE		
		CONTRACT NO. 78833		
	ILLINOIS	FED. AID PROJECT		

MODEL: PLOT
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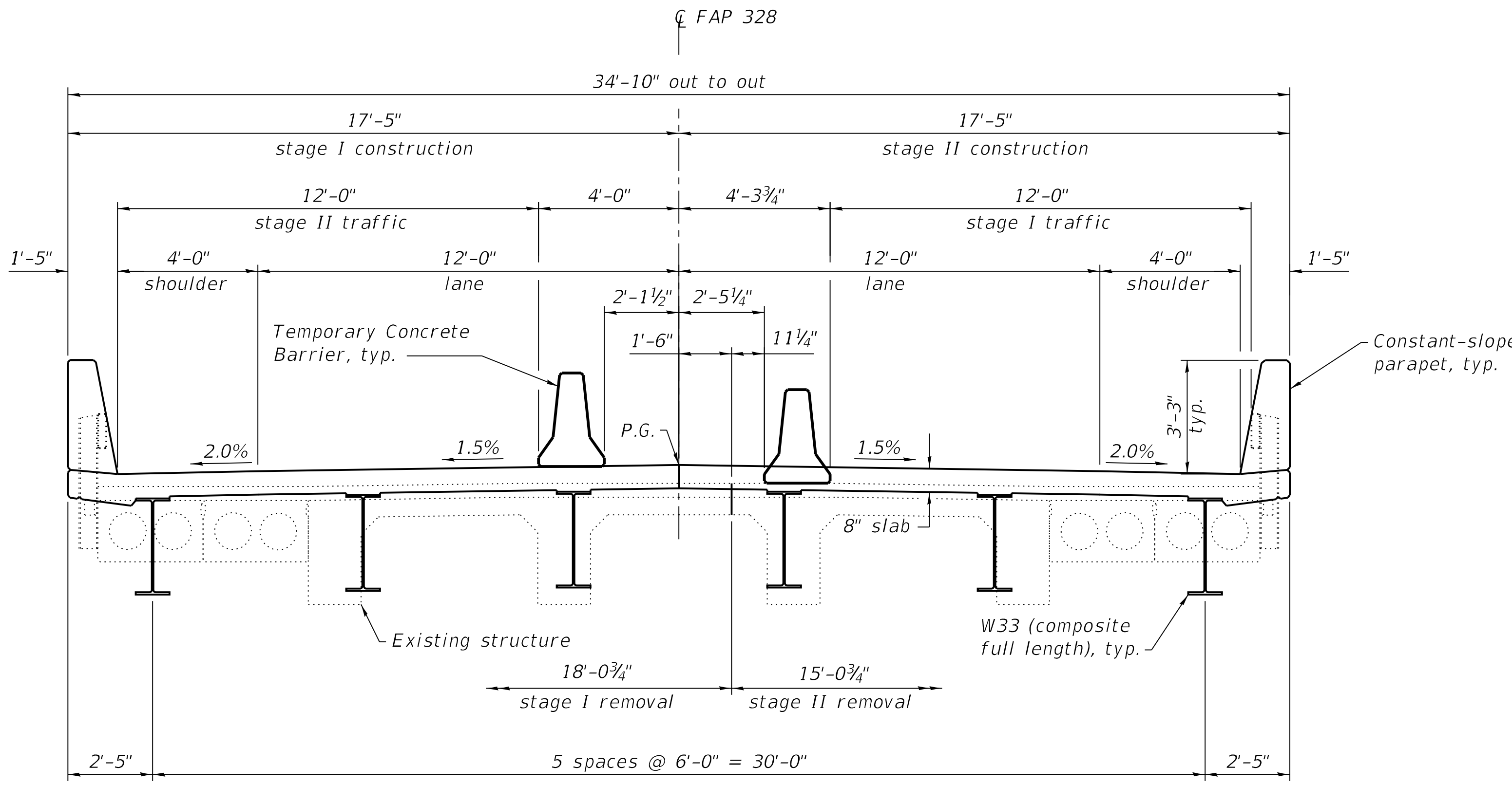
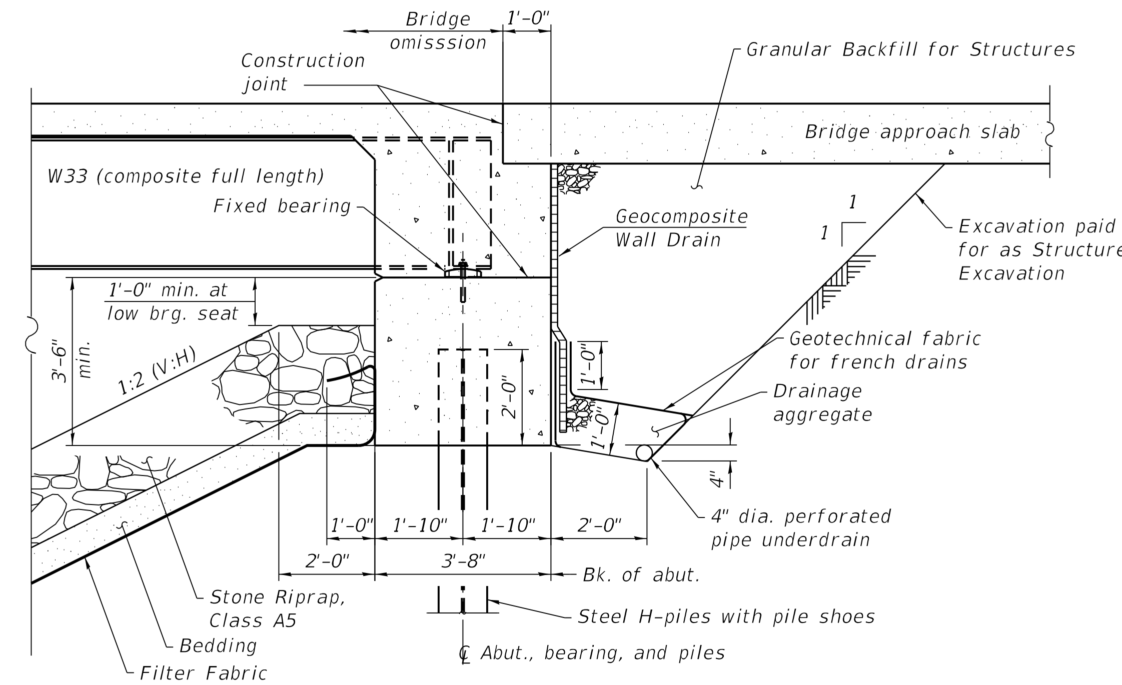
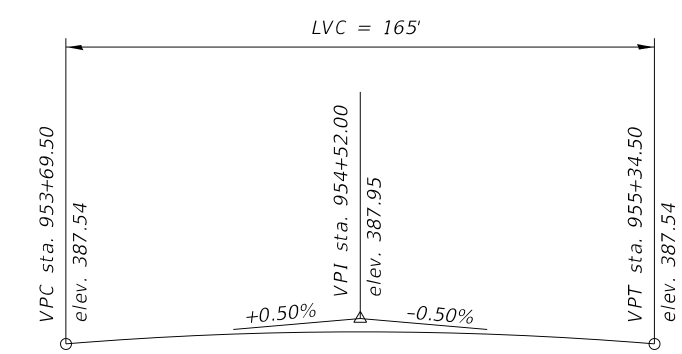


CROSS SECTION
(Looking South)



SECTION THROUGH INTEGRAL ABUTMENT



PROFILE GRADE
(Along ℄ FAP 328)

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)		
	N. Abut.	S. Abut.	Item 113
Q100	380.3	380.3	8
Q200	380.3	380.3	
Design	380.3	380.3	
Check	380.3	380.3	

WATERWAY INFORMATION TABLE

Drainage Area = 17.65 sq. mi.

Existing Overtopping Elev. 385.38 at Sta. 945+00
Proposed Overtopping Elev. 385.38 at Sta. 945+00

Flood Event	Freq. Yr.		Discharge (cfs) Existing	Discharge (cfs) Proposed	Waterway Opening (sq. ft.) Existing	Waterway Opening (sq. ft.) Proposed	Natural H.W.E.	Head (ft.) Existing	Head (ft.) Proposed	Headwater Elevation Existing	Headwater Elevation Proposed
	10	Main Channel	2533	2511	345	382	383.2	1.7	1.8	384.9	385.0
		Relief Structure	777	799	162	162					
		TOTAL	3310	3310	507	544					
Existing Overtopping	13	Main Channel	2849	-	350	-	383.3	2.1	-	385.4	-
		Relief Structure	838	-	165	-					
		TOTAL	3687	-	515	-					
Proposed Overtopping	35	Main Channel	-	3040	-	414	383.7	-	1.7	-	385.4
		Relief Structure	-	1917	-	174					
		TOTAL	-	4957	-	588					
Design	50	Main Channel	3661	3363	370	420	383.8	2.0	1.6	385.8	385.4
		Relief Structure	1659	1957	180	180					
		TOTAL	5320	5320	550	600					
Base	100	Main Channel	3758	3027	370	428	384.1	2.0	1.5	3861	385.6
		Relief Structure	2462	3193	183	183					
		TOTAL	6220	6220	553	611					
Scour Design Check	200	Main Channel	4326	3538	370	428	384.3	1.8	1.4	386.1	385.7
		Relief Structure	2865	3653	183	183					
		TOTAL	7191	7191	553	611					

10 year velocity through existing bridge = 10.7 ft/s
10 year velocity through proposed bridge = 10.3 ft/s

DETAILS
US 45 OVER LOST CREEK
FAP ROUTE 328 - SECTION 105B-3
WHITE COUNTY
STATION 954+52.00
STRUCTURE NO. 097-0083

EXHBIT D

BORING LOGS

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 3/30/21

ROUTE US 45 **DESCRIPTION** Bridge over Lost Creek **LOGGED BY** L. Estel

SECTION 105,B 105 BY-2 (existing) **LOCATION** 1.5 mile N of Enfield (near N. Abut.), **SEC.** 32, **TWP.** 4S, **RNG.** 8E, **PM**

COUNTY White **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 097-0023
Station 954+52

BORING NO. 1-S
Station 953+93
Offset 12.0ft Lt
Ground Surface Elev. 387.7 ft

Surface Water Elev. 374.5 ft
Stream Bed Elev. 373.9 ft

Groundwater Elev.:
First Encounter 355.2 ft
Upon Completion ft
After Hrs. ft

Description	Elev. (bottom of layer)	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored Pavement	386.20				
Stiff Brown with specks of dark Brown, Moist SILTY CLAY	383.20		1 2 3	1.2 B	20
Soft Brown with specks of dark Brown, Moist SILTY CLAY		-5	1 1 2	0.4 B	24
(Tan with specks of Brown)	378.20		1 2 3	0.3 B	24
M. Stiff Tan-brown, Moist SILTY CLAY	375.70	-10	1 1 3	1.0 B	26
Stiff Tan-brown and mottled Red-brown, Moist SILTY CLAY	373.20		1 2 4	1.4 B	23
V. Stiff Tan-brown and mottled Brown, Moist CLAY	370.70	-15	1 4 5	3.5 B	25
Stiff Tan-brown and mottled Brown, Moist CLAY	368.20		1 3 4	1.4 B	22
M. Stiff Grey Brown, Moist CLAY		-20	1		
M. Stiff Grey Brown, Moist CLAY *(continued)*			2 3	1.0 B	24
	363.20		1 3 3	1.0 B	28
M. Stiff Dark Grey, Moist CLAY		-25	WOH 1 1	0.5 B	25
	358.20		WOH 1 1	0.5 B	22
Loose Grey, V. Moist to Wet SANDY LOAM 5% m. SAND, 62% f. SAND, 24% SILT, 9% CLAY, non-plastic (Lab 007)	355.70	-30	1 3 5		17
Loose Grey, V. Moist to Wet m. & f. SAND 6% c. SAND to f. GRAVEL, 37% m. SAND, 46% f. SAND, 8% SILT, 3% CLAY, non-plastic (Lab 008)	353.20		WOH WOH 4		17
Hard dark Grey, Moist CLAY with specks of rock fragments on pebbles		-35	7 12 15	5.1 B	16
(V. Stiff)			2 6 9	3.9 B	18
(Hard)		-40	2		

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

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 3/30/21

ROUTE US 45 **DESCRIPTION** Bridge over Lost Creek **LOGGED BY** L. Estel

SECTION 105,B 105 BY-2 (existing) **LOCATION** 1.5 mile N of Enfield (near N. Abut.), **SEC.** 32, **TWP.** 4S, **RNG.** 8E, **PM**

COUNTY White **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 097-0023
Station 954+52

BORING NO. 1-S
Station 953+93
Offset 12.0ft Lt
Ground Surface Elev. 387.7 ft

Surface Water Elev. 374.5 ft
Stream Bed Elev. 373.9 ft

Groundwater Elev.:
First Encounter 355.2 ft
Upon Completion ft
After Hrs. ft

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
(Hard) *(continued)*		7	4.5	17
		10	B	
343.20				
V. Stiff dark Grey, Moist CLAY	-45	2		
		7	2.9	19
		10	B	
338.20				
Stiff Green-grey, Moist SILTY CLAY	-50	1		
		4	1.9	17
		7	B	
333.20				
Stiff Green-grey, Moist SILTY CLAY with a SANDSTONE seam	-55	1		
		6	1.7	25
		9	B	
328.20				
Hard Grey, Dry CLAY SHALE	-60	100/4"		

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
			9.2	12
			S	
	-65			
Bottom of hole @ 59.9 ft				
Ground surface elevation referenced to Benchmark WP097-00232, IP&C on W. side of US 45 @ Sta 955+00; Elev. 385.68				
Hammer Efficiency: 86.5% To convert "N" values to "N60", multiply by 1.44				
	-70			
	-75			
	-80			

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\WHITE\STRUCTURES\097-0023 US 45 OVER LOST CREEK\097-0023 IL 45 OVER LOST CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 6/9/21
Latitude 38 07 36 Longitude -88 20 11.54 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 4/2/21

ROUTE US 45 **DESCRIPTION** Bridge over Lost Creek **LOGGED BY** L. Estel

SECTION 105,B 105 BY-2 (existing) **LOCATION** 1.5 mile N of Enfield (near S. Abut.), **SEC.** 32, **TWP.** 4S, **RNG.** 8E, **PM**

COUNTY White **DRILLING METHOD** Hollow Stem Auger (8"O.D. 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 097-0023
Station 954+52

BORING NO. 2-S
Station 955+12
Offset 12.0ft Rt
Ground Surface Elev. 387.2 ft

Surface Water Elev. 374.5 ft
Stream Bed Elev. 373.9 ft

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

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored Pavement					
	385.70				
M. Stiff Brown and mottled Grey, Moist SILTY CLAY			1		
			3	0.6	24
			3	B	
	382.70				
Soft Brown, Moist to V. Moist SILTY CLAY		-5	WOH		
			1	0.4	32
			2	B	
	380.20				
Stiff Tan-grey, Moist SILTY CLAY			WOH		
			2	1.4	22
			3	B	
	377.70				
M. Stiff Tan-grey, Moist SILTY CLAY		-10	WOH		
			2	0.9	27
			3	B	
			1		
			3	0.9	25
			5	B	
(Brown-grey and mottled Brown)		-15	1		
			3	0.6	21
			5	B	
	370.20				
Stiff dark Grey and mottled Brown, Moist CLAY			1		
			2	1.4	22
			4	B	
	367.70				
		-20	1		

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Soft dark Grey and mottled Brown, Moist SILTY CLAY *(continued)*			2	0.4	23
			3	B	
	365.20				
M. Stiff dark Grey, Moist CLAY			1		
			1	0.7	28
			2	B	
	362.70				
V. Soft dark Grey, Moist to V. Moist SANDY LOAM		-25	1		
			2	0.2	24
% Fines <#200: 33%, non-plastic (Estimated based on visual ID and Lab 07)			1	B	
	360.20				
M. Stiff dark Grey, Moist CLAY LOAM			WOH		
			1	0.6	17
			3	B	
	357.70				
M. Stiff dark Grey, Moist SILTY CLAY LOAM		-30	1		
			3	0.9	18
			2	S	
	355.20				
V. Stiff dark Grey, Moist SILTY CLAY LOAM			2		
			8	3.9	14
			10	S	
		-35	3		
			7	2.4	17
			10	S	
	350.20				
V. Stiff dark Grey, Moist SILTY CLAY LOAM with CLAY TILL			4		
			8	2.8	16
			12	S	
		-40	1		

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\WHITE\STRUCTURES\097-0023 US 45 OVER LOST CREEK\097-0023 IL 45 OVER LOST CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 6/9/21
Latitude 38 07 35.24 Longitude -88 20 11.81 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 4/2/21

ROUTE US 45 **DESCRIPTION** Bridge over Lost Creek **LOGGED BY** L. Estel

SECTION 105,B 105 BY-2 (existing) **LOCATION** 1.5 mile N of Enfield (near S. Abut.), **SEC.** 32, **TWP.** 4S, **RNG.** 8E, **PM**

COUNTY White **DRILLING METHOD** Hollow Stem Auger (8"O.D. 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs

STRUCT. NO. 097-0023
Station 954+52

BORING NO. 2-S
Station 955+12
Offset 12.0ft Rt
Ground Surface Elev. 387.2 ft

Surface Water Elev. 374.5 ft
Stream Bed Elev. 373.9 ft

Groundwater Elev.:
First Encounter ____ ft
Upon Completion ____ ft
After ____ **Hrs.** ____ ft

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
V. Stiff dark Grey, Moist SILTY CLAY LOAM with CLAY TILL *(continued)*			6 10	3.7 B	16
	342.70				
Hard dark Grey, Moist CLAY		-45	3 7 11	4.5 B	18
	337.70				
V. Stiff dark Grey, Moist SILTY CLAY LOAM		-50	1 7 10	3.5 B	15
	332.70				
V. Stiff dark Grey, Moist Weathered CLAY SHALE		-55	5 15 21	3.7 S	17
	327.70				
Hard Grey, Dry CLAY SHALE		-60	100/6"		

(Bore hole continued with rock coring)

Bottom of hole @ 69.0 ft

No free water encountered

Ground surface elevation reference to Benchmark WP097-00232, IP&C on W. side of US 45 @ Sta 955+00; Elev. 385.68

Hammer Efficiency: 86.5%
To convert "N" values to "N60", multiply by 1.44

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

Illinois Department of Transportation
Division of Highways
District 9

ROCK CORE LOG

Date 4/2/21

ROUTE US 45 **DESCRIPTION** Bridge over Lost Creek **LOGGED BY** L. Estel

SECTION 105,B 105 BY-2 (existing) **LOCATION** 1.5 mile N of Enfield (near S. Abut.), **SEC.** 32, **TWP.** 4S, **RNG.** 8E, **PM**

COUNTY White **CORING METHOD** Conventional rotary with polymer

STRUCT. NO. 097-0023
Station 954+52

CORING BARREL TYPE & SIZE NV3 5FT NWJ

Core Diameter 1.78 **in**
Top of Rock Elev. 327.70 **ft**
Begin Core Elev. 327.20 **ft**

BORING NO. 2-S
Station 955+12
Offset 12.0ft Rt
Ground Surface Elev. 387.2 **ft**

Description	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Hard Grey, Dry CLAY SHALE, Fined Grained, Field Hardness: Low 60.0 to 64.0 ft		1	69	50	10	101.9
Hard Grey, Dry CLAY SHALE, Fined Grained, Field Hardness: Low 64.0 to 65.25 ft (Field Hardness: Low with layers that are Friable 65.25 to 69.0 ft) 318.20	-65	2	100	17	10	35.5 26.6
Bottom of hole @ 69.0 feet Ground surface elevation referenced to Benchmark WP097-00232, IP&C on W. side of US 45 @ Sta 955+00; Elev. 385.68	-70 -75 -80					

Color pictures of the cores Yes, attached
Cores will be stored for examination until 5 Years after Construction
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

US 45
White Co. 097-0023
Boring 2-S
4-2-21 Lab 12

Boring #	Specimen#	Thickness	L/D ratio	Depth	Unconfined Compression Reading	psi
2-B	1	1.6””	*0.9:1	61.5’	3,520	1,415 psi
2-B	2	3.9”	2.2:1	65.5’	1,225	493 psi
2-B	3	2.4”	*1.3:1	66.5’	920	370 psi

*Desirable specimen length to diameter ratios are between 2.0:1 and 2.5:1. The results may differ from results obtained from a test specimen that meets the requirements.

Foundation Core Instructions
Use 1.78" for the diameter
(Pounds divided by 2.487)=psi

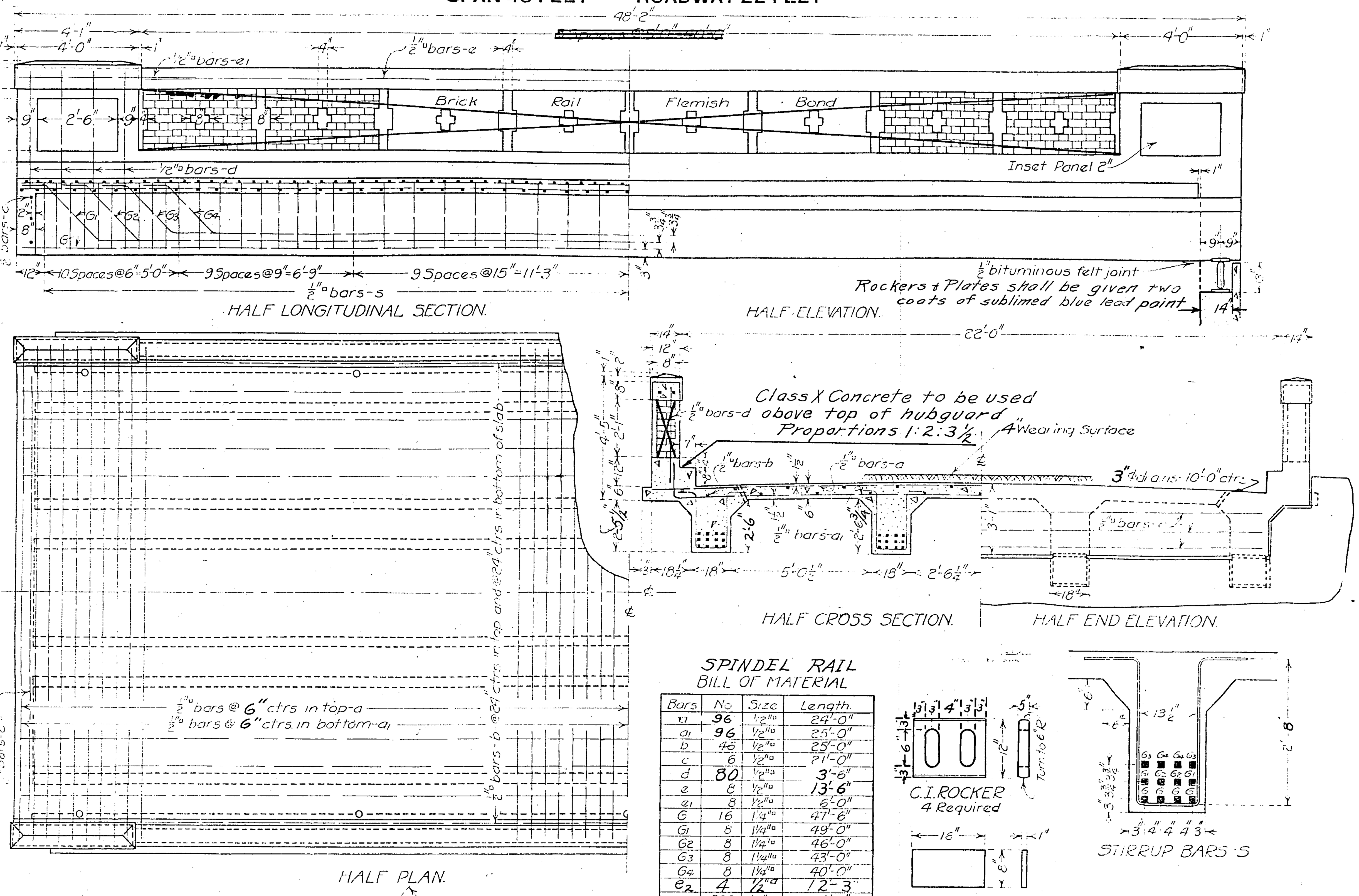
$$\frac{\pi d^2}{4} = 2.487$$

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

REINFORCED CONCRETE DECK GIRDER
SPAN 45 FEET ROADWAY 22 FEET

BOND ISSUE ROUTE NO.	COUNTY	SEC.	TOTAL SHEETS	SHEET NO.
140	White	105B	72	71

SHEET NO 1
3 SHEETS



SPINDEL RAIL
BILL OF MATERIAL

Bars	No	Size	Length
a	96	½"□	24'-0"
a1	96	½"□	25'-0"
b	46	½"□	25'-0"
c	6	½"□	21'-0"
d	80	½"□	3'-6"
e	8	½"□	13'-6"
e1	8	½"□	6'-0"
G	16	1¼"□	47'-6"
G1	8	1¼"□	49'-0"
G2	8	1¼"□	46'-0"
G3	8	1¼"□	43'-0"
G4	8	1¼"□	40'-0"
e2	4	½"□	12'-3"
s	228	½"□	8'-0"
Reinforcing Steel-Lbs.			18650
Class A Concrete-Cu.Yds.			56.5
Class X Concrete			7.4
4 C.I. Rockers-Lbs.			800
8 Steel Plates-Lbs.			290.
4" P.C.C. Pavement-Sq.Yds.			112
Name Plate			1

Class A Concrete to be used below top of hubguard. Proportions-1:2½:4.

Lost Creek Bridge
S.B.I. Rte. 140 Sect. 105-B
White County
Station 954+52

STANDARD	COMPUTED	H.B. Nelson
	CHECKED	C.C. Wood
	DRAWN	H.B.N.
SPECIAL	CHECKED	H.W. Bush
	ASSEMBLED	F.R. Anderson
	CHECKED	J.E. Graham

EXAMINED June 14 1928 — BRIDGE ENGINEER
PASSED — ENGINEER OF DESIGN
APPROVED — CHIEF HIGHWAY ENGINEER

1007

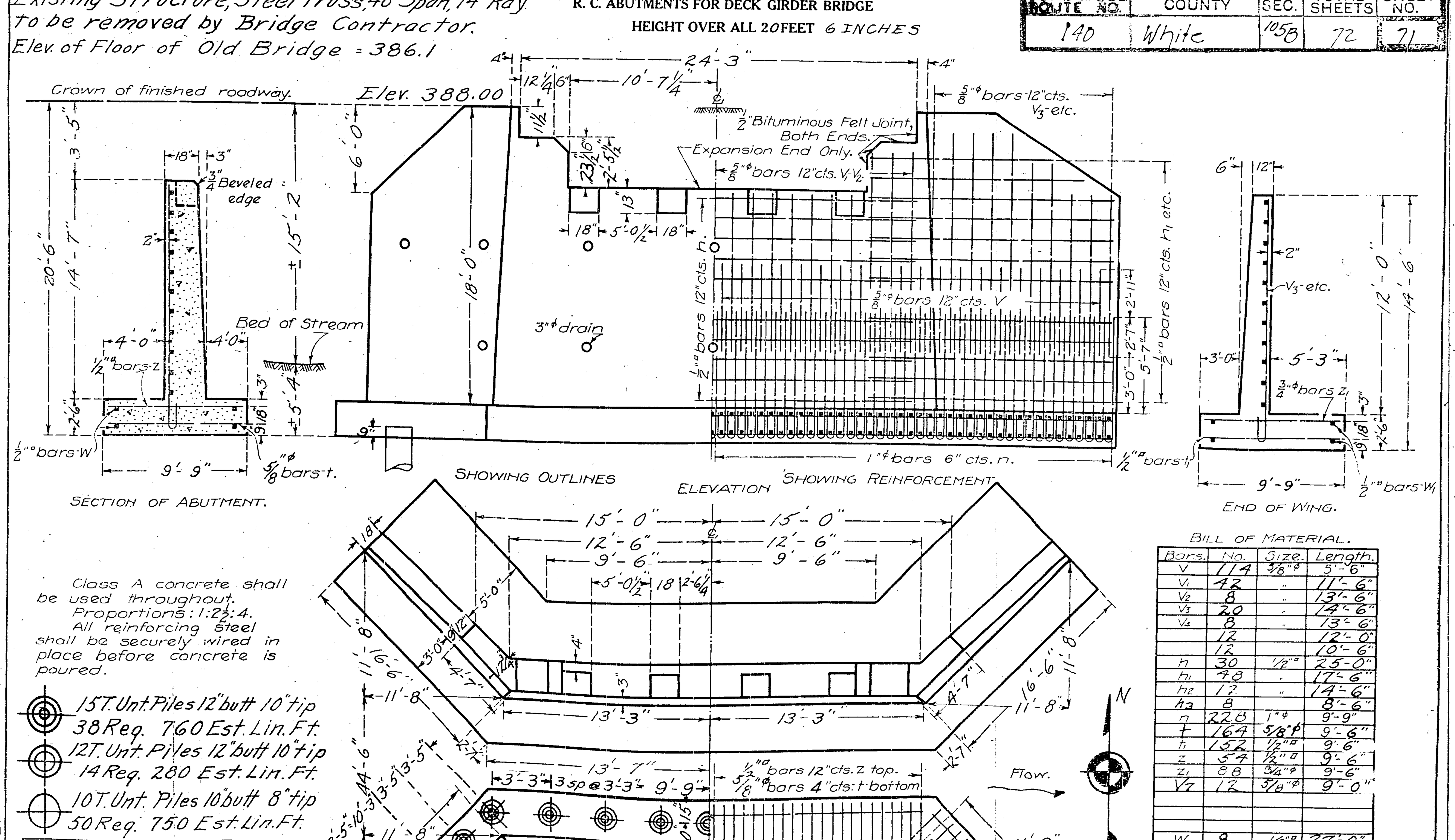
B.M. #68 S.&W. in dead Maple tree left
Sta. 968+45 Elev. 384.78
Existing Structure, Steel truss, 48' Span, 14' Rdy. to be removed by Bridge Contractor.
Elev. of Floor of Old Bridge = 386.1

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

R. C. ABUTMENTS FOR DECK GIRDER BRIDGE
HEIGHT OVER ALL 20 FEET 6 INCHES

Sheet No. 3
3 Sheets.

BOND ISSUE ROUTE NO.	COUNTY	SEC.	TOTAL SHEETS	SHEET NO.
140	White	105B	72	71



Class A concrete shall be used throughout. Proportions: 1:2½:4.
All reinforcing steel shall be securely wired in place before concrete is poured.

15T. Unt. Piles 12" butt 10" tip — 38 Req. 760 Est. Lin. Ft.
12T. Unt. Piles 12" butt 10" tip — 14 Req. 280 Est. Lin. Ft.
10T. Unt. Piles 10" butt 8" tip — 50 Req. 750 Est. Lin. Ft.

BILL OF MATERIAL.

Bars.	No.	Size.	Length.
V	114	⅝"φ	5'-6"
V1	42	"	11'-6"
V2	8	"	13'-6"
V3	20	"	14'-6"
V4	8	"	13'-6"
	12		12'-0"
	12		10'-6"
h	30	½"□	25-0"
h1	48	"	17'-6"
h2	12	"	14'-6"
h3	8		8'-6"
n	228	1"φ	9'-9"
t	164	⅝"φ	9'-6"
t1	152	½"□	9'-6"
z	54	½"□	9'-6"
z1	88	¾"φ	9'-6"
V7	12	⅝"φ	9'-0"
W	8	½"□	27'-0"
W1	16	"	19'-0"
Reinforcing Steel-Lbs.			14560
Concrete-Cu.Yds.			199.2

STANDARD	COMPUTED	C.C. Wood
	CHECKED	H.W. Bush
	DRAWN	H.W.B. F.R.G.
SPECIAL	CHECKED	C.C.W.
	ASSEMBLED	F.R. Anderson
	CHECKED	J.E. Graham

EXAMINED June 14, 1928 — BRIDGE ENGINEER
PASSED — ENGINEER OF DESIGN
APPROVED — CHIEF HIGHWAY ENGINEER

Lost Creek Bridge
S.B.I. Rte. 140 Sect. 105-B
White County
Station 954+52

11 (52742—500)

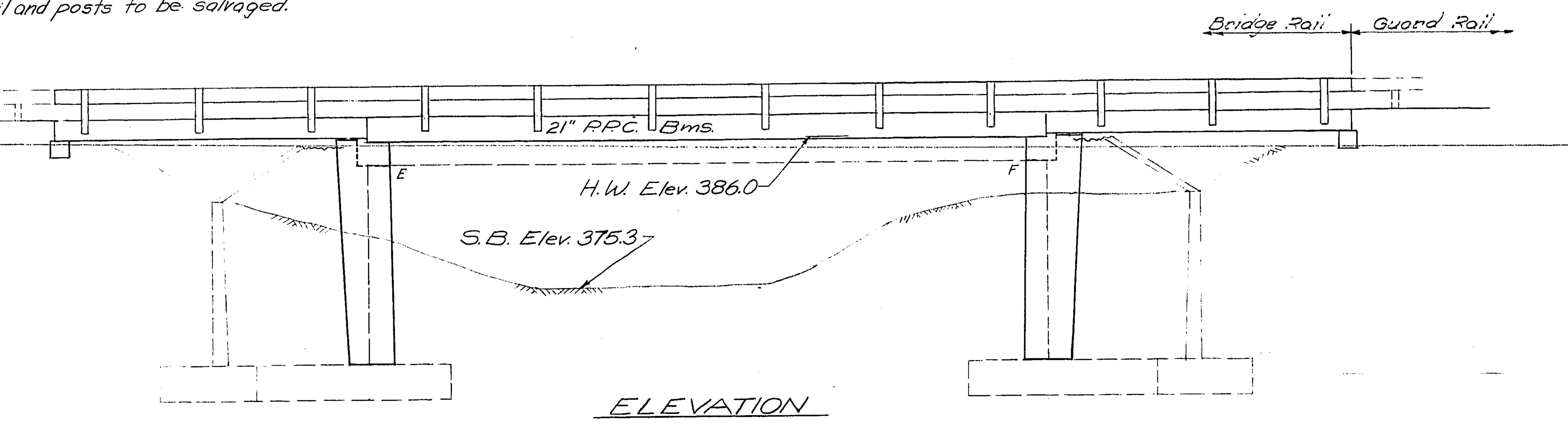
1156.

B.M. Chiseled "a" on S.W. Wing of Bridge Sta. 954+52 Elev. 387.84
Existing Structure: Built as S.B.I. Rte. 140, Sec. 105B, Sta. 954+52 in 1928. Superstructure: R.C. Deck Girder
Substructure: R.C. Closed Abuts. Structure to be widened with P.P.C. beams utilizing stage construction.
Existing handrail and posts to be salvaged.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
S.B.I. 140 F.A.	105 BY-2	WHITE	9	5
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT.		

SHEET NO. 1
5 SHEETS



ELEVATION

GENERAL NOTES

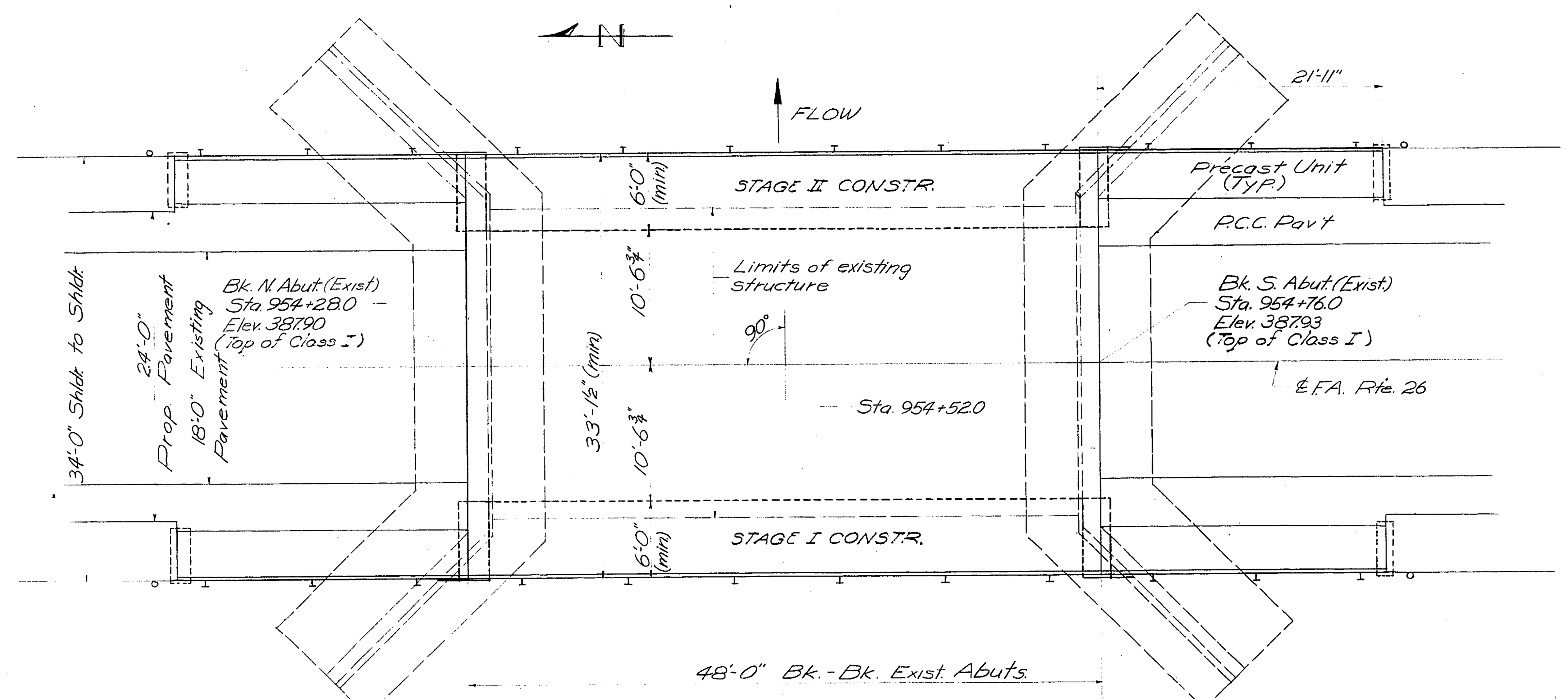
All reinforcement bars shall be lapped 24 diameters unless otherwise shown.

It shall be the responsibility of the Contractor to verify all dimensions and conditions existing in the field prior to construction and ordering of materials.

Expansion bolts shall consist of self drilling expansion anchors and ¾"φ hooked bolts. Hooked bolts shall extend a minimum of 12" into new concrete unless otherwise shown.

Shoulder transition to wingwall shall be shaped with broken concrete. Cost Incidental.

The top surface of the beams shall be finished in accordance with Art. 505.06 of the Standard Specifications except that the surface shall not be roughened by brooming. The finished surface shall be free of depressions and high spots with sharp corners.



PLAN

TOTAL BILL OF MATERIAL

	ITEM	UNIT	SUPER	SUB	TOTAL
	Bit. Conc. Surf. Cse. Cl. I	Tons	22		22
*	Waterproofing Membrane System	Sq. Yds.	184		184
	Portland Cement Concrete Pavement (10")	Sq. Yds.	37		37
	Pavement Fabric	Sq. Yds.	37		37
	Concrete Removal	Cu. Yds.	9	4	13
	Expansion Bolts (¾"φ)	Each	56	124	180
	Class X Concrete	Cu. Yds.		21.9	21.9
	Precast Concrete Bridge Slab	Sq. Ft.	329		329
	Precast Prestressed Conc. Dk. Bms (21")	Sq. Ft.	576		576
	Steel Railing, Type S	Lin. Ft.	184		184
	Reinforcement Bars	Lbs		710	710
	Temporary Guardrail	Lin. Ft.	48		48
	Bit. Conc. Surf. Removal	Sq. Yds	113		113
*	Portland Cement Mortar Fairing Cse.	Lin. Ft.	192		192

* See Special Provisions.

WATERWAY INFORMATION

Drainage Area: 17 sq. miles
Character: rolling, clay, wooded, cultivated
Present Opening: Main Structure 325 sq. ft.
Overflow Culvert 150 sq. ft.
Required Opening: Total 475 sq. ft.
Proposed Opening: Total 475 sq. ft.
$Q_{(50)}$: 3200 cfs
All Time H.W. Elev. = 387.4 (1950)

DESIGN STRESSES

FIELD UNITS
f'c = 1000 psi (Sub)
fs = 20,000 psi (Reinf.)
n = 10

PRECAST UNITS
f'c = 4500 psi
fc = 1800 psi
fs = 20,000 psi
n = 8

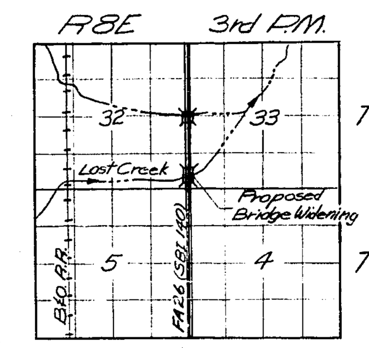
PRECAST PRESTRESSED UNITS
f'c = 5000 psi
f'ci = 4000 psi
f's = 270,000 psi 7/16" φ Strands
fsi = 188,700 psi 7/16" φ Strands

LOADING HS20-44 (New Constr.)

DESIGNED	John W. Quinlan wH	
CHECKED	Wei Henry / J. Schneller	
DRAWN		
CHECKED	w/ H	

March 4 1974
EXAMINED — ENGINEER OF BRIDGES AND TRAFFIC STRUCTURES
PASSED W. E. Baumann — ENGINEER OF DESIGN
APPROVED Harry R. Hanley — DIRECTOR OF HIGHWAYS

CARL ... STATE OF ILLINOIS 2287 ... STRUCTURAL ...



LOCATION SKETCH

GENERAL PLAN & ELEVATION
FA RTE 88 (SBI 140) over LOST CREEK
FA RTE 88 (SBI 140) - SEC. 105-BY-2
WHITE COUNTY
STA 954+52.0

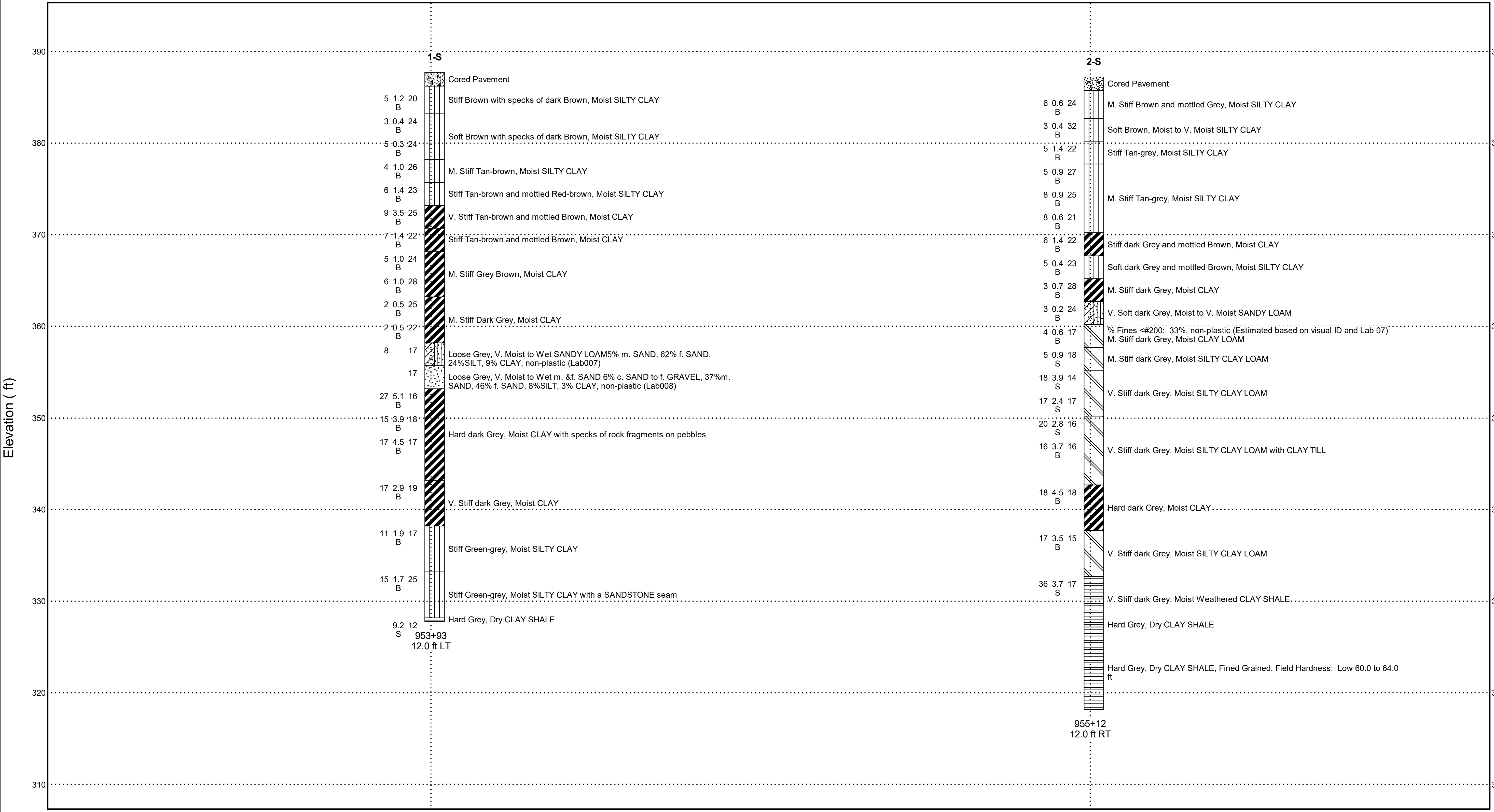
Rev W H 3-22-75

Revised 4-29-77
Revised 8-16-77

K&E CO. 19-1255

EXHIBIT E

SUBSURFACE PROFILE



PRINTERMOD 11X17 20-1109.05.GPJ IL_DOT.GDT 2/6/23

Illinois Department of Transportation
Division of Highways

NOT TO HORIZONTAL SCALE

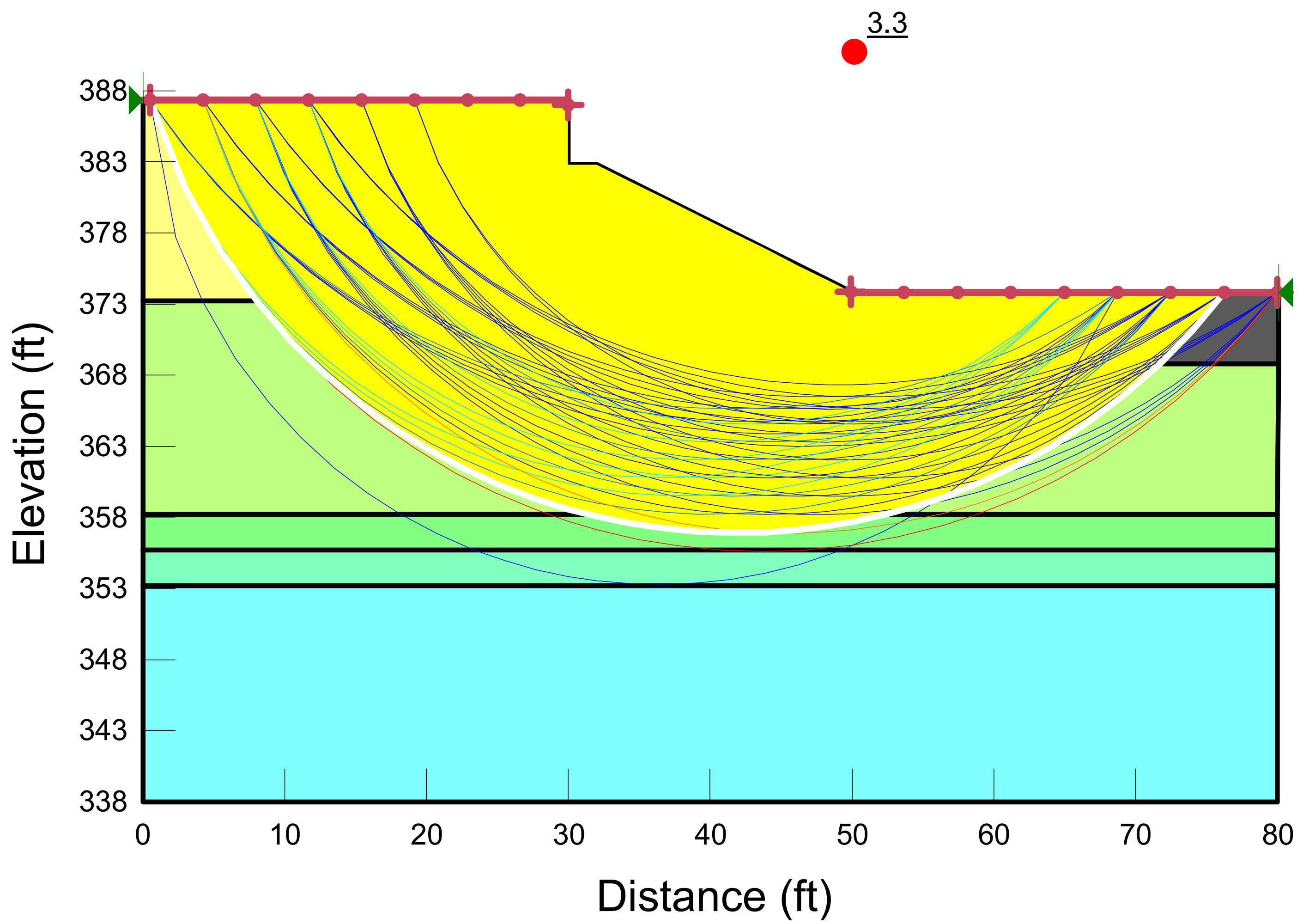
SUBSURFACE PROFILE

Route: US 45
Section: 105,B 105 BY-2 (existing)
County: White

EXHIBIT F

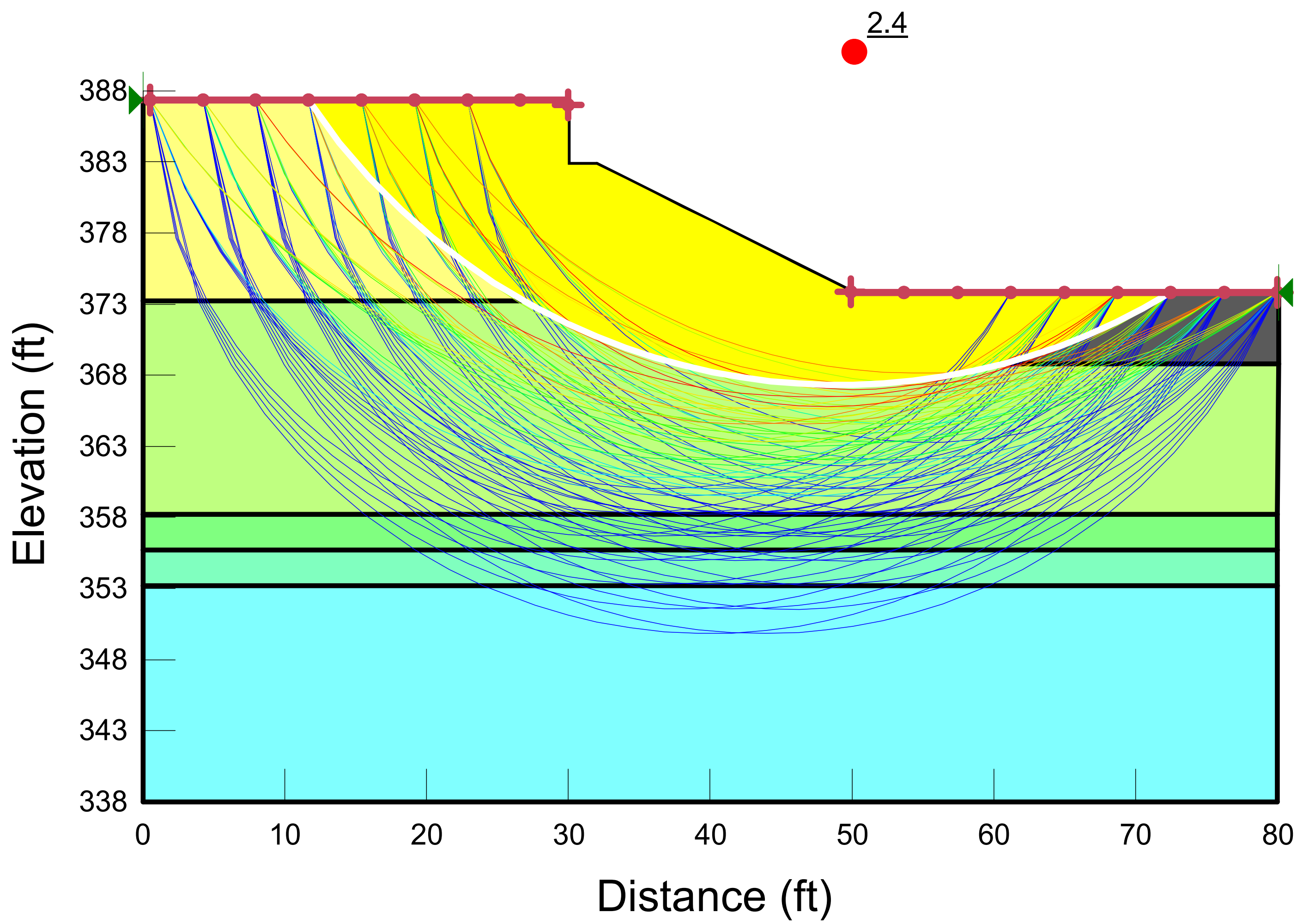
SLOPE W SLOPE STABILITY ANALYSIS

US 45 over Lost Creek
North Abutment (Boring 1-S)
End-of-Construction (Undrained Analysis)



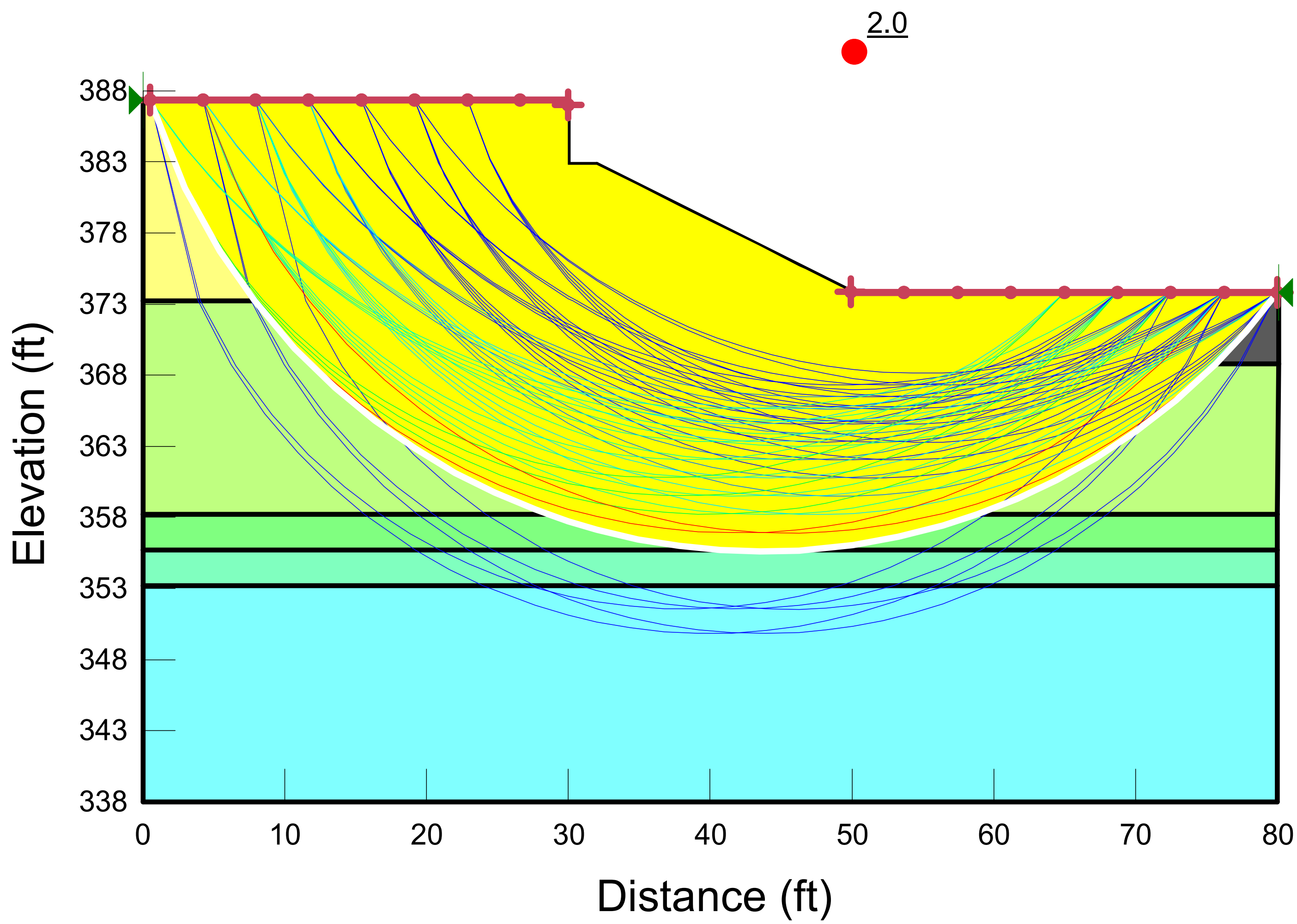
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	1,300	0
	Clay II	Mohr-Coulomb	120	4,100	0
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sand	Mohr-Coulomb	115	0	34
	Sandy Loam	Mohr-Coulomb	120	200	0
	Silty Clay	Mohr-Coulomb	120	860	0

US 45 over Lost Creek
North Abutment (Boring 1-S)
Long Term (Drained Analysis)



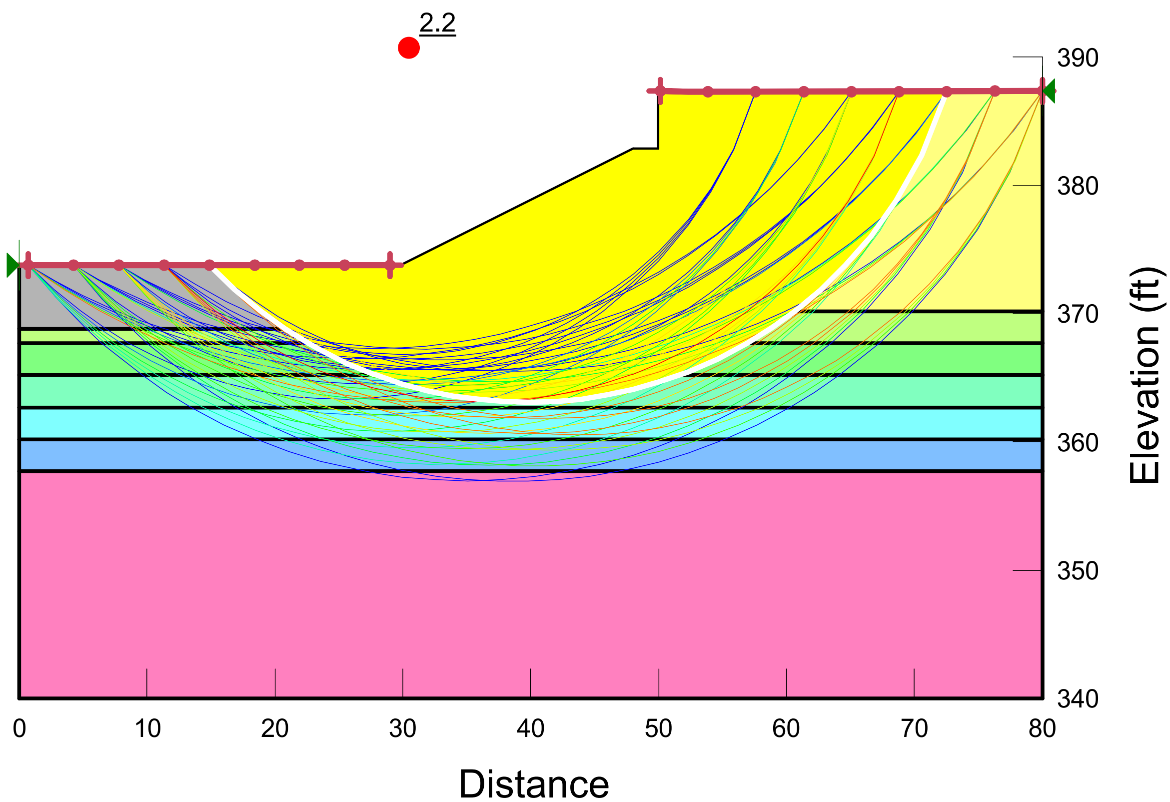
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	100	26
	Clay II	Mohr-Coulomb	120	100	26
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sand	Mohr-Coulomb	115	0	34
	Sandy Loam	Mohr-Coulomb	120	0	30
	Silty Clay	Mohr-Coulomb	120	100	26

US 45 over Lost Creek
North Abutment (Boring 1-S)
End-of-Construction (Undrained Analysis w/ Seismic Load)



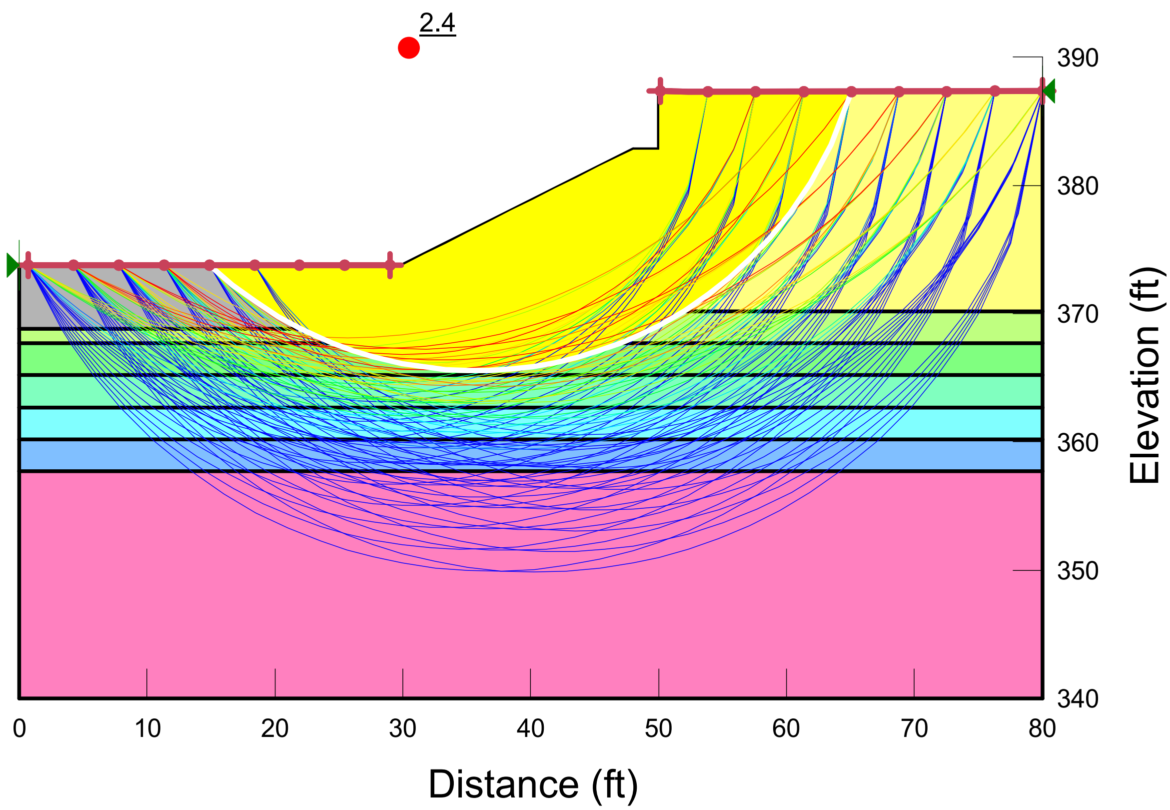
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	1,300	0
	Clay II	Mohr-Coulomb	120	4,100	0
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sand	Mohr-Coulomb	115	0	34
	Sandy Loam	Mohr-Coulomb	120	200	0
	Silty Clay	Mohr-Coulomb	120	860	0

US 45 over Lost Creek
South Abutment (Boring 2-S)
End-of-Construction (Undrained Analysis)



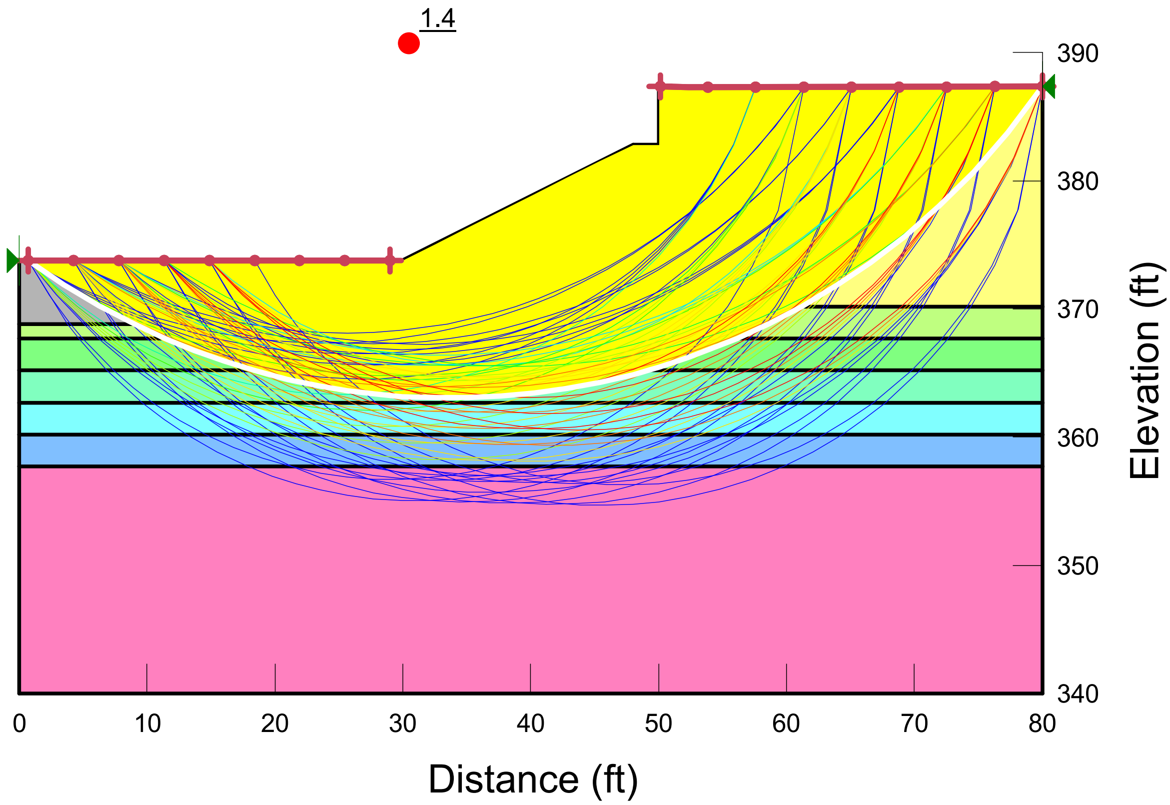
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	1,400	0
	Clay II	Mohr-Coulomb	120	200	0
	Clay Loam	Mohr-Coulomb	120	900	0
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sandy Loam	Mohr-Coulomb	120	600	0
	Silty Clay	Mohr-Coulomb	120	800	0
	Silty Clay II	Mohr-Coulomb	120	700	0
	Silty Clay Loam	Mohr-Coulomb	125	2,740	28

US 45 over Lost Creek
South Abutment (Boring 2-S)
Long Term (Drained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	100	26
	Clay II	Mohr-Coulomb	120	50	26
	Clay Loam	Mohr-Coulomb	120	100	26
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sandy Loam	Mohr-Coulomb	120	0	30
	Silty Clay	Mohr-Coulomb	120	100	26
	Silty Clay II	Mohr-Coulomb	120	50	26
	Silty Clay Loam	Mohr-Coulomb	125	100	28

US 45 over Lost Creek
South Abutment (Boring 2-S)
End-of-Construction (Undrained Analysis w/ Seismic Load)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clay	Mohr-Coulomb	120	1,400	0
	Clay II	Mohr-Coulomb	120	200	0
	Clay Loam	Mohr-Coulomb	120	900	0
	Concrete	High Strength	150		
	Rip Rap	Mohr-Coulomb	125	0	38
	Sandy Loam	Mohr-Coulomb	120	600	0
	Silty Clay	Mohr-Coulomb	120	800	0
	Silty Clay II	Mohr-Coulomb	120	700	0
	Silty Clay Loam	Mohr-Coulomb	125	2,740	28

EXHIBIT G

LIQUEFACTION ANALYSIS

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ==================================== 1-S
ELEVATION OF BORING GROUND SURFACE ========================= 387.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 355.20 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE =================== 355.20 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.341
EARTHQUAKE MOMENT MAGNITUDE =============================== 5.1
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 0.00 FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 8 IN.
SAMPLING METHOD=== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.362**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **392** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.1
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.297**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
383.2	4.5	5	1.2				20	0.124	0.558	8.678	8.678	0.102	0.124	0.558	0.558	1.347	**0.323**	0.922	**0.204**	**N.L. (1)**
380.7	7	3	0.4				24	0.111	0.836	4.779	4.779	0.070	0.111	0.836	0.836	1.205	**0.200**	0.871	**0.193**	**N.L. (1)**
378.2	9.5	5	0.3				24	0.108	1.106	7.910	7.910	0.095	0.108	1.106	1.106	1.153	**0.259**	0.815	**0.181**	**N.L. (1)**
375.7	12	4	1				26	0.122	1.411	6.186	6.186	0.081	0.122	1.411	1.411	1.088	**0.209**	0.756	**0.168**	**N.L. (1)**
373.2	14.5	6	1.4				23	0.125	1.723	8.956	8.956	0.104	0.125	1.723	1.723	1.048	**0.257**	0.697	**0.154**	**N.L. (1)**
370.7	17	9	3.5				25	0.137	2.066	12.796	12.796	0.139	0.137	2.066	2.066	1.007	**0.330**	0.638	**0.141**	**N.L. (1)**
368.2	19.5	7	1.4				22	0.125	2.378	9.510	9.510	0.109	0.125	2.378	2.378	0.974	**0.250**	0.581	**0.129**	**N.L. (1)**
365.7	22	5	1				24	0.122	2.683	6.488	6.488	0.084	0.122	2.683	2.683	0.952	**0.188**	0.530	**0.117**	**N.L. (1)**
363.2	24.5	6	1				28	0.122	2.988	7.431	7.431	0.091	0.122	2.988	2.988	0.929	**0.200**	0.483	**0.107**	**N.L. (1)**
360.7	27	2	0.5				25	0.114	3.273	2.373	2.373	0.055	0.114	3.273	3.273	0.917	**0.119**	0.442	**0.098**	**N.L. (1)**
358.2	29.5	2	0.5				22	0.114	3.558	2.274	2.274	0.054	0.114	3.558	3.558	0.902	**0.116**	0.408	**0.090**	**N.L. (1)**
355.7	32	8		33			17	0.116	3.848	8.722	15.170	0.162	0.116	3.848	3.848	0.854	**0.326**	0.379	**0.084**	**N.L. (1)**
353.2	34.5	4		11			17	0.108	4.118	4.200	5.520	0.076	0.108	4.118	4.118	0.874	**0.157**	0.355	**0.079**	**N.L. (1)**
350.7	37	27	5.1				16	0.142	4.473	28.952	28.952	0.408	0.142	4.473	4.473	0.770	**0.742**	0.335	**0.074**	**N.L. (1)**
348.2	39.5	15	3.9				18	0.138	4.818	14.342	14.342	0.154	0.138	4.818	4.818	0.809	**0.293**	0.320	**0.071**	**N.L. (1)**
343.2	44.5	17	4.5				17	0.140	5.518	14.927	14.927	0.159	0.140	5.518	5.518	0.778	**0.293**	0.297	**0.066**	**N.L. (1)**
338.2	49.5	17	2.9				19	0.134	6.188	13.849	13.849	0.149	0.134	6.188	6.188	0.761	**0.267**	0.283	**0.063**	**N.L. (1)**
333.2	54.5	11	1.9				17	0.129	6.833	8.375	8.375	0.099	0.129	6.833	6.833	0.772	**0.181**	0.275	**0.061**	**N.L. (1)**
328.2	59.5	15	1.7				25	0.128	7.473	10.713	10.713	0.119	0.128	7.473	7.473	0.743	**0.210**	0.270	**0.060**	**N.L. (1)**
386.7	1	100	4.5					0.140	-0.717	######	231.912	1.708	0.140	-0.717	-0.717	#NUM!	**#NUM!**	0.984	**0.218**	**N.L. (1)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===================================== 1-S
ELEVATION OF BORING GROUND SURFACE ========================== 387.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ======================= 355.20 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==================== 355.20 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.341
EARTHQUAKE MOMENT MAGNITUDE ================================ 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 0.00 FT.
HAMMER EFFICIENCY=== 73 %
BOREHOLE DIAMETER== 8 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **392** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 150
Ground Motion Prediction Equations = NMSZ
PGA = **0.099**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
383.2	4.5	5	1.2				20	0.124	0.558	8.678	8.678	0.102	0.124	0.558	0.558	1.347	**0.137**	0.939	**0.208**	**N.L. (1)**
380.7	7	3	0.4				24	0.111	0.836	4.779	4.779	0.070	0.111	0.836	0.836	1.205	**0.085**	0.899	**0.199**	**N.L. (1)**
378.2	9.5	5	0.3				24	0.108	1.106	7.910	7.910	0.095	0.108	1.106	1.106	1.153	**0.110**	0.855	**0.190**	**N.L. (1)**
375.7	12	4	1				26	0.122	1.411	6.186	6.186	0.081	0.122	1.411	1.411	1.088	**0.088**	0.809	**0.179**	**N.L. (1)**
373.2	14.5	6	1.4				23	0.125	1.723	8.956	8.956	0.104	0.125	1.723	1.723	1.048	**0.109**	0.762	**0.169**	**N.L. (1)**
370.7	17	9	3.5				25	0.137	2.066	12.796	12.796	0.139	0.137	2.066	2.066	1.007	**0.140**	0.716	**0.159**	**N.L. (1)**
368.2	19.5	7	1.4				22	0.125	2.378	9.510	9.510	0.109	0.125	2.378	2.378	0.974	**0.106**	0.672	**0.149**	**N.L. (1)**
365.7	22	5	1				24	0.122	2.683	6.488	6.488	0.084	0.122	2.683	2.683	0.952	**0.080**	0.632	**0.140**	**N.L. (1)**
363.2	24.5	6	1				28	0.122	2.988	7.431	7.431	0.091	0.122	2.988	2.988	0.929	**0.085**	0.595	**0.132**	**N.L. (1)**
360.7	27	2	0.5				25	0.114	3.273	2.373	2.373	0.055	0.114	3.273	3.273	0.917	**0.050**	0.563	**0.125**	**N.L. (1)**
358.2	29.5	2	0.5				22	0.114	3.558	2.274	2.274	0.054	0.114	3.558	3.558	0.902	**0.049**	0.536	**0.119**	**N.L. (1)**
355.7	32	8		33			17	0.116	3.848	8.722	15.170	0.162	0.116	3.848	3.848	0.854	**0.138**	0.513	**0.114**	**N.L. (1)**
353.2	34.5	4		11			17	0.108	4.118	4.200	5.520	0.076	0.108	4.118	4.118	0.874	**0.066**	0.494	**0.110**	**N.L. (1)**
350.7	37	27	5.1				16	0.142	4.473	28.952	28.952	0.408	0.142	4.473	4.473	0.770	**0.314**	0.479	**0.106**	**N.L. (1)**
348.2	39.5	15	3.9				18	0.138	4.818	14.342	14.342	0.154	0.138	4.818	4.818	0.809	**0.124**	0.467	**0.103**	**N.L. (1)**
343.2	44.5	17	4.5				17	0.140	5.518	14.927	14.927	0.159	0.140	5.518	5.518	0.778	**0.124**	0.449	**0.100**	**N.L. (1)**
338.2	49.5	17	2.9				19	0.134	6.188	13.849	13.849	0.149	0.134	6.188	6.188	0.761	**0.113**	0.439	**0.097**	**N.L. (1)**
333.2	54.5	11	1.9				17	0.129	6.833	8.375	8.375	0.099	0.129	6.833	6.833	0.772	**0.076**	0.432	**0.096**	**N.L. (1)**
328.2	59.5	15	1.7				25	0.128	7.473	10.713	10.713	0.119	0.128	7.473	7.473	0.743	**0.089**	0.428	**0.095**	**N.L. (1)**
386.7	1	100	4.5					0.140	-0.717	######	231.912	1.708	0.140	-0.717	-0.717	#NUM!	**#NUM!**	0.988	**0.219**	**N.L. (1)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ==================================== 2-S
ELEVATION OF BORING GROUND SURFACE ========================= 387.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ============================ FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========================= FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.341
EARTHQUAKE MOMENT MAGNITUDE =============================== 5.1
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ============== 0.00 FT.
HAMMER EFFICIENCY=== 73 %
BOREHOLE DIAMETER=== 8 IN.
SAMPLING METHOD=== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.362**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **419** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.1
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.297**

ELEV. OF SAMPLE (FT.)	BORING DATA: BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	CONDITIONS DURING DRILLING: EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	CONDITIONS DURING EARTHQUAKE: EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
382.7	4.5	6	0.6		20	40	24	0.053	0.239	11.615	11.615	0.128	0.053	0.239	0.519	1.500	**0.452**	0.936	**0.452**	**N.L. (2)**
380.2	7	3	0.4		20	40	32	0.049	0.361	5.560	5.560	0.076	0.049	0.361	0.798	1.434	**0.258**	0.892	**0.437**	**N.L. (2)**
377.7	9.5	5	1.4		20	40	22	0.063	0.519	9.426	9.426	0.108	0.063	0.519	1.111	1.378	**0.352**	0.844	**0.401**	**N.L. (2)**
375.2	12	5	0.9		20	40	27	0.058	0.664	9.534	9.534	0.109	0.058	0.664	1.412	1.304	**0.336**	0.792	**0.374**	**N.L. (2)**
372.7	14.5	8	0.9		20	40	25	0.058	0.809	15.354	15.354	0.164	0.058	0.809	1.713	1.291	**0.499**	0.737	**0.346**	**N.L. (2)**
370.2	17	8	0.6		20	40	21	0.053	0.941	15.141	15.141	0.161	0.053	0.941	2.002	1.239	**0.472**	0.681	**0.321**	**N.L. (2)**
367.7	19.5	6	1.4		35	60	22	0.063	1.099	11.015	11.015	0.122	0.063	1.099	2.315	1.169	**0.337**	0.627	**0.293**	**N.L. (2)**
365.2	22	5	0.4		20	40	23	0.049	1.221	9.007	9.007	0.104	0.049	1.221	2.594	1.132	**0.279**	0.575	**0.271**	**N.L. (2)**
362.7	24.5	3	0.7		35	60	28	0.055	1.359	5.267	5.267	0.074	0.055	1.359	2.887	1.094	**0.191**	0.527	**0.248**	**N.L. (2)**
360.2	27	3		33			24	0.051	1.486	5.137	10.941	0.122	0.051	1.486	3.171	1.088	**0.312**	0.484	**0.229**	**1.362 (C)**
357.7	29.5	4	0.6		10	20	17	0.053	1.619	6.668	6.668	0.085	0.053	1.619	3.459	1.059	**0.212**	0.447	**0.212**	**N.L. (2)**
355.2	32	5	0.9		10	20	18	0.058	1.764	8.089	8.089	0.097	0.058	1.764	3.760	1.041	**0.238**	0.416	**0.196**	**1.214 (C)**
352.7	34.5	18	3.9		10	20	14	0.076	1.954	30.198	30.198	0.482	0.076	1.954	4.106	1.030	**1.173**	0.389	**0.181**	**N.L. (2)**
350.2	37	17	2.4		20	40	17	0.070	2.129	27.149	27.149	0.343	0.070	2.129	4.437	0.999	**0.808**	0.367	**0.170**	**N.L. (2)**
347.7	39.5	20	2.8		20	40	16	0.072	2.309	31.444	31.444	0.620	0.072	2.309	4.773	0.969	**1.418**	0.350	**0.160**	**N.L. (2)**
342.7	44.5	16	3.7		35	60	16	0.075	2.684	22.509	22.509	0.249	0.075	2.684	5.460	0.930	**0.548**	0.324	**0.146**	**N.L. (2)**
337.7	49.5	18	4.5		35	60	18	0.078	3.074	23.818	23.818	0.270	0.078	3.074	6.162	0.889	**0.567**	0.309	**0.137**	**N.L. (2)**
332.7	54.5	17	3.5		35	60	15	0.074	3.444	20.867	20.867	0.226	0.074	3.444	6.844	0.865	**0.463**	0.299	**0.132**	**N.L. (2)**
327.7	59.5	36	3.7				17	0.075	3.819	46.509	46.509	0.260	0.075	3.819	7.531	0.790	**0.485**	0.293	**0.128**	**N.L. (3)**
326.7	60.5	100	4.5					0.078	3.897	######	131.303	0.957	0.078	3.897	7.672	0.784	**1.773**	0.292	**0.127**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===================================== 2-S
ELEVATION OF BORING GROUND SURFACE ========================== 387.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ============================ FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========================= FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.341
EARTHQUAKE MOMENT MAGNITUDE ================================ 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 0.00 FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 8 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **419** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 150
Ground Motion Prediction Equations = NMSZ
PGA = **0.099**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
382.7	4.5	6	0.6		20	40	24	0.053	0.239	11.615	11.615	0.128	0.053	0.239	0.519	1.500	**0.191**	0.950	**0.458**	**N.L. (2)**
380.2	7	3	0.4		20	40	32	0.049	0.361	5.560	5.560	0.076	0.049	0.361	0.798	1.434	**0.109**	0.916	**0.449**	**N.L. (2)**
377.7	9.5	5	1.4		20	40	22	0.063	0.519	9.426	9.426	0.108	0.063	0.519	1.111	1.378	**0.149**	0.878	**0.417**	**N.L. (2)**
375.2	12	5	0.9		20	40	27	0.058	0.664	9.534	9.534	0.109	0.058	0.664	1.412	1.304	**0.142**	0.837	**0.395**	**N.L. (2)**
372.7	14.5	8	0.9		20	40	25	0.058	0.809	15.354	15.354	0.164	0.058	0.809	1.713	1.291	**0.211**	0.794	**0.373**	**N.L. (2)**
370.2	17	8	0.6		20	40	21	0.053	0.941	15.141	15.141	0.161	0.053	0.941	2.002	1.239	**0.200**	0.751	**0.354**	**N.L. (2)**
367.7	19.5	6	1.4		35	60	22	0.063	1.099	11.015	11.015	0.122	0.063	1.099	2.315	1.169	**0.143**	0.708	**0.331**	**N.L. (2)**
365.2	22	5	0.4		20	40	23	0.049	1.221	9.007	9.007	0.104	0.049	1.221	2.594	1.132	**0.118**	0.667	**0.314**	**N.L. (2)**
362.7	24.5	3	0.7		35	60	28	0.055	1.359	5.267	5.267	0.074	0.055	1.359	2.887	1.094	**0.081**	0.630	**0.297**	**N.L. (2)**
360.2	27	3		33			24	0.051	1.486	5.137	10.941	0.122	0.051	1.486	3.171	1.088	**0.132**	0.597	**0.282**	**0.468 (C)**
357.7	29.5	4	0.6		10	20	17	0.053	1.619	6.668	6.668	0.085	0.053	1.619	3.459	1.059	**0.090**	0.568	**0.269**	**N.L. (2)**
355.2	32	5	0.9		10	20	18	0.058	1.764	8.089	8.089	0.097	0.058	1.764	3.760	1.041	**0.101**	0.543	**0.257**	**0.393 (C)**
352.7	34.5	18	3.9		10	20	14	0.076	1.954	30.198	30.198	0.482	0.076	1.954	4.106	1.030	**0.496**	0.522	**0.243**	**N.L. (2)**
350.2	37	17	2.4		20	40	17	0.070	2.129	27.149	27.149	0.343	0.070	2.129	4.437	0.999	**0.342**	0.505	**0.234**	**N.L. (2)**
347.7	39.5	20	2.8		20	40	16	0.072	2.309	31.444	31.444	0.620	0.072	2.309	4.773	0.969	**0.601**	0.492	**0.225**	**N.L. (2)**
342.7	44.5	16	3.7		35	60	16	0.075	2.684	22.509	22.509	0.249	0.075	2.684	5.460	0.930	**0.232**	0.472	**0.213**	**N.L. (2)**
337.7	49.5	18	4.5		35	60	18	0.078	3.074	23.818	23.818	0.270	0.078	3.074	6.162	0.889	**0.240**	0.459	**0.204**	**N.L. (2)**
332.7	54.5	17	3.5		35	60	15	0.074	3.444	20.867	20.867	0.226	0.074	3.444	6.844	0.865	**0.196**	0.452	**0.199**	**N.L. (2)**
327.7	59.5	36	3.7				17	0.075	3.819	46.509	46.509	0.260	0.075	3.819	7.531	0.790	**0.205**	0.447	**0.195**	**N.L. (3)**
326.7	60.5	100	4.5					0.078	3.897	######	131.303	0.957	0.078	3.897	7.672	0.784	**0.750**	0.446	**0.195**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_c/LL ≤ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

EXHIBIT H

PILE LENGTH/PILE TYPE

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

SUBSTRUCTURE==================================== N Abutment
REFERENCE BORING ================================= 1-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 382.34 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 380.34 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1050 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts =========== 241.17 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts =========== 90.44 KIPS

PILE TYPE AND SIZE ============= Steel HP 14 X 117
Pile Perimeter============================== 4.850 FT. Unplugged Pile Perimeter============= 7.117 FT.
Pile End Bearing Area========================== 1.469 SQFT. Unplugged Pile End Bearing Area======= 0.239 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
929 KIPS	**929** KIPS	**511** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
378.24	2.10	0.30			2.5		23.1	3.6		***7.0***	7	0	0	4	4
375.74	2.50	1.00			8.6	20.6	39.9	12.6	3.3	***20.9***	21	0	0	12	7
373.24	2.50	1.40			11.1	28.8	94.3	16.3	4.7	***44.3***	44	0	0	24	9
370.74	2.50	3.50	9		20.8	72.1	71.8	30.5	11.7	***67.7***	68	0	0	37	12
368.24	2.50	1.40			11.1	28.8	***74.7***	16.3	4.7	82.7	75	0	0	41	14
365.74	2.50	1.00			8.6	20.6	***83.3***	12.6	3.3	95.4	83	0	0	46	17
363.24	2.50	1.00			8.6	20.6	***81.6***	12.6	3.3	106.3	82	0	0	45	19
360.74	2.50	0.50			4.7	10.3	***86.3***	6.9	1.7	113.3	86	0	0	47	22
358.24	2.50	0.50			4.7	10.3	***110.1***	6.9	1.7	123.3	110	0	0	61	24
355.74	2.50		8	Fine Sand	1.7	29.3	***97.1***	2.4	4.8	123.3	97	0	0	53	27
353.24	2.50		4	Medium Sand	0.9	14.6	188.3	1.3	2.4	***139.3***	139	0	0	77	29
350.74	2.50	5.10	27		25.2	105.0	188.8	37.0	17.1	***172.3***	172	0	0	95	32
348.24	2.50	3.90	15		22.5	80.3	223.7	33.1	13.1	***207.4***	207	0	0	114	34
343.24	5.00	4.50	17		50.4	92.7	***241.2***	74.0	15.1	276.0	241	0	0	133	39
338.24	5.00	2.90			36.2	59.7	***256.8***	53.1	9.7	325.8	257	0	0	141	44
333.24	5.00	1.90			27.3	39.1	***280.0***	40.1	6.4	365.2	280	0	0	154	49
328.24	5.00	1.70			25.4	35.0	453.4	37.3	5.7	***426.5***	427	0	0	235	54
327.24	1.00			Shale	60.4	183.0	***513.9***	88.7	29.8	515.2	514	0	0	283	55.1
326.24	1.00			Shale	60.4	183.0	***574.3***	88.7	29.8	603.8	574	0	0	316	56.1
325.24	1.00			Shale	60.4	183.0	***634.7***	88.7	29.8	692.5	635	0	0	349	57.1
324.24	1.00			Shale	60.4	183.0	***695.1***	88.7	29.8	781.2	695	0	0	382	58.1
323.24	1.00			Shale	60.4	183.0	***755.5***	88.7	29.8	869.8	756	0	0	416	59.1
322.24	1.00			Shale	60.4	183.0	***815.9***	88.7	29.8	958.5	816	0	0	449	60.1
321.24	1.00			Shale	60.4	183.0	***876.4***	88.7	29.8	1047.1	876	0	0	482	61.1
320.24	1.00			Shale	60.4	183.0	***936.8***	88.7	29.8	1135.8	~~937~~	~~0~~	~~0~~	~~515~~	~~62.1~~
319.24	1.00			Shale	60.4	183.0	***997.2***	88.7	29.8	1224.4	~~997~~	~~0~~	~~0~~	~~548~~	~~63.1~~
318.24	1.00			Shale	60.4	183.0	***1057.6***	88.7	29.8	1313.1	~~1058~~	~~0~~	~~0~~	~~582~~	~~64.1~~
317.24	1.00			Shale	60.4	183.0	***1118.0***	88.7	29.8	1401.7	~~1118~~	~~0~~	~~0~~	~~615~~	~~65.1~~
316.24	1.00			Shale	60.4	183.0	***1178.4***	88.7	29.8	1490.4	~~1178~~	~~0~~	~~0~~	~~648~~	~~66.1~~
315.24	1.00			Shale	60.4	183.0	***1238.9***	88.7	29.8	1579.0	~~1239~~	~~0~~	~~0~~	~~681~~	~~67.1~~
314.24	1.00			Shale	60.4	183.0	***1299.3***	88.7	29.8	1667.7	~~1299~~	~~0~~	~~0~~	~~715~~	~~68.1~~
313.24	1.00			Shale	60.4	183.0	***1359.7***	88.7	29.8	1756.3	~~1360~~	~~0~~	~~0~~	~~748~~	~~69.1~~
312.24	1.00			Shale	60.4	183.0	***1420.1***	88.7	29.8	1845.0	~~1420~~	~~0~~	~~0~~	~~781~~	~~70.1~~
311.24	1.00			Shale	60.4	183.0	***1480.5***	88.7	29.8	1933.6	~~1481~~	~~0~~	~~0~~	~~814~~	~~71.1~~
310.24	1.00			Shale		183.0			29.8						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

SUBSTRUCTURE===================================== S Abutment
REFERENCE BORING ================================ 2-S
LRFD or ASD or SEISMIC =============================== LRFD
PILE CUTOFF ELEV. ================================= 382.34 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 380.34 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1050 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 241.17 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 90.44 KIPS

PILE TYPE AND SIZE ============= Steel HP 14 X 117
Pile Perimeter============================== 4.850 FT. Unplugged Pile Perimeter============== 7.117 FT.
Pile End Bearing Area=========================== 1.469 SQFT. Unplugged Pile End Bearing Area======== 0.239 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
929 KIPS	**929** KIPS	**511** KIPS	**59** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
380.20	0.14	0.40			0.2		29.0	0.3		***5.0***	5	0	0	3	2
377.70	2.50	1.40			11.1	28.8	29.9	16.3	4.7	***19.6***	20	0	0	11	5
375.20	2.50	0.90			7.9	18.5	37.8	11.6	3.0	***31.2***	31	0	0	17	7
372.70	2.50	0.90			7.9	18.5	***39.5***	11.6	3.0	41.8	39	0	0	22	10
370.20	2.50	0.60			5.6	12.4	61.5	8.2	2.0	***52.7***	53	0	0	29	12
367.70	2.50	1.40			11.1	28.8	***52.1***	16.3	4.7	65.7	52	0	0	29	15
365.20	2.50	0.40			3.8	8.2	***62.1***	5.6	1.3	72.3	62	0	0	34	17
362.70	2.50	0.70			6.4	14.4	***58.2***	9.4	2.3	80.0	58	0	0	32	20
360.20	2.50	0.20			2.0	4.1	***68.4***	2.9	0.7	84.3	68	0	0	38	22
357.70	2.50	0.60			5.6	12.4	***80.2***	8.2	2.0	93.4	80	0	0	44	25
355.20	2.50	0.90			7.9	18.5	149.8	11.6	3.0	***115.1***	115	0	0	63	27
352.70	2.50	3.90	18		22.5	80.3	***141.5***	33.1	13.1	143.1	141	0	0	78	30
350.20	2.50	2.40			15.9	49.4	***165.6***	23.3	8.0	167.8	166	0	0	91	32
347.70	2.50	2.80			17.7	57.7	201.8	25.9	9.4	***196.7***	197	0	0	108	35
342.70	5.00	3.70	16		43.3	76.2	***261.6***	63.6	12.4	263.0	262	0	0	144	40
337.70	5.00	4.50	18		50.4	92.7	***291.4***	74.0	15.1	333.6	291	0	0	160	45
332.70	5.00	3.50	17		41.5	72.1	443.9	60.9	11.7	***412.6***	413	0	0	227	50
331.70	1.00			Shale	60.4	183.0	504.3	88.7	29.8	***501.2***	501	0	0	276	50.6
330.70	1.00			Shale	60.4	183.0	***564.8***	88.7	29.8	589.9	565	0	0	311	51.6
329.70	1.00			Shale	60.4	183.0	***625.2***	88.7	29.8	678.5	625	0	0	344	52.6
328.70	1.00			Shale	60.4	183.0	***685.6***	88.7	29.8	767.2	686	0	0	377	53.6
327.70	1.00			Shale	60.4	183.0	***746.0***	88.7	29.8	855.8	746	0	0	410	54.6
326.70	1.00			Shale	60.4	183.0	***806.4***	88.7	29.8	944.5	806	0	0	444	55.6
325.70	1.00			Shale	60.4	183.0	***866.8***	88.7	29.8	1033.1	867	0	0	477	56.6
324.70	1.00			Shale	60.4	183.0	***927.3***	88.7	29.8	1121.8	927	0	0	510	57.6
323.70	1.00			Shale	60.4	183.0	***987.7***	88.7	29.8	1210.5	~~988~~	~~*0*~~	~~*0*~~	~~*543*~~	~~*58.6*~~
322.70	1.00			Shale	60.4	183.0	***1048.1***	88.7	29.8	1299.1	~~1048~~	~~*0*~~	~~*0*~~	~~*576*~~	~~*59.6*~~
321.70	1.00			Shale		183.0			29.8						