STRUCTURE GEOTECHNICAL REPORT

SN 011-0515

EX SN 011-0011

IL 29 over Flatt Branch
FAP Route 75, IL 29
Section: (4) BR, D
Christian County

D-96-511-06

Contract 72A26

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IDOT Region 4 District 6
Geotechnical Unit

Checked By: SmB

Approved By:
Greg Heckel, PE
D6 Materials Engineer

Date: October 27, 2020
Rev. 1 January 19, 2021
Rev. 2 June 7, 2021

Date: June 25, 2021

Prepared For: Brandon Poiter S.E.
TWM Engineering
618-624-4488

Attachments: Preliminary TSL
Subsurface Profile
Boring Logs

This Report has been prepared based on a preliminary TSL from August 2020. Contact the author if there are any questions regarding this Report or if there are modifications to structure location, size, geometry, or vertical alignment.

Electronic copies of boring logs are available upon request for inclusion in the plans. Calculations are also available upon request.

This Report has been prepared according to the 2012 IDOT Bureau of Bridges and Structures Bridge Manual and AASHTO LRFD Bridge Design Specifications 9th Edition –with Interims.

Project Description and Proposed Structure Information

The project includes replacing an existing 203'-0" long and 36'-0" wide three-span slab bridge structure (SN 011-0011) with a new 213'-8" long and 42'-10" wide, three-span structure (SN 011-0515). The proposed structure will utilize integral abutments founded on piling. Work will be completed under stage construction.

Site Investigation

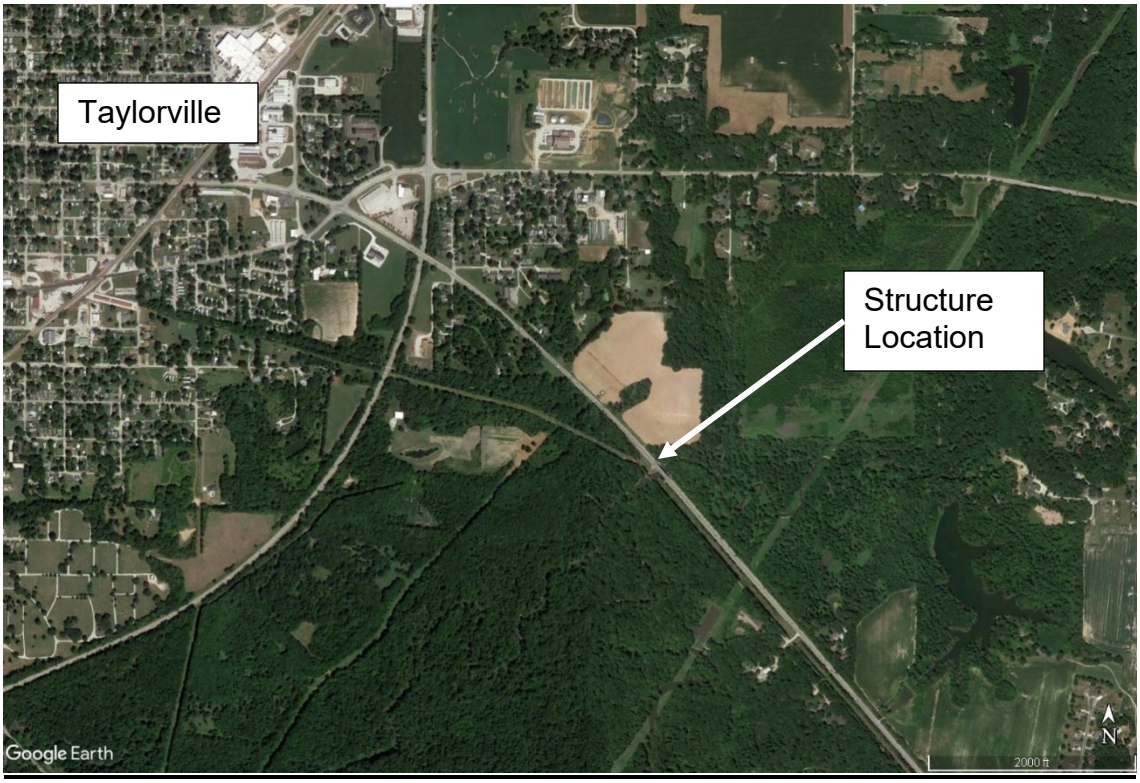
The project is located approximately 0.75 miles Southeast of the IL 29/48 intersection east of Taylorville over Flat Branch Creek. The land surrounding this site is rolling timber ground with timber lined creeks. The new bridges will be in the same footprint of the existing IL 29 2-lane structure. There is a bike path and bridge located approximately 140' southwest of the roadway bridge.

The original structure was built in 1965 as part the relocation of IL 29. The current structure is a three-span wide-flange steel beam bridge. The foundation consists of stub abutments founded on concrete pile and solid wall concrete piers founding on creosoted timber pile.
It has a back-to-back abutment length of 203'-0" and an out-to-out width of 36'-0".

Water in Flat Branch Creek flows from the North to South. There is no evidence of scour at the abutments or pier. There are concrete slope walls which a slightly cracked.

Borings from 1963 are available. However, the 1963 boring logs utilized a rope and cathead method to determine SPT N-values, so they are not appropriate for use in design if new borings can be obtained. New borings were advanced by the District 6 drill crew using hollow stem auger methods according to AASHTO T 206 and the IDOT Geotechnical Manual. Borings were filled with cuttings immediately after drilling to allow traffic on the roadway.

Location Map



Existing Structure

Proposed Structure

Geotechnical Evaluation

Settlement: No change in grade is proposed. No settlement problems are anticipated.

Slope Stability: There is no evidence of any slope stability problems with the existing cross slopes. Slope stability analysis indicated a Factor-of-Safety greater than the 1.5 required.

Seismic Considerations: The following table shows recommended seismic design data based on a 1000-year return period event.

Seismic Performance Zone (SPZ)	2
Spectral Acceleration at 1 second (S_{D1})	0.171g
Design Spectral Acceleration at 0.2 Seconds (S_{DS})	0.338g
Soil Site Class	D

Seismic Performance Zone 2 requires liquefaction and seismic slope stability analysis to be performed. The analysis showed no liquefaction losses on the piling as well as no decrease in slope stability.

Scour: Scour elevations for a 100 and 200-year event was determined by the design consultant. The estimated Q100 and Q200 scour depths are 10.4' and 11.70' at the piers respectively. The design scour elevation at abutments is equal to the proposed bottom of abutment elevation. The following table shows elevations used in evaluating scour information at the piers.

Elevations Used to Evaluate Scour

Bottom of Abutment	579.31'(W) / 579.14'(E)
Finished Ground Line	563.5± (P1) / 563.4± (P2)
Streambed	559.5
Bottom of Solid Wall Encasement	557.0

Unadjusted Scour Elevations (ft)					
Event / Limit State	West Abut.	Pier #1	Pier #2	East Abut.	Item 113
Q_{100}	579.31'	555.60'	555.50'	579.14'	5
Q_{200}	579.31'	554.80'	554.70'	579.14'	5

From section *"2.3.6.3.2 Scour Consideration and Design Scour Table"* of the 2012 IDOT Bridge Manual the estimated scour elevations may be adjusted based on the unconfined cohesive strength of the soil determined from the soil boring. For pier #1 (east pier) the average Qu = 3.2 tsf. This strength would equate to a 50% reduction in the unadjusted Q100 scour depth of 7.9 ft and Q200 scour depth of 8.7 ft. For pier #2 (west pier) the average Qu = 0.45 tsf. This strength would equate to a 0% reduction in scour depth.

The following table shows recommended design scour elevations at each substructure unit. Some adjustment to bottom of abutment elevation may be made during final design.

Scour Design Table

Event / Limit State	West Abut.	Pier #1	Pier #2	East Abut.	Item 113
Calculated Q100	579.31'	559.60'	555.50'	579.14'	5
Calculated Q200		559.20'	554.70'		
Design Scour Elevation		557.00'	555.50'		
Check Scour Elevation		557.00'	554.70'		

Foundation Evaluation

Subsurface conditions determined during the investigation indicate inadequate bearing capacity for spread footings, inadequate side resistance and no bedrock identified for supporting reasonably sized drilled shafts, and no bedrock is present for end-bearing H-piles.

Vertical Loading

Preliminary maximum factored loads, provided by the structure designer, are approximately 960 kips vertical at the abutments and 2,060 kips for the piers.

As mentioned earlier, the proposed bridge has an out-to-out width of 42'-10". The bridge has a 0-skew angle. The following table shows the factored loads based on 3 ft.& 8 ft. pile spacing along the skew length of the substructures.

Substructure Factored Loading Summary

		Factored Load Per Pile	
Substructure Type	Total Factored Load	3.0' Ctr.	8.0' Ctr.
Abutment	960 kips	67.24	179.31
Pier	2060 kips	144.29	384.78

Losses

Downdrag: There is no profile grade change, therefore there will not any downdrag induced onto the piling.

Scour: Based on the design scour elevation indicated earlier combined with the bottom of solid wall encasement 2.5 ft below streambed, scour effect the piers differently. Pier 1 has no scour loss because the bottom of solid wall encasement is equal to the design scour elevation. However, the Pier 2 design scour elevation is below the solid wall encasement, so scour loss will be included in the pile data. The scour loss for each pile size at Pier 2 is shown in the piling tables.

Liquefaction: Because the site is in Seismic Performance Zone 2, liquefaction was analyzed. Based on the soil boring information and BBS liquefaction spreadsheet, no losses were identified.

Piling Design Tables

Based on the subsurface conditions, this structure should be founded on friction pilling. In this report 12", 14" and 16" metal shell piles along with the HP12x53 shape were analyzed.

In all cases, driving a pile to its maximum nominal required bearing is not appropriate. For metal shell piles, a high N-value sand or hard till layer is present that will significantly increase driving stress increasing the probability of damage. For H-piles, the boring depth is insufficient to reliably predict pile length at higher nominal bearing values. The nominal required bearing values shown in the tables should not be exceeded, with the exception of minor adjustments required for final design. To reduce the risk of pile damage during driving, shoes are recommended on metal shell piles.

The table below shows elevations used to develop estimated length values.

	Abutments	Piers
Pile Cutoff	581.2	581.9
Ground During Driving	579.2	557.0

West Abutment Pile Design Table (Boring 1)

	12” MS 0.25” Wall		14” MS 0.25” Wall		14” MS 0.312” Wall		16” MS 0.312” Wall		HP 12x53	
	Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips	
FRA kips	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft
70	128	27	128	25	128	25	-	-	128	28
90	164	31	164	27	164	27	164	25	164	35
110	200	37	200	32	200	32	200	27	200	41
140	255	43	255	38	255	38	255	34	255	45
160			291	42	291	42	291	38	291	47
180							328	42	328	54

For metal shell piles, grey shading in a cell indicates hard driving encountered where there is a high probability of pile damage during driving at higher NRB for metal shell piles.
Pier 1 boring information was used to supplement information below the West Abutment boring depth.

Pier 1 Pile Design Table (Boring 3)

	12” MS 0.25” Wall		14” MS 0.25” Wall		14” MS 0.312” Wall		16” MS 0.312” Wall		HP 12x53	
	Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips	
FRA kips	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft
150	273	42	273	40	273	40	273	40	273	50
190	346	46	346	46	346	46	346	41	346	56
230					418	46	418	46		
300							546	46		
350										
380										

For metal shell piles, grey shading in a cell indicates hard driving encountered where there is a high probability of pile damage during driving at higher NRB for metal shell piles.
For HP shapes, grey shading indicates boring depth is insufficient for a reliable length at higher NRB.

Pier 2 Pile Design Table (Boring 4)

	12” MS 0.25” Wall		14” MS 0.25” Wall		14” MS 0.312” Wall		16” MS 0.312” Wall		HP 12x53	
	Loss = 1 kip		Loss = 1 kip		Loss = 1 kip		Loss = 1 kip		Loss = 1 kip	
FRA kips	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft
150	275	47	275	47	275	47	275	45	275	58
190	348	57	348	554	348	48	348	47	348	63
230					420	57	420	49		
300							548	59		
350										
380										

For metal shell piles, grey shading in a cell indicates hard driving encountered where there is a high probability of pile damage during driving at higher NRB for metal shell piles.
For HP shapes, grey shading indicates boring depth is insufficient for a reliable length at higher NRB.
Pier 1 boring information was used to supplement information below the Pier 2 boring depth.

East Abutment Pile Design Table (Boring 2)

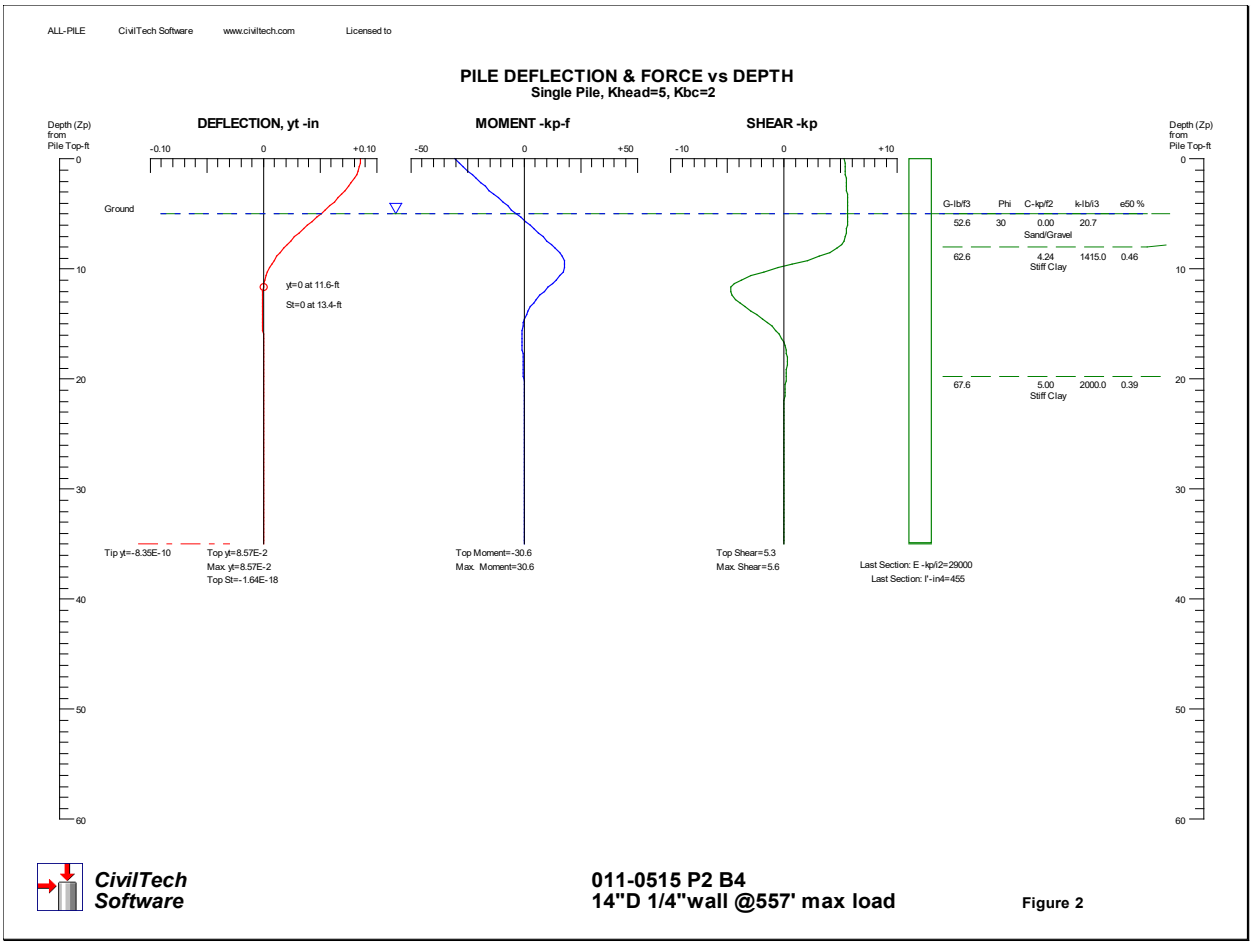
	12” MS 0.25” Wall		14” MS 0.25” Wall		14” MS 0.312” Wall		16” MS 0.312” Wall		HP 12x53	
	Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips		Loss = 0 kips	
FRA kips	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft	NRB kips	Est. L ft
70	128	38	128	38	128	38	128	38	128	47
90	164	38	164	38	164	38	164	38	164	59
110	200	38	200	38	200	38	200	38	200	62
140	255	42	255	38	255	38	255	38		
160	291	46	291	40	291	40	291	38		
180	328	53	328	44	328	44	328	44		

For HP shapes, grey shading indicates boring depth is insufficient for a reliable length at higher NRB.
Pier 1 and 2 boring information was used to supplement information below the East Abutment boring depth.

Lateral Loading

As mentioned earlier, the metal shell pile depth is limited by a high N-value layer. Additionally, the design scour elevation at Pier 2 is below the bottom of solid wall encasement. Because of the combination of limited driving depth and scour, pile fixity is a consideration at Pier 2. The structure designer provided a transverse lateral load range of 2.6 to 5.3 kips per pile in the transverse direction.

AllPile software was used to perform a lateral load analysis on metal shell piles at Pier 2 to determine a minimum tip elevation to develop deflection fixity. The analysis model was based on a fixed condition with the top of pile located at the bottom of the solid wall at an elevation of 557.1 ft. The model included a ground elevation of 552 ft, which is 3.5 ft below the recommended design scour elevation. The analysis indicated a maximum depth to deflection fixity of 12 ft, which corresponds to a tip elevation of 545.1 ft. The corresponding minimum pile length is 36 ft. The Pile Design Tables indicate all piles at Pier 2 will exceed a length of 36 ft. An example output is shown below.



Example AllPile Report for a 14” MS Pile with 0.25” Walls With the Maximum Per Pile Load Applied

Additional AllPile output reports are available upon request. The table on the following page shows soil inputs for use by the structure designer for any additional soil-structure interaction analyses.

Soil Parameters -- SN 011-0515									
Sub Unit	Layer	Depth		Unit Wt. (pcf)	Cohesion (psi)	ϕ (deg)	k (pci)	e_{50}	Boring
		Top Elev.	Bottom Elev.						
West Abutment	1	586.5	580.5	115	5.6	30	126.9	0.0098	Boring #1
	2	580.5	578.5	110	3.5	28	53.4	0.0167	
	3	578.5	575.5	115	1.4	30	16	0.029	
	4	575.5	572.5	115	13.9	30	666.3	0.0063	
	5	572.5	568.5	115	8	30	313.3	0.0084	
	6	568.5	565.5	115	18.1	30	866	0.0055	
	7	565.5	560.5	120	-	33	33.3	-	
	8	560.5	555.5	120	11.1	33	533.3	0.0069	
	9	555.5	529.5	125	22.22	36	1065.8	0.0049	
Pier #1	1	568.7	563.7	115	-	30	29.3	-	Boring #3
	2	563.7	560.2	120	20.8	33	999.2	0.005	
	3	560.2	557.7	120	9.7	33	446.5	0.0074	
	4	557.7	555.2	120	34.7	33	1665.3	0.0043	
	5	555.2	542.7	120	24.5	33	1165.7	0.0048	
	6	542.7	538.7	125	36.1	36	1732	0.0043	
	7	538.7	518.7	130	-	40	92.5	-	
Pier #2	1	565.3	558.3	110	2.8	28	34.7	0.0193	Boring #4
	2	558.3	549.3	115	-	30	20.7	-	
	3	549.3	537.3	125	29.5	36	1415.5	0.0046	
	4	537.3	525.3	130	44.4	40	2000	0.0039	
East Abutment	1	586.3	580.8	115	6.9	30	2334	0.009	Boring #2
	2	580.8	575.8	115	11.1	30	533.3	0.0069	
	3	575.8	568.3	115	6.6	30	206.8	0.0092	
	4	568.3	560.3	115	6.9	30	233.4	0.009	
	5	560.3	543.3	110	-	28	12	-	
	6	543.3	537.3	130	12.5	40	599.71	0.0066	

ϕ = phi angle
k = subgrade modulus
E_{50} = strain at 50% deflection in p-y curve

Approach Pavement

Foundation conditions beneath proposed approach pavement footings have been reviewed, based on available boring data, the available bearing capacity is greater than required. For structure replacement projects, experience indicates approach pavement footings do not experience excessive settlement when there is no new fill beneath the footing, and it is constructed on undisturbed soil. No remedial action is required.

Construction Considerations

Stage Construction: This project will be constructed under staged construction. Using a profile grade of 586.5 ft and a bottom of excavation elevation of 579.2 ft results in a retained height of 7.3 ft. The west abutment location has a low strength layer extending to 575.5± ft. To account for this low strength layer, the retained height used to model the design has been increased to 11 ft. As a result, a temporary sheet pile wall is feasible at both abutments. The sheet pile embedment should be 12 ft below the excavation and the minimum section modulus is 10 in^3/ft at both abutments.

Cofferdams: Based on an EWSE of 565.3 ft and a bottom of solid wall elevation of 557.0 ft, at Type 2 cofferdam is required. At Pier 1, a seal coat is not required because both the 1963 boring and 2020 boring indicate sand is not present at the Pier 1 location.

At Pier 2, loose clay loam with sand seams and sand is present below the bottom of solid wall elevation. A seal coat is not required if a minimum sheet pile tip elevation of 546 ft is specified, which will embed into silty clay loam till and cutoff seepage.

Evaluate the proposed pier locations to ensure cofferdam construction will not conflict with existing pier foundation battered timber piles.

Ground Improvement: No ground improvement is required.

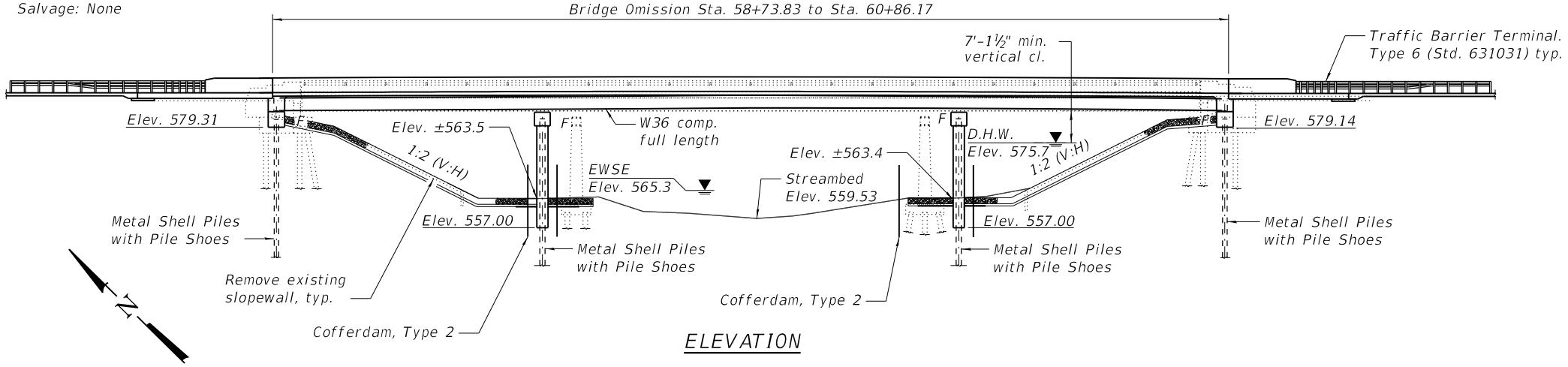
The following is a list of spreadsheets and software programs that were used in the geotechnical analysis:

- BBS – Integral Abutment Feasibility Analysis Spreadsheet
- BBS – Soil Site Classification
- BBS -- Liquefaction Analysis
- AASHTO Guide Specification for LRFD Seismic Bridge Design
- AASHTO LRFD Bridge Design Specification
- BBS Pile Capacity and Length Estimates Spreadsheet
- AllPile Lateral Load Analysis Software
- BBS Seal Coat Analysis Spreadsheet
- BBS Temporary Sheet Pile Design Analysis Spreadsheet

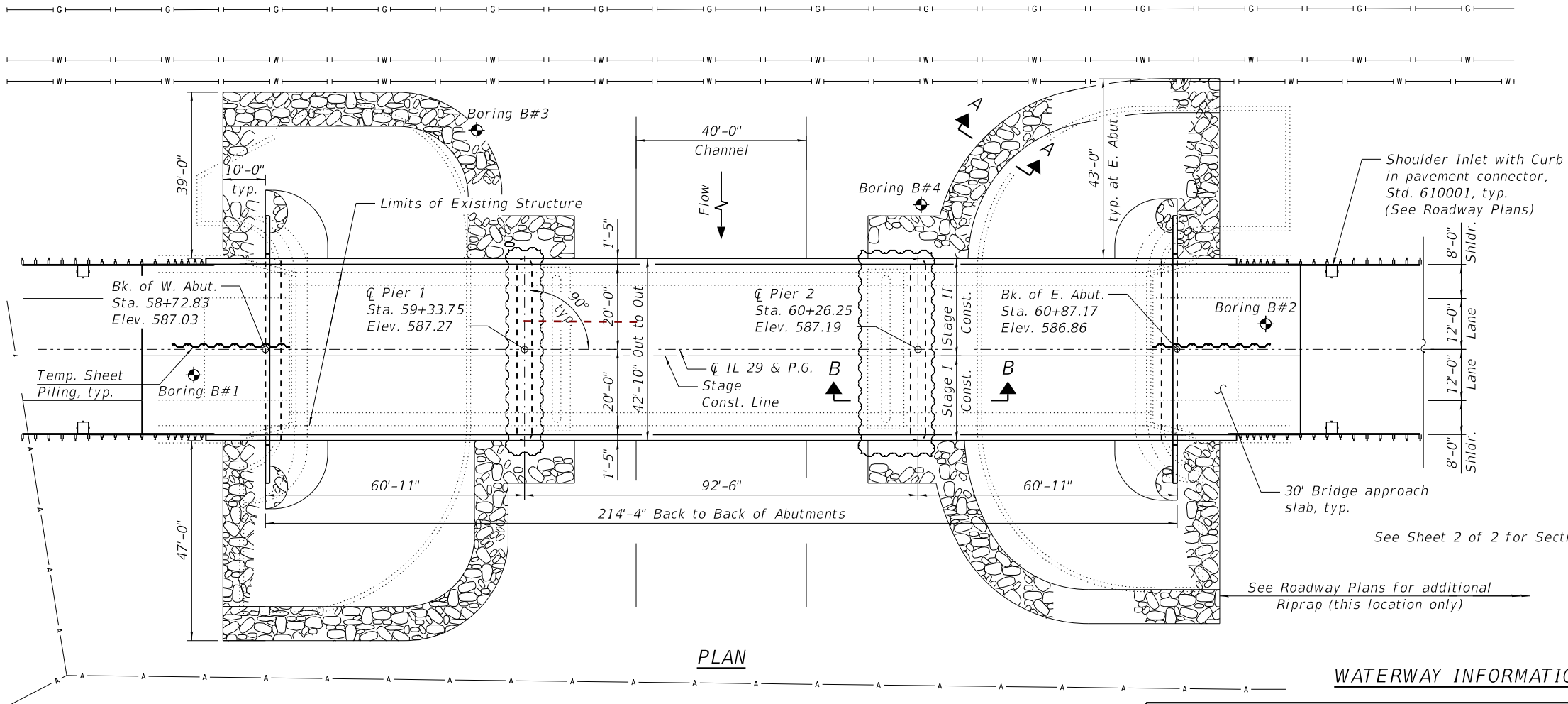
Bench Mark: BM #611 – Chiseled 'X' on the NW wingwall of SN 011-0011. Sta. 58+71.60; 19.39' Lt; Elevation 588.26

Existing Structure: SN 011-0011 was originally constructed in 1965 as F.A. 25, Section 4B-1 at Sta.59+80. The bridge is a three span continuous steel WF beam bridge supported by stub abutments on concrete piles and concrete solid wall piers with spread footing on creosoted timber piles. The back-to-back abutment length is 203'-0" and the out-to-out deck width is 36'-0". Structure is to be removed and replaced. Staged construction will be utilized to maintain traffic.

Salvage: None



ELEVATION



See Sheet 2 of 2 for Section A-A and B-B

PLAN

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				
	W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	579.31	559.6	555.5	579.14	5
Q200	579.31	559.2	554.7	579.14	
Design	579.31	557.0	555.5	579.14	
Check	579.31	557.0	554.7	579.14	

LOADING HL-93

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

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

SEISMIC DATA

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.171g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.338g
Soil Site Class = D

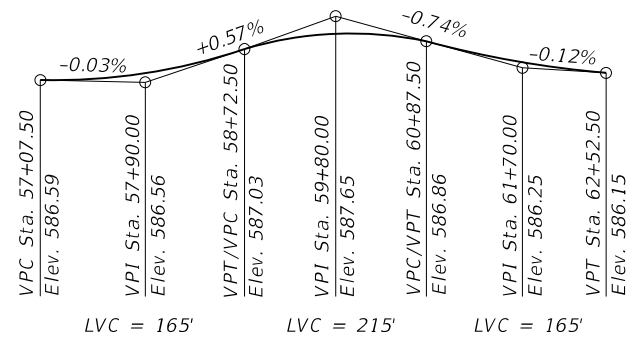
DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Concrete Superstructure)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50W)

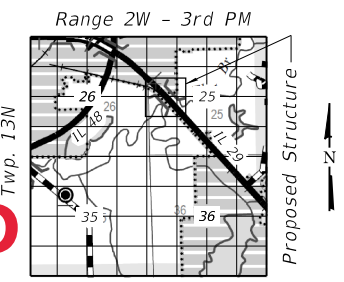
HIGHWAY CLASSIFICATION

F.A.P. Rte. 75 – IL 29
Functional Class: Other Principal Arterial
ADT: 7,050 (2019); 7,820 (2039)
ADTT: 550 (2019); 610 (2039)
DHV: 782 (2039)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50



PROFILE GRADE

Along ℄ IL 29



LOCATION SKETCH

APPROVED
JUNE 25, 2021
AS A BASIS FOR PREPARATION OF DETAILED PLANS

WATERWAY INFORMATION

Drainage Area = 277.9 sq. miles. Low Grade Elev. 585.86 @ Sta. - 63+20

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	6,800	1744	1802	574.6	0.6	0.5	575.2	575.1
Design	50	10,300	1889	2010	575.7	0.9	0.9	576.4	576.4
Base	100	11,700	1953	2092	575.9	1.2	1.1	577.1	577.0
Scour Design Check	200	12,575	2055	2139	576.1	1.3	1.3	577.4	577.4
Overtopping	>500								
Max. Calc.	500	15,200	2180	2276	576.6	1.6	1.6	578.2	578.2

GENERAL PLAN & ELEVATION
IL 29 OVER FLAT BRANCH
F.A.P. RTE. 75 SEC. (4)BR,D
CHRISTIAN COUNTY
STA. 59+80.00
STRUCTURE NO. 011-0515

MODEL: Default
FILE NAME: P:\2010\10066ZIL 29 Bridges\4 CADD - DWG\4.4 Struc\011015-72A26-TSL.dgn
6/23/2021 4:08:16 PM

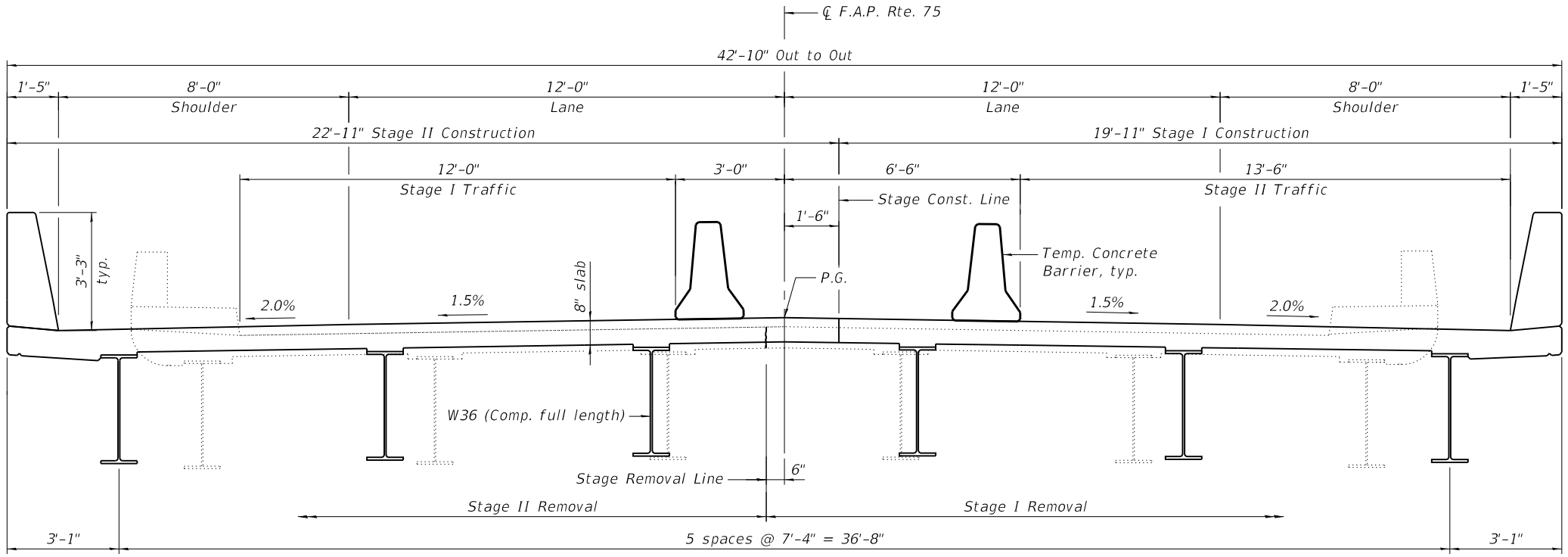
TWM ENGINEERING GEOSPATIAL SERVICES
TWM, INC. WWW.TWM-INC.COM
IL DESIGN FIRM LICENSE NO: 184-001220

USER NAME =		DESIGNED -	NP	REVISED -	
		CHECKED -	BWP	REVISED -	
PLOT SCALE =		DRAWN -	NP	REVISED -	
PLOT DATE =		CHECKED -	BWP	REVISED -	

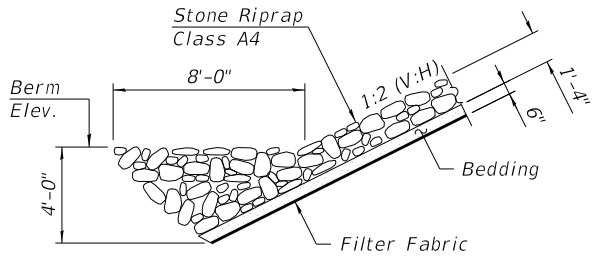
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

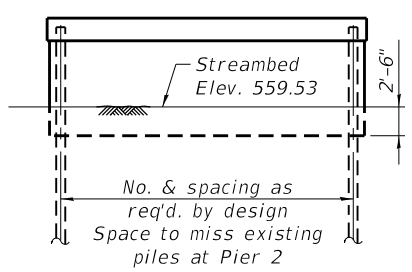
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
75	(4)BR,D	CHRISTIAN		
		CONTRACT NO. 72A26		
	ILLINOIS	FED. AID PROJECT		



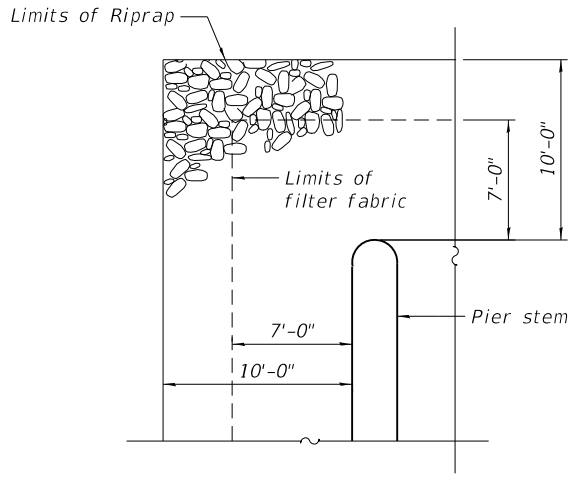
CROSS-SECTION
(Looking East)



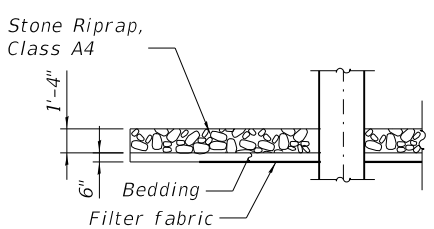
SECTION A-A



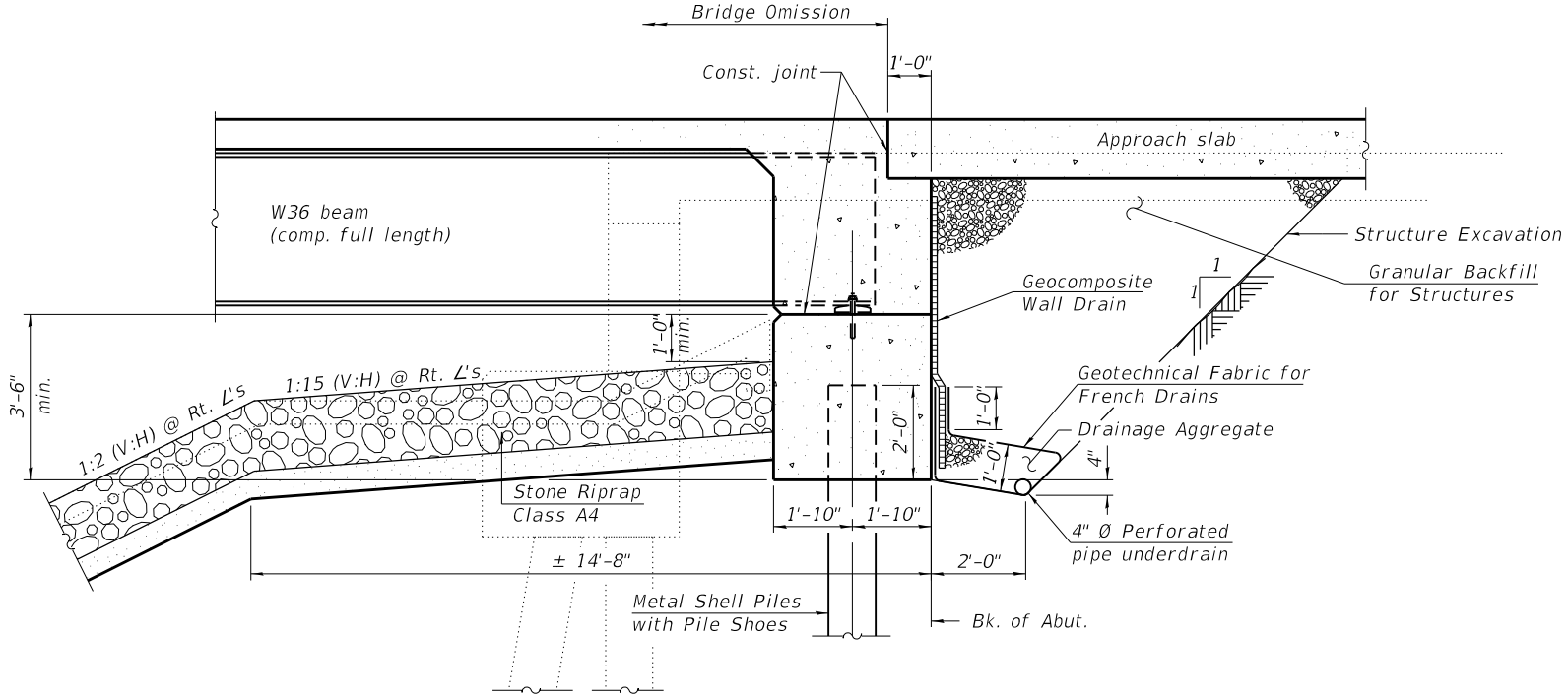
PIER SKETCH



RIPRAP PROTECTION AT PIERS
(Pier 2 shown, Pier 1 similar by rotation)



SECTION B-B
(Pier 2 shown, Pier 1 similar by rotation)



SECTION THRU INTEGRAL ABUTMENT

APPROVED

JUNE 25, 2021

AS A BASIS FOR
PREPARATION OF DETAILED PLANS

DETAILS
IL 29 OVER FLAT BRANCH
F.A.P. RTE. 75 SEC. (4)BR,D
CHRISTIAN COUNTY
STA. 59+80.00
STRUCTURE NO. 011-0515

MODEL: Default
FILE NAME: P:\2010\100662\IL 29 Bridges\4 CADD - DWG\4.4 Struc\011051S-72A26-TSL.dgn
6/23/2021 4:01:42 PM

TWM ENGINEERING GEOSPATIAL SERVICES
TWM, INC. WWW.TWM-INC.COM
IL DESIGN FIRM LICENSE NO: 184-001220

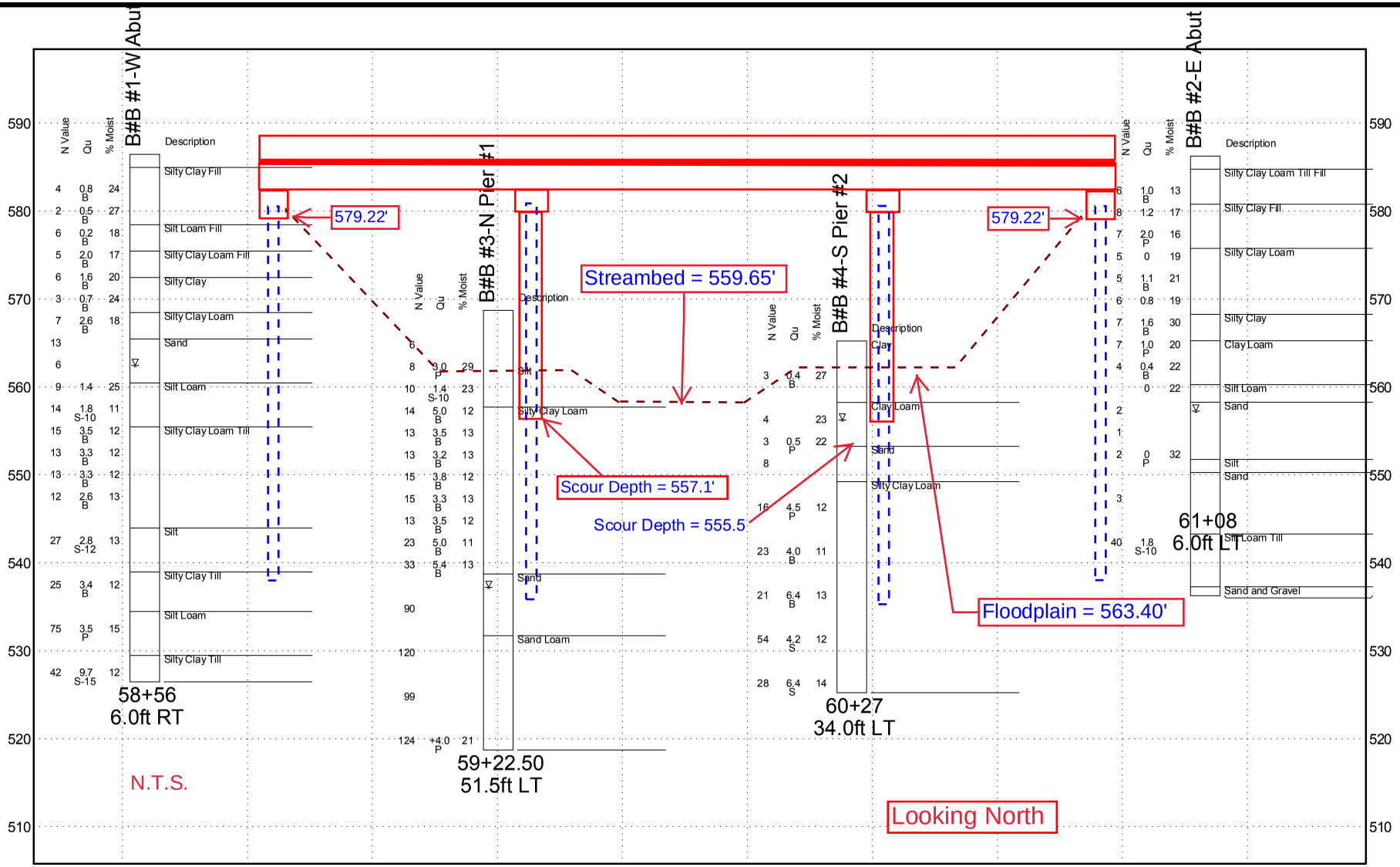
USER NAME =		DESIGNED - NP	REVISED -		
		CHECKED - BWP	REVISED -		
PLOT SCALE =		DRAWN - NP	REVISED -		
PLOT DATE =		CHECKED - BWP	REVISED -		

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
75	(4)BR,D	CHRISTIAN		
		CONTRACT NO. 72A26		
	ILLINOIS FED. AID PROJECT			

Structure Number EX SN 011-0011 PR SN 011-0515 Bridge Replacement over Flatt Brance Creek
Located in the SW 1/4 of Section 25, Township 13 N, Range 2 W of the 3 P.M.



NOT TO HORIZONTAL SCALE

VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Groundwater
▽ First Encounter
▼ Completion
▼ after (refer to log) hours

Abbreviations
WOH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Seating

Illinois Department of Transportation
Division of Highways
IDOT

SUBSURFACE DATA PROFILE

Route: IL 29
Section: FAP Rte 75. Sec. (4)BR,D
County: Christian

SUBSURFACE DATA PROFILE 011-0515 FLAT BRANCH CREEK.GPJ D6TEMPLT.GDT 10/30/20

SUBSURFACE DATA PROFILE 011-0515 FLAT BRANCH CREEK.GPJ D6TEMPLT.GDT 10/30/20

Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 8/25/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80
BORING NO. B #1-W Abut
Station 58+56
Offset 6.0ft RT
Ground Surface Elev. 586.47 ft

Surface Water Elev. 562.34 ft
Stream Bed Elev. 560.34 ft
Groundwater Elev.:
First Encounter 562.5 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Material
				HMA and Concrete Pavement
				584.97
				Gray Moist SILTY CLAY (Fill)
	1			
	1	0.8	24	
-5	3	B		
	0			
	1	0.5	27	
	1	B		
				578.47
				Tan Dry SILT LOAM (Fill)
	1			
	3	0.2	18	
-10	3	B		
				575.47
	0			Tan and Gray Moist SILTY CLAY LOAM (Fill)
	2	2.0	17	
	3	B		
				572.47
	0			Gray Moist SILTY CLAY
	3	1.6	20	
-15	3	B		
	0			
	1	0.7	24	w/ oxidation staining
	2	B		
				568.47
	0			Lt Gray Moist SILTY CLAY LOAM
	2	2.6	18	
-20	5	B		

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Material
				Lt Gray Moist SILTY CLAY LOAM *(continued)*
				565.47
	0			Gray and Tan V. Moist Fine Grained SAND w/ iron oxide staining
	6			
	7			
	1			
	3			Brown Wet Large Grained SAND w/ Pea Gravel FREE WATER
-25	3			
				560.47
	1			Gray Moist SILT LOAM
	3	1.4	25	
	6			
	0			
	8	1.8	11	Silt Loam Till
-30	6	S-10		
				555.47
	1			Dk Gray Moist SILTY CLAY LOAM (Till)
	7	3.5	12	
	8	B		
	1			
	5	3.3	12	
-35	8	B		
	1			
	5	3.3	12	
	8	B		
	0			
	4	2.6	13	
-40	8	B		

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:\SOILS\GINT FILES\011 CHRISTIAN\BRIDGE BORINGS\011-0515 FLAT BRANCH CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 10/30/20
Latitude 39.32.4167 N Longitude 89.15.5845 W Datum NAD83 Job Number D-96-511-06

Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 8/25/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80
BORING NO. B #1-W Abut
Station 58+56
Offset 6.0ft RT
Ground Surface Elev. 586.47 ft

Surface Water Elev. 562.34 ft
Stream Bed Elev. 560.34 ft
Groundwater Elev.:
First Encounter 562.5 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Dk Gray Moist SILTY CLAY LOAM (Till) *(continued)*				
543.97				
Lt Gray SILT		2		
		12	2.8	13
	-45	15	S-12	
538.97				
Brown and Gray Moist SILTY CLAY (Till) w/ 2" Large Grained Sand Seam @ 50ft		5		
		9	3.4	12
	-50	16	B	
534.47				
Lt Gray SILT LOAM w/ chunks of Shale hard drilling		6		
		28	3.5	15
	-55	47	P	
529.47				
Brown and Gray SILTY CLAY (Till)		4		
		15	9.7	12
526.47	-60	27	S-15	

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)

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Latitude 39.32.4167 N Longitude 89.15.5845 W Datum NAD83 Job Number D-96-511-06

Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 9/22/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80
BORING NO. B #3-N Pier #1
Station 59+22.50
Offset 51.5ft LT
Ground Surface Elev. 568.73 ft

Surface Water Elev. 561.53 ft
Stream Bed Elev. 560.34 ft
Groundwater Elev.:
First Encounter 537.2 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				No Recovery Rock Jammed in Retainer
	1			
-5	3 3			
	0			
	4 4	3.0 P	29	Tan and Gray Moist SILT
	1			
-10	4 6	1.4 S-10	23	Gray Moist Silt V. Moist @10ft
557.73				
	2			Gray to Dk Gray Moist SILTY CLAY LOAM (Till)
	6 8	5.0 B	12	
	1			
-15	5 8	3.5 B	13	Dk Gray
	0			
	5 8	3.2 B	13	
	1			
-20	6 9	3.8 B	12	
				Gray to Dk Gray Moist SILTY CLAY LOAM (Till) *(continued)*
	1			
	6 9	3.3 B	13	
	1			
-25	4 9	3.5 B	12	
	3			
	8 15	5.0 B	11	
	3			
538.73 -30	10 23	5.4 B	13	Lt Gray to Gray w/ Sand Lenses
				Fine to Medium Grained SAND FREE WATER
	WOH			▽
	WOH 6			
	0			
-35	30 60			
531.73				
				Lt Gray Fine Grained V. Moist SAND LOAM Washed
	6			
-40	47 73			

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
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Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 9/22/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80

BORING NO. B #3-N Pier #1
Station 59+22.50
Offset 51.5ft LT
Ground Surface Elev. 568.73 ft

Surface Water Elev. 561.53 ft
Stream Bed Elev. 560.34 ft

Groundwater Elev.:
▽ **First Encounter** 537.2 ft
▽ **Upon Completion** plugged ft
▼ **After** ____ **Hrs.** plugged ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	
				Lt Gray Fine Grained V. Moist SAND LOAM Washed *(continued)*
	3			
	35			
-45	64			
	0			
	35	+4.0	21	
518.73 -50	89	P		
				Boring Complete
-55				
-60				

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)

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Latitude 39.32.4167 N Longitude 89.15.5845 W Datum NAD83 Job Number D-96-511-06

Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 9/24/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones

SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80

BORING NO. B #4-S Pier #2
Station 60+27
Offset 34.0ft LT
Ground Surface Elev. 565.25 ft

Surface Water Elev. 561.53 ft
Stream Bed Elev. 560.34 ft

Groundwater Elev.:
First Encounter 556.3 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Dk Gray Moist CLAY
	0			
	1	0.4	27	
-5	2	B		
				558.25
				Dk Gray V. Moist CLAY LOAM w/ Sand Seams FREE WATER
	2			▽
	2		23	
-10	2			
	WOH			
	1	0.5	22	Dk Gray V. Moist Clay Loam to Medium Grained Sand @12ft
	2	P		553.25
				Lt Gray Fine Grained SAND Washed
	3			
	3			
-15	5			
				549.25
				Gray Moist SILTY CLAY LOAM(Till)
	1			
	6	4.5	12	
-20	10	P		
				Gray Moist SILTY CLAY LOAM(Till) *(continued)*
	2			
	10	4.0	11	Gray and Brown
-25	13	B		
	2			
	8	6.4	13	
-30	13	B		
	3			
	20	4.2	12	
-35	34	S		
	2			
	11	6.4	14	
-40	17	S		525.25

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
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Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 8/26/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80
BORING NO. B #2-E Abut
Station 61+08
Offset 6.0ft LT
Ground Surface Elev. 586.28 ft

Surface Water Elev. 562.34 ft
Stream Bed Elev. 560.34 ft
Groundwater Elev.:
First Encounter 557.3 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Material Description
				HMA and Concrete Pavement
				584.78
				Brown Moist SILTY CLAY LOAM (Till) (Fill)
	1			
	3	1.0	13	
-5	3	B		
				580.78
				Gray Moist SILTY CLAY (Fill)
	2			
	5	1.2	17	
	3			
	1			
	3	2.0	16	Gray to Brown and Gray Silty Clay Till
-10	4	P		
				575.78
				Brown Moist SILTY CLAY LOAM (Till) w/ iron oxide staining
	1			
	2	0	19	
	3			
	1			
	2	1.1	21	Gray and Brown
-15	3	B		
	1			
	2	0.8	19	
	4			
				568.28
				Dk Gray Moist SILTY CLAY w/ woody organics
	1			
	3	1.6	30	
-20	4	B		

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Material Description
				Dk Gray Moist SILTY CLAY w/ woody organics *(continued)*
				565.28
	1			Gray Moist CLAY LOAM
	3	1.0	20	
	4	P		
	1			
	1	0.4	22	
-25	3	B		
				560.28
	WOH			Gray V. Moist SILT LOAM w/ iron oxide staining
	WOH	0	22	
	1			
				558.28
	WOH			Tan to Gray Medium Grained SAND FREE WATER ▽
	1			
-30	1			
	0			
	0			Gray Medium Grained Sand w/ 3" Sandy Loam Seam @ 32.5ft
	1			
	0			
	1	0	32	
-35	1	P		Gray Wet SILT
				550.28
	WOH			Gray Wet SAND
	WOH			
	1			
	WOH			
	0			medium grained
-40	3			Rope broke, pulled off hole

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
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Illinois Department of Transportation
Division of Highways
District 6

SOIL BORING LOG

Date 8/26/20

ROUTE IL 29 **DESCRIPTION** Bridge Replacement over Flatt Brance Creek **LOGGED BY** S. Jones
SECTION FAP Rte 75. Sec. (4)BR,D **LOCATION** SW 1/4, **SEC.** 25, **TWP.** 13 N, **RNG.** 2 W, 3 **PM**

COUNTY Christian **DRILLING METHOD** HSA **HAMMER TYPE** 140# Auto

STRUCT. NO. EX SN 011-0011 PR SN 011-0515
Station 59+80

BORING NO. B #2-E Abut
Station 61+08
Offset 6.0ft LT
Ground Surface Elev. 586.28 ft

Surface Water Elev. 562.34 ft
Stream Bed Elev. 560.34 ft

Groundwater Elev.:
First Encounter 557.3 ft
Upon Completion plugged ft
After ____ **Hrs.** plugged ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Gray Wet SAND *(continued)*				
543.28				
Lt Gray SILT LOAM (Till)		4		
		18	1.8	
	-45	22	S-10	
537.28		13		
Med Grained SAND and Gravel w/ Chert lenses		20/4"		
536.28	-50			
Drill Rig Broke Down				
Boring Complete				
	-55			
	-60			

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
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Latitude 39.32.4167 N Longitude 89.15.5845 W Datum NAD83 Job Number D-96-511-06

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== B #1-W Abut
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 581.22 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 579.20 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 ========== 960 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 179.31 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 67.24 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.25" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 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
459 KIPS	**295** KIPS	**162** KIPS	**42** 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 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.)
575.50	3.70	0.20	6		3.5		***26.9***				27	0	0	15	6
572.50	3.00	2.00	5		20.0	23.5	***42.3***				42	0	0	23	9
570.00	2.50	1.60	6		14.4	18.8	***46.1***				46	0	0	25	11
568.50	1.50	0.70	3		4.5	8.2	***73.0***				73	0	0	40	13
565.50	3.00	2.60	7		23.8	30.5	***153.8***				154	0	0	85	16
563.00	2.50		13	Fine Sand	10.3	87.5	***117.0***				117	0	0	64	18
560.50	2.50		6	Fine Sand	4.8	40.4	***97.8***				98	0	0	54	21
557.50	3.00	1.40	9		15.8	16.4	***118.2***				118	0	0	65	24
555.50	2.00	1.80	14		12.5	21.1	***150.7***				151	0	0	83	26
553.00	2.50	3.50	15		24.6	41.0	***172.9***				173	0	0	95	28
550.50	2.50	3.30	13		23.5	38.7	***196.4***				196	0	0	108	31
548.00	2.50	3.30	13		23.5	38.7	***211.7***				212	0	0	116	33
544.00	4.00	2.60	12		31.8	30.5	***245.8***				246	0	0	135	37
539.00	5.00	2.80	27		41.8	32.8	***294.6***				295	0	0	162	42
534.50	4.50	3.40	25		43.3	39.9	***676.6***				~~677~~	~~0~~	~~0~~	~~372~~	~~47~~
529.50	5.00		75	Hard Till	117.0	378.5	***627.0***				~~627~~	~~0~~	~~0~~	~~345~~	~~52~~
526.50	3.00		42	Hard Till	27.3	212.0	***942.0***				~~942~~	~~0~~	~~0~~	~~518~~	~~55~~
521.50	5.00		99	Hard Till	195.8	499.7	***1137.8***				~~1138~~	~~0~~	~~0~~	~~626~~	~~60~~
516.50	5.00		99	Hard Till		499.7									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier #1
REFERENCE BORING ========== 3-N-Pier #1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 581.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 557.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 557.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2060 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 384.78 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 144.29 KIPS

PILE TYPE AND SIZE ========== Metal Shell 12"Φ w/.25" walls
Pile Perimeter========== 3.142 FT.
Pile End Bearing Area========== 0.785 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
392 KIPS	**189** KIPS	**104** KIPS	**45** 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 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.)
555.60	1.40	5.00	14		14.3		***44.5***				44	0	0	24	26
553.10	2.50	3.50	13		21.1	30.2	***62.9***				63	0	0	35	29
550.60	2.50	3.20	13		19.7	27.6	***87.8***				88	0	0	48	31
548.10	2.50	3.80	15		22.4	32.7	***105.9***				106	0	0	58	34
545.60	2.50	3.30	15		20.2	28.4	***127.8***				128	0	0	70	36
543.10	2.50	3.50	13		21.1	30.2	***161.8***				162	0	0	89	39
540.60	2.50	5.00	23		25.6	43.1	***266.6***				267	0	0	147	41
539.60	1.00		33	Hard Till	5.7	122.4	***272.4***				272	0	0	150	42
538.60	1.00		33	Hard Till	5.7	122.4	***185.4***				185	0	0	102	43
537.60	1.00		6	Medium Sand	1.7	29.7	***187.1***				187	0	0	103	44
536.60	1.00		6	Medium Sand	1.7	29.7	***188.9***				189	0	0	104	45
535.60	1.00		6	Medium Sand	1.7	29.7	***605.9***				~~606~~	~~0~~	~~0~~	~~333~~	~~46~~
534.60	1.00		90	Medium Sand	56.7	445.0	***662.6***				~~663~~	~~0~~	~~0~~	~~364~~	~~47~~
533.60	1.00		90	Medium Sand	56.7	445.0	***719.3***				~~719~~	~~0~~	~~0~~	~~396~~	~~48~~
532.60	1.00		90	Medium Sand	56.7	445.0	***776.0***				~~776~~	~~0~~	~~0~~	~~427~~	~~49~~
531.60	1.00		90	Medium Sand	56.7	445.0	***758.6***				~~759~~	~~0~~	~~0~~	~~417~~	~~50~~
526.60	5.00		100	Hard Till	171.1	370.8	***926.0***				~~926~~	~~0~~	~~0~~	~~509~~	~~55~~
521.60	5.00		99	Hard Till	167.9	367.1	***1097.5***				~~1098~~	~~0~~	~~0~~	~~604~~	~~60~~
516.60	5.00		100	Hard Till		370.8									

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IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 581.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 557.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 555.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2060 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 43.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 383.26 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 143.72 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.25" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 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
459 KIPS	**245** KIPS	**134** KIPS	**46** 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 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.)
555.50	1.50	0.25	4		1.8		***4.7***				5	1	0	2	26
553.00	2.50	0.25	4		2.9	2.9	***40.4***				40	1	0	21	29
549.25	3.75		8	Fine Sand	9.5	35.8	***67.0***				67	1	0	36	33
543.25	6.00	4.50	16		71.6	52.8	***132.6***				133	1	0	72	39
538.25	5.00	4.00	23		54.4	46.9	***215.2***				215	1	0	117	44
535.75	2.50	6.40	21		29.8	75.0	***245.0***				245	1	0	134	46
533.25	2.50	6.40	21		29.8	75.0	***472.3***				~~472~~	~~1~~	~~0~~	~~259~~	~~49~~
530.75	2.50		54	Hard Till	33.3	272.5	***505.6***				~~506~~	~~1~~	~~0~~	~~277~~	~~51~~
528.25	2.50		54	Hard Till	33.3	272.5	***341.4***				341	1	0	187	54
525.25	3.00	6.40	28		35.8	75.0	***377.2***				377	1	0	206	57
522.75	2.50	6.40	28		29.8	75.0	***831.6***				~~832~~	~~1~~	~~0~~	~~456~~	~~59~~
520.25	2.50		99	Hard Till	97.9	499.7	***929.5***				~~929~~	~~1~~	~~0~~	~~510~~	~~62~~
517.75	2.50		99	Hard Till	97.9	499.7	***1027.4***				~~1027~~	~~1~~	~~0~~	~~564~~	~~64~~
515.25	2.50		99	Hard Till	97.9	499.7	***1125.3***				~~1125~~	~~1~~	~~0~~	~~618~~	~~67~~
512.75	2.50		99	Hard Till		499.7									

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IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== 2-E-Abut
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 581.20 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 579.20 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 ========== 960 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 43.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 178.60 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 66.98 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.25" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 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
459 KIPS	**318** KIPS	**175** KIPS	**42** 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 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.)
577.80	1.40	1.20	8		6.6		***30.0***				30	0	0	17	3
575.80	2.00	2.00	7		13.4	23.5	***21.1***				21	0	0	12	5
572.80	3.00	0.10	5		1.4	1.2	***34.3***				34	0	0	19	8
570.30	2.50	1.10	5		11.0	12.9	***41.7***				42	0	0	23	11
568.30	2.00	0.80	6		6.8	9.4	***57.9***				58	0	0	32	13
565.30	3.00	1.60	7		17.3	18.8	***68.2***				68	0	0	37	16
562.80	2.50	1.00	7		10.2	11.7	***71.3***				71	0	0	39	18
560.30	2.50	0.40	4		4.6	4.7	***72.4***				72	0	0	40	21
558.30	2.00	0.10	1		1.0	1.2	***85.6***				86	0	0	47	23
555.80	2.50		2	Medium Sand	1.7	13.5	***80.6***				81	0	0	44	25
553.30	2.50		1	Medium Sand	0.8	6.7	***75.9***				76	0	0	42	28
550.30	3.00	0.10	2		1.4	1.2	***82.8***				83	0	0	46	31
548.30	2.00		1	Medium Sand	0.7	6.7	***97.0***				97	0	0	53	33
543.30	5.00		3	Medium Sand	5.1	20.2	***283.7***				284	0	0	156	38
541.30	2.00		40	Hard Till	17.0	201.9	***300.8***				301	0	0	165	40
539.30	2.00		40	Hard Till	17.0	201.9	***317.8***				318	0	0	175	42
537.30	2.00		40	Hard Till	17.0	201.9	***799.1***				~~799~~	~~0~~	~~0~~	~~440~~	~~44~~
536.30	1.00		99	Medium Sand	75.4	666.2	***359.7***				360	0	0	198	45
535.30	1.00		30	Hard Till	6.0	151.4	***365.7***				366	0	0	201	46
534.30	1.00		30	Hard Till	6.0	151.4	***371.8***				372	0	0	204	47
533.30	1.00		30	Hard Till	6.0	151.4	***377.8***				378	0	0	208	48
532.30	1.00		30	Hard Till	6.0	151.4	***383.8***				384	0	0	211	49
531.30	1.00		30	Hard Till	6.0	151.4	***389.8***				390	0	0	214	50
530.30	1.00		30	Hard Till	6.0	151.4	***395.8***				396	0	0	218	51
528.30	2.00		30	Hard Till	12.0	151.4	***407.9***				408	0	0	224	53
523.30	5.00		30	Hard Till	30.1	151.4	***786.2***				~~786~~	~~0~~	~~0~~	~~432~~	~~58~~
518.30	5.00		99	Hard Till	195.8	499.7	***982.1***				~~982~~	~~0~~	~~0~~	~~540~~	~~63~~
513.30	5.00		99	Hard Till		499.7									