Millennia Professional Services, Ltd

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Structural Geotechnical Report

Interstate 74 over French Creek
FAI Route 74, Section 48(30B)BR
Knox County, Illinois
PTB153-042
Replacement Structures 048-0106 and 048-0107

Prepared For:
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Knox County, Illinois

1.0 Project Description and Proposed Structure Information

1.1 Introduction

This report summarizes the results of a geotechnical investigation performed for the design of replacement structures for the existing bridges carrying Interstate 74 over French Creek south of Galesburg, Knox County, Illinois. The purpose of this study was to provide a geotechnical assessment of the planned replacement structures, based on subsurface conditions encountered at four borings performed by Millennia this year and eight borings performed by the Illinois Department of Transportation (IDOT) in 1965, for the existing structures. This report describes the exploration procedures used, presents the field and laboratory data, includes an assessment of the subsurface conditions in the area, and provides geotechnical recommendations for the construction.

1.2 Project Description

The project consists of the removal and replacement of the existing Interstate 74 bridges over French Creek in Knox County, Illinois. The general site area is shown on the attached Vicinity Map, Figure 1 in Appendix A. A plan that shows the approximate locations of the borings performed for this study, as well as the boring locations performed in 1965 is presented as the Site and Boring Location Plan, Figure 2 in Appendix A. French Creek is oriented north and south beneath the existing I-74 overpass structures and flows in a southern direction. The existing bridges are about 119-foot long, three-span concrete deck structures supported on steel beams. The end abutments of each existing bridge are founded on steel piles. The intermediate supports appear to be founded on spread footings. It is our understanding that the existing structures will be replaced with new single-span bridges using integral abutments. Based on the information provided, it appears that staged construction will be required to maintain traffic during construction.

1.3 Proposed Structure Information

The proposed structures will consist of two single-span bridges with concrete decks. The superstructures will be supported by integral abutments. It is our understanding that the roadway profile across the bridges will remain essentially unchanged, with little or no grade change for the embankments.

2.0 Subsurface Exploration and Laboratory Testing

2.1 Subsurface Exploration

From March 26 through 29, 2019, MPS conducted a subsurface exploration at the site, consisting of four soil test borings, designated as Borings B-1 EB and -2EB for the eastbound structures and Borings B-1 WB and -2WB for the westbound structures. The approximate locations of both sets of borings, as well as the borings previously drilled for the previous IDOT study in 1965 are indicated on the Site and Boring Location Plan, Figure 2.

The borings were advanced using hollow-stem auger drilling methods. Samples were obtained at 2.5-foot intervals until shale bedrock was encountered, and at 5-foot intervals thereafter to boring termination. Split-spoon samples were recovered using a 2-inch outside-diameter sampler, driven by a 140-pound hammer. This hammer has an energy efficiency rating of 75%. The split-spoon samples were placed in containers for later testing in the laboratory. The sampling sequence for each boring is summarized on the boring logs in Appendix B.

All of the borings were extended below the depth of approximately 35 feet (about 10 feet into augered shale), using NQ-size diamond bit, rock coring methods. The core samples recovered were measured in the field for percent recovery and RQD value. Each core sample was placed in a box for transport to the laboratory. Photographs were taken of the rock core samples and are attached in Appendix B.

Unconfined compression tests were performed on selected split-spoon samples using a Rimac field testing machine. The resulting unconfined compressive strengths are reported on the boring logs.

MPS has also included the boring log data from the 1960’s plan set in Appendix B.

2.2 Laboratory Testing

A laboratory testing program consisting of natural moisture contents, Atterberg limits, and particle size distribution was conducted by MPS to determine selected engineering properties of the obtained soil samples. The results of the individual tests are presented on the boring logs in Appendix B.

3.0 Subsurface Conditions

Details of the subsurface conditions encountered at the borings are shown on the boring logs. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at the boring locations on the dates shown; the reported conditions may be different at other locations and at other times.

3.1 Geology

The site lies on the Galesburg Plain of the Till Plains Section of the Central Lowland Physiographic Province. The surficial deposits surrounding the upland areas around the bridge site consist of Illinoisan Till of the Glasford Formations. Alluvial deposits consisting of the Cahokia Alluvium are present near the banks of French Creek. The alluvium consists of deposits of sand, silt, and clay, with local deposits of sandy gravel. The underlying bedrock is of the Pennsylvanian Carbondale Formation. This unit is a cyclic deposit, consisting of repeated layers of shale, limestone and sandstone, with thin layers of coal and underclay. The upper bedrock within the project area is predominantly shale.

3.2 Generalized Subsurface Profile

Existing fill or possible fill material related to the construction of the roadway embankment was encountered in each of the borings drilled for this study, to depths ranging from approximately 10 to 15 feet. The embankment soils typically consist of clay loam, silty clay loam, and silty clay. Trace amounts of gravel sized rock fragments were observed in the fill. Moisture contents range from 12 to 26%. The standard penetration test (N) values range from 4 to 16 blows per foot (bpf). Rimac unconfined compression test values on samples range from 1.5 to 3.9 tons per square foot (tsf).

Natural cohesive soils were encountered below the embankment fill at the site and are predominantly made up of silty clay, silty clay loam, and silt loam. The thickness of the cohesive material varies from about 2.5 to 10 feet. The natural soils contain variable amounts of sand, sand seams, and gravel. Moisture contents vary from 19 to 28%. The standard penetration test (N) values range 2 to 9 blows per foot (bpf). Rimac unconfined compression test values on samples range from 0.3 to 0.9 tsf.

Natural granular soils were encountered below the cohesive layer and above shale bedrock. The granular soils generally consist of sandy loam, gravelly sand, and clayey gravel. N-values in the granular soils vary from 3 to 13 bpf. The thickness of the granular soil varies from about 2.5 to 6 feet.

During the course of the fieldwork, shale bedrock was encountered at levels ranging from Elevation 611 to 613.5, approximately 24.0 to 26.5 feet below the natural ground surface. The N-values in the shale range from 50 for 3 inches to 50 for 5 inches of penetration. Moisture contents recorded in the split spoon samples of the shale vary from 7 to 13%. The shale bedrock was cored below a depth of approximately 35 feet at each of the boring locations. The shale is typically very soft to soft and is very fine grained. The core recovery ranges from 95 to 100% and the rock quality designation (RQD) varies from 0 to 93%.

The approximate elevations at which the top of shale were encountered for both this study and the study performed in the 1960's are summarized in Table 1 below:

Table 1
Bedrock Elevations (Approx.)

Boring No.	Approximate Top of Shale Elevation (ft.)
B-1EB	611.9
B-2EB	611.2
B-1WB	612.5
B-2WB	612.3
1*	611.4
2*	613.3
3*	614.1
4*	613.6
5*	612.3
6*	613.1
7*	612.4
8*	612.4

*= boring drilled for 1960's study

3.3 Groundwater

Groundwater was observed at all of the borings during drilling or at completion, at depths ranging from 10 feet (Elevation 612.4) to 25 feet (Elevation 625.9). The presence or absence of groundwater at a particular location does not necessarily indicate that groundwater will be present or absent at that location at other times. Groundwater levels may vary significantly over time due to the effect of seasonal variations in precipitation, the water level in the French Creek, or other factors not evident at the time of exploration.

4.0 Geotechnical Evaluations

4.1 Earthwork and Slope Stability

Grade changes on the approach embankments will be minimal along the roadways. For lane shifts or constructability, it may require that the embankments be widened accordingly in the vicinity of the abutments. It is our understanding that no significant changes to the inclination of the end slopes are planned. As such, we do not anticipate any issues related to slope stability.

4.2 Settlement

The proposed grade changes will be minimal for the new bridge profile. Therefore, issues related to settlement are not anticipated.

4.4 Mining Activity

A review of abandoned coal mines was made using the Illinois State Geological Survey (ISGS) website for mapped coal mines in Knox County, Illinois. Based on this information, the project site is unlikely to be undermined. The nearest coal mine is approximately 6 miles east of the site, near Brimfield.

4.5 Seismicity

Although several significant areas of seismic activity are present in the central United States, the site area is most directly affected by the Wabash Seismic Zone, located in south and east-central Illinois. An assessment of seismic criteria in accord with AASHTO 2009 Guide Specifications for LRFD Seismic Bridge Design has been performed for the site. The IDOT Spreadsheet “Seismic Site Class Determination” was used to determine a Soil Site Class C. We understand that IDOT utilizes the approximate fixity elevation as the point of reference. The United States Geological Survey (USGS) Design Maps Summary Report website was used with the Site Class C classification to provide acceleration coefficient values Sd_s of 0.12 g and Sd_1 of 0.075 g. The results of the Site Class determination and the Design Maps Summary Report are presented in Appendix C. Based on the guidelines in the IDOT All Geotechnical Manual Users (AGMU), including Table 3.15.2-1 in that manual, the Seismic Performance Zone is 1.
The site soils do not appear to be susceptible to liquefaction and the effects of liquefaction may be ignored for this site.

4.6 Scour

Abutment slope protection should be included to protect against scour potential. Countermeasure options for scour at bridge locations could include webwalls to eliminate debris collection between columns, riprap, partially grouted riprap, geotextile sand containers, and sheet piling. Lining the abutment slopes with either Class A4 or A5 stone riprap appears to be appropriate scour protection for the new structures. Skin friction and lateral load design values for piers and driven piles should be ignored in the scour zone. Based on information provided by Oates Associates, Inc., the design scour elevations for the 100-year and 200-year events for the bridges are shown in Table 2.

Table 2.1
Summary of Design Scour Elevations
Westbound Structure

Event/Limit State	**Design Scour Elevations (ft.)**		**Item 113**
	West Abutment	East Abutment	
Q100	628.27	629.14	8
Q200	628.27	629.14	
Design	628.27	629.14	
Check	628.27	629.14	

Table 2.2
Summary of Design Scour Elevations
Eastbound Structure

Event/Limit State	**Design Scour Elevations (ft.)**		**Item 113**
	West Abutment	East Abutment	
Q100	628.06	628.79	8
Q200	628.06	628.79	
Design	628.06	628.79	
Check	628.06	628.79	

5.0 Foundation Evaluations and Design Recommendations

5.1 Driven Pile Foundations

The bridge structures may be supported on driven pile foundations. Pile capacities and driving depths have been assessed using the IDOT pile design spreadsheet "Pile Capacity and Length Estimates," version 10/18/2011. Steel H-piles and metal shell piles are both considered to be feasible for this site. However, metal shell piles are not recommended because of the proximity of rock where a possibility of pile damage during driving may occur. Hard driving is anticipated to penetrate a sufficient distance into the shale to achieve the maximum factored capacity, particularly for the heavier sections. Numerous available pile sections may be suitable, and final selection would be based on availability and structural requirements such as pile spacing, installation requirements, etc. Capacity reductions for liquefaction and downdrag do not apply at this site.

The four abutments have been assessed for selected pile sections. Copies of a typical input spreadsheet giving the input parameters for each substructure, and the corresponding summary sheets for the various pile types that are analyzed by the spreadsheet, are included in Appendix D. These tables provide the pile embedment length to develop various capacities, up to that approaching the factored design capacity of the pile. The tables were prepared for pile lengths corresponding to selected depths of the input stratigraphy. Data for key assumptions such as pile cutoff elevation and ground surface elevation against pile driving were provided to MPS by Oates Associates, Inc.

Preliminary factored loading for the bridges are in the following Table.

Table 5.1.

Preliminary Factored Axial Loads at Abutments (kips)

Strength I	Service I	Extreme I
1,722	1,244	1,226

Integral abutments are being considered for the new bridge structures. Use has been made of the pile selection chart given in ABD 12.3, 2012 Integral Abutment Bridge Policies.

The piles exhibited in the tables in Appendix D are the pile sections that are readily available in accordance with the IDOT Geotechnical Manual. With the exception of some of the pipe pile sections, the piles will achieve their nominal structural capacity within the shale. Pile sections that are lighter than those given in the tables for a given pile dimension and location will have a similar capacity-elevation relation, but are expected to reach the maximum capacity at a higher elevation. Steel H-piles should be driven into rock to their maximum required bearing, as indicated on the IDOT pile design length spreadsheets. It should be noted that H-Piles driven into shale may run shorter (or longer) than the IDOT pile design length spreadsheets estimate.

Table 5.2.
Estimated Pile Length Tables Eastbound Structure – West Abutment
(Pile Cutoff Elevation: 628.06)

Pile Type and Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft.)
HP 8x36	286	157	24
HP 10x42	335	184	23
HP 10x57	454	250	26
HP 12x53	418	230	23
HP 12x63	497	273	25
HP 12x74	589	324	27
HP 12x84	664	365	28
HP 14x73	578	318	24
HP 14x89	705	388	26
HP 14x102	810	445	28
HP 14x117	929	511	30

Table 5.3.
Estimated Pile Length Tables Eastbound Structure – East Abutment
(Pile Cutoff Elevation: 628.79)

Pile Type and Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft.)
HP 8x36	286	157	26
HP 10x42	335	184	26
HP 10x57	454	250	28
HP 12x53	418	230	26
HP 12x63	497	273	27
HP 12x74	589	324	29
HP 12x84	664	365	30
HP 14x73	578	318	27
HP 14x89	705	388	29
HP 14x102	810	445	30
HP 14x117	929	511	32

Table 5.4.
Estimated Pile Length Tables Westbound Structure – West Abutment
(Pile Cutoff Elevation: 628.27)

Pile Type and Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft.)
HP 8x36	286	157	24
HP 10x42	335	184	24
HP 10x57	454	250	26
HP 12x53	418	230	24
HP 12x63	497	273	25
HP 12x74	589	324	27
HP 12x84	664	365	28
HP 14x73	578	318	25
HP 14x89	705	388	27
HP 14x102	810	445	28
HP 14x117	929	511	30

Table 5.5.
Estimated Pile Length Tables Westbound Structure – East Abutment
(Pile Cutoff Elevation: 629.14)

Pile Type and Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft.)
HP 8x36	286	157	26
HP 10x42	335	184	26
HP 10x57	454	250	28
HP 12x53	418	230	26
HP 12x63	497	273	27
HP 12x74	589	324	29
HP 12x84	664	365	30
HP 14x73	578	318	27
HP 14x89	705	388	29
HP 14x102	810	445	30
HP 14x117	929	511	32

6.0 Construction Considerations

6.1 Temporary Sheeting and Soil Retention

The construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction. Trenching, excavating, and bracing should be performed in accordance with Occupational Safety and Health Administration (OSHA) regulations, and other applicable regulatory agencies. In accordance with the OSHA excavation standards, the soil at the site is considered to be Type C, which requires a side slope for excavations no steeper than 1.5H:1.0V. However, worker safety and classification of the excavation soil is the responsibility of the contractor. The excavation side slopes for structure foundations may interfere with existing utilities. This will require a temporary soil retention system such as a cantilever sheet pile wall, sheeting, or other temporary support.

Traffic along I-74 will be maintained by utilizing staged construction. It appears as though either a temporary sheet pile, which includes cantilever temporary sheet piling, or a soil retention system, will be feasible at the abutments. Cantilever sheet pile systems may be designed using IDOT Design Guide 3.13.1 – Temporary Sheet Piling Design. Temporary soil retention systems should be designed by an Illinois licensed structural engineer retained by the construction contractor.

6.2 Subgrade Water Protection

Groundwater seepage should be anticipated for excavations extending more than a few feet below the roadway level along I-74 if construction occurs during periods when the water level approaches the design high water elevation. It is anticipated that excavations for the pile cap foundations may be adequately dewatered using sump and pump methods.

6.3 Driven Pile Installation

The driven piles are to be furnished and installed according to the requirements of Section 512 of the IDOT Standard Specifications, 2012. MPS recommends that at least one test pile be driven at each substructure location, in accordance with Section 512.15. The piles should be fitted with reinforced tips to reduce the potential for damage during driving.

6.4 Subgrade, Fill, and Backfill

Earthwork activities including backfill and fill should be performed in accordance with Section 205 of the Standard Specifications.

7.0 Closing

This report has been prepared for the exclusive use of Oates Associates, Inc. and the Illinois Department of Transportation for use in the design and construction of the proposed I-74 over French Creek bridge structures project in Knox County, Illinois. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made to the professional advice and recommendations included herein. This report is not for use by parties other than those named or for purposes other than those stated herein. It may not contain sufficient information for the use of other parties or for other purposes.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed by MPS to determine the applicability of the analyses and recommendations considering the changed conditions and time lapse. The report should also be reviewed by MPS if changes occur in structure location, size, and type, or in the planned loads, elevations, grading plans, and project concepts.

These analyses and recommendations are based on data obtained from site reconnaissance, the borings performed for this study and other pertinent information presented herein. This report does not reflect any variations between, beyond, or below the borings. Should such variations become evident, it may be necessary to re-evaluate the recommendations of this report after performing on-site observation during the construction period and noting the characteristics of any such variation.

We appreciate this opportunity to be of service to you and would be pleased to discuss any aspect of this report with you at your convenience.

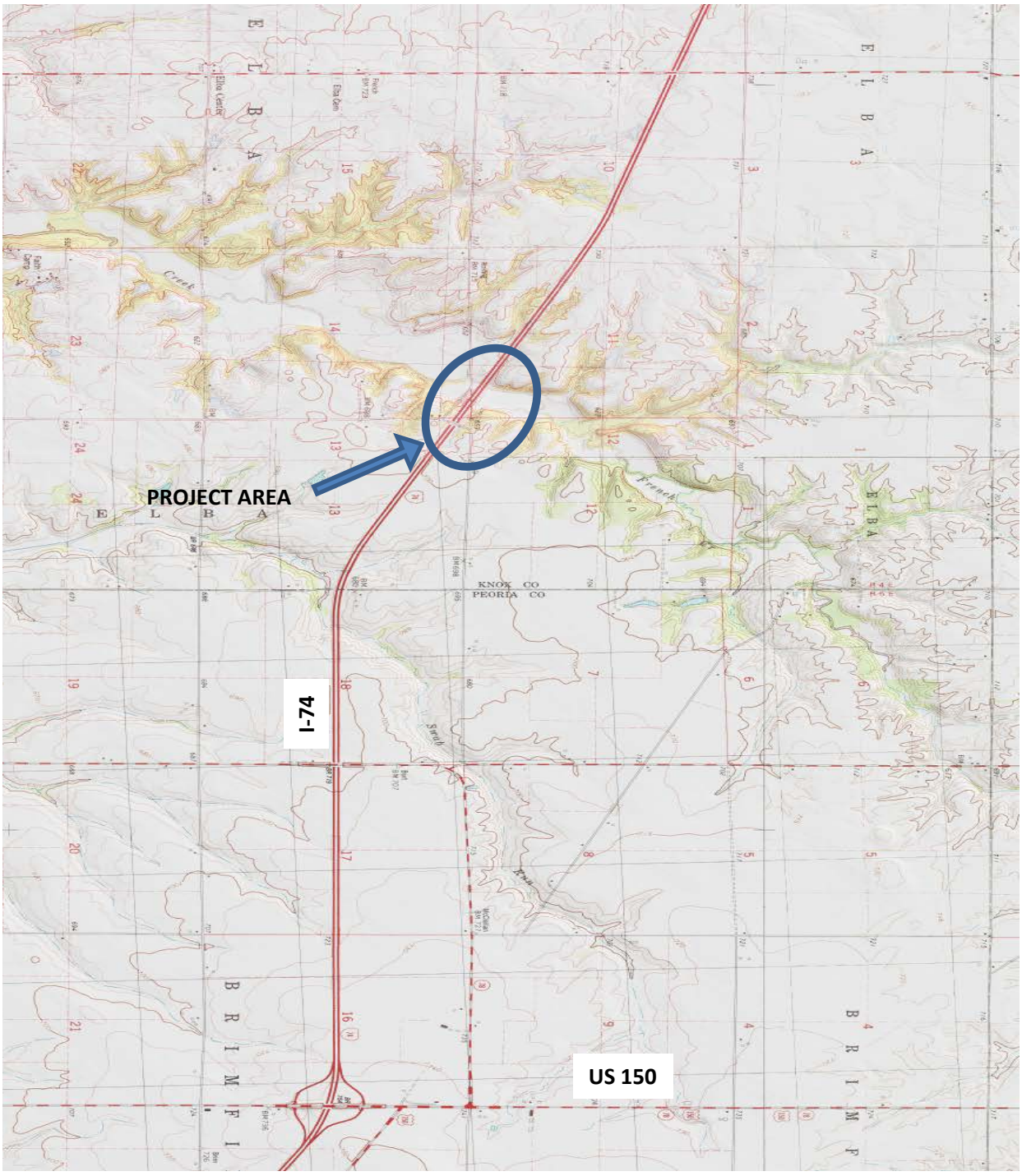
Sincerely,

Millennia Professional Services of Illinois, Ltd.

Jacob A. Schaeffer, P.E.
Project Manager

John S. Kottemann, P.E.
Senior Project Manager

Appendix A: Vicinity Map and Boring Location Plan



NOT TO SCALE

NOTE: IMAGE OBTAINED FROM TOPOQUEST 4-25-19.

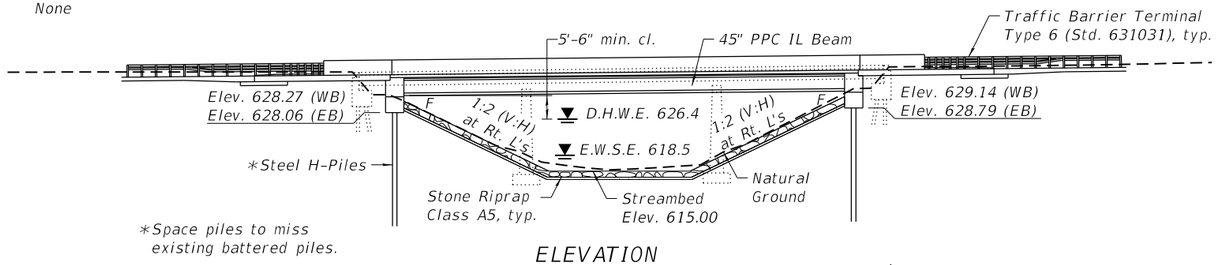
VICINITY MAP		
I-74 over French Creek Replacement Structures 048-0106 and 048-0107 Knox County, Illinois		
Drawn By: JAS	Checked By: JSK	
Project No.: MG18013	Date: 4/25/19	Figure 1

Benchmark: B.M. 9003: Chiseled "X" on east end of east concrete pad for crash barrels at the centerline of the bridge pier for Knox County Road overpass over I-74. Elevation 670.51

Existing Structure: S.N. 048-0054 & 0055 originally built in 1968 as Section 48-30B. The structures are 3-span continuous wide flange steel beam bridges on stub abutments founded on steel piles and solid wall piers founded on spread footings. The spans are 36'-0" - 41'-11" - 36'-0" with a 13°45' skew. The back-to-back of abutments is approximately 118'-9" and out-to-out width is 42'-0". Traffic to be maintained using staged construction.

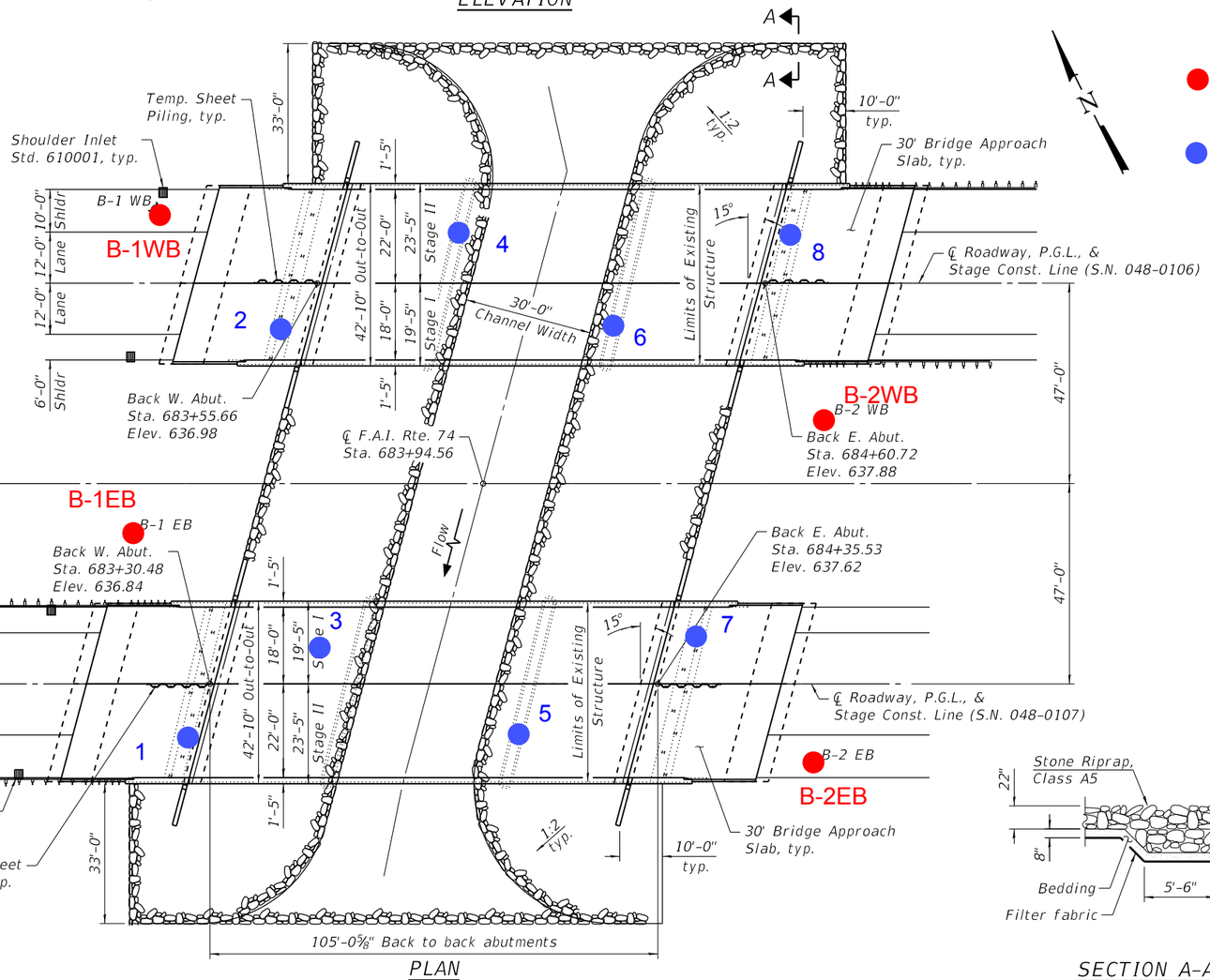
Salvage: None

Figure 2: Boring Location Plan



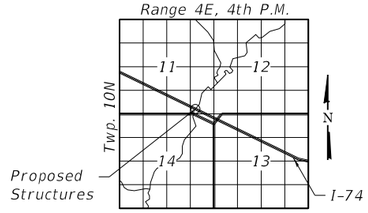
*Space piles to miss existing battered piles.

ELEVATION

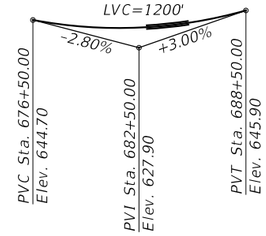


PLAN

SECTION A-A



LOCATION SKETCH



PROFILE GRADE

Along ℄ Roadway

● = Approximate location of Boring performed for 2019 study

● = Approximate location of Boring performed for 1960's study

LOADING HL-93

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

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)

PRECAST PRESTRESSED UNITS

f'c = 8,500 psi
f'ci = 6,500 psi
fpu = 270,000 psi (0.6" ϕ Low Relaxation Strands)
fpbt = 202,300 psi (0.6" ϕ Low Relaxation Strands)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.075
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.120
Soil Site Class = C

HIGHWAY CLASSIFICATION

F.A.I. Rte. 74 (I-74)
Functional Class: Interstate
ADT: 7,050 (2015); 6,663 (2032)
ADTT: 2,050 (2015); 1,950 (2032)
DHV: 666 (a.m., 2032)
Design Speed: 70 m.p.h.
Posted Speed: 70 m.p.h.
1-Way Traffic
Directional Distribution: 100

DESIGN SCOUR ELEVATION TABLE - WESTBOUND

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	E. Abut.	Item 113
Q100	628.27	629.14	8
Q200	628.27	629.14	
Design	628.27	629.14	
Check	628.27	629.14	

DESIGN SCOUR ELEVATION TABLE - EASTBOUND

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	E. Abut.	Item 113
Q100	628.06	628.79	8
Q200	628.06	628.79	
Design	628.06	628.79	
Check	628.06	628.79	

WATERWAY INFORMATION

Drainage Area = 23.6 sq. mi.
Exist. Overtopping Elev. 636.80 @ Sta. 683+00
Prop. Overtopping Elev. 636.80 @ Sta. 683+00

Flood	Freq. Yr.	Q C.F.S.	Opening Ft² Exist.	Opening Ft² Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	2,750	427	463	624.5	0.6	0.0	625.1	624.5
Design	50	4,280	559	605	626.4	1.1	0.4	627.5	626.8
Base	100	4,980	608	657	627.1	1.4	0.6	628.5	627.7
Scour Check	200	5,690	659	711	627.8	1.6	0.8	629.4	628.6
Max. Calc.	500	6,650	750	807	628.9	1.8	1.0	630.7	629.9

10 Year Velocity through Existing Bridge = 7.2 fps
10 Year Velocity through Proposed Bridge = 6.2 fps

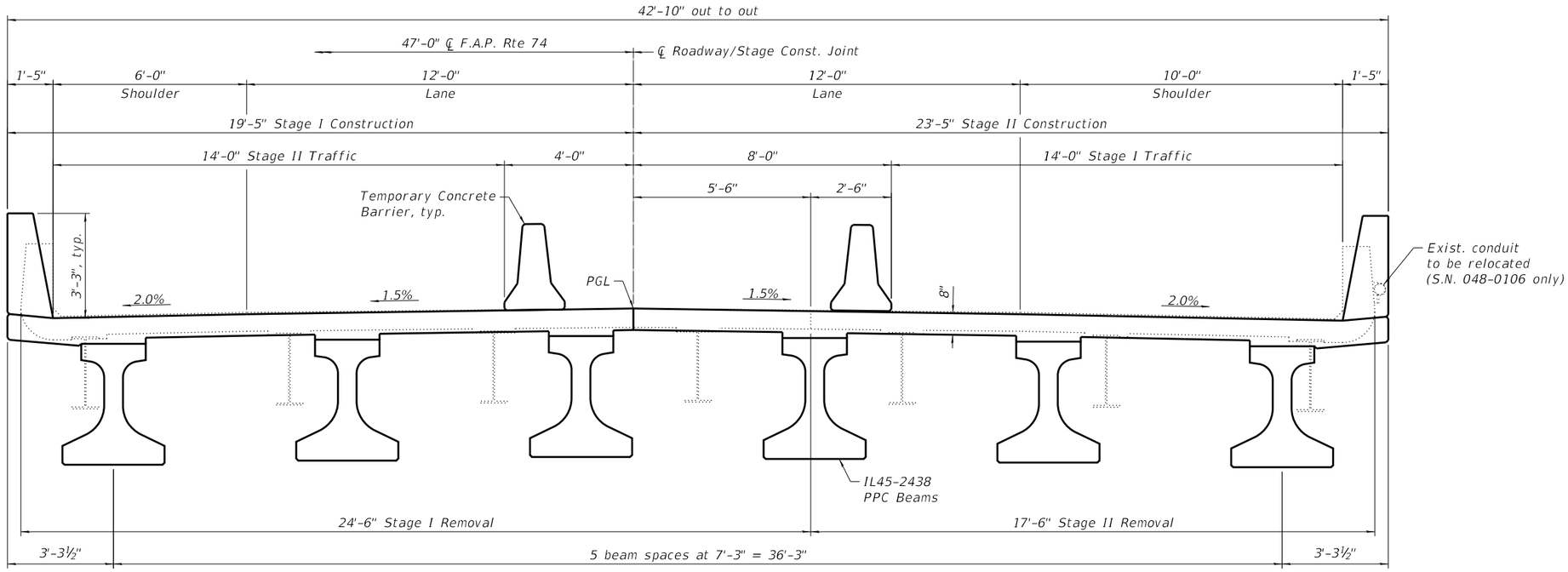
GENERAL PLAN & ELEVATION
I-74 OVER FRENCH CREEK
F.A.I. RTE. 74
SEC. 48(30B)BR
KNOX COUNTY
STATION 683+94.56
STRUCTURE NO. 048-0106 (WB)
STRUCTURE NO. 048-0107 (EB)

PRINT DATE: 8/27/2019 10:57:08 AM Z:\17035 Oates I-74 over French Creek\DGN\Bridge\prelim\Plotsheets\TS&LI.dgn

EFK•Moen Civil Engineering Design

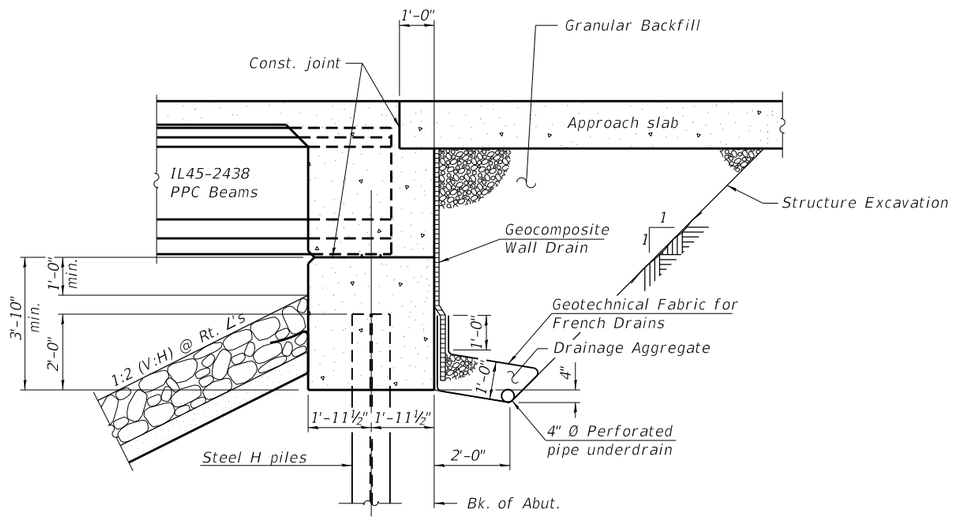
USER NAME = acb	DESIGNED - ACB	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	
	CHECKED - CDL	REVISED -		
PLOT SCALE = 0.1667 ' / in.	DRAWN - ACB	REVISED -		
PLOT DATE = 8/27/2019	CHECKED - CDL	REVISED -		SHEET 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	48(30B)BR	KNOX		
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT		



CROSS SECTION

(Looing west at S.N. 048-0106, Looking east at S.N. 048-0107 similar)



SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ∠'s)

DETAILS
I-74 OVER FRENCH CREEK
F.A.I. RTE. 74
SEC. 48(30B)BR
KNOX COUNTY
STATION 683+94.56
STRUCTURE NO. 048-0106 (WB)
STRUCTURE NO. 048-0107 (EB)

PRINT DATE: 8/27/2019 10:57:09 AM Z:\I7035 Oates I-74 over French Creek\DGN\Bridge\prelim\Plotsheets\TS&L2.dgn

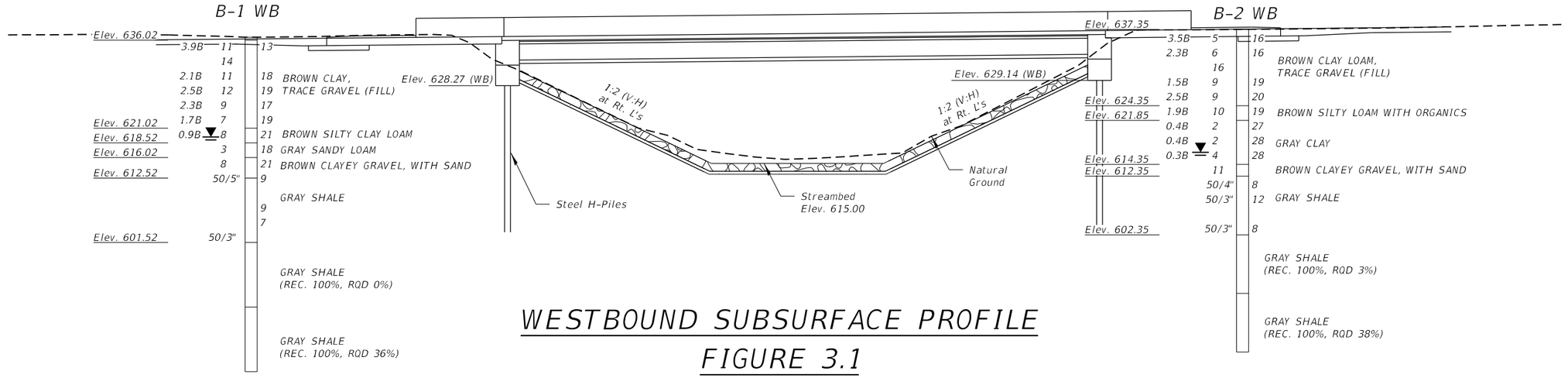
EFK•Moen
Civil Engineering Design

USER NAME = acb		DESIGNED - ACB	REVISED -	
		CHECKED - CDL	REVISED -	
PLOT SCALE = 0.1667 ' / in.		DRAWN - ACB	REVISED -	
PLOT DATE = 8/27/2019		CHECKED - CDL	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

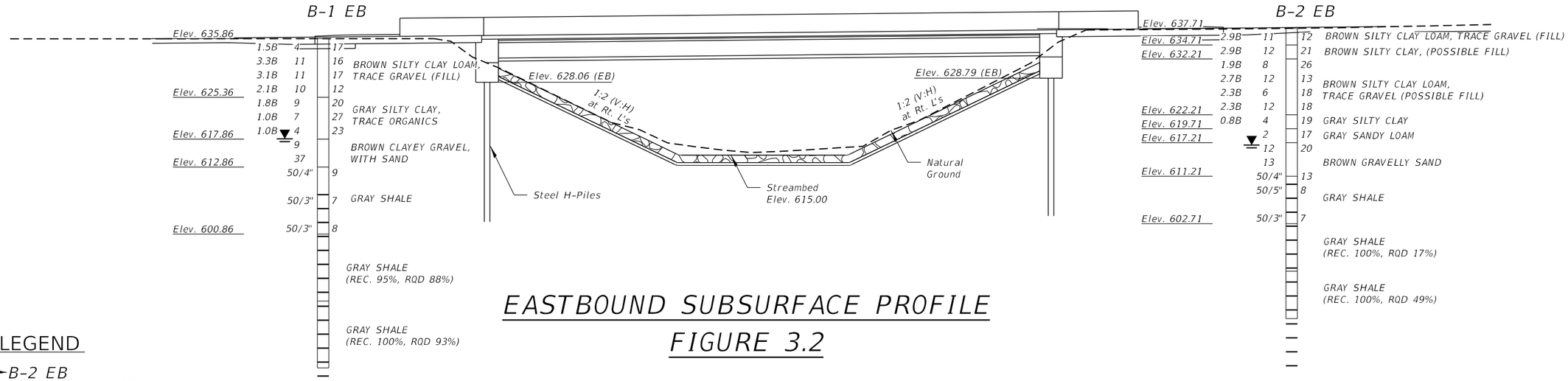
SHEET 2 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	48(30B)BR	KNOX		
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT		



WESTBOUND SUBSURFACE PROFILE

FIGURE 3.1



EASTBOUND SUBSURFACE PROFILE

FIGURE 3.2

LEGEND

BORING NUMBER → B-2 EB

UNCONFINED COMPRESSIVE STRENGTH (tsf) → 2.9B

N-VALUE (bpf) → 12

SOIL DESCRIPTION → CLAY LOAM

13 ← MOISTURE CONTENT

▼ = GROUNDWATER ENCOUNTERED AT BORING

MILLENNIA PROFESSIONAL SERVICES
www.mps-il.com

USER NAME = tlopez	DESIGNED -	REVISED -
	DRAWN - T. LOPEZ	REVISED -
PLOT SCALE = 0.1000 ' / In.	CHECKED - J. SCHAEFFER	REVISED -
PLOT DATE = 9/18/2019	DATE - 04/19/2019	REVISED -

REPLACEMENT STRUCTURES
048-0106 AND 048-0107

INTERSTATE 74 OVER FRENCH CREEK

SCALE: 1" = 20' | SHEET OF SHEETS | STA. | TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	48-[29RS-7, 30RS-1]; 72-3RS-2	KNOX		
	ILLINOIS PTB153-042			

Appendix B. Boring Logs and Laboratory Test Results

Boring Logs for This Study

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 3/28/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

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

STRUCT. NO. 048-0055
Station

BORING NO. B-1 EB
Station 683+12
Offset 12.0 ft Right
Ground Surface Elev. 635.86 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 617.9 ft
Upon Completion 625.9 ft
After 24 **Hrs.** 625.9 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	2			Brown Silty Clay Loam, Trace Gravel (FIll)
	2 2	1.5 B	17	
	6			
-5	5 6	3.3 B	16	
	3			
	4 7	3.1 B	17	
	2			
▽▼10	4 6	2.1 B	12	
625.36				Gray Silty Clay, Trace Organics
	3			
	4 5	1.8 B	20	
	3			
-15	4 3	1.0 B	27	
	0			
	1 3	1.0 B	23	
617.86▼				Brown Clayey Gravel, with Sand
	4			
-20	5 4			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				Brown Clayey Gravel, with Sand *(continued)*
	1			
	3 34			
611.86	16			
	50/4"		9	Gray Shale
-25				
	44			
	50/3"		7	
-30				
	37			
	50/3"		8	
600.86 -35				Borehole continued with rock coring.
-40				

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

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

ROCK CORE LOG

Date 3/28/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY Peoria **CORING METHOD**

STRUCT. NO. 048-0055
Station

BORING NO. B-1 EB
Station 683+12
Offset 12.0 ft Right
Ground Surface Elev. 635.86 **ft**

CORING BARREL TYPE & SIZE
Core Diameter 2 **in**
Top of Rock Elev. 611.86 **ft**
Begin Core Elev. 600.86 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray to Dark Gray (Soft) Very Fine Grained SHALE	600.86		1	95	88		
		-40					
		-45					
			2	100	93		
		-50					
	580.86	-55					

End of Boring

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 3/26/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

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

STRUCT. NO. 048-0054
Station

BORING NO. B-1 WB
Station 683+18
Offset 64.0 ft Left
Ground Surface Elev. 636.52 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 619.5 ft ▼
Upon Completion 619.5 ft ▽
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				Bituminous shoulder (6 inch) 636.02
				Brown Clay, Trace Gravel (Fill)
	8			
	5 6	3.9 B	13	
	14			
-5	8 6			
	3			
	4 7	2.1 B	18	
	3			
-10	5 7	2.5 B	19	
	3			
	4 5	2.3 B	17	
	2			
-15	3 4	1.7 B	19	
	1			
				621.02
				Brown Silty Clay Loam
▽▼	3 5	0.9 B	21	
	1			
				618.52
				Gray Sandy Loam
-20	1 2		18	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				616.02
				Brown Clayey Gravel, with Sand
	2			
	3 5		21	
	16			612.52
-25	50/5"		9	Gray Shale
	50/5"			
-30			9	
	41			
	50/3"		7	
-35				601.52
				Borehole continued with rock coring.
-40				

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

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

ROCK CORE LOG

Date 3/26/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY Peoria **CORING METHOD**

STRUCT. NO. 048-0054
Station

BORING NO. B-1 WB
Station 683+18
Offset 64.0 ft Left
Ground Surface Elev. 636.52 **ft**

CORING BARREL TYPE & SIZE
Core Diameter 2 **in**
Top of Rock Elev. 612.52 **ft**
Begin Core Elev. 601.52 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Dark Gary (Soft to Very Soft) Very Fine Grained SHALE	601.52		1	100	0		
		-40					
		-45					
			2	100	36		
		-50					
	581.52	-55					

End of Boring
Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 3/29/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

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

STRUCT. NO. 048-0055
Station

BORING NO. B-2 EB
Station 684+72
Offset 66.0 ft Right
Ground Surface Elev. 637.71 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 616.7 ft ▼
Upon Completion 617.7 ft ▽
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	7			Brown Silty Clay Loam, Trace Gravel (Fill)
	7 4	2.9 B	12	
634.71				
	5			Brown Silty Clay, Trace Gravel (Possible Fill)
-5	5 7	2.9 B	21	
632.21				
	2			Brown Silty Clay Loam, Trace Gravel (Possible Fill)
	3 5	1.9 B	26	
	4			
-10	6 6	2.7 B	13	
	2			
	3 3	2.3 B	18	
	3			
-15	5 7	2.3 B	18	
622.21				
	2			Gray Silty Clay
	2 2	0.8 B	19	
619.71				
	1			Gray Sandy Loam
▽ -20	1 1		17	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
617.21				
	0			Brown Gravelly Sand ▼
	4 8		20	
	3			
-25	5 8			
611.21	28			
	50/4"		13	Gray Shale
	25			
-30	50/5"		8	
	37			
-35	50/3"		7	
602.71				
				Borehole continued with rock coring.
-40				

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

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

ROCK CORE LOG

Date 3/29/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** West Abutment, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY Peoria **CORING METHOD**

STRUCT. NO. 048-0055
Station

BORING NO. B-2 EB
Station 684+72
Offset 66.0 ft Right
Ground Surface Elev. 637.71 **ft**

CORING BARREL TYPE & SIZE
Core Diameter 2 **in**
Top of Rock Elev. 611.21 **ft**
Begin Core Elev. 602.71 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Dark Gary (Soft to Very Soft) Very Fine Grained SHALE	602.71		1	100	17		
		-40					
		-45					
			2	100	49		
		-50					
	582.71	-55					

End of Boring
Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation

Division of Highways
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 3/27/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** East Abutment, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

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

STRUCT. NO. 048-0054
Station

BORING NO. B-2 WB
Station 684+75
Offset 15.0 ft Left
Ground Surface Elev. 637.35 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 616.4 ft
Upon Completion 612.4 ft
After 24 **Hrs.** 620.4 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	2			Brown Silty Clay Loam, Trace Gravel (Fill)
	2 3 2	3.5 B	16	
-5	3 3 5	2.3 B	16	
	8 8 4			
-10	5 4 2	1.5 B	19	
	3 6 3	2.5 B	20	
624.35				
				Gray Silty Loam with organics
-15	5 5 1	1.9 B	19	
621.85				
	1 1 0	0.4 B	27	Gray Clay
-20	1 1	0.4 B	28	
	1			Gray Clay *(continued)*
	2 2	0.3 B	28	-Trace Gravel below 21.0 ft.
614.35				
	3			Brown Clayey Gravel, with Sand
-25	5 6			
612.35				
	19			Gray Shale
	50/4" 25		8	
-30	50/3"		12	
	34			
-35	50/3"		8	
602.35				
				Borehole continued with rock coring.
-40				

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

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

ROCK CORE LOG

Date 3/27/19

ROUTE FAI RTE 74 **DESCRIPTION** WO 14 I-74 Over French Creek **LOGGED BY** L. Williams

SECTION SEC 48(30B)BR **LOCATION** East Abutment, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY Peoria **CORING METHOD**

STRUCT. NO. 048-0054
Station

BORING NO. B-2 WB
Station 684+75
Offset 15.0 ft Left
Ground Surface Elev. 637.35 **ft**

CORING BARREL TYPE & SIZE
Core Diameter 2 **in**
Top of Rock Elev. 612.35 **ft**
Begin Core Elev. 602.35 **ft**

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Dark Gray (Soft) Very Fine Grained SHALE	602.35		1	100	3		
		-40					
		-45					
			2	100	38		
		-50					
	582.35	-55					

End of Boring
Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Boring Log Information for 1960's Study

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

	48308	KNOX	32	15

SHEET NO. 11
12 SHEETS

COUNTY Knox
Boring No. 1
Station 683+35
Offset 60ft. Rt. along Pier #1

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 629.4			
Medium Brown Silty CLAY LOAM	5	0.6 B	29
	4	0.6 B	-
616.4			
Loose Brown Angular Well graded SAND (Traces of Gravel)	7	-	-
	5	-	-
611.4			
Hard Gray Shaley CLAY	100/2"	3.9 B	14
	50/2"	-	-
	100/0"	-	14
End of Boring 604.9			

Surface Water El. -
Groundwater El. at Completion 618.4
After 24 Hours 619.4

COUNTY Knox
Boring No. 2
Station 683+35
Offset 30ft. Rt. along Pier #1

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 625.1			
Soft Brown Silty CLAY LOAM	10	0.5 B	-
	7	0.4 B	-
619.1			
Loose Brown Angular, Well Graded SAND (Traces of Gravel)	10	-	-
	6	-	-
614.1			
Hard Gray Shaley CLAY	50/3"	-	-
	50/2"	-	-
	100/0"	-	-
607.6			
Note: Boring could not be obtained on line of Pier #1, All material throughout area of borings was consistent. Moisture contents on this boring comparable to Boring #1			

Surface Water El. -
Groundwater El. at Completion 619.1
After ... Hours

COUNTY Knox
Boring No. 3
Station 683+44
Offset 30ft. Rt. along Pier #2

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 626.1			
Soft Brown Silty CLAY LOAM	10	0.5 B	-
	7	0.4 B	-
619.1			
Loose Brown Angular, Well Graded SAND (Traces of Gravel)	10	-	-
	6	-	-
614.1			
Hard Gray Shaley CLAY	50/3"	-	-
	50/2"	-	-
	100/0"	-	-
607.6			
Note: Boring could not be obtained on line of Pier #2, All material throughout area of borings was consistent. Moisture contents on this boring comparable to Boring #1			

Surface Water El. -
Groundwater El. at Completion 619.1
After ... Hours

COUNTY Knox
Boring No. 4
Station 683+24
Offset 60½ Rt. along Pier #2

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 629.4			
Medium Brown Silty CLAY LOAM	8	0.7 B	-
	4	0.8 B	-
618.4			
Very Soft Gray Sandy LOAM	2	0.2 B	-
614.4			
Medium Brown Angular, Well Graded SAND (Traces of Gravel)	14	-	-
613.4			
Hard Gray Shaley CLAY	50/3"	-	-
	50/3"	-	-
	100/0"	-	-
End of Boring 606.9			
Note: Moisture contents comparable to Boring #2.			

Surface Water El. -
Groundwater El. at Completion 617.4
After ... Hours

COUNTY Knox
Boring No. 5
Station 683+35
Offset 60ft. Rt. along Pier #1

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 629.4			
Very Soft Brown Silty CLAY LOAM	5	0.6 B	-
620.9			
Soft Brown Silty CLAY LOAM	5	0.6 B	-
618.3			
Loose Brown Angular Well-graded SAND (Traces of Gravel)	9	-	-
615.9			
Medium Brown SAND (Traces of Gravel)	10	-	-
613.3			
Hard Gray Shaley CLAY	50/4"	3.3 B	-
	50/3"	-	-
	50/2"	-	-
End of Boring 606.9			
Note: Moisture contents comparable to Boring #1			

Surface Water El. -
Groundwater El. at Completion 618.3
After 20 Hours 619.3

DESIGNED John W Clark Jr.
CHECKED Carl Stumpf
DRAWN
CHECKED Carl Stumpf

EXAMINED Aug. 5 1965
PASSED H. J. Alton
APPROVED W. E. Stumpf

N - Standard Penetration Test - Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140# hammer falling 30".

Qu - Unconfined Compressive Strength - t/s.f.

w - Water Content - percentage of oven dry weight - %

Type Failure
B - Bulge Failure
S - Shear Failure
E - Estimated Value

BORING DATA
F.A.I.RT 74 SEC 48-30B
KNOX COUNTY
STA. 683+93.70

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

I.A. RTE. NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I.-74	48308	KNOX	32	16
FED. ROAD DIST. NO.	ILLINOIS	FED. AID PROJECT		

SHEET NO. 12
12 SHEETS

COUNTY. Knox — Boring No. 5 — Station 684+19.5 — Offset 60'Rt. ℄ along Pier #2

Surface Water El. --- — Groundwater El. at Completion 618.8 — After 22 Hours 618.8

Elevation	Depth	N	Qu t/s.f.	w (%)
Ground Surface 624.8	0			
Stiff Brown Silty CLAY LOAM				
		7	3.0 S	-
619.8	-5			
Very Soft Brown Sandy LOAM		4	0.0 S	-
617.3				
Loose Brown Angular, Well Graded SAND (Traces of Gravel)		4	-	-
	-10			
		-	-	-
612.3				
Hard Gray Shaley CLAY		50/4"	-	-
	-15			
		50/5"	-	-
		50/2"	-	-
End of Boring 605.8	-20			
Note: Moisture contents comparable to Boring #6.				

Elevation	Depth
	-25
	-30
	-35
	-40
	-45

COUNTY. Knox — Boring No. 6 — Station 684+19.5 — Offset 39'Rt. ℄ along Pier #2

Surface Water El. --- — Groundwater El. at Completion 619.1 — After 32 Hours 618.3

Elevation	Depth	N	Qu t/s.f.	w (%)
Ground Surface 625.1	0			
Stiff Brown Silty CLAY LOAM		6	1.2 S	27
621.6				
Very Soft Brown Silty CLAY LOAM	-5	6	0.0 S	-
618.1				
Very Soft Brown Sandy LOAM		4	0.0 S	-
615.6	-10			
Loose Brown Angular well graded SAND (traces of Gravel)		5	-	27
613.1				
Hard Gray Shaley CLAY		100/4"	-	11
	-15			
		50/4"	-	-
		50/3"	-	-
	-20			
		50/2"	-	-

Hard Gray Shaley CLAY 601.6 — End of Boring — 24

Elevation	Depth
	-25
	-30
	-35
	-40
	-45

COUNTY. Knox — Boring No. 7 — Station 684+24 — Offset 58'Rt. ℄ along E. Abut.

Surface Water El. --- — Groundwater El. at Completion 618.9 — After 66 Hours 618.9

Elevation	Depth	N	Qu t/s.f.	w (%)
Ground Surface 624.9	0			
Very Soft Brown Silty CLAY LOAM		6	0.1 S	-
619.9	-5			
Very Soft Brown Sandy LOAM		2	0.0 S	-
617.4				
Loose Brown Angular, Well graded SAND (Traces of Gravel)		4	-	-
	-10			
		9	-	-
612.4				
Hard Gray Shaley CLAY		100/4"	-	-
	-15			
		50/5"	-	-
		100/3"	-	-
End of Boring 605.9	-20			
Note: Moisture contents comparable to Boring #6.				

Elevation	Depth
	-25
	-30
	-35
	-40
	-45

COUNTY. Knox — Boring No. 8 — Station 684+24 — Offset 60'Lt. ℄ along E. Abut.

Surface Water El. --- — Groundwater El. at Completion 618.9 — After 69 Hours 618.9

Elevation	Depth	N	Qu t/s.f.	w (%)
Ground Surface 624.9	0			
Soft Brown Silty CLAY LOAM		6	0.6 S	24
619.9	-5			
Very Soft Brown Sandy LOAM		4	0.0 S	-
612.4				
Medium Brown Angular, well graded SAND (Traces of Gravel)		11	-	16
	-10			
		22	-	-
612.4				
Hard Gray Shaley CLAY		100/4"	-	11
	-15			
		50/2"	-	-
		50/2"	-	12
End of Boring 605.9	-20			

Elevation	Depth
	-25
	-30
	-35
	-40
	-45

DESIGNED	John W Clark Jr.	AUG. 5 1965
CHECKED	Tai Ping Ch	EXAMINED Carl Hammatt
DRAWN		PASSED H. D. Litton
CHECKED	Tai Ping Ch	APPROVED V.E. Statt

N - Standard Penetration Test - Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140# hammer falling 30".

Qu - Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight - %

Type Failure
B - Brittle Failure
S - Shear Failure
E - Estimated Value

BORING DATA
F.A.I.RT.74 SEC.48-30B
KNOX COUNTY
STA.683+93.70

FAI Rte 74 Sec. 48-30B Knox Co. Dist. 4

Rock Core Photographs

Rock Core Photographs
WO 14 I-74 Over French Creek
Project No. MG18013
Millennia Professional Services
Boring B-1 EB

Run	Depth (ft.)	Recovery (%)	RQD (%)
1	35.0-45.0	95	88

Boring B-1 EB

Run	Depth (ft.)	Recovery (%)	RQD (%)
2	45.0-55.0	100	93

Rock Core Photographs
WO 14 I-74 Over French Creek
Project No. MG18013
Millennia Professional Services

Boring B-2 EB

Run	Depth (ft.)	Recovery (%)	RQD (%)
1	35.0-45.0	100	17

Boring B-2 EB

Run	Depth (ft.)	Recovery (%)	RQD (%)
2	45.0-55.0	100	49

Rock Core Photographs
WO 14 I-74 Over French Creek
Project No. MG18013
Millennia Professional Services

Boring B-1 WB

Run	Depth (ft.)	Recovery (%)	RQD (%)
1	35.0-45.0	100	0

Boring B-1 WB

Run	Depth (ft.)	Recovery (%)	RQD (%)
2	45.0-55.0	100	30

Rock Core Photographs
WO 14 I-74 Over French Creek
Project No. MG18013
Millennia Professional Services
Boring B-2 WB

Run	Depth (ft.)	Recovery (%)	RQD (%)
1	35.0-45.0	100	3

Boring B-2 WB

Run	Depth (ft.)	Recovery (%)	RQD (%)
2	45.0-55.0	100	38

Appendix C. Seismic Site Class Spreadsheet

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====I-74 over French Creek

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	628	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1EB	
Top of Boring Elev.	636	ft.
Approximate Fixity Elev.	622	ft.

Individual Site Class Definition:

N (bar):	58	(Blows/ft.)	Soil Site Class C
N_{ch} (bar):	85	(Blows/ft.)	Soil Site Class C <----Controls
s_u (bar):	4.36	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	633.5	2.50	4	1.50	
	631.0	2.50	11	3.30	
	628.5	2.50	11	3.10	
	626.0	2.50	10	2.10	B
	623.5	2.50	9	1.80	
1.0	621.0	2.50	7	1.00	
3.5	618.5	2.50	4	1.00	B
6.0	616.0	2.50	9		
8.5	613.5	2.50	37		B
100.0	522.0	91.50	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	629	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2EB	
Top of Boring Elev.	638	ft.
Approximate Fixity Elev.	623	ft.

Individual Site Class Definition:

N (bar):	32	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	38	(Blows/ft.)	Soil Site Class D <----Controls
s_u (bar):	4.38	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	635.5	2.50	11	2.90	B
	633.0	2.50	12	2.90	B
	630.5	2.50	8	1.90	
	628.0	2.50	12	2.70	
	625.5	2.50	6	2.30	
	623.0	2.50	12	2.30	B
2.5	620.5	2.50	4	0.80	B
5.0	618.0	2.50	2		B
7.5	615.5	2.50	12		
10.0	613.0	2.50	13		B
100.0	523.0	90.00	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	628	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1WB	
Top of Boring Elev.	636.5	ft.
Approximate Fixity Elev.	622	ft.

Individual Site Class Definition:

N (bar):	41	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	47	(Blows/ft.)	Soil Site Class D <----Controls
s_u (bar):	4.42	(ksf)	Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	634.0	2.50	11	3.90	
	631.5	2.50	14	2.10	
	629.0	2.50	7	2.10	
	626.5	2.50	12	2.50	
	624.0	2.50	9	2.30	
0.5	621.5	2.50	7	1.70	B
3.0	619.0	2.50	8	0.90	B
5.5	616.5	2.50	3		B
8.0	614.0	2.50	8		B
100.0	522.0	92.00	100	5.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)	629	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2WB	
Top of Boring Elev.	637	ft.
Approximate Fixity Elev.	623	ft.

Individual Site Class Definition:

N (bar):	23	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	82	(Blows/ft.)	Soil Site Class C
s_u (bar):	2.49	(ksf)	Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	634.5	2.50	5	3.50	
	632.0	2.50	6	2.30	
	629.5	2.50	16	2.30	
	627.0	2.50	9	1.50	
	624.5	2.50	9	2.50	B
1.0	622.0	2.50	10	1.90	B
3.5	619.5	2.50	2	0.40	B
6.0	617.0	2.50	2	0.40	B
8.5	614.5	2.50	4	0.30	B
11.0	612.0	2.50	11		B
100.0	523.0	89.00	100	5.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar):	39	(Blows/ft.)	Soil Site Class D
N_{ch} (bar):	63	(Blows/ft.)	Soil Site Class C <----Controls
s_u (bar):	3.9	(ksf)	Soil Site Class C

Appendix D. Pile Capacity Summaries

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== East Bound-West Abutment
REFERENCE BORING ========== B-1 EB
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 630.06 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 628.06 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 628.06 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1722 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ========
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

PILE TYPE AND SIZE ========== Steel HP 8 X 36
Plugged Pile Perimeter========== 2.695 FT. Unplugged Pile Perimeter========== 3.892 FT.
Plugged Pile End Bearing Area========== 0.454 SQFT. Unplugged Pile End Bearing Area===== 0.074 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
286 KIPS	**286** KIPS	**157** KIPS	**24** 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 PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED 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.)
625.56	2.50	2.10	10		8.1		19.5	11.7		***13.5***	14	0	0	7	5
623.06	2.50	1.80	9		7.3	11.5	***21.8***	10.6	1.9	23.3	22	0	0	12	7
620.56	2.50	1.00	7		4.8	6.4	***26.6***	6.9	1.0	30.2	27	0	0	15	10
618.06	2.50	1.00	4		4.8	6.4	***35.2***	6.9	1.0	37.7	35	0	0	19	12
615.56	2.50		9	Sandy Gravel	1.4	10.2	68.2	2.0	1.7	***44.9***	45	0	0	25	15
612.06	3.50		37	Sandy Gravel	11.3	41.8	94.2	16.3	6.8	***63.6***	64	0	0	35	18
611.06	1.00			Shale	33.6	56.5	127.8	48.5	9.2	***112.0***	112	0	0	62	19
610.06	1.00			Shale	33.6	56.5	161.4	48.5	9.2	***160.5***	161	0	0	88	20
609.06	1.00			Shale	33.6	56.5	***194.9***	48.5	9.2	209.0	195	0	0	107	21
608.06	1.00			Shale	33.6	56.5	***228.5***	48.5	9.2	257.5	229	0	0	126	22
607.06	1.00			Shale	33.6	56.5	***262.1***	48.5	9.2	306.0	262	0	0	144	23
606.06	1.00			Shale	33.6	56.5	***295.6***	48.5	9.2	354.4	~~296~~	~~0~~	~~0~~	~~163~~	~~24~~
605.06	1.00			Shale	33.6	56.5	***329.2***	48.5	9.2	402.9	~~329~~	~~0~~	~~0~~	~~181~~	~~25~~
604.06	1.00			Shale	33.6	56.5	***362.8***	48.5	9.2	451.4	~~363~~	~~0~~	~~0~~	~~200~~	~~26~~
603.06	1.00			Shale	33.6	56.5	***396.4***	48.5	9.2	499.9	~~396~~	~~0~~	~~0~~	~~218~~	~~27~~
602.06	1.00			Shale	33.6	56.5	***429.9***	48.5	9.2	548.4	~~430~~	~~0~~	~~0~~	~~236~~	~~28~~
601.06	1.00			Shale	33.6	56.5	***463.5***	48.5	9.2	596.8	~~464~~	~~0~~	~~0~~	~~255~~	~~29~~
600.06	1.00			Shale	33.6	56.5	***497.1***	48.5	9.2	645.3	~~497~~	~~0~~	~~0~~	~~273~~	~~30~~
599.06	1.00			Shale	33.6	56.5	***530.6***	48.5	9.2	693.8	~~531~~	~~0~~	~~0~~	~~292~~	~~31~~
598.06	1.00			Shale	33.6	56.5	***564.2***	48.5	9.2	742.3	~~564~~	~~0~~	~~0~~	~~310~~	~~32~~
597.06	1.00			Shale	33.6	56.5	***597.8***	48.5	9.2	790.7	~~598~~	~~0~~	~~0~~	~~329~~	~~33~~
596.06	1.00			Shale	33.6	56.5	***631.4***	48.5	9.2	839.2	~~631~~	~~0~~	~~0~~	~~347~~	~~34~~
595.06	1.00			Shale	33.6	56.5	***664.9***	48.5	9.2	887.7	~~665~~	~~0~~	~~0~~	~~366~~	~~35~~
594.06	1.00			Shale	33.6	56.5	***698.5***	48.5	9.2	936.2	~~699~~	~~0~~	~~0~~	~~384~~	~~36~~
593.06	1.00			Shale	33.6	56.5	***732.1***	48.5	9.2	984.7	~~732~~	~~0~~	~~0~~	~~403~~	~~37~~
592.06	1.00			Shale	33.6	56.5	***765.7***	48.5	9.2	1033.1	~~766~~	~~0~~	~~0~~	~~421~~	~~38~~
591.06	1.00			Shale	33.6	56.5	***799.2***	48.5	9.2	1081.6	~~799~~	~~0~~	~~0~~	~~440~~	~~39~~
590.06	1.00			Shale	33.6	56.5	***832.8***	48.5	9.2	1130.1	~~833~~	~~0~~	~~0~~	~~458~~	~~40~~
589.06	1.00			Shale	33.6	56.5	***866.4***	48.5	9.2	1178.6	~~866~~	~~0~~	~~0~~	~~477~~	~~41~~
588.06	1.00			Shale	33.6	56.5	***899.9***	48.5	9.2	1227.1	~~900~~	~~0~~	~~0~~	~~495~~	~~42~~
587.06	1.00			Shale	33.6	56.5	***933.5***	48.5	9.2	1275.5	~~934~~	~~0~~	~~0~~	~~513~~	~~43~~
586.06	1.00			Shale	33.6	56.5	***967.1***	48.5	9.2	1324.0	~~967~~	~~0~~	~~0~~	~~532~~	~~44~~
585.06	1.00			Shale	33.6	56.5	***1000.7***	48.5	9.2	1372.5	~~1001~~	~~0~~	~~0~~	~~550~~	~~45~~
584.06	1.00			Shale	33.6	56.5	***1034.2***	48.5	9.2	1421.0	~~1034~~	~~0~~	~~0~~	~~569~~	~~46~~
583.06	1.00			Shale	33.6	56.5	***1067.8***	48.5	9.2	1469.5	~~1068~~	~~0~~	~~0~~	~~587~~	~~47~~
582.06	1.00			Shale	33.6	56.5	***1101.4***	48.5	9.2	1517.9	~~1101~~	~~0~~	~~0~~	~~606~~	~~48~~
581.06	1.00			Shale	33.6	56.5	***1134.9***	48.5	9.2	1566.4	~~1135~~	~~0~~	~~0~~	~~624~~	~~49~~
580.06	1.00			Shale		56.5			9.2						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Bound East Abutment
REFERENCE BORING ========== B-2 EB
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 630.79 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 628.79 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 628.79 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1722 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ========
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

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
810 KIPS	**810** KIPS	**445** KIPS	**30** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 102
Plugged Pile Perimeter========== 4.800 FT. Unplugged Pile Perimeter========== 7.058 FT.
Plugged Pile End Bearing Area========== 1.439 SQFT. Unplugged Pile End Bearing Area===== 0.208 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED 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.)
625.79	3.00	2.30	6		18.3		64.7	27.0		***33.7***	34	0	0	19	5
622.79	3.00	2.30	12		18.3	46.4	***52.8***	27.0	6.7	56.3	53	0	0	29	8
620.29	2.50	0.80	4		7.1	16.1	***50.5***	10.4	2.3	65.3	51	0	0	28	11
617.79	2.50		2	Fine Sand	0.4	6.8	87.2	0.6	1.0	***71.2***	71	0	0	39	13
615.29	2.50		12	Clean Coarse Sand	2.9	43.0	93.7	4.2	6.2	***75.9***	76	0	0	42	16
611.29	4.00		13	Clean Coarse Sand	5.0	46.6	231.3	7.3	6.7	***102.5***	102	0	0	56	20
610.29	1.00			Shale	59.8	179.2	291.1	87.9	25.9	***190.4***	190	0	0	105	20.5
609.29	1.00			Shale	59.8	179.2	350.9	87.9	25.9	***278.3***	278	0	0	153	21.5
608.29	1.00			Shale	59.8	179.2	410.7	87.9	25.9	***366.2***	366	0	0	201	22.5
607.29	1.00			Shale	59.8	179.2	470.4	87.9	25.9	***454.2***	454	0	0	250	23.5
606.29	1.00			Shale	59.8	179.2	***530.2***	87.9	25.9	542.1	530	0	0	292	24.5
605.29	1.00			Shale	59.8	179.2	***590.0***	87.9	25.9	630.0	590	0	0	325	25.5
604.29	1.00			Shale	59.8	179.2	***649.8***	87.9	25.9	717.9	650	0	0	357	26.5
603.29	1.00			Shale	59.8	179.2	***709.6***	87.9	25.9	805.9	710	0	0	390	27.5
602.29	1.00			Shale	59.8	179.2	***769.4***	87.9	25.9	893.8	769	0	0	423	28.5
601.29	1.00			Shale	59.8	179.2	***829.2***	87.9	25.9	981.7	~~829~~	~~0~~	~~0~~	~~456~~	~~29.5~~
600.29	1.00			Shale	59.8	179.2	***889.0***	87.9	25.9	1069.6	~~889~~	~~0~~	~~0~~	~~489~~	~~30.5~~
599.29	1.00			Shale	59.8	179.2	***948.8***	87.9	25.9	1157.6	~~949~~	~~0~~	~~0~~	~~522~~	~~31.5~~
598.29	1.00			Shale	59.8	179.2	***1008.6***	87.9	25.9	1245.5	~~1009~~	~~0~~	~~0~~	~~555~~	~~32.5~~
597.29	1.00			Shale	59.8	179.2	***1068.4***	87.9	25.9	1333.4	~~1068~~	~~0~~	~~0~~	~~588~~	~~33.5~~
596.29	1.00			Shale	59.8	179.2	***1128.2***	87.9	25.9	1421.4	~~1128~~	~~0~~	~~0~~	~~621~~	~~34.5~~
595.29	1.00			Shale	59.8	179.2	***1188.0***	87.9	25.9	1509.3	~~1188~~	~~0~~	~~0~~	~~653~~	~~35.5~~
594.29	1.00			Shale	59.8	179.2	***1247.8***	87.9	25.9	1597.2	~~1248~~	~~0~~	~~0~~	~~686~~	~~36.5~~
593.29	1.00			Shale	59.8	179.2	***1307.6***	87.9	25.9	1685.1	~~1308~~	~~0~~	~~0~~	~~719~~	~~37.5~~
592.29	1.00			Shale	59.8	179.2	***1367.4***	87.9	25.9	1773.1	~~1367~~	~~0~~	~~0~~	~~752~~	~~38.5~~
591.29	1.00			Shale	59.8	179.2	***1427.2***	87.9	25.9	1861.0	~~1427~~	~~0~~	~~0~~	~~785~~	~~39.5~~
590.29	1.00			Shale	59.8	179.2	***1487.0***	87.9	25.9	1948.9	~~1487~~	~~0~~	~~0~~	~~818~~	~~40.5~~
589.29	1.00			Shale	59.8	179.2	***1546.7***	87.9	25.9	2036.8	~~1547~~	~~0~~	~~0~~	~~851~~	~~41.5~~
588.29	1.00			Shale	59.8	179.2	***1606.5***	87.9	25.9	2124.8	~~1607~~	~~0~~	~~0~~	~~884~~	~~42.5~~
587.29	1.00			Shale	59.8	179.2	***1666.3***	87.9	25.9	2212.7	~~1666~~	~~0~~	~~0~~	~~916~~	~~43.5~~
586.29	1.00			Shale	59.8	179.2	***1726.1***	87.9	25.9	2300.6	~~1726~~	~~0~~	~~0~~	~~949~~	~~44.5~~
585.29	1.00			Shale	59.8	179.2	***1785.9***	87.9	25.9	2388.5	~~1786~~	~~0~~	~~0~~	~~982~~	~~45.5~~
584.29	1.00			Shale	59.8	179.2	***1845.7***	87.9	25.9	2476.5	~~1846~~	~~0~~	~~0~~	~~1015~~	~~46.5~~
583.29	1.00			Shale	59.8	179.2	***1905.5***	87.9	25.9	2564.4	~~1906~~	~~0~~	~~0~~	~~1048~~	~~47.5~~
582.29	1.00			Shale	59.8	179.2	***1965.3***	87.9	25.9	2652.3	~~1965~~	~~0~~	~~0~~	~~1081~~	~~48.5~~
581.29	1.00			Shale	59.8	179.2	***2025.1***	87.9	25.9	2740.3	~~2025~~	~~0~~	~~0~~	~~1114~~	~~49.5~~
580.29	1.00			Shale	59.8	179.2	***2084.9***	87.9	25.9	2828.2	~~2085~~	~~0~~	~~0~~	~~1147~~	~~50.5~~
579.29	1.00			Shale		179.2			25.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Bound-West Abutment
REFERENCE BORING ========== B-1 WB
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 630.27 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 628.27 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 628.27 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1722 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ========
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

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
418 KIPS	**418** KIPS	**230** KIPS	**24** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED 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.)
625.77	2.50	2.50	12		13.4		45.1	19.5		***23.0***	23	0	0	13	5
623.27	2.50	2.30	9		12.6	31.7	49.4	18.5	3.5	***40.6***	41	0	0	22	7
620.77	2.50	1.70	7		10.4	23.4	***48.8***	15.2	2.6	54.5	49	0	0	27	10
618.27	2.50	0.90	8		6.5	12.4	***50.2***	9.5	1.4	63.4	50	0	0	28	12
615.77	2.50		3	Fine Sand	0.5	7.3	***62.9***	0.7	0.8	65.5	63	0	0	35	15
612.77	3.00		8	Sandy Gravel	2.2	19.6	168.1	3.3	2.1	***80.0***	80	0	0	44	18
611.77	1.00			Shale	49.4	122.5	217.5	72.3	13.4	***152.3***	152	0	0	84	18.5
610.77	1.00			Shale	49.4	122.5	266.9	72.3	13.4	***224.5***	225	0	0	123	19.5
609.77	1.00			Shale	49.4	122.5	316.3	72.3	13.4	***296.8***	297	0	0	163	20.5
608.77	1.00			Shale	49.4	122.5	***365.7***	72.3	13.4	369.0	366	0	0	201	21.5
607.77	1.00			Shale	49.4	122.5	***415.1***	72.3	13.4	441.3	415	0	0	228	22.5
606.77	1.00			Shale	49.4	122.5	***464.5***	72.3	13.4	513.5	~~465~~	~~0~~	~~0~~	~~256~~	~~23.5~~
605.77	1.00			Shale	49.4	122.5	***514.0***	72.3	13.4	585.8	~~514~~	~~0~~	~~0~~	~~283~~	~~24.5~~
604.77	1.00			Shale	49.4	122.5	***563.4***	72.3	13.4	658.0	~~563~~	~~0~~	~~0~~	~~310~~	~~25.5~~
603.77	1.00			Shale	49.4	122.5	***612.8***	72.3	13.4	730.3	~~613~~	~~0~~	~~0~~	~~337~~	~~26.5~~
602.77	1.00			Shale	49.4	122.5	***662.2***	72.3	13.4	802.6	~~662~~	~~0~~	~~0~~	~~364~~	~~27.5~~
601.77	1.00			Shale	49.4	122.5	***711.6***	72.3	13.4	874.8	~~712~~	~~0~~	~~0~~	~~391~~	~~28.5~~
600.77	1.00			Shale	49.4	122.5	***761.0***	72.3	13.4	947.1	~~761~~	~~0~~	~~0~~	~~419~~	~~29.5~~
599.77	1.00			Shale	49.4	122.5	***810.4***	72.3	13.4	1019.3	~~810~~	~~0~~	~~0~~	~~446~~	~~30.5~~
598.77	1.00			Shale	49.4	122.5	***859.9***	72.3	13.4	1091.6	~~860~~	~~0~~	~~0~~	~~473~~	~~31.5~~
597.77	1.00			Shale	49.4	122.5	***909.3***	72.3	13.4	1163.8	~~909~~	~~0~~	~~0~~	~~500~~	~~32.5~~
596.77	1.00			Shale	49.4	122.5	***958.7***	72.3	13.4	1236.1	~~959~~	~~0~~	~~0~~	~~527~~	~~33.5~~
595.77	1.00			Shale	49.4	122.5	***1008.1***	72.3	13.4	1308.3	~~1008~~	~~0~~	~~0~~	~~554~~	~~34.5~~
594.77	1.00			Shale	49.4	122.5	***1057.5***	72.3	13.4	1380.6	~~1058~~	~~0~~	~~0~~	~~582~~	~~35.5~~
593.77	1.00			Shale	49.4	122.5	***1106.9***	72.3	13.4	1452.8	~~1107~~	~~0~~	~~0~~	~~609~~	~~36.5~~
592.77	1.00			Shale	49.4	122.5	***1156.3***	72.3	13.4	1525.1	~~1156~~	~~0~~	~~0~~	~~636~~	~~37.5~~
591.77	1.00			Shale	49.4	122.5	***1205.7***	72.3	13.4	1597.3	~~1206~~	~~0~~	~~0~~	~~663~~	~~38.5~~
590.77	1.00			Shale	49.4	122.5	***1255.2***	72.3	13.4	1669.6	~~1255~~	~~0~~	~~0~~	~~690~~	~~39.5~~
589.77	1.00			Shale	49.4	122.5	***1304.6***	72.3	13.4	1741.8	~~1305~~	~~0~~	~~0~~	~~718~~	~~40.5~~
588.77	1.00			Shale	49.4	122.5	***1354.0***	72.3	13.4	1814.1	~~1354~~	~~0~~	~~0~~	~~745~~	~~41.5~~
587.77	1.00			Shale	49.4	122.5	***1403.4***	72.3	13.4	1886.3	~~1403~~	~~0~~	~~0~~	~~772~~	~~42.5~~
586.77	1.00			Shale	49.4	122.5	***1452.8***	72.3	13.4	1958.6	~~1453~~	~~0~~	~~0~~	~~799~~	~~43.5~~
585.77	1.00			Shale	49.4	122.5	***1502.2***	72.3	13.4	2030.8	~~1502~~	~~0~~	~~0~~	~~826~~	~~44.5~~
584.77	1.00			Shale	49.4	122.5	***1551.6***	72.3	13.4	2103.1	~~1552~~	~~0~~	~~0~~	~~853~~	~~45.5~~
583.77	1.00			Shale	49.4	122.5	***1601.1***	72.3	13.4	2175.3	~~1601~~	~~0~~	~~0~~	~~881~~	~~46.5~~
582.77	1.00			Shale	49.4	122.5	***1650.5***	72.3	13.4	2247.6	~~1650~~	~~0~~	~~0~~	~~908~~	~~47.5~~
581.77	1.00			Shale	49.4	122.5	***1699.9***	72.3	13.4	2319.8	~~1700~~	~~0~~	~~0~~	~~935~~	~~48.5~~
580.77	1.00			Shale		122.5			13.4						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Bound-East Abutment
REFERENCE BORING ========== B-2 WB
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 631.14 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 629.14 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 629.14 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1722 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ========
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area===== 0.151 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
589 KIPS	**589** KIPS	**324** KIPS	**29** 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 PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED 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.)
626.64	2.50	1.48	9		9.7		45.1	14.1		***19.3***	19	0	0	11	5
624.14	2.50	2.47	9		13.5	35.5	50.5	19.7	5.2	***37.8***	38	0	0	21	7
621.64	2.50	1.90	10		11.4	27.3	***40.3***	16.6	4.0	51.3	40	0	0	22	10
619.14	2.50	0.40	2		3.2	5.7	***43.5***	4.7	0.8	56.0	44	0	0	24	12
616.64	2.50	0.40	2		3.2	5.7	***45.3***	4.7	0.8	60.5	45	0	0	25	15
614.14	2.50	0.30	4		2.5	4.3	71.6	3.6	0.6	***67.6***	68	0	0	37	17
611.64	2.50		11	Sandy Gravel	2.6	28.1	173.8	3.8	4.1	***86.1***	86	0	0	47	20
610.64	1.00			Shale	50.5	127.7	224.2	73.6	18.9	***159.7***	160	0	0	88	20.5
609.64	1.00			Shale	50.5	127.7	274.7	73.6	18.9	***233.3***	233	0	0	128	21.5
608.64	1.00			Shale	50.5	127.7	325.1	73.6	18.9	***306.9***	307	0	0	169	22.5
607.64	1.00			Shale	50.5	127.7	***375.6***	73.6	18.9	380.5	376	0	0	207	23.5
606.64	1.00			Shale	50.5	127.7	***426.0***	73.6	18.9	454.1	426	0	0	234	24.5
605.64	1.00			Shale	50.5	127.7	***476.5***	73.6	18.9	527.7	476	0	0	262	25.5
604.64	1.00			Shale	50.5	127.7	***526.9***	73.6	18.9	601.3	527	0	0	290	26.5
603.64	1.00			Shale	50.5	127.7	***577.4***	73.6	18.9	674.9	577	0	0	318	27.5
602.64	1.00			Shale	50.5	127.7	***627.8***	73.6	18.9	748.5	~~628~~	~~0~~	~~0~~	~~345~~	~~28.5~~
601.64	1.00			Shale	50.5	127.7	***678.3***	73.6	18.9	822.1	~~678~~	~~0~~	~~0~~	~~373~~	~~29.5~~
600.64	1.00			Shale	50.5	127.7	***728.7***	73.6	18.9	895.7	~~729~~	~~0~~	~~0~~	~~401~~	~~30.5~~
599.64	1.00			Shale	50.5	127.7	***779.2***	73.6	18.9	969.3	~~779~~	~~0~~	~~0~~	~~429~~	~~31.5~~
598.64	1.00			Shale	50.5	127.7	***829.6***	73.6	18.9	1042.9	~~830~~	~~0~~	~~0~~	~~456~~	~~32.5~~
597.64	1.00			Shale	50.5	127.7	***880.1***	73.6	18.9	1116.5	~~880~~	~~0~~	~~0~~	~~484~~	~~33.5~~
596.64	1.00			Shale	50.5	127.7	***930.5***	73.6	18.9	1190.1	~~931~~	~~0~~	~~0~~	~~512~~	~~34.5~~
595.64	1.00			Shale	50.5	127.7	***981.0***	73.6	18.9	1263.7	~~981~~	~~0~~	~~0~~	~~540~~	~~35.5~~
594.64	1.00			Shale	50.5	127.7	***1031.4***	73.6	18.9	1337.3	~~1031~~	~~0~~	~~0~~	~~567~~	~~36.5~~
593.64	1.00			Shale	50.5	127.7	***1081.9***	73.6	18.9	1410.9	~~1082~~	~~0~~	~~0~~	~~595~~	~~37.5~~
592.64	1.00			Shale	50.5	127.7	***1132.3***	73.6	18.9	1484.5	~~1132~~	~~0~~	~~0~~	~~623~~	~~38.5~~
591.64	1.00			Shale	50.5	127.7	***1182.8***	73.6	18.9	1558.1	~~1183~~	~~0~~	~~0~~	~~651~~	~~39.5~~
590.64	1.00			Shale	50.5	127.7	***1233.2***	73.6	18.9	1631.7	~~1233~~	~~0~~	~~0~~	~~678~~	~~40.5~~
589.64	1.00			Shale	50.5	127.7	***1283.7***	73.6	18.9	1705.3	~~1284~~	~~0~~	~~0~~	~~706~~	~~41.5~~
588.64	1.00			Shale	50.5	127.7	***1334.2***	73.6	18.9	1778.9	~~1334~~	~~0~~	~~0~~	~~734~~	~~42.5~~
587.64	1.00			Shale	50.5	127.7	***1384.6***	73.6	18.9	1852.5	~~1385~~	~~0~~	~~0~~	~~762~~	~~43.5~~
586.64	1.00			Shale	50.5	127.7	***1435.1***	73.6	18.9	1926.1	~~1435~~	~~0~~	~~0~~	~~789~~	~~44.5~~
585.64	1.00			Shale	50.5	127.7	***1485.5***	73.6	18.9	1999.7	~~1486~~	~~0~~	~~0~~	~~817~~	~~45.5~~
584.64	1.00			Shale	50.5	127.7	***1536.0***	73.6	18.9	2073.3	~~1536~~	~~0~~	~~0~~	~~845~~	~~46.5~~
583.64	1.00			Shale	50.5	127.7	***1586.4***	73.6	18.9	2146.9	~~1586~~	~~0~~	~~0~~	~~873~~	~~47.5~~
582.64	1.00			Shale	50.5	127.7	***1636.9***	73.6	18.9	2220.5	~~1637~~	~~0~~	~~0~~	~~900~~	~~48.5~~
581.64	1.00			Shale	50.5	127.7	***1687.3***	73.6	18.9	2294.1	~~1687~~	~~0~~	~~0~~	~~928~~	~~49.5~~
580.64	1.00			Shale		127.7			18.9						