STRUCTURE GEOTECHNICAL REPORT

IL 127 over Hartline Creek

Existing S.N. 002-0027
Proposed S.N. 002-0039

F.A.S. Route 1907
SECTION 17B-4
ALEXANDER COUNTY, ILLINOIS
JOB NO. P-99-006-22
PTB 203-048
KEG NO. 22-1060.05

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EXHIBITS

1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Introduction

The geotechnical study summarized in this report was performed by Kaskaskia Engineering Group, LLC (KEG) for a proposed bridge replacement carrying IL 127 over Hartline Creek. The project is located in Alexander County, Illinois. The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of the removal and replacement of a three-span bridge (Ex. SN 002-0027) carrying IL 127 over Hartline Creek. The existing structure was built in 1973. It has a total length of 118'-6" from back-to-back of abutments and an out-to-out width of 33'-1 5/8". The general location of the proposed structure is shown on a Location Map, Exhibit A. The project is located in Elco, IL and lies within the limits of the Third Principal Meridian (T14S, R1W) within the Coastal Plain Province.

1.3 Proposed Structure Information

The proposed structure (SN 002-0039) will consist of a three-span bridge, which will be built on a 40°-degree skew over Hartline Creek. It will provide two 13' wide driving lanes and have a total bridge width of 34'10" out-to-out. The bridge will measure 128'-6" back-to-back abutments. A Type, Size, and Location Plan (TS&L) is included in Exhibit B.

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

2.0 FIELD EXPLORATION

2.1 Subsurface Exploration and Testing

Information regarding the site exploration was provided by IDOT District 9 and Veenstra & Kimm, Inc. According to the information provided, two borings, designated 1-S, and 2-S, were drilled on May 15th and May 16th, 2023. An additional boring designated 3-S was drilled on October 26th, 2023. The drilling was performed using 3.25-inch I.D. hollow-stem augers. Standard penetration tests (SPTs) were mostly conducted at 2.5-ft. intervals to 40 ft. after pavement and 5.0-ft. intervals to termination depths in accordance with ASTM International D1586 Standard, using an automatic hammer. MSPT was collected from shale samples. The field testing consisted of Rimac strength tests on all intact cohesive samples, as well as a pocket penetrometer. The boring locations are shown on the TS&L, Exhibit B. Detailed information regarding the nature and thickness of the soils encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C.

2.2 Subsurface Conditions

The profiles at the three (3) boring locations exhibited layers of silt, clay, silty clay/silty clay loam, silty loam, and gravel. The depths for all the borings varied. Boring 1-S and Borings 2-S were advanced until shale was encountered, and 10 ft. of MSPT samples were collected for Boring 1-S and 20 ft for Boring 2-S. Boring 3-S was advanced until a minimum nominal driven bearing capacity of 500 kips for a 14-in-diameter metal sheet pile was achieved. The bedrock in 1-S and 2-S consisted of clay shale. Table 2.2.1 summarizes the pavement structure(s), depth of drilling, rock topography, and ground surface elevation (GSE) of the borings as measured while drilling. Table 2.2.2 describes the general condition of the subsurface.

Table 2.2.1 - Boring Information Summary

Designation	Asphalt	PCC	Base Aggregate	Depth (ft)	Top of Shale (ft.)	GSE (ft.)
1-S	5”	17”	-	56.5	45	379.4
2-S	3”	12”	9”	80	65	379.4
3-S	-	-	-	69	-	370.9

Table 2.2.2 – Subsurface Profile Summary

Soil Type	N-Values (bpf)	Q_u (tsf)	WC (%)	Boring
Silty Clay	0 to 11	0.1 to 1.25	22 to 32	All Borings
Silty Loam	2 to 11	0.2 to 1.0	22 to 46	All Borings
Silty Clay Loam	0 to 24	0.1 to 4.95	15 to 31	All Borings
Silt	0 to 1	-	28 to 30	2-S
Clay	0 to 52	0.6 to 4.5	20 to 31	2-S, 3-S
Gravelly Clay/Clayey Gravel	13 to 24	0.8 to 1.0	18 to 25	1-S, 2-S
Gravel	4 to 47	-	14 to 80	All Borings

2.3 Groundwater

Groundwater was encountered at the time of drilling in all borings. On Boring 1-S was encountered at El. 359.9 (19.5 ft below GSE), on Boring 2-S El. 364.9 (14.5 ft. below GSE), and on Boring 3-S El. 362.9 (8 ft. below GSE). It should be further noted that the groundwater level is subject to seasonal and climatic variations, including the level of adjacent affluents. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

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

3.2 Slope Stability

Stability analysis using SLOPE/W was performed using the proposed structure geometry on the TS&L. Both the north and south slopes have a 2:1(H:V) slope with a height of roughly seventeen feet. Three conditions were modeled for each scenario: end-of-construction, long-term, and seismic stability. A critical factor of safety (FOS) was calculated for each condition. According to the IDOT Geotechnical Manual, the target FOS is 1.5 for end-of-construction and long-term slope stability.

Undrained soil parameters were used to model the end-of-construction condition. Full cohesion and a friction angle of 0 degrees were assumed for cohesive soils. Drained soil parameters with nominal cohesion and full friction angle values were used to model the long-term condition and analyze the theoretical condition where pore water pressure dissipated. The drained strength parameters for cohesive materials included a nominal cohesion value between 50 and 150 psf, with friction angles between 26 and 38 degrees.

The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is shown in Table 3.2.1. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit F.

The results of the analysis, as provided in Table 3.2.1, indicate an acceptable FOS will exist under undrained conditions (end-of-construction) and drained conditions (long term). The FOSs for the north abutment seismic condition, however, is less than the required 1.1. In an effort to increase the FOS for the seismic condition, the abutment pile was modeled, which raised the FOS to 1.1. The FOS due to this adjustment is represented in parenthesis in the table and is included in the exhibit.

Table 3.2.1 – Slope Stability Critical FOS

Location (1V:2H Slope)	Critical FOS		
	End-of Construction	Long Term	Seismic
North Abutment (Boring 1-S)	1.8	1.5	0.7(1.1)
South Abutment (Boring 2-S)	3.1	1.5	1.4

3.3 Seismic Considerations

Seismic Site Class was estimated based on the method described by the IDOT Seismic Manual, updated in 2024 as described in IDOT AGMU Memo 24.1 – IDOT Seismic Manual Update – Planning Requirements. The updated IDOT Seismic Manual uses the 2023 AASHTO Seismic Hazard which requires the use of shear wave velocity to determine site class. See Table 3.3.1 for the shear wave velocities calculated for each individual layer in each boring, as well as the accompanying site classes found in Table 3.2.3-1 of the IDOT Seismic Manual. The shear wave velocities were calculated using the SPT correlations found in Table 3.2.1-1 of the IDOT Seismic Manual. Table 3.3.2 shows the weighted average of the shear wave velocities for each boring calculated for the top 100 feet encountered. As the boring spacing for the site does not exceed 200 ft, the shear wave velocities for each boring were averaged to determine a global site class for the structure.

Table 3.3.1 – Shear Wave Velocities and Site Class by Soil Layer

Boring	Soil Type	Elev at Bot. (ft.)	Epoch (Holocene or Pleistocene)	σ'_v (psf)	N Value (Average)	N60 Values	Shear Wave Velocity, v_s (ft/s)	Soil Site Class
1-S	Silty Clay	372.4	H	420	8	9	285	E
	Silty Loam	359.9	H	1590	6	9	2571	BC
	Silty Clay Loam	352.4	H	2556	3	4	442	E
	Gravelly Clay	347.4	H	2928.5	13	19	602	DE
	Silty Clay Loam	344.9	H	3157	24	35	684	DE
	Gravelly Clay	339.4	H	3401.2	8	12	584	DE
	Gravel	334.4	H	3729.8	80	115	1089	CD
	Shale (soft)	279.40	P	5042.8	80	115	2500	BC
2-S	Silty Clay Loam	374.9	H	270	19	27	298	E
	Silty Loam	367.4	H	990	6	9	1601	C
	Silt	364.9	H	1577.5	1	1	300	E
	Clayey Gravel	357.4	H	1949.8	15	22	708	D
	Silty Loam	354.9	H	2256.5	5	7	3444	B
	Silt	352.4	H	2388	1	1	342	E
	Clay	349.9	H	2519.5	4	6	472	E
	Silty Clay Loam	344.9	H	2735.5	5	7	497	E
	Silty Loam	334.4	H	3181.9	6	9	5145	A
	Silty Clay	324.4	H	3772.3	2	3	477	E
	Gravel	314.4	H	4373.3	31	45	938	D
	Shale (soft)	279.4	P	5956.8	31	45	2500	BC
3-S	Silty Loam	366.9	H	240	3	4	322	E
	Silty Clay Loam	362.9	H	720	1	1	233	E
	Gravel	360.4	H	1038.3	4	6	494	E
	Silty Clay	323.4	H	2182.1	3	4	421	E
	Gravel	303.9	H	3858.1	32	46	921	D
	Clay	301.9	H	4526	52	75	874	D
	Extrapolated layer	270.9	P	5502.3	29	42	525	DE

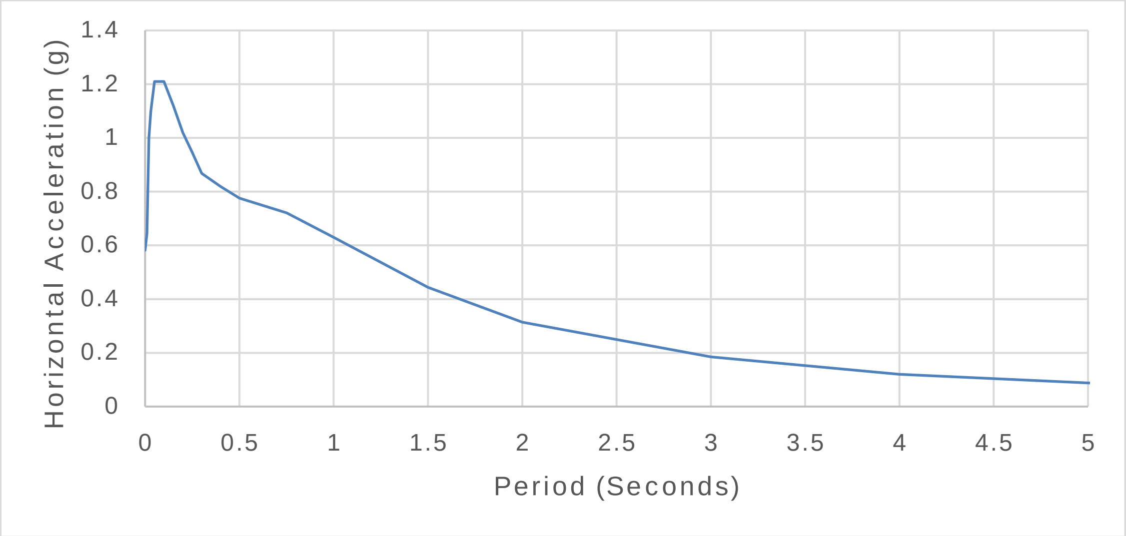
Table 3.3.2 – Weighted Average Shear Wave Velocity and Site Class by Boring

Boring	Weighted Average Shear Wave Velocity, v_s (ft/s)	Boring Soil Site Class
1-S	1060	CD
2-S	911	D
3-S	487	E
Global	**819**	**D**

The Seismic Design Category (SDC) in the AASHTO Guide Specifications for LRFD Seismic Bridge Design is based on the seismic acceleration for a structure with a period of one second, which has been modified for site class. For locations with an overall global site shear wave velocity less than 1,450 ft/s, S_{D1} is taken as the larger of the spectral acceleration coefficient, S_a at 1 second, or 90% of the maximum value of the product TS_a for periods from 1.0 seconds to 5.0 seconds. Figure 3.3.1 shows the required seismic data to be shown on the TSL plans.

Figure 3.3.1 - Summary of Seismic Data

2023 AASHTO Seismic Hazard
Site Class D
Latitude 37.3033, Longitude -89.2625



Vertical Acceleration = 2/3 * Horizontal Acceleration
S_{D1}= 0.630g
SDC = D

As indicated in the figure above, the Seismic Design Category (SDC) is D, based on the Soil Site Class D and Figure 3.5-6 in the IDOT Seismic Manual.

3.4 Scour

Veenstra and Kimm, Inc. developed the design scour elevations for the proposed structure, which are included below in Table 3.4.1.

Table 3.4.1 – Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)				
	North Abutment	Pier 1	Pier 2	South Abutment	Item 113
Q_{100}	372.05	361.1	361.1	371.85	8
Q_{200}	372.05	361.1	361.1	371.85	
Design	372.05	361.1	361.1	371.85	
Check	372.05	361.1	361.1	371.85	

3.5 Liquefaction

A liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis. The PGA and Mw to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website: https://earthquake.usgs.gov/hazards/interactive/ for both NMSZ (far source-site) and CEUS (near source-site) models. The deaggregation data indicated three source-sites presumed to be from the New Madrid Fault, contributing at least 5% to the hazard for this site; hence, a PGA maximum from the NMSZ Model was necessary. As all three sites were located 30 km away from the proposed bridge location, only the highest magnitude of the three, 7.5, was analyzed. The Maximum Horizontal Ground Surface Acceleration value was found using the PGA from the NMSZ source, which was calculated in the IDOT Liquefaction Analysis Spreadsheet.

All borings (1-S through 3-S) were analyzed for liquefaction. The results from the analysis showed potential for liquefaction in only one boring, 2-S, as summarized in Table 3.5.1 below. The layer that was classified as liquefiable was a Gravel with Sandy Loam located below the groundwater table noted during drilling. Therefore, reduction for liquefaction was considered for the pile design capacity and other foundation considerations. A summary of the liquefaction analysis is included in Exhibit G, Liquefaction Analysis.

Table 3.5.1 – Potential Liquefaction Zones

Boring	Substructure	Depth (ft)	Elevation	Soil Type	Factor of Safety CRR/CSR	Source
2-S	South Abutment	17-19.5	362.4-359.9	Gravel with Sandy Loam	0.927 (D)	NMSZ

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 Driven Piles

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

The factored reactions and the preliminary design vertical loads, as provided by Veenstra and Kimm, Inc., are provided in Table 4.1.1.

Table 4.1.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (Kips)
Abutments	860
Piers	1240

The estimated pile lengths for applicable Metal Shell piles are shown in Tables 4.1.2 through 4.1.5 and H-pile types are shown in Tables 4.1.6 through 4.1.9 below. Nominal required bearing resistance for all H-piles is governed by the maximum nominal required bearing resistance. The values presented are for the sections indicated, assuming 50 ksi steel and an empirical dynamic driving coefficient of 0.54. This dynamic driving coefficient was developed by IDOT to provide reasonable confidence that the dynamic stresses in the pile during driving will not cause damage to the pile. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 4.1.2 - Estimated Pile Lengths for Metal Shell 12" ϕ w/.25" walls

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	392	216	-	36	374.05
Piers 1 & 2 (3-S)	392	216	-	69	376.00
South Abutment (2-S)	392	216	349	58	373.85

Table 4.1.3 - Estimated Pile Lengths for Metal Shell 14" ϕ w/.25" walls

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	459	252	-	36	374.05

Piers 1 & 2 (3-S)	459	252	-	68	376.00
South Abutment (2-S)	459	252	409	57	373.85

Table 4.1.4 - Estimated Pile Lengths for Metal Shell 14” ϕ w/.312” walls

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	570	313	-	36	374.05
Piers 1 & 2 (3-S)	570	313	-	73	376.00
South Abutment (2-S)	570	313	520	60	373.85

Table 4.1.5 - Estimated Pile Lengths for Metal Shell 16” ϕ w/.312” walls

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	654	360	-	36	374.05
Piers 1 & 2 (3-S)	654	360	-	71	376.00
South Abutment (2-S)	654	360	597	59	373.85

Table 4.1.6 - Estimated Pile Lengths for HP 10x42 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	335	184	-	45	374.05

South Abutment (2-S)	335	184	306	66	373.85

Table 4.1.7 - Estimated Pile Lengths for HP 12x53 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	418	230	-	45	374.05
South Abutment (2-S)	418	230	323	67	373.85

Table 4.1.8 - Estimated Pile Lengths for HP 12x63 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	497	273	-	47	374.05
South Abutment (2-S)	497	273	462	68	373.85

Table 4.1.9 - Estimated Pile Lengths for HP 14x73 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Rs Seismic Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (1-S)	578	318	-	46	374.05
South Abutment (2-S)	578	318	537	68	373.85

As shown in the Tables above and in Pile Length/Pile Type, Exhibit G, liquefaction has been included in the pile estimates for the South Abutment, and Scour has been included in the piles estimates for the North Abutment and the Piers.

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

The piles are expected to be driven into sandy gravel and penetrable shale; pre-coring should not be required to reach estimated embedment depths. Therefore, KEG recommends using pile shoes and metal shell conical tips to facilitate driving, protect piles from damage, and avoid sudden overstress.

4.2 Lateral Pile Response

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

Table 4.2.1 - Soil Parameters for Lateral Pile Load Analysis

Boring	Soil Type	Depth at Bot. of Layer (ft)	γ (pcf)	Undrained		Drained		N Value (Ave.)	Assumed% Fines < #200	K (pci)	ε50
				c (psf)	Φ (deg.)	c (psf)	Φ (deg.)				
1-S	Silty Clay	372.40	120	850	0	100	26	8	65	100	0.01
	Silty Loam	359.90	120	-	30	-	30	6	65	25	-
	Silty Clay Loam	352.40	120	500	28	50	28	3	65	30	0.02
	Gravelly Clay	347.40	120	800	0	100	38	13	60	100	0.01
	Silty Clay Loam	344.90	120	800	28	150	28	24	65	100	0.01
	Gravelly Clay	339.40	120	825	0	100	38	8	60	100	0.01
	Gravel	334.40	125	-	38	-	38	80	3	-	-
2-S	Silty Clay Loam	374.90	120	4950	28	100	28	19	65	2000	0.004
	Silty Loam	367.40	120	-	30	-	30	6	65	25	-
	Silt	364.90	110	400	0	50	26	1	98	30	0.02
	Clayey Gravel	357.40	120	-	38	-	38	15	20	-	-
	Silty Loam	354.90	120	-	29	-	29	5	65	20	-
	Silt	352.40	110	400	0	50	26	0	98	30	0.02
	Clay	349.90	120	1300	0	100	26	4	85	500	0.007
	Silty Clay Loam	344.90	120	800	28	100	28	5	65	100	0.01

Boring	Soil Type	Depth at Bot. of Layer (ft)	γ (pcf)	Undrained		Drained		N Value (Ave.)	Assumed% Fines < #200	K (pci)	ε50
				c (psf)	Φ (deg.)	c (psf)	Φ (deg.)				
	Silty Loam	334.40	120	-	30	-	30	6	65	20	-
	Silty Clay	324.40	120	300	0	50	26	2	65	30	0.02
	Gravel	314.40	125	-	38	-	38	31	3	-	-
3-S	Silty Loam	366.90	120	-	28	-	28	3	65	25	-
	Silty Clay Loam	362.90	120	350	28	50	28	1	65	30	0.02
	Gravel	360.40	125	-	38	-	38	4	3	-	-
	Silty Clay/Silty Clay Loam	323.40	120	400	0	50	26	3	65	30	0.02
	Gravel	303.90	125	-	38	-	38	32	3	-	-
	Clay	301.90	120	4500	0	150	26	52	85	2000	0.004

Table 4.2.2 - Rock Parameters for Lateral Pile Load Analysis

Boring ID	Rock Type	Depth at Bottom (ft.)	y (psf)	ϕ°	Qu (tsf)
1-S	Shale	319.40	135	12	4.00
2-S	Shale	304.40	135	12	2.25
2-S	Shale	301.90	145	15	28.9
2-S	Shale	299.40	135	12	2.40

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Construction Activities

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

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

5.2 Temporary Sheeting and Soil Retention

Temporary shoring may be required at various stages of this project due to the proposed staged-construction layout shown in the TS&L.

Temporary Soil Retention Systems may be required versus Temporary Shoring, depending upon the surcharge loading, and retained heights required to be supported during construction. An

Illinois-licensed Structural Engineer is required to seal the design of Temporary Soil Retention Systems, if deemed necessary.

5.3 Cofferdams and Seal Coats

Cofferdams will be required at the proposed pier locations. The Estimated Water Surface Elevation (E.W.S.E.) is listed as EL. 367.0 ft. which would put the E.W.S.E less than six feet above the top of the lower pier, calling for a Type I Cofferdam. All cofferdams are required to be dewatered. A seal coat will reduce the potential for water to seep beneath the sheet piling in the dewatered cofferdam. As per the 2023 IDOT Bridge Manual, General Note 28 shall be added to the plans if a seal coat is specified.

The contractor is required to retain an Illinois-licensed structural engineer to design the cofferdams. Per the Bridge Manual, the plans and computations shall be submitted to the Bureau of Bridges and Structures for review and final approval before beginning any work on the structure.

5.4 Site and Soil Conditions

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

6.0 COMPUTATIONS

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

7.0 GEOTECHNICAL DATA

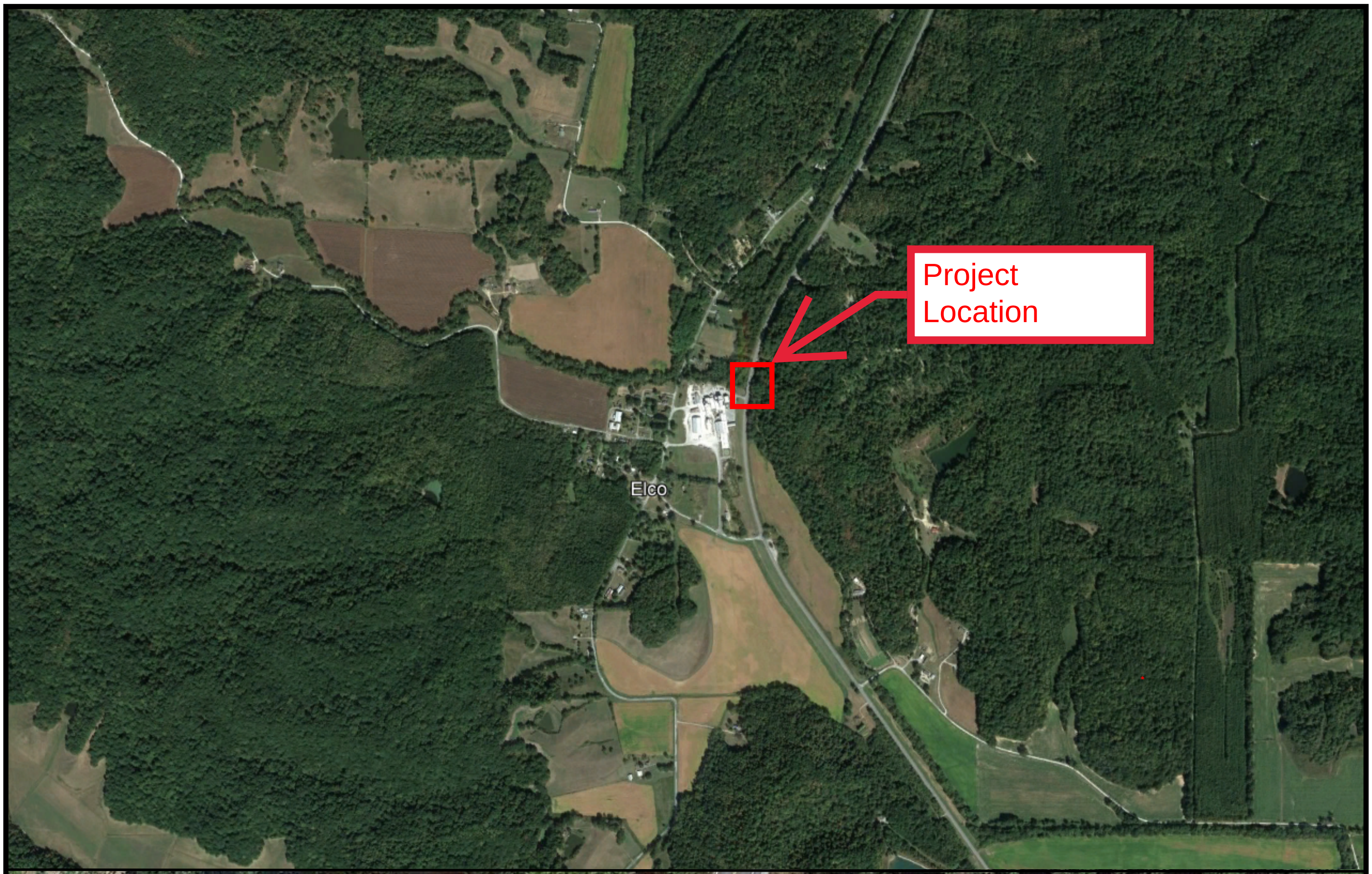
Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D**.**
Pile Design Tables can be found in Exhibit G.

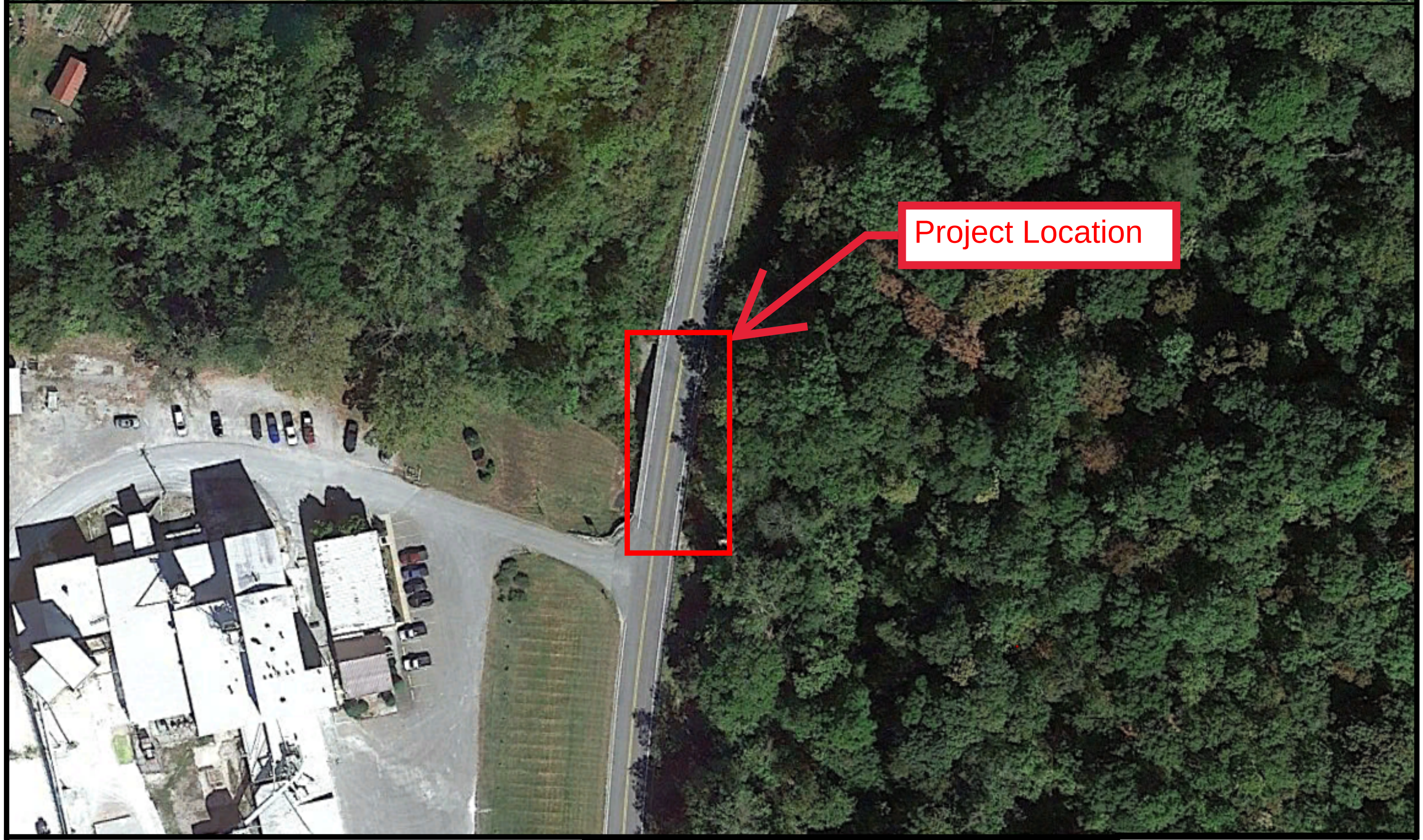
8.0 LIMITATIONS

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

EXHIBIT A

LOCATION MAP





Kaskaskia
Engineering Group, LLC

LOCATION MAP

**IL-127over Hartline Creek
Alexander County, Illinois**

Exhibit No.

A

KEG JOB #22-1060.05

EXHBIT B

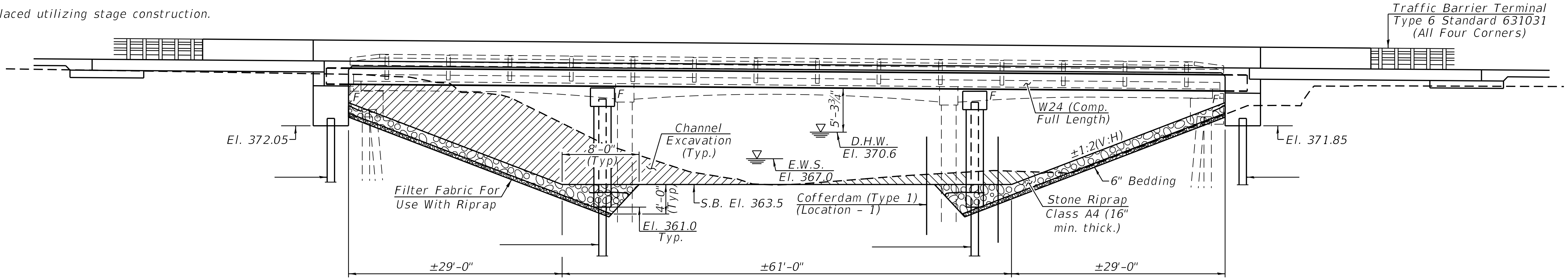
TYPE, SIZE, AND LOCATION PLAN (TS&L)

Benchmark 36 - Chiseled "□" in Southwest Corner of Northwest Wingwall on SN 002-0027. Sta. 569+06.80, 17.7' Rt. Elev.380.956

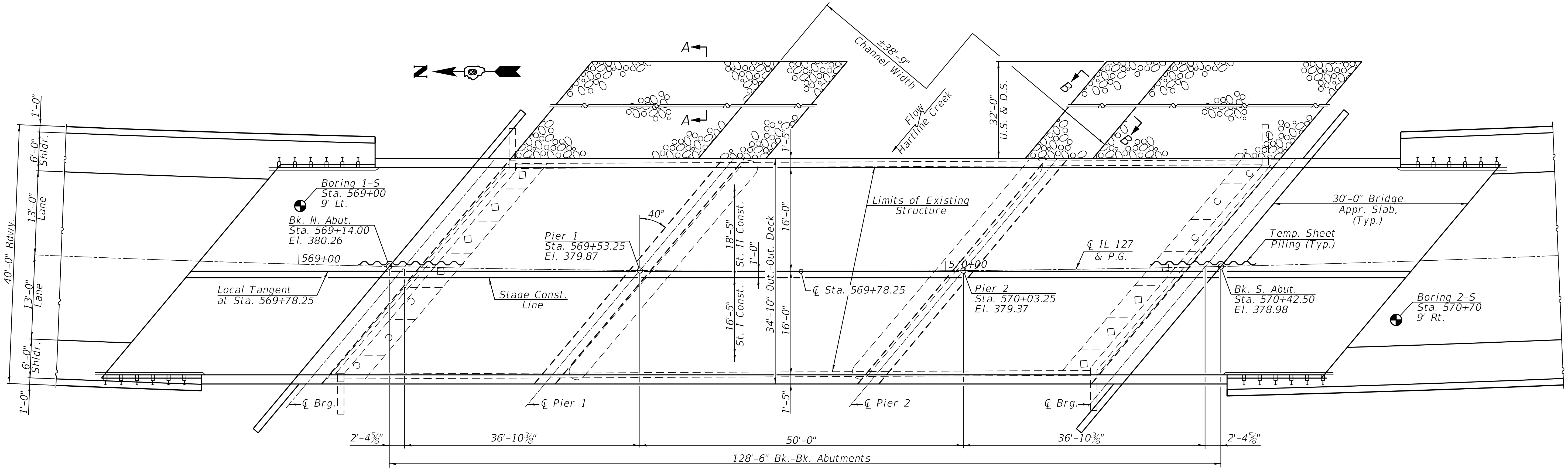
Existing Structure: S.N 002-0027 was originally constructed in 1973 as part of F.A. Rt. 144, Section 17B-1. The existing structure is a three-span continuous concrete superstructure on reinforced concrete pile supported abutments and reinforced concrete pile supported solid wall piers. The existing structure has a clear width of 31'-7⅝" and the out-to-out width of 33'-1⅝". The back-to-back of abutment length is 118'-6" on a 40°17'34" left forward skew.

The structure will be replaced utilizing stage construction.

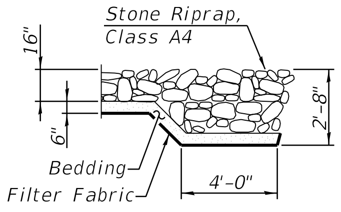
No Salvage



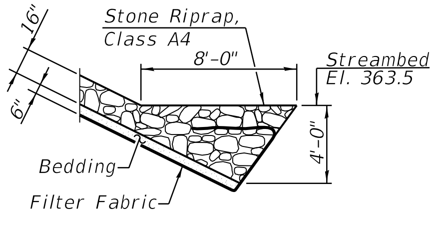
ELEVATION



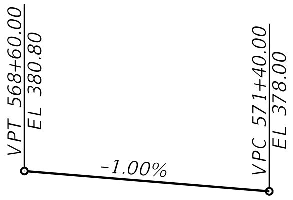
PLAN



SECTION A-A

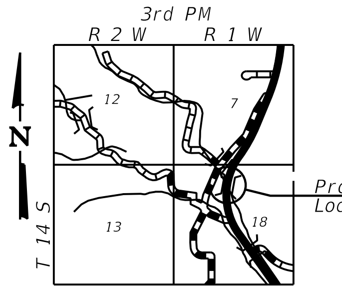


SECTION B-B



PROFILE GRADE
(Along ℄ IL-127)

Boring 3-S
Sta. 569+86
64' Rt.



LOCATION SKETCH

GENERAL PLAN & ELEVATION
I-127 OVER HARTLINE CREEK
F.A.S. RT. 1907 -SEC. 17B-4
ALEXANDER COUNTY
STATION 569+78.25
STRUCTURE NO. 002-0039

Veenstra & Kimm, Inc.
Springfield, IL. Phone: (217)544-8033

USER NAME = ___	DESIGNED - KES	REVISED - ___	
	CHECKED - DHC	REVISED - ___	
PLOT SCALE = ___	DRAWN - JRP	REVISED - ___	
PLOT DATE = ___	CHECKED - DHC	REVISED - ___	

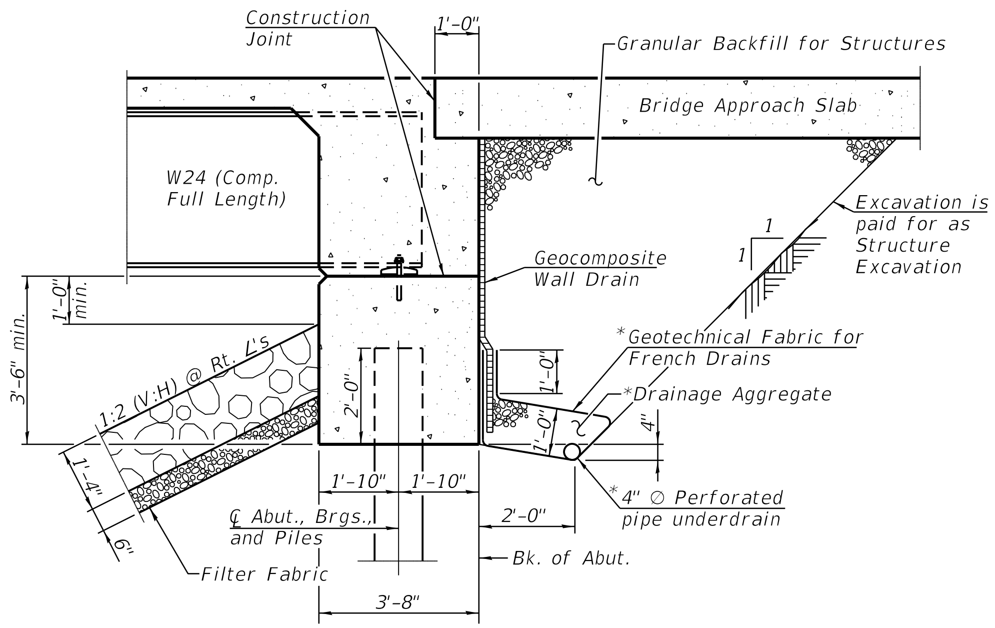
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1907	17B-4	ALEXANDER	___	___

CONTRACT NO. 78989

ILLINOIS FED. AID PROJECT

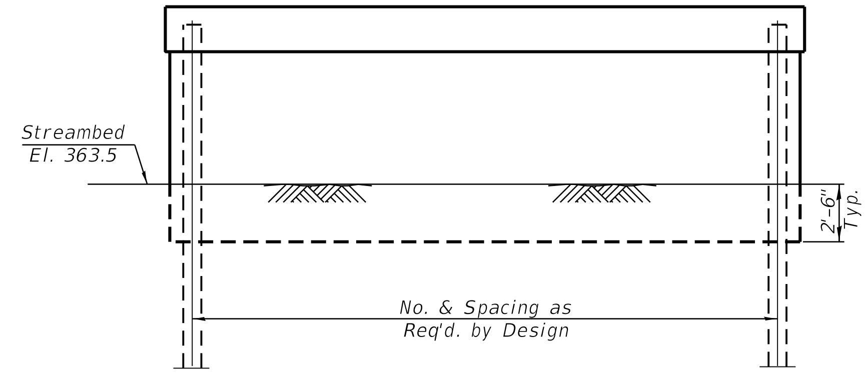


SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ∠'s)

*Included in the cost of Pipe Underdrains for Structures.

Note:
All drainage system components shall extend to 2'-0" from the end of each wingwall except an outlet pipe shall extend until intersecting with the side slopes. The pipes shall drain into concrete headwalls. (See Article 601.05 of the Standard Specifications and Highway Standard 601101).



PIER SKETCH

WATERWAY INFORMATION

Drainage Area = 3.4 Sq. Mi.	Exist. Overtopping Elev. = 375.9 at Sta. 575+68 Prop. Overtopping Elev. = 375.9 at Sta. 575+68									
Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft.		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	596	143	148	369.2	0.2	0.1	369.4	369.3
Design	50	1,043	207	217	370.6	0.3	0.3	370.9	370.9
Base	100	1,266	232	250	371.1	0.4	0.4	371.5	371.5
Scour Check	200	1,525	260	284	371.6	0.5	0.4	372.1	372.0
Max. Calc.	500	1,879	288	320	372.1	0.7	0.5	372.8	372.6

10 Yr. Outlet Velocity through Exist. Structure = 4.2 ft/s
10 Yr. Outlet Velocity through Prop. Structure = 4.0 ft/s

DESIGN SCOUR TABLE

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	N. Abut.	Pier 1	Pier 2	S. Abut.	
Q100	372.05	361.1	361.1	371.85	8
Q200	372.05	361.1	361.1	371.85	
Design	372.05	361.1	361.1	371.85	
Check	372.05	361.1	361.1	371.85	

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

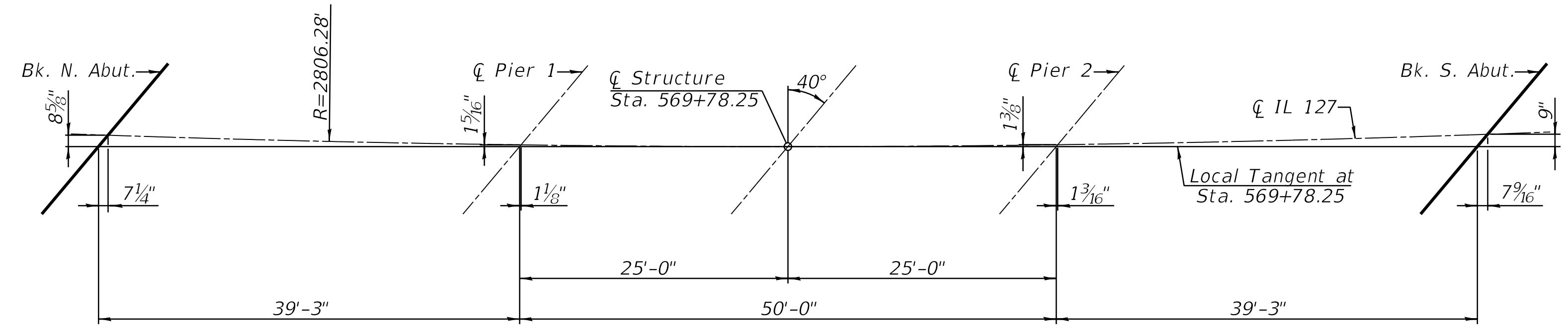
DESIGN STRESSES

FIELD UNITS

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

HIGHWAY CLASSIFICATION

F.A.S. Rte. 1907 - IL Rte. 127
Functional Class: Major Collector
ADT: 900 (2021); 1,150 (2046)
ADTT: 50 (2021); 65 (2046)
DHV: 105 (2046)
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50



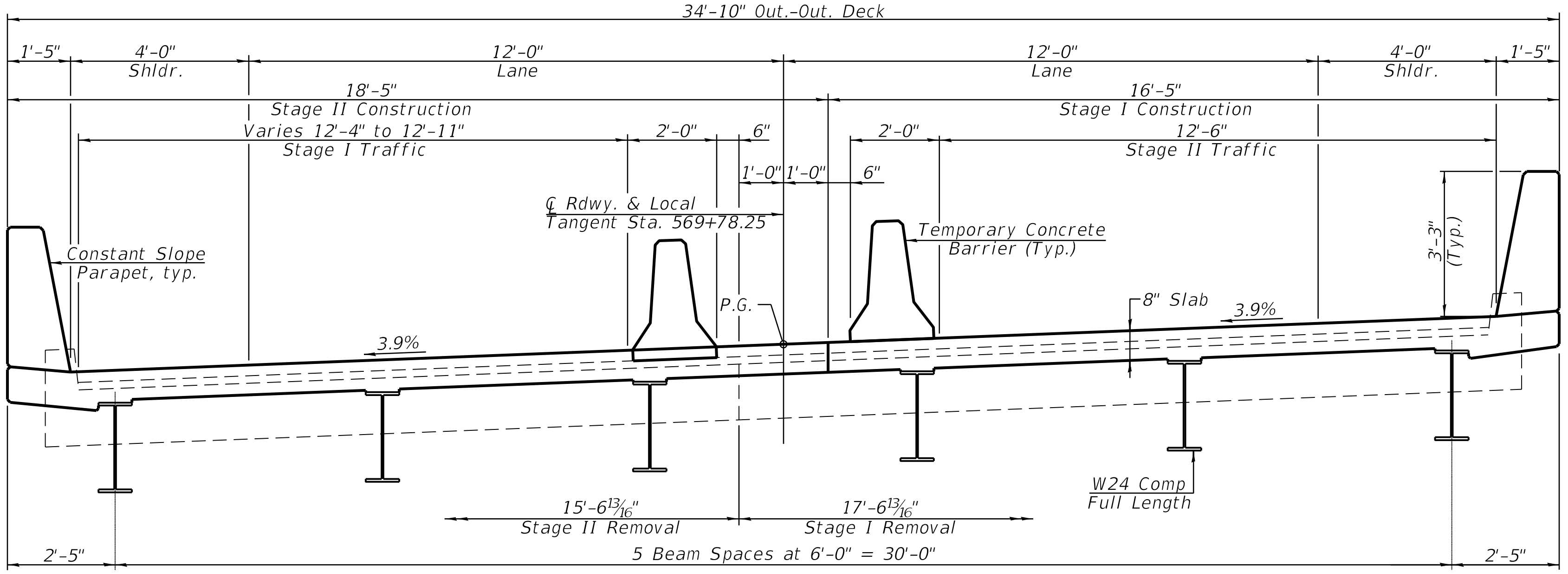
OFFSET SKETCH

LOADING HL-93

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

SEISMIC DATA

Seismic Performance Zone (SPZ) =
Design Spectral Acceleration at 1.0 sec. (SD1) = 0. g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0. g
Soil Site Class =



PROPOSED CROSS SECTION

(Looking South)

EXIST. CURVE DATA

PI STA = 577+20.17
Δ = 67°28'33" (LT)
D = 02°02'30"
R = 2,806.28'
T = 1,874.24'
L = 3,304.89'
E = 568.33'
e = 0.039 '/'
PC STA = 558+45.93
PT STA = 591+50.82 Bk. = 590+97.99 Ah.

DETAILS
I-127 OVER HARTLINE CREEK
F.A.S. RT. 1907 -SEC. 17B-4
ALEXANDER COUNTY
STATION 569+78.25
STRUCTURE NO. 002-0039

VEENSTRA & KIMM INC.
Springfield, IL. Phone: (217)544-8033
IL. Design Firm No. 184-001939

USER NAME = ___	DESIGNED - KES	REVISED - ___
	CHECKED - DHC	REVISED - ___
PLOT SCALE = ___	DRAWN - JRP	REVISED - ___
PLOT DATE = ___	CHECKED - DHC	REVISED - ___

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	(10-1,10-3-1)B-2	GALLATIN	___	___
		CONTRACT NO. 78969		
	ILLINOIS	FED. AID PROJECT		

EXHIBIT C

BORING LOGS

Illinois Department of Transportation

Memorandum

To: Carrie Nelson Attn: Ehren Kirby

From: Douglas Helfrich By: Aaron Hayes AH

Subject: Additional Boring Log

Date: April 16, 2024

IL 127 over Hartline Creek
SN 076-0027 (Ex.)
Section: 17B-1 (Ex.)
Alexander County

A third boring was completed for the design of the replacement to the structure listed above and is attached. The location was to the west of the south pier. Bedrock was not encountered during this boring, but it was drilled to a depth that will achieve a minimum Nominal Driven Bearing capacity of 500 kips for a 14 in. diameter metal sheel pile.

Attachment
AWH:ah

C: Soils File
S:\Materials Geotechnical Unit\gINT\PROJECTS\Projects File\Alexander\Structures

gonzalez COMPANIES, LLC

SOIL BORING LOG

Page 1 **of** 2

Date 23/10/26

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** Gonzalez (NRK)

SECTION 17B-1 (Ex.) **LOCATION** 2.3 mi. S of Union Co. (Near S. Pier), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, 3rd **PM**, **Latitude** 37.30329, **Longitude** -89.26276

COUNTY Alexander **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto 140 lb HE 87

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 3-S
Station 569+86
Offset 64.0 ft RT
Ground Surface Elev. 370.9 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 362.9 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Soft, Gray, Moist, SILTY LOAM		3 2 1	0.4 S	26
366.9				
Soft, Gray, Moist, SILTY CLAY LOAM	-5	WH 1 1	0.5 P	28
		WH WH WH	0.2 S	31
362.9 ▼				
Loose, Brown, Wet, GRAVEL, With Gray SANDY CLAY, Trace Wood	-10	2 2 2		42
360.4				
Soft, Gray, Moist, SILTY CLAY LOAM, Trace Gravel		1 1 1	0.1 S	28
357.9				
Soft, Gray, Moist, SILTY CLAY	-15	WH WH WH	0.5 S	29
		WH WH WH	0.1 S	32
352.9				
Soft, Gray, Moist, SILTY CLAY LOAM, Trace Sand	-20	WH 2 1	0.1 S	26

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Soft, Gray, Moist, SILTY CLAY LOAM, Trace Sand *(continued)*		WH WH 2	0.3 S	30
Trace Coarse Gravel	-25	2 2 2	0.4 S	25
345.4				
Soft to Medium Stiff, Gray, Moist, CLAY		WH WH WH	0.6 S	31
342.9				
Soft, Gray, Moist, SILTY CLAY	-30	WH WH WH	0.3 S	32
		WH 3 2	0.6 S	27
337.9				
Medium Stiff, Gray, Moist, SILTY CLAY LOAM	-35	1 2 2	0.7 S	26
Gray with Black		WH 2 3	0.6 S	26
332.9				
Soft, Gray, Moist, SILTY CLAY		WH WH 2	0.5 S	28
330.9	-40			

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

Page 2 **of** 2

SOIL BORING LOG

Date 23/10/26

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** Gonzalez (NRK)

SECTION 17B-1 (Ex.) **LOCATION** 2.3 mi. S of Union Co. (Near S. Pier), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, 3rd **PM**, **Latitude** 37.30329, **Longitude** -89.26276

COUNTY Alexander **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto 140 lb HE 87

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 3-S
Station 569+86
Offset 64.0 ft RT
Ground Surface Elev. 370.9 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 362.9 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Stiff, Gray, Moist, CLAY, Trace Fine to Coarse Gravel		WH 7 4	0.4 S	22
	-45			
323.4				
Dense, Brown, Moist, Fine to Coarse GRAVEL, with SILTY CLAY Binder		8 20 27		17
	-50			
		10 14 14		16
	-55			
		5 7 14		18
	-60			

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dense, Brown, Moist, Fine to Coarse GRAVEL, with SILTY CLAY Binder *(continued)*		8 15 19		14
	-65			
303.9				
Hard; Brown, Red and Gray; Moist CLAY		10 18 34	4.5 P	20
301.9				
Boring terminated at 69 feet. Ground surface elevation referenced to BM 26, Square Cut on NW Corner of Parapet; EL. 380.96.	-70			
	-75			
	-80			

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

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation

Memorandum

To:	Carrie Nelsen	Attn: Mike Stephenson
From:	Douglas Helfrich	By: Aaron Hayes AH
Subject:	Boring Logs	
Date:	July 20, 2023	

IL 127 over Hartline Creek
SN 002-0027 (Ex.)
Section: 17B-1 (Ex.)
Alexander County

Foundation boring logs have been obtained for design of the replacement to the structure listed above and are attached.

Boring 1-S, near the north abutment, shows a potentially liquefiable layer at a depth of 12 to 19.5 ft. Boring 2-S, near the south abutment, shows potentially liquefiable layers at depths of 12 to 14.5 ft, 22 to 27 ft, and 34.5 to 45 ft. A liquefaction analysis should be completed once the proposed structure's final dimensions are determined.

Borings completed for the design of the existing structure built in 1973 have been attached for additional subsurface information. Also attached is a General Plan and Elevation sheet for the existing structure.

Attachments
AWH:ah

C: Soils File
S:\Materials Geotechnical Unit\gINT\PROJECTS\Projects File\Alexander\Structures

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Page 1 **of** 2

Date 5/15/23

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** L. Estel

SECTION 17B-1 (ex.) **LOCATION** 2.3 mi. S of Union Co. (Near N. Abut.), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, **PM**

COUNTY Alexander **DRILLING METHOD** HSA (8" OD, 3.25" ID) **HAMMER TYPE** Auto SPT 140 lbs (HE 86.5%)

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 1-S
Station 569+00
Offset 9.0ft Lt
Ground Surface Elev. 379.4 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. 364.4 ft

Groundwater Elev.:
▽ **First Encounter** 359.9 ft
▼ **Upon Completion** ______ ft
▼ **After** _____ **Hrs.** ______ ft

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored Pavement, 5" HMA over 17" PCC				
377.57				
Stiff Brown, Moist SILTY CLAY		3 3 4	1.25 S	24
374.90				
Soft Grey, Moist SILTY CLAY with GRAVEL	-5	2 6 3	0.45 B	24
372.40				
Medium Stiff Brown, Moist SILTY LOAM		1 2 2	0.60 B	22
369.90				
Medium Dense Grey, Moist SILTY LOAM with 8" Layer of Crushed GRAVEL	-10	8 6 5		24
367.40				
Very Loose Grey, Very Moist SILTY LOAM		1 1 1		
364.90				
Medium Stiff Brownish Grey, Moist SILT to SILTY LOAM	-15	1 3 3	0.60 B	28
362.40				
Stiff Grey, Moist SILTY LOAM		1 2 3	1.0 B	46
▽ 359.90				
	-20	WOH		

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Very Soft Grey, Moist SILTY CLAY LOAM *(continued)*		WOH WOH	0.20 B	28
357.40				
Soft Grey, Moist SILTY CLAY LOAM		WOH 1 3	0.45 B	27
354.90				
(Medium stiff)	-25	1 2 3	0.85 B	24
352.40				
Medium Stiff Brown, Moist GRAVEL with SILTY CLAY Binder		4 8 5	0.80 S	18
	-30	3 9 5	0.80 B	20
347.40				
Medium Stiff Brown and Grey, Moist SILTY CLAY LOAM with Layers of GRAVEL		3 12 12	0.80 B	26
344.90				
Medium Dense Brown, Moist GRAVEL with CLAY LOAM Binder	-35	11 11 11	1.00 S	21
342.40				
(Loose)		1 3 3	0.65 B	22
339.40	-40			

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\ALEXANDER 002\STRUCTURES\002-0027 IL 127 OVER HARTLINE CREEK\002-0027 127 OVER HARTLINE CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 7/20/23
Latitude 37.3035159 Longitude -89.2624680 Datum NAD83 Job Number

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\ALEXANDER 002\STRUCTURES\002-0027 IL 127 OVER HARTLINE CREEK\002-0027 127 OVER HARTLINE CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 7/20/23
Latitude 37.3035159 Longitude -89.2624680 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 5/15/23

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** L. Estel

SECTION 17B-1 (ex.) **LOCATION** 2.3 mi. S of Union Co. (Near N. Abut.), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, **PM**

COUNTY Alexander **DRILLING METHOD** HSA (8" OD, 3.25" ID) **HAMMER TYPE** Auto SPT 140 lbs (HE 86.5%)

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 1-S
Station 569+00
Offset 9.0ft Lt
Ground Surface Elev. 379.4 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. 364.4 ft

Groundwater Elev.:
∇ First Encounter 359.9 ft
▼ Upon Completion ft
▼ After Hrs. ft

		DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Very Dense Brown, GRAVEL with CLAY LOAM Binder			14 55 25	0.35 S	19
	334.40	-45			
Very Stiff Black/Brown/Grey/Tan, Moist Weathered CLAY SHALE Modified SPT procedure @ 45 ft UCS, Qu = 3.9 tsf = 7.8 ksf (outside recommended operating parameters, test designed for rock with UCS from 10 to 100 ksf)			8 22 9		
	331.90		7		
Very Stiff Brown and Black, Moist Weathered CLAY SHALE Modified SPT procedure @ 47.5 ft UCS, Qu = 2.0 tsf = 4.0 ksf (outside recommended operating parameters, test designed for rock with UCS from 10 to 100 ksf)			10 16		15
	329.40	-50	9		
Very Stiff Brown, Black and Grey, Moist Weathered CLAY SHALE Modified SPT procedure @ 50.0 ft UCS, Qu = 3.1 tsf = 6.2 ksf (outside recommended operating parameters, test designed for rock with UCS from 10 to 100 ksf)			25 31		
	326.90				
Hard Brown, Dry to Moist Weathered CLAY SHALE Modified SPT procedure @ 52.5 ft UCS, Qu = 5.5 tsf = 11.1 ksf (see attached report)					17
	324.40	-55			
Hard Brown, Moist to Dry Weathered CLAY SHALE Modified SPT procedure @ 55 ft UCS, Qu = 5.5 tsf = 11.1 ksf (see attached report)					14
		-60			

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Bottom of hole @ 56.5 feet Free water encountered @ 19.5 ft To Convert "N" values to "N60", multiply by 1.44; Hammer efficiency = 86.5% Ground surface elevation referenced to BM 26, Square Cut on NW Corner of Parapet; EL. 380.96				
	-65			
	-70			
	-75			
	-80			

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

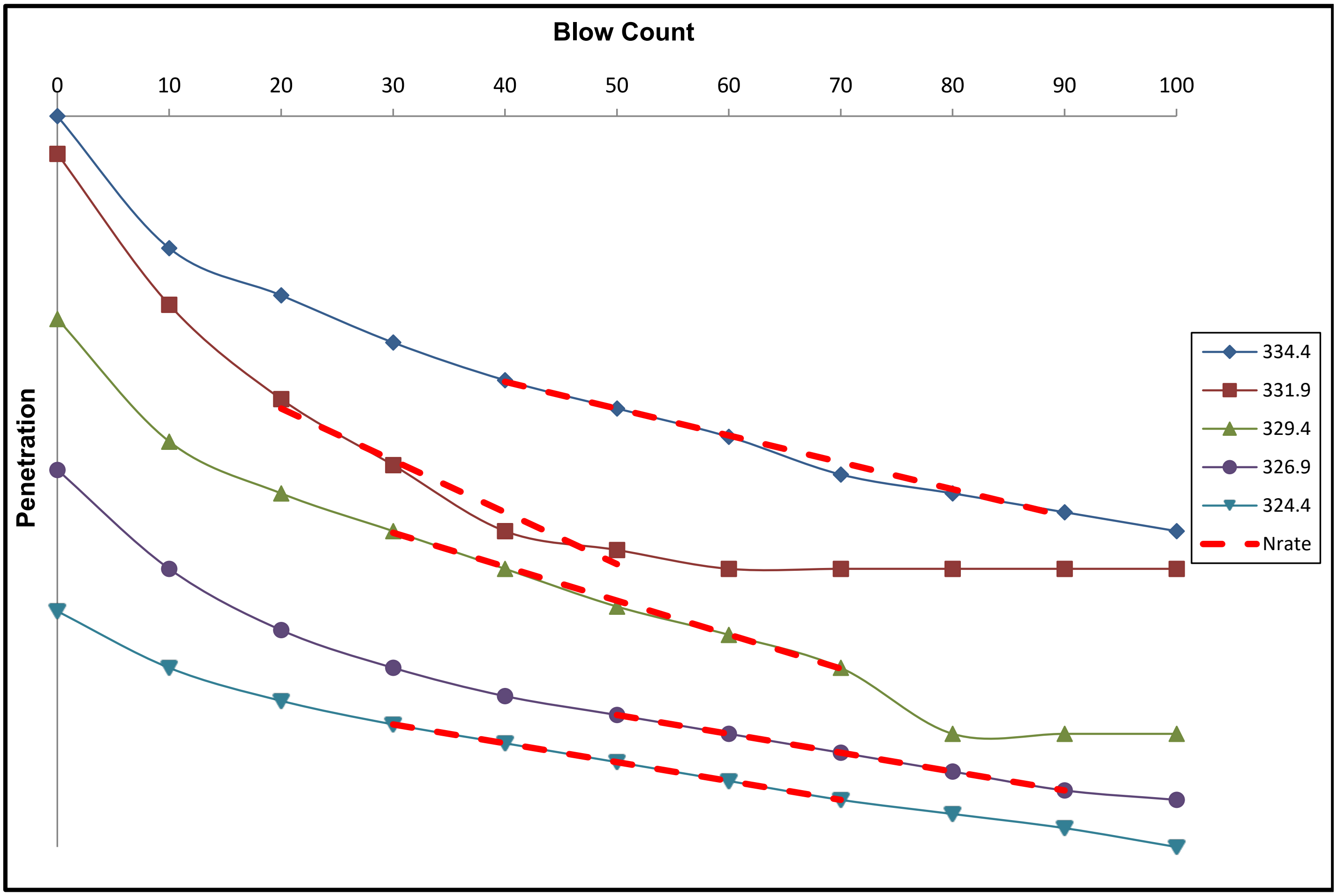
Illinois Department of Transportation

Modified SPT Log

Route: IL 127 Structure No.: 002-0027 (Exist.) (Prop.) Date: 5/15/23 Page: 1 of 1
Section: 17B-1 (ex.) Description: 2.3 Mile S of Union CO., SEC. 18 TWP. 14S, RNG. 1W, PM
County: Alexander Logged by: O Byers Sampler Tube Length: 22 in.
Boring No.: 1-S Station: 569+00 Offset: 9' LT Latitude: 37.3035159 Longitude: -89.262468
Drill Rig: CME 75 Hammer Type: Auto 140# Hammer Efficiency (%): 87 Surface Elevation: 379.40
Borehole Diameter. (in.) 8 Split-barrel Sampler Description: 1.375-in. I.D.

Measured Rod Length (in.)	*Blows where exposed rod length is measured (blows)*											$N_{rate,90}$ (bpf)	q_u (ksf)	Young's Modulus (ksi)
Test Elevation	0	10	20	30	40	50	60	70	80	90	100			
334.40	22	15	12.5	10	***8***	***6.5***	***5***	3	***2***	***1***		81.0	7.8	1.83
331.90	22	14	***9***	***5.5***	***2***	***1***						41.9	4.0	0.98
329.40	22	15.5	12.75	***10.8***	***8.75***	6.75	***5.25***	***3.5***				64.1	6.2	1.47
326.90	22	16.75	13.5	11.5	10	***9***	***8***	***7***	***6***	***5***	4.5	115.3	11.1	2.55
324.40	22	19	17.25	***16***	***15***	***14***	***13***	***12***	11.25	10.5	9.5	115.3	11.1	2.55

Note: "***Values***" indicates data used to calculate $N_{rate,90}$.



Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Page 1 of 3

Date 5/16/23

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** L. Estel

SECTION 17B-1 (ex.) **LOCATION** 2.3 Miles S of Union Co. (Near S. Abut.), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, **PM**

COUNTY Alexander **DRILLING METHOD** HSA (8" OD, 3.25" ID) **HAMMER TYPE** Auto SPT 140 lbs (HE 86.5%)

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 2-S
Station 570+70
Offset 9.0ft Rt
Ground Surface Elev. 379.4 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. 364.4 ft

Groundwater Elev.:
▽ **First Encounter** 364.9 ft
▼ **Upon Completion** ft
▼ **After** Hrs. ft

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Cored Pavement, 3" HMA over 12" PCC and 9" Gravel				
377.40				
Hard Brown, Dry to Moist SILTY CLAY LOAM		13 9 10	4.95 S	15
374.90				
Medium Stiff Brownish Grey, Moist SILTY LOAM	-5	2 2 3	0.80 S	22
372.40				
(Grey)		1 3 3	0.95 S	21
369.90				
Soft Grey, Moist to Very Moist SILTY LOAM	-10	5 4 3	0.45 S	22
367.40				
Very Soft Grey, Very Moist SILT 0% f. GRAVEL/c. SAND, 0% m. SAND, 2% f. SAND, 89% SILT, 9% CLAY, LL = 28, PI = 7 (Lab 19)		WOH WOH 1		28
▽ 364.90				
Medium Dense Brown, Very Moist Brown GRAVEL with SANDY LOAM 63% f. GRAVEL/c. SAND, 13% m. SAND, 5% f. SAND, 15% SILT, 5% CLAY, Non-Plastic (Lab 20)	-15	5 8 10		25
		3 6 7		25
	-20	5		

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
		9 6		25
357.40				
Soft Grey, Moist SILTY LOAM		1 2 3	0.40 B	28
354.90				
Very Soft Grey, Very Moist SILT 0% f. GRAVEL/c. SAND, 0% m. SAND, 2% f. SAND, 89% SILT, 9% CLAY, LL = 28, PI = 7 (Lab 19)	-25	WOH WOH WOH		30
352.40				
Stiff Grey, Moist CLAY		2 2 2	1.30 B	29
349.90				
Medium Stiff Grey, Moist SILTY CLAY LOAM	-30	2 2 3	0.80 B	29
		WOH 2 4	0.80 B	26
344.90				
Soft Grey, Moist SILTY LOAM	-35	2 3 3	0.30 B	27
342.40				
Medium Stiff Grey, Moist SILTY LOAM		1 2 4	0.80 B	26
	-40			

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\ALEXANDER 002\STRUCTURES\002-0027 IL 127 OVER HARTLINE CREEK\002-0027 127 OVER HARTLINE CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 7/20/23
Latitude 37.3030524 Longitude -89.2626084 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 5/16/23

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** L. Estel

SECTION 17B-1 (ex.) **LOCATION** 2.3 Miles S of Union Co. (Near S. Abut.), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, **PM**

COUNTY Alexander **DRILLING METHOD** HSA (8" OD, 3.25" ID) **HAMMER TYPE** Auto SPT 140 lbs (HE 86.5%)

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 2-S
Station 570+70
Offset 9.0ft Rt
Ground Surface Elev. 379.4 ft

Surface Water Elev. 364.7 ft
Stream Bed Elev. 364.4 ft

Groundwater Elev.:
▽ **First Encounter** 364.9 ft
▼ **Upon Completion** ft
▼ **After** Hrs. ft

		DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Medium Stiff Grey, Moist SILTY LOAM *(continued)*			1		
			2		26
			3		
	334.40	-45			
Soft Grey, Moist CLAY to SILTY CLAY			1		
			1	0.45	28
			2	B	
	329.40	-50			
Very Soft Grey, Moist CLAY to SILTY CLAY			WOH		
			WOH	0.15	25
			WOH	B	
	324.40	-55			
Medium Dense Grey and Tan, Moist GRAVEL with SILTY CLAY binder			6		
			7		19
			8		
	319.40	-60			

		DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
Dense Grey and Tan, Moist GRAVEL with SILTY CLAY binder			24		
			22		19
			25		
	314.40	-65			
Very Stiff Blue Grey, Moist Weathered CLAY SHALE Modified SPT procedure @ 65 ft UCS, Qu = 2.05 tsf = 4.1 ksf (outside recommended operating parameters, test designed for rock with UCS from 10 to 100 ksf)			6		
			10		25
			17		
	309.40	-70			
Very Stiff Blue/Grey/Brown/Red, Dry Weathered CLAY SHALE Modified SPT procedure @ 70 ft UCS, Qu = 2.4 tsf = 4.8 ksf (outside recommended operating parameters, test designed for rock with UCS from 10 to 100 ksf)			6		
			8		24
			18		
	304.40	-75			
Hard Blue/Grey/Brown/Red, Dry Weathered CLAY SHALE Modified SPT procedure @ 75 ft UCS, Qu = 28.9 tsf = 57.9 ksf (see attached report)					
					22
	301.90				
Very Stiff Brown and Red, Dry Weathered CLAY SHALE Modified SPT procedure @ 77.5 ft UCS, Qu = 2.4 tsf = 4.8 ksf (outside recommended operating parameters, test designed for rock			9		
			15		25
			19		
		-80			

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\ALEXANDER 002\STRUCTURES\002-0027 IL 127 OVER HARTLINE CREEK\002-0027 127 OVER HARTLINE CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 7/20/23
Latitude 37.3030524 Longitude -89.2626084 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Page 3 **of** 3

Date 5/16/23

ROUTE IL 127 **DESCRIPTION** Bridge over Hartline Creek **LOGGED BY** L. Estel

SECTION 17B-1 (ex.) **LOCATION** 2.3 Miles S of Union Co. (Near S. Abut.), **SEC.** 18, **TWP.** 14S, **RNG.** 1W, **PM**

COUNTY Alexander **DRILLING METHOD** HSA (8" OD, 3.25" ID) **HAMMER TYPE** Auto SPT 140 lbs (HE 86.5%)

STRUCT. NO. 002-0027
Station 569+78

BORING NO. 2-S
Station 570+70
Offset 9.0ft Rt
Ground Surface Elev. 379.4 **ft**

Surface Water Elev. 364.7 **ft**
Stream Bed Elev. 364.4 **ft**

Groundwater Elev.:
▽ **First Encounter** 364.9 **ft**
▼ **Upon Completion** ____ **ft**
▼ **After** ____ **Hrs.** ____ **ft**

	DEPTH (ft)	**BLOWS**	**UCS Qu (tsf)**	**MOIST (%)**
with UCS from 10 to 100 ksf) Bottom of hole @ 79.0 ft Free Water encountered @ 14.5 ft To convert "N" values to "N60", multiply by 1.44; Hammer efficiency = 86.5% Ground surface elevation referenced to BM 26, Square Cut on NW Corner of Parapet; EL. 380.96	-85 -90 -95 -100			

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

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\ALEXANDER 002\STRUCTURES\002-0027 IL 127 OVER HARTLINE CREEK\002-0027 127 OVER HARTLINE CREEK.GPJ Data Template D6TEMPLT.GDT Date Printed 7/20/23
Latitude 37.3030524 Longitude -89.2626084 Datum NAD83 Job Number

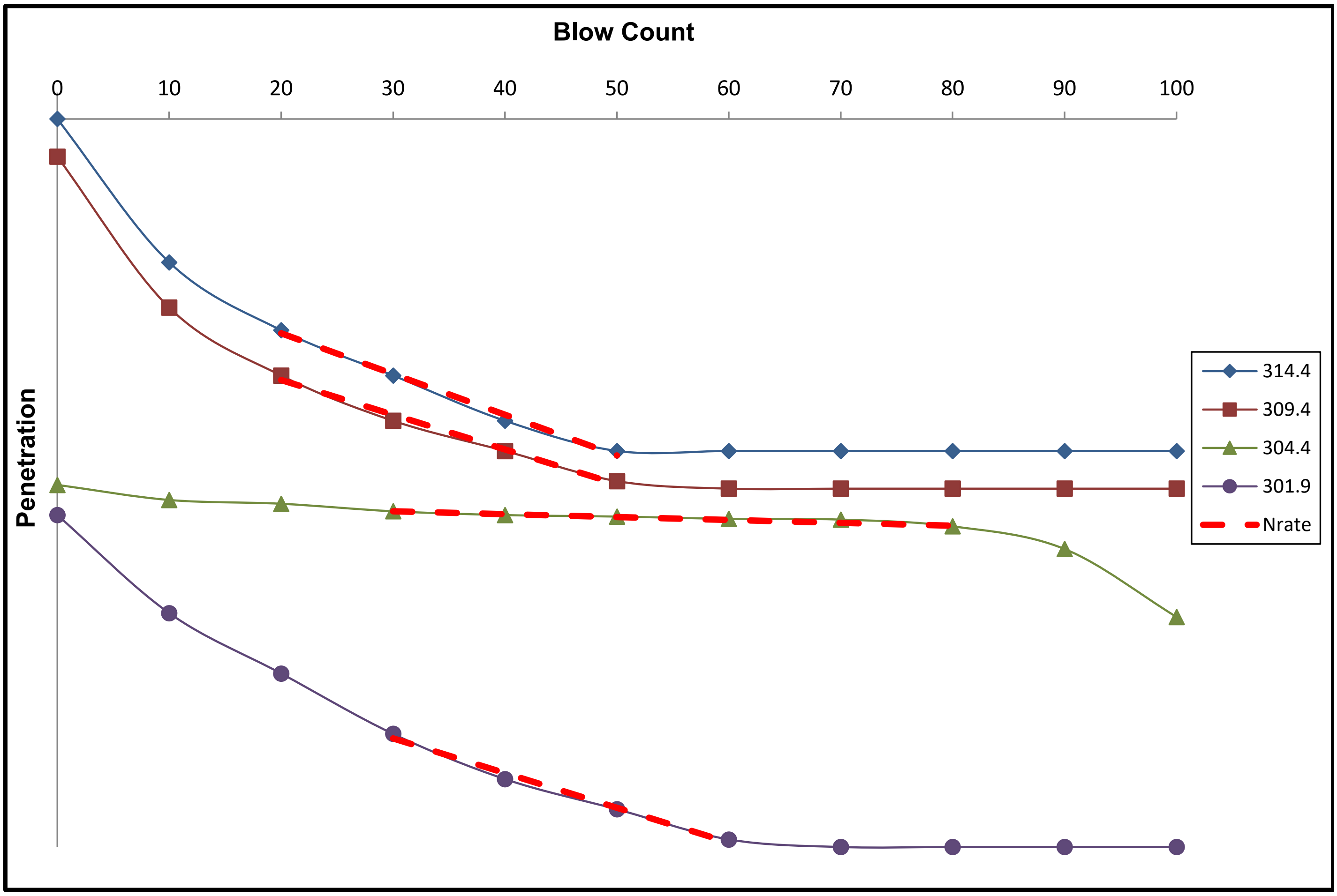
Illinois Department of Transportation

Modified SPT Log

Route: IL 127 Structure No.: 002-0027 (Exist.) (Prop.) Date: 5/16/23 Page: 1 of 1
Section: 18 Description: 2.3 Mile S of Union CO., SEC. 18, TWP. 14S, RNG. 1W, PM
County: Alexander Logged by: O Byers Sampler Tube Length: 22 in.
Boring No.: 2-S Station: 570+70 Offset: 9' RT Latitude: 37.3030524 Longitude: -89.262608
Drill Rig: CME 75 Hammer Type: Auto 140# Hammer Efficiency (%): 87 Surface Elevation: 379.40
Borehole Diameter. (in.) 8 Split-barrel Sampler Description: 1.375-in. I.D.

	Measured Rod Length (in.)	*Blows where exposed rod length is measured (blows)*											$N_{rate,90}$ (bpf)	q_u (ksf)	Young's Modulus (ksi)
		0	10	20	30	40	50	60	70	80	90	100			
Test Elevation	314.40	22	12.5	***8***	***5***	***2***	***0***						42.7	4.1	1.00
	309.40	22	12	***7.5***	***4.5***	***2.5***	***0.5***						50.1	4.8	1.16
	304.40	22	21	20.75	***20.3***	***20***	***19.9***	***19.8***	19.7	***19.3***	17.75	13.25	603.2	57.9	15.22
	301.90	22	15.5	11.5	***7.5***	***4.5***	***2.5***	***0.5***					50.1	4.8	1.16

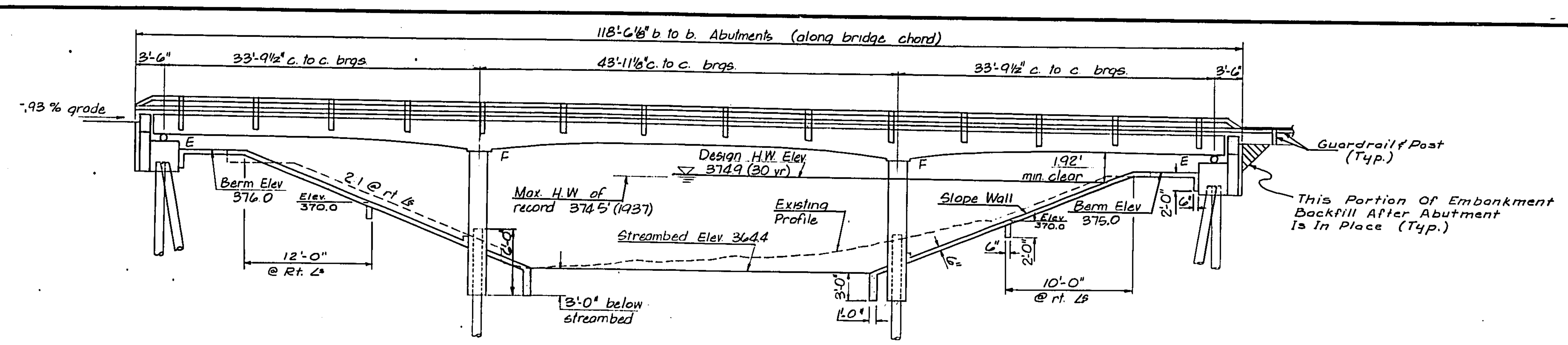
Note: "***Values***" indicates data used to calculate $N_{rate,90}$.



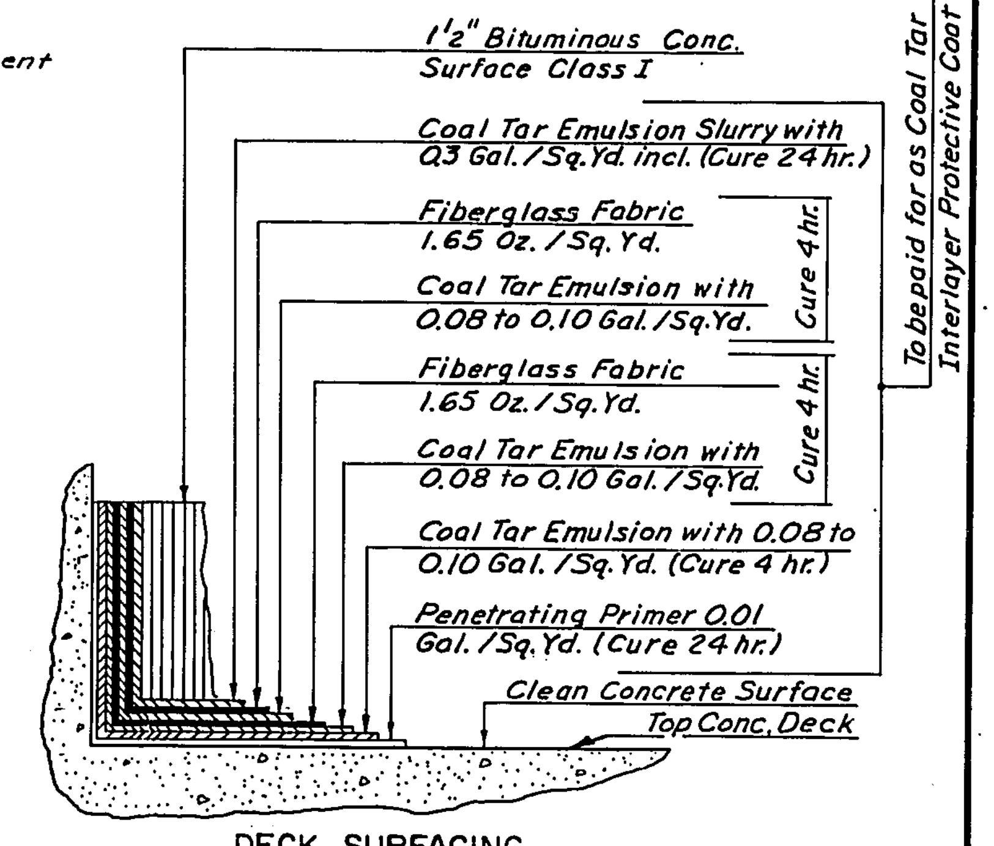
B.M. – R.R. spike in North side of 32" Elm 154 Rt. Sta. 570+11 Elev. 377.64
B.M. – Chiseled square on S.E. Conc. Wing-wall 15' Lt. Sta. 570+41 Elev. 378.38
Salvable material to become property of the Contractor.
Superstructure – 5 - W 21x 59 Girders W7 6½" reinf. conc. Slab.
Substructure – Reinf. conc. Bent Cap W7 5 timber Piles, & reinf. conc. Abut. Cap W7 5 timber Piles & conc. Wings.

ROUTE NO.	SEC.	COUNTY	TOTAL SHEETS	SHEET NO.
F.A. 144	17B-1	ALEXANDER	18	7
FED. ROAD DIST. NO. 7		ILLINOIS	PROJECT	

SHEET 1 OF 8

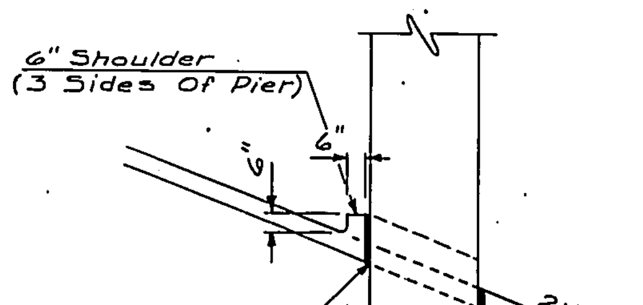


ELEVATION

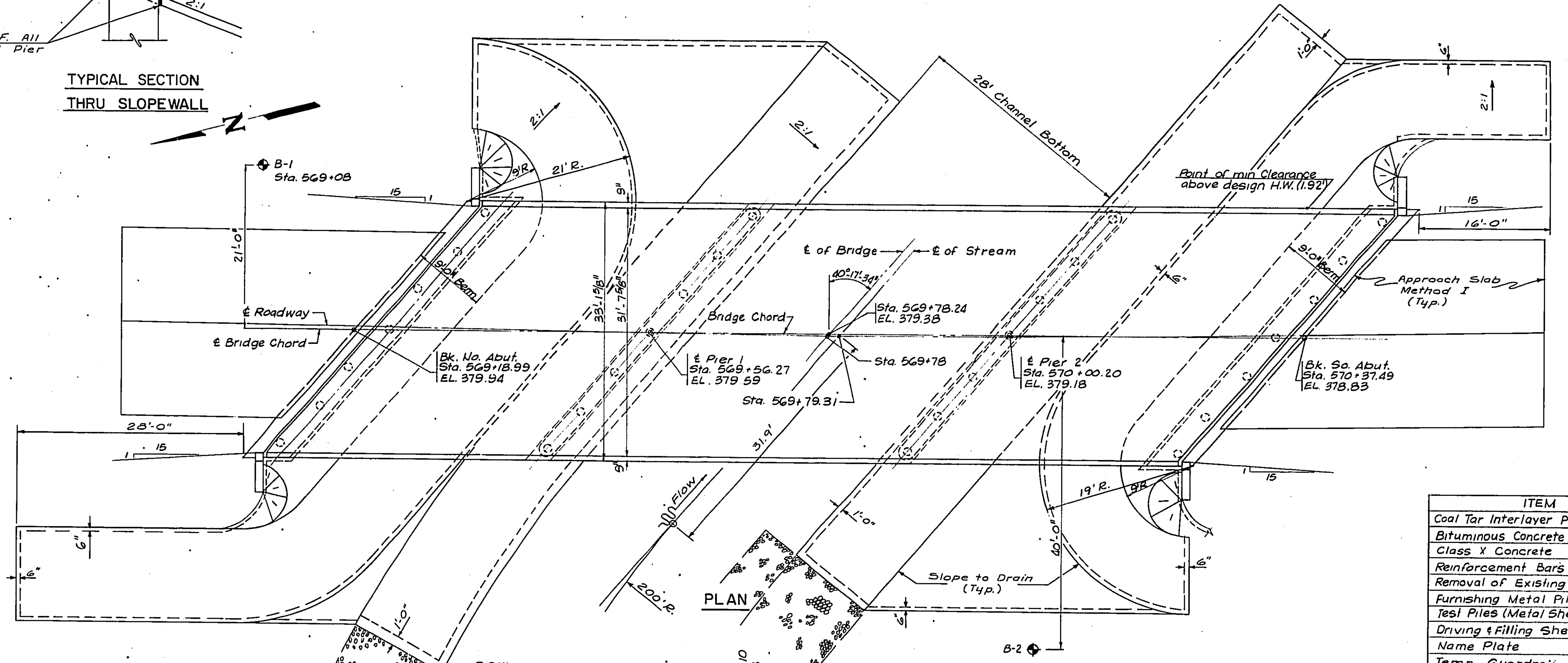


DECK SURFACING

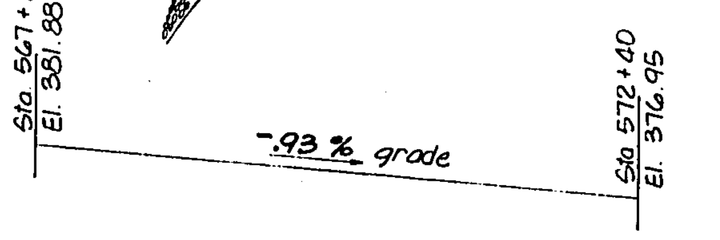
with Coal Tar Interlayer Protective Coat



TYPICAL SECTION THRU SLOPEWALL



PLAN



PROPOSED PROFILE

LETTERING FOR NAME PLATE

STATION 569+78
BUILT 197   BY
STATE OF ILLINOIS
F.A. RT. 144   SEC. 17B-1
LOADING HS 20

Locate Name Plate @ northwest corner of Bridge.
(SEE STD. 2113)

TOTAL BILL OF MATERIAL

ITEM	UNIT	SUPER.	SUB.	TOTAL
Coal Tar Interlayer Protective Coat	Sq. Yds.	420.	—	420.
Bituminous Concrete Surface Crse., Class I	Ton	36.3	—	36.3
Class X Concrete	Cu. Yds.	231.2	147.4	378.6
Reinforcement Bars	Lbs.	60,918	15,261	76,179
Removal of Existing Structures	Each	-	-	1
Furnishing Metal Pile Shells, 12"	Lin. ft.	—	1170	1170
Test Piles (Metal Shell)	Each	-	2	2
Driving & Filling Shells	Lin. ft.	-	1170	1170
Name Plate	Each	1	-	1
Temp. Guardrail	Lin. Ft.	225	-	225
Steel Railing, Type N	Lin. Ft.	237	—	237
Slope Wall, 6 inch	Sq. Yds.	—	—	915
Furnishing & Erecting Structural Steel	Lbs.	7,103	—	7,103
Protective Coat	Sq. Yds.	40		40
Preformed Joint Sealer (2½")	Lin. Ft.	87		87

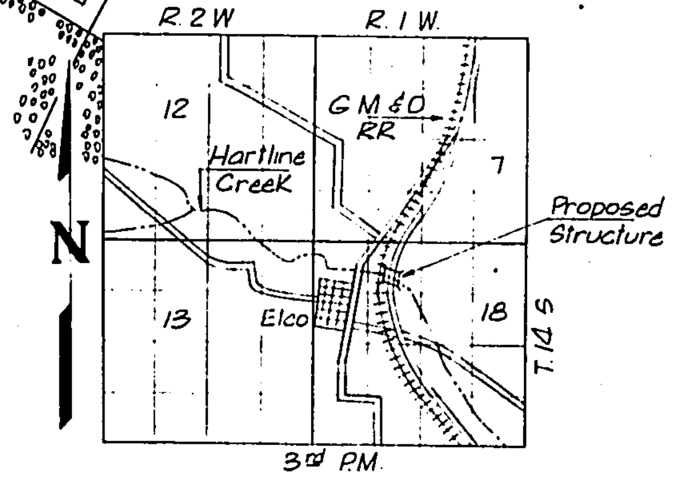
WATERWAY DATA

Drainage Area	2170 Acres
Present Opening	410 Sq. ft.
Required Opening (30 yr.)	475 Sq. ft.
Proposed Opening	475 Sq. ft.
Design Discharge	3300 c.f.s.
Created Head	0.6 Ft.

Character: 20% cultivated, 20% pasture, 60% timber

DESIGN STRESSES

$f_s = 20000$ psi
$f_c = 1400$ psi
$n = 10$



LOCATION PLAN

EXISTING CURVE DATA

Δ = 67°-06'   L = 3723.2'
D = 2°-03'   T = 1853.5'
R = 2795.06'   E = 558.7'
Proposed Superelevation = .039 ⅟
P.I. Sta. 577+17.6

Loading HS 20-44
+25 psf (future wearing surface)

Eugene R. Wilkinson
Illinois Structural No. 2969

GENERAL PLAN & ELEVATION
F.A. RT. 144 OVER HARTLINE CREEK
SECTION 17B-1
ALEXANDER COUNTY

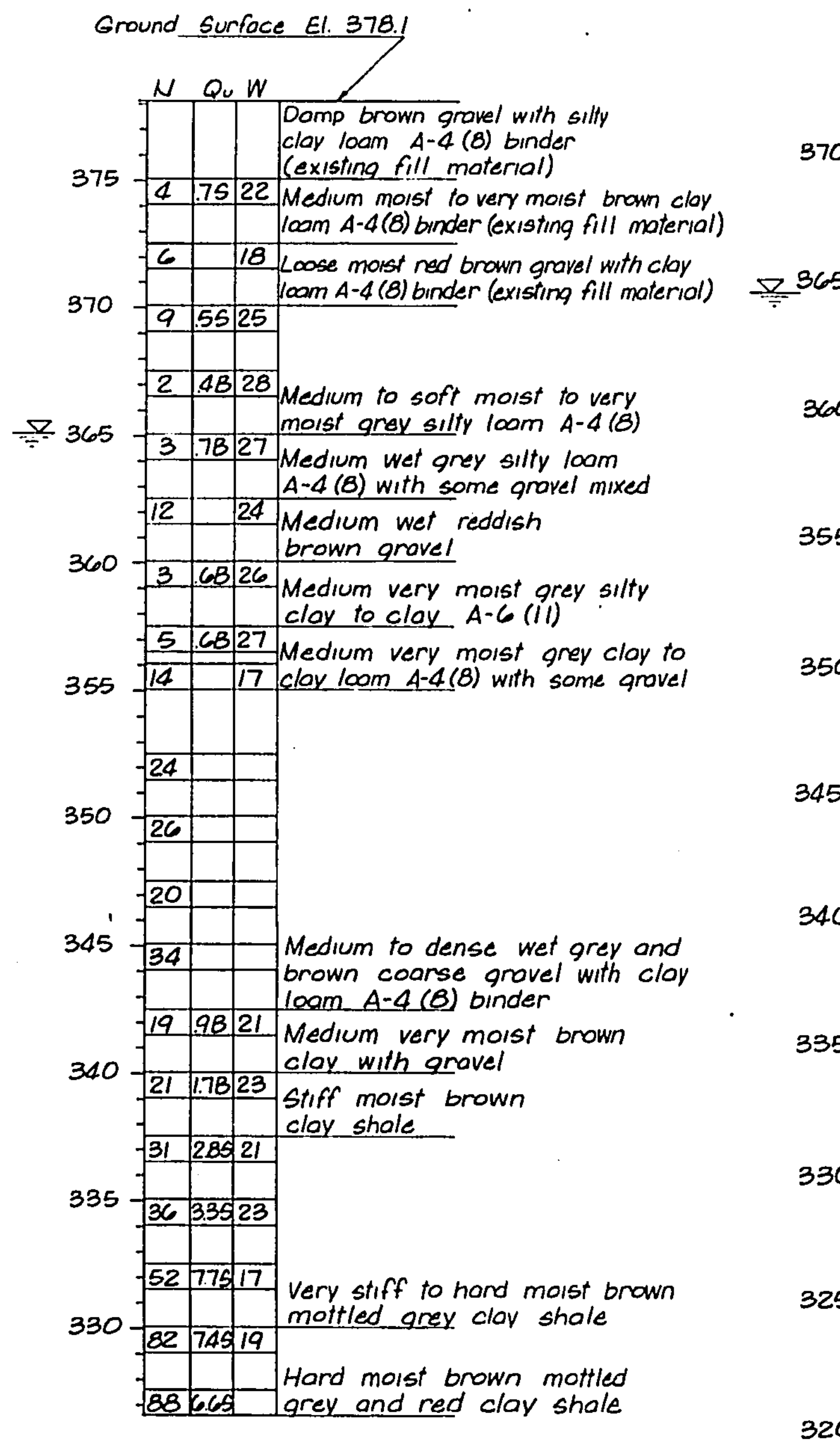
DESIGNED T.J.R.
CHECKED DM
DRAWN R.R.N.
CHECKED T.J.R.

WALTER E. HANSON COMPANY
STRUCTURAL ENGINEERS
CONSULTANTS
SPRINGFIELD, ILLINOIS   PEORIA, ILLINOIS

FILE NO. 71055
DATE March 1, 1972

ROUTE NO.	SEC.	COUNTY	TOTAL SHEETS	SHEET NO.
F.A. 144	17B-1	ALEXANDER	18	8
FED. ROAD DIST. NO. 7	ILLINOIS	PROJECT		

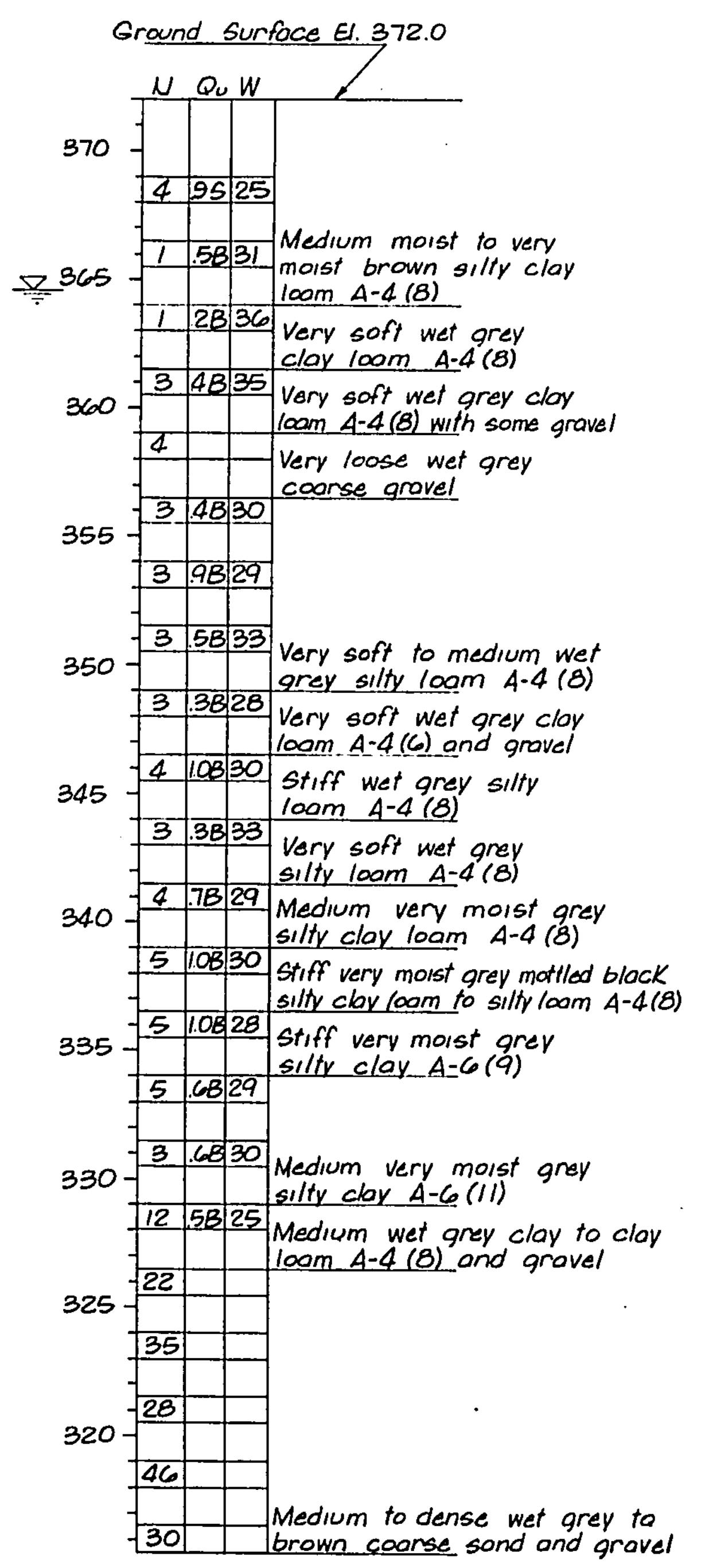
SHEET 2 OF 8



Note: Groundwater elevations shown are for 24 hours after completion of boring.

B-1

Sta. 569+08 – 21' Lt. ℄ Rd.



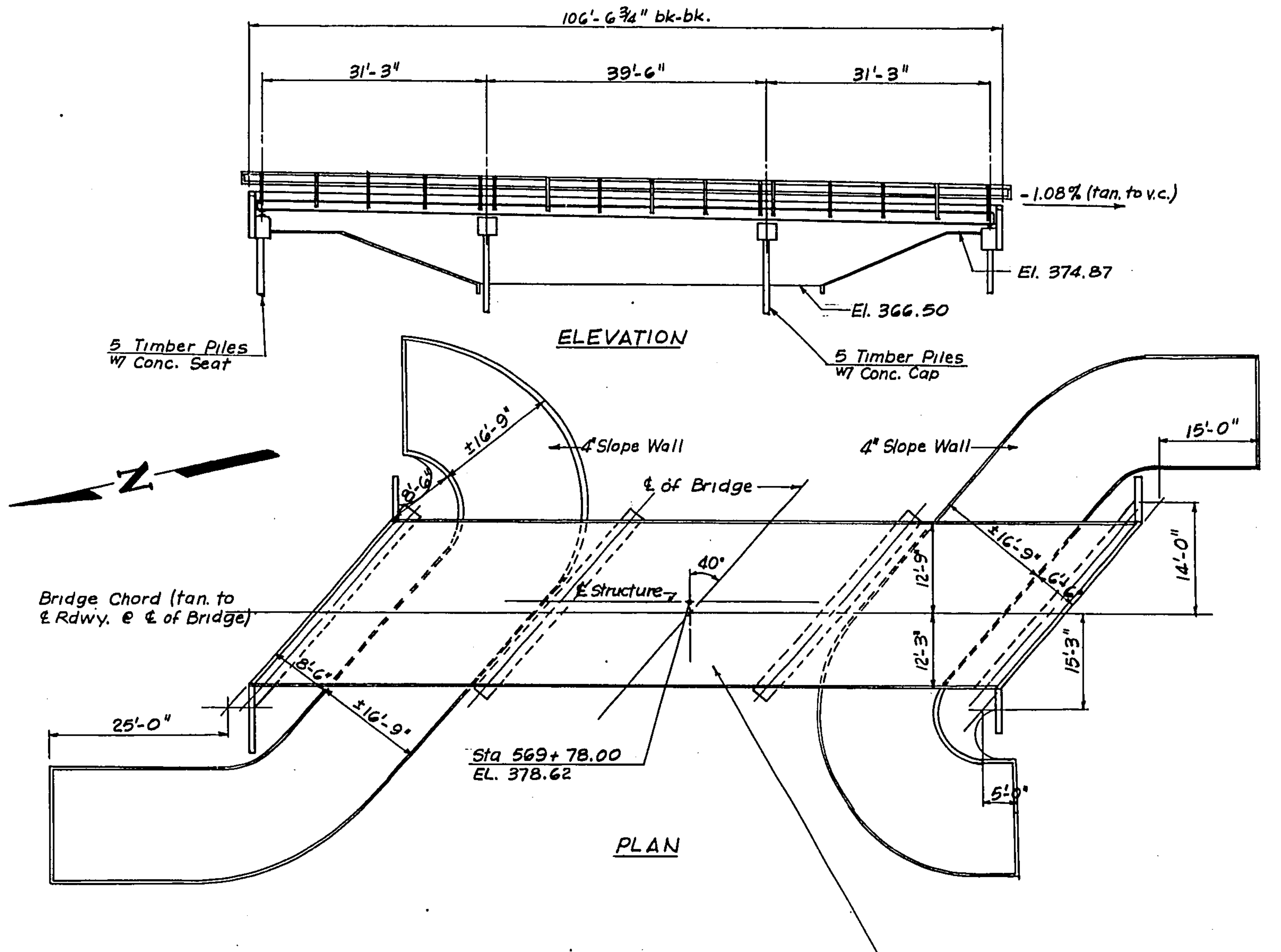
B-2

Sta. 570+03 - 40' Rt. ℄ Rd.

BORING DATA

LEGEND:

N ≡ No. of blows per ft. to drive 2" o.d. Split Spoon Sampler 12" w/ 140# Hammer falling 30".
Qu ≡ Unconfined Compressive Strength in ton/s.f.
w ≡ Water content as percentage of oven dry wt. in %.
B ≡ Indicates bulge failure.
S ≡ Indicates shear failure.



Note: For Phase removal of Exist. Structure, see Sh. 4 of 8.

EXISTING STRUCTURE

GENERAL NOTES

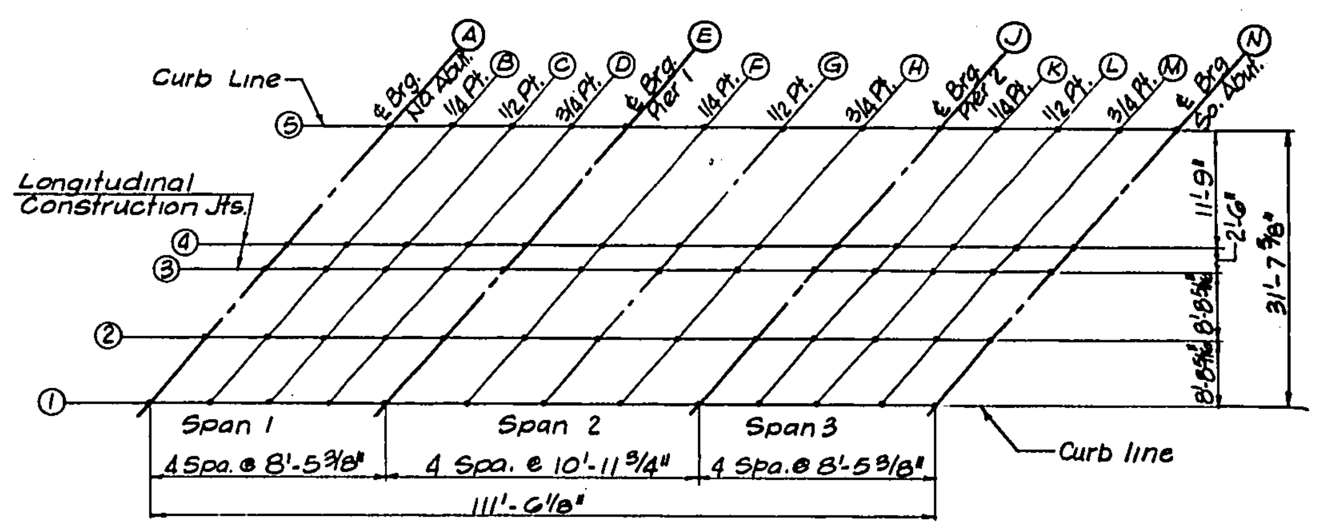
1. ALL REINFORCEMENT BARS SHALL BE LAPPED 24 BAR DIAMETERS, UNLESS OTHERWISE DESIGNATED ON DRAWINGS.
2. CLASS X CONCRETE SHALL BE USED THROUGHOUT.
3. THE CONCRETE FLOOR SLAB SHALL BE FINISHED AND POURED IN ACCORDANCE WITH ARTICLE 503.15 OF THE STANDARD SPECIFICATIONS.
4. EXPANSION GUARD ANGLES SHALL RECEIVE THE BASIC LEAD SILICO CHROMATE PAINT SYSTEM.
5. FIELD WELDING FOR INSTALLATION OF TEMPORARY SIDE MOUNTED GUARDRAIL SHALL BE WITH LOW HYDROGEN MILD STEEL ELECTRODES.
6. FOR ITEMS: TEMPORARY GUARDRAIL, PILING, REMOVAL OF EXISTING STRUCTURES, AND SEQUENCE OF CONSTRUCTION OPERATIONS, SEE SPECIAL PROVISIONS.
7. ALL BEARINGS, INCLUDING ROLLERS, ANCHOR BOLTS AND LEAD PLATES, SHALL BE FABRICATED AND SET IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND SHALL BE INCLUDED IN THE QUANTITY OF STRUCTURAL STEEL.
8. COST OF EXCAVATING AND DEWATERING FOR PIER CONSTRUCTION SHALL BE INCIDENTAL TO THE ITEMS OF CONSTRUCTION.
9. CONTRACTOR SHALL DRIVE TWO TEST PILES IN PERMANENT LOCATIONS AS DIRECTED BY THE ENGINEER. ONE WILL BE SET IN THE SOUTH ABUTMENT AND ONE IN PIER 1.
10. SLOPEWALL SHALL BE REINFORCED WITH WELDED WIRE FABRIC 6"X 6" MESH, WEIGHING 58#/100 SQ. FT.
11. THE CONTRACTOR SHALL MAKE ALLOWANCE FOR THE DEFLECTION OF FORMS, SHRINKAGE AND SETTLEMENT OF FALSEWORK, IN ADDITION TO ALLOWANCE FOR DEAD LOAD DEFLECTION.
12. PROTECTIVE COAT SHALL NOT BE APPLIED TO SURFACE TO WHICH COAL TAR INTERLAYER PROTECTIVE COAT IS APPLIED.

TABLE OF SLAB ELEVATIONS

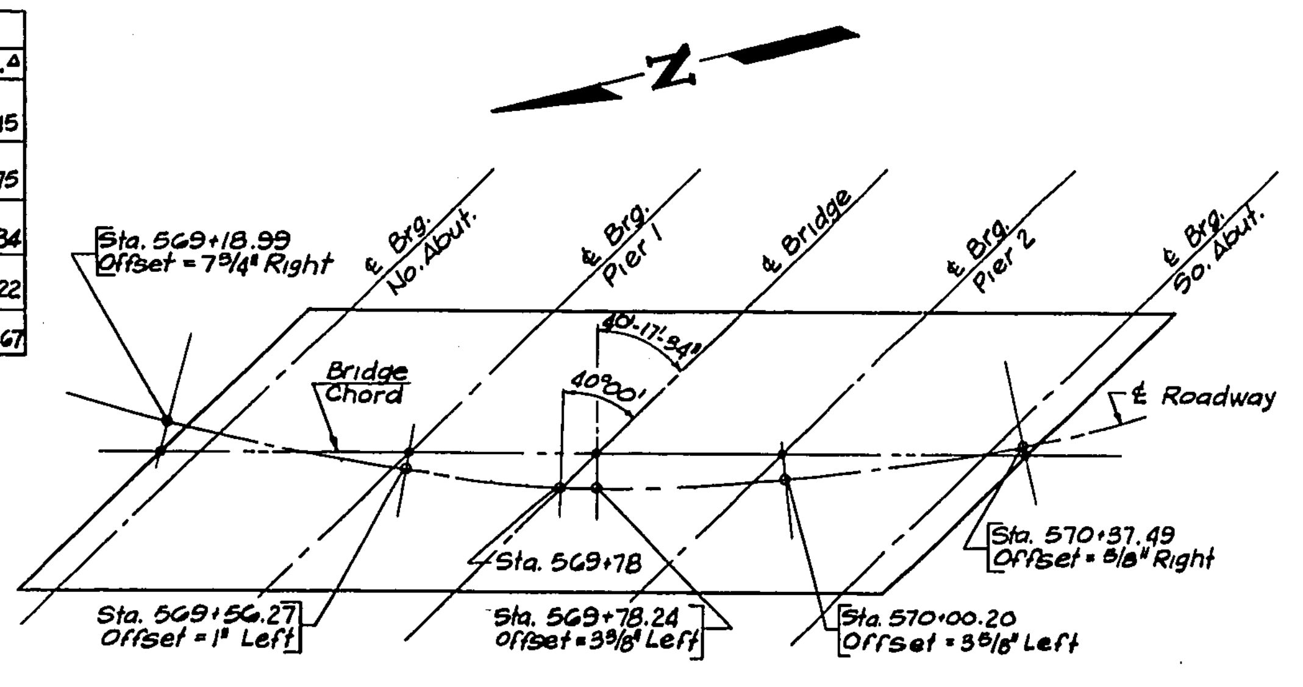
Point / Line	A		B		C		D		E		F		G	
	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△
1	380.68	380.63	380.56	380.59	380.48	380.51	380.40	380.41	380.32	380.32	380.22	380.23	380.12	380.15
2	380.23	380.23	380.15	380.18	380.07	380.10	379.99	380.00	379.91	379.91	379.81	379.83	379.71	379.75
3	379.82	379.82	379.74	379.77	379.66	379.69	379.58	379.59	379.50	379.50	379.40	379.42	379.30	379.34
4	379.70	379.70	379.62	379.66	379.55	379.58	379.47	379.48	379.39	379.39	379.29	379.30	379.18	379.22
5	379.15	379.15	379.07	379.10	378.99	379.03	378.92	378.93	378.84	378.84	378.74	378.75	378.63	378.67

Point / Line	H		J		K		L		M		N	
	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△	F.E.	W/DL△
1	380.01	380.03	379.91	379.91	379.83	379.84	379.75	379.79	379.68	379.71	379.60	379.60
2	379.61	379.62	379.50	379.50	379.43	379.44	379.35	379.38	379.27	379.30	379.19	379.19
3	379.20	379.21	379.10	379.10	379.02	379.03	378.94	378.97	378.86	378.89	378.78	378.78
4	379.08	379.10	378.98	378.98	378.90	378.91	378.82	378.85	378.74	378.78	378.67	378.67
5	378.53	378.55	378.43	378.43	378.35	378.36	378.27	378.30	378.19	378.22	378.11	378.11

LEGEND: F.E. ≡ Finished Slab Elevation
W/DL△ ≡ Finished Slab Elevation w/ correction added for Dead Load Deflection.



PLAN-LOCATION OF SLAB ELEVATION POINTS



CENTERLINE OF ROADWAY GEOMETRY

EXISTING STRUCTURE, SLAB ELEVATIONS,
BORING DATA, GEOMETRY
F.A. RT. 144 OVER HARTLINE CREEK
SECTION 17B-1
ALEXANDER COUNTY

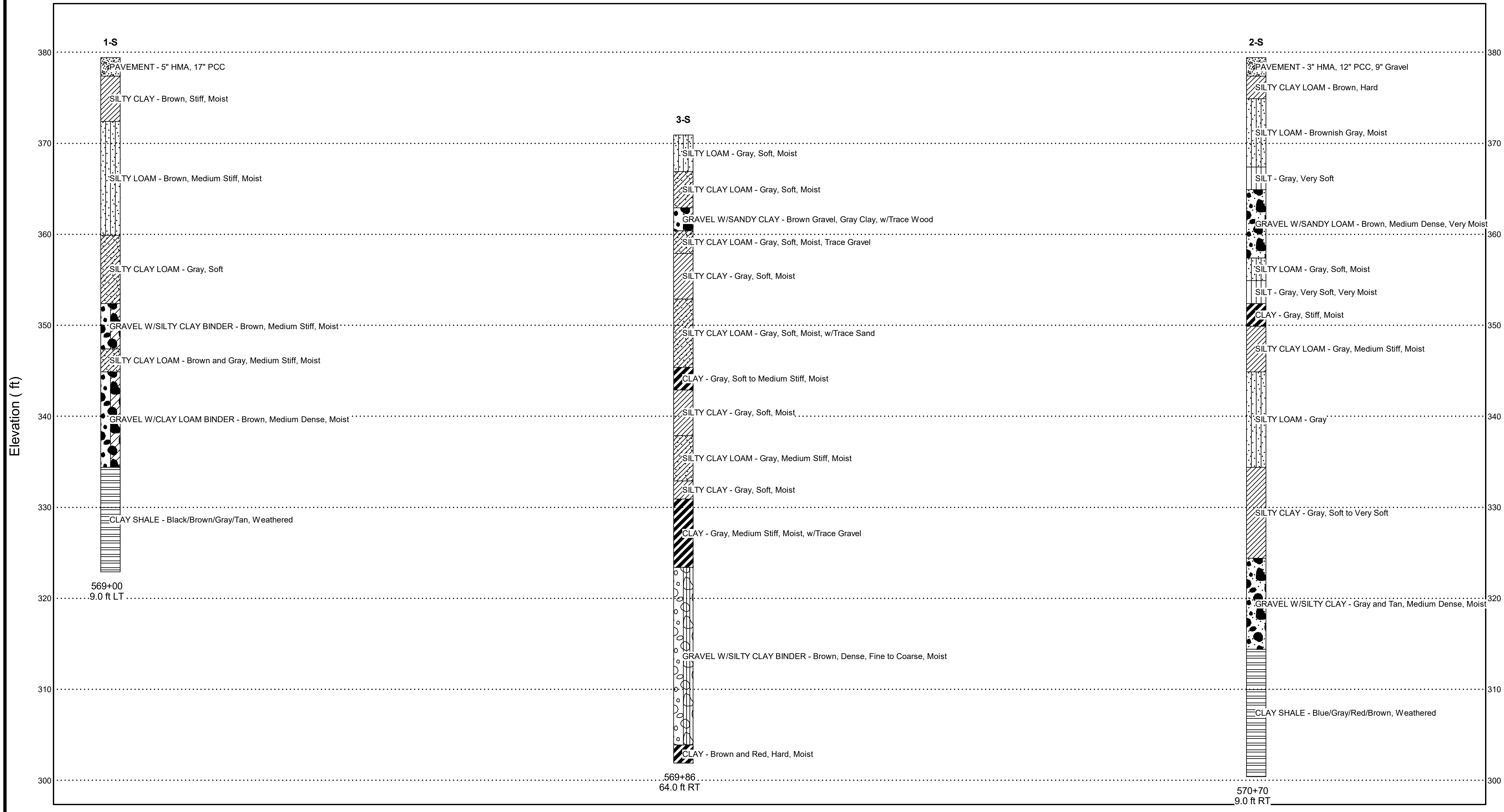
DESIGNED T.J.R.
CHECKED DM
DRAWN R.R.N.
CHECKED T.J.R.

WALTER E. HANSON COMPANY
STRUCTURAL ENGINEERS
CONSULTANTS
SPRINGFIELD, ILLINOIS PEORIA, ILLINOIS

FILE NO. 71055
DATE March 1, 1972

EXHIBIT D

SUBSURFACE PROFILE



NOT TO HORIZONTAL SCALE

Illinois Department of Transportation
Division of Highways

SUBSURFACE PROFILE

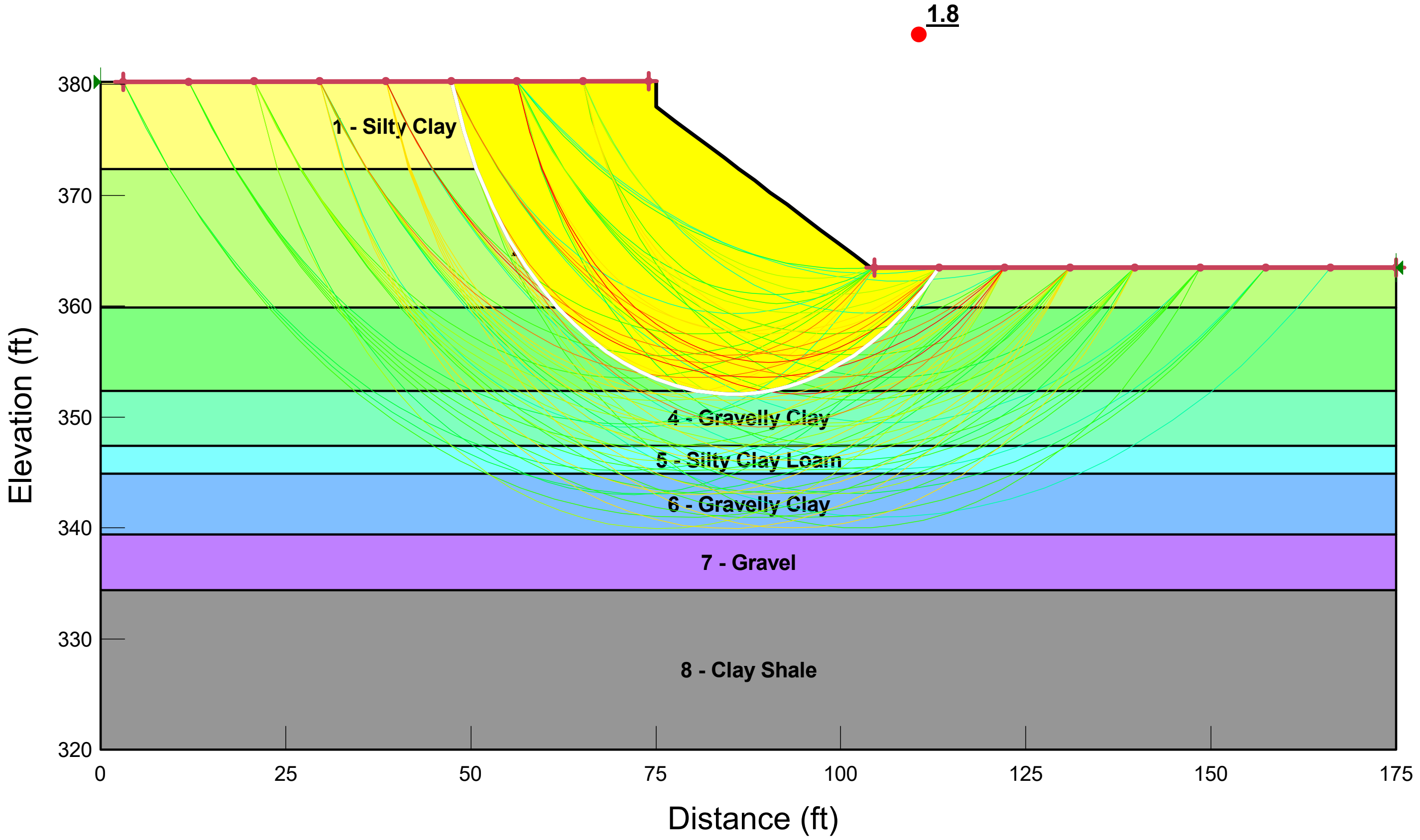
Route: IL 127
Section: 17B-1(ex.)
County: Alexander

PRINTERMOD 11X17 22-1060.05 - IL 127 OVER HARTLINE CREEK.GPJ IL_DOT.GDT 6/6/24

EXHIBIT E

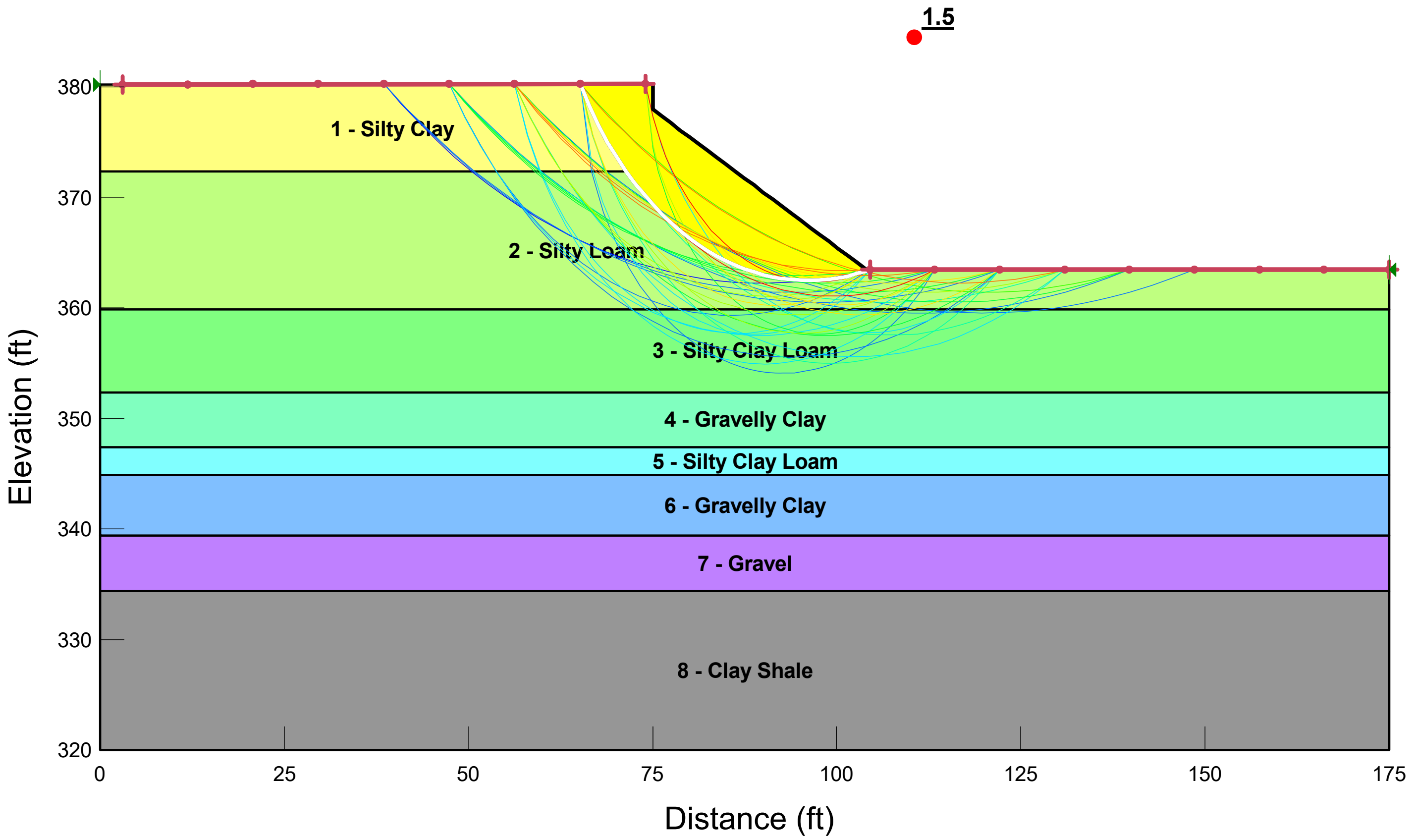
SLOPE W SLOPE STABILITY ANALYSIS

IL 127 over Hartline Creek
North Abutment
Boring 1-S (1V:2H)
End of Construction (Undrained Condition)



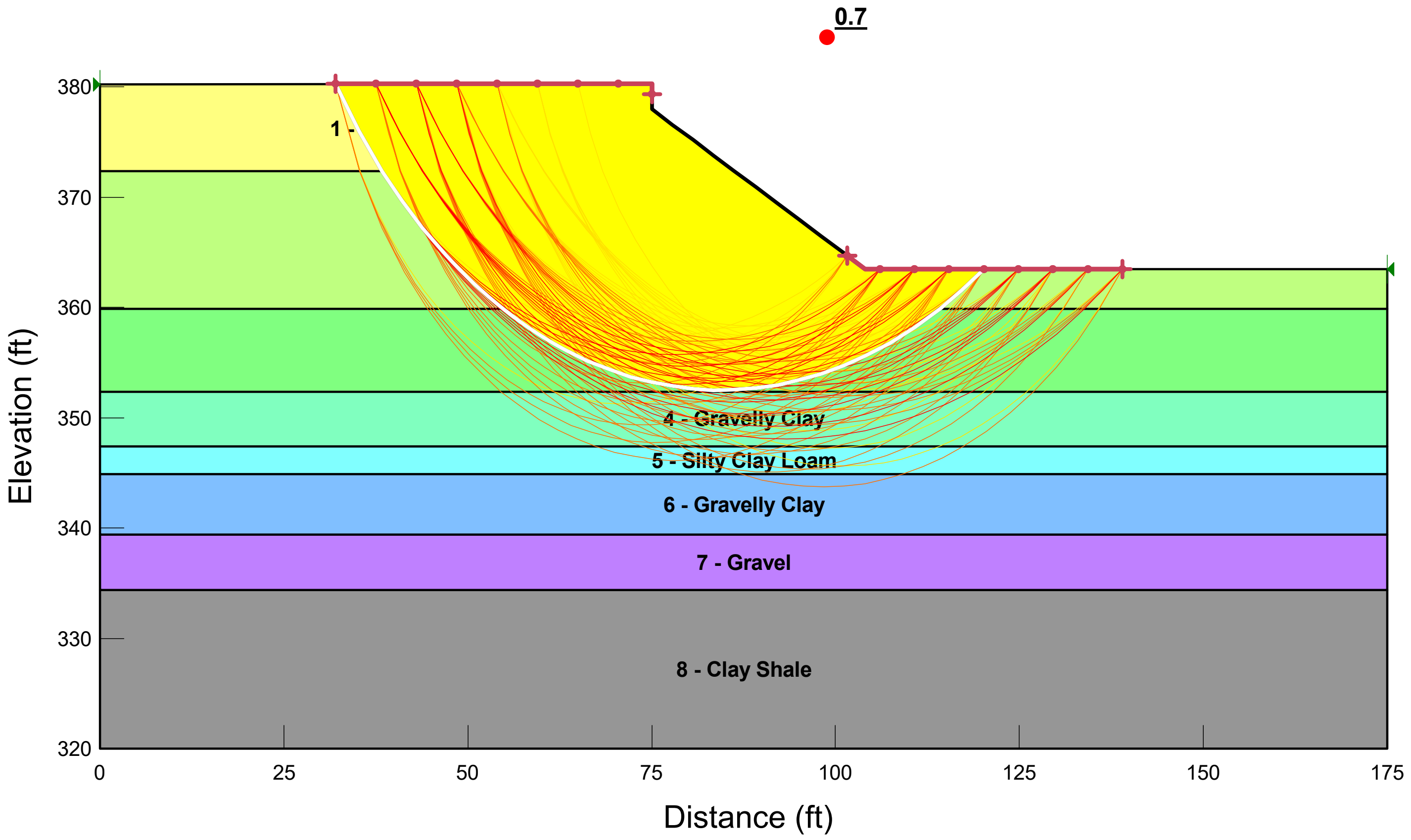
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay	Mohr-Coulomb	120	850	0
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silty Clay Loam	Mohr-Coulomb	120	500	0
🟩	4 - Gravelly Clay	Mohr-Coulomb	125	800	0
🟦	5 - Silty Clay Loam	Mohr-Coulomb	120	800	0
🟦	6 - Gravelly Clay	Mohr-Coulomb	125	825	0
🟪	7 - Gravel	Mohr-Coulomb	125	0	38
⬛	8 - Clay Shale	Mohr-Coulomb	135	4,000	12

IL 127 over Hartline Creek
North Abutment
Boring 1-S (1V:2H)
Long Term (Drained Condition)



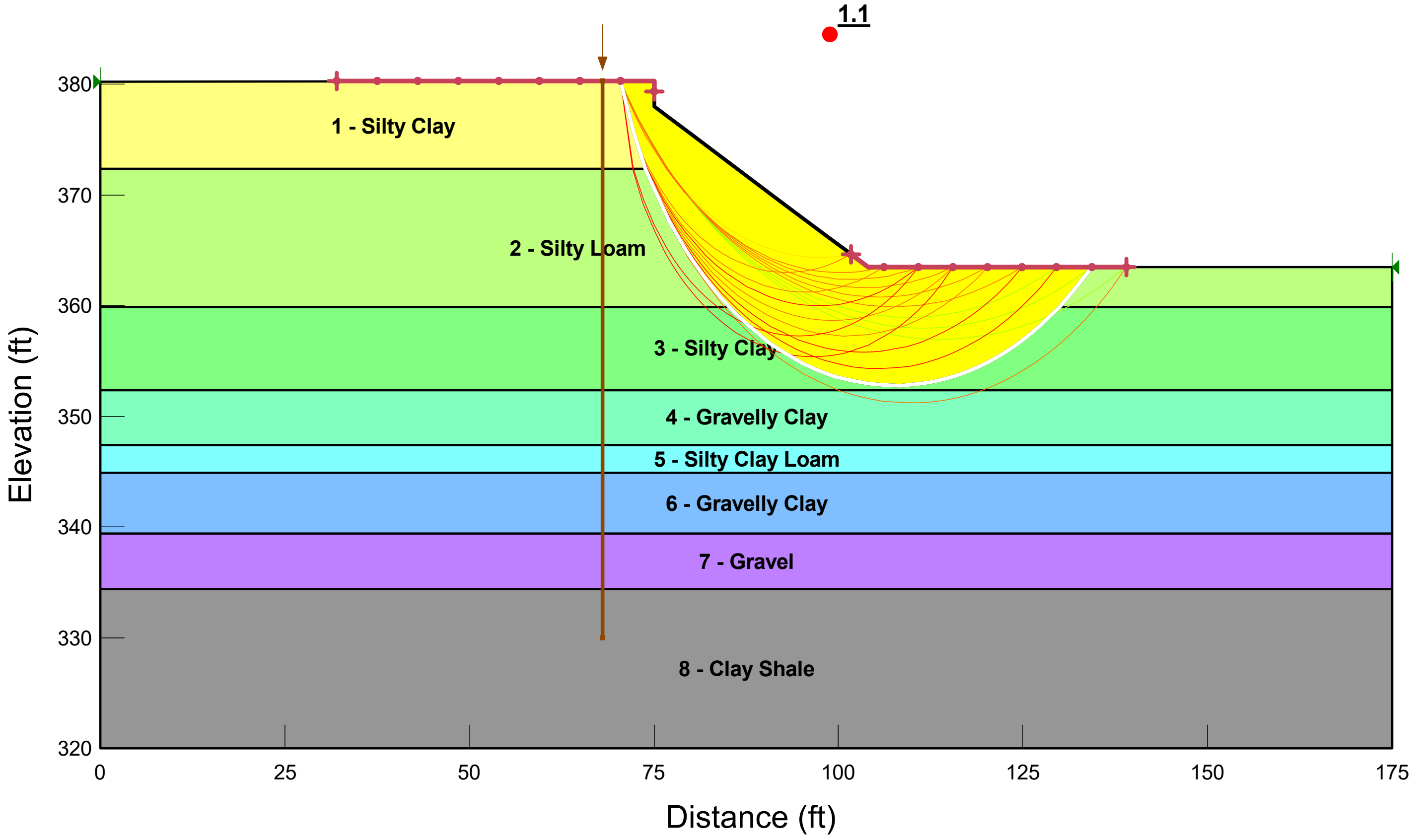
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay	Mohr-Coulomb	120	100	26
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silty Clay Loam	Mohr-Coulomb	120	50	28
🟩	4 - Gravelly Clay	Mohr-Coulomb	125	100	38
🟦	5 - Silty Clay Loam	Mohr-Coulomb	120	150	28
🟦	6 - Gravelly Clay	Mohr-Coulomb	125	100	38
🟪	7 - Gravel	Mohr-Coulomb	125	0	38
⬛	8 - Clay Shale	Mohr-Coulomb	135	4,000	12

IL 127 over Hartline Creek
North Abutment
Boring 1-S (1V:2H)
Seismic (Ks=0.362)



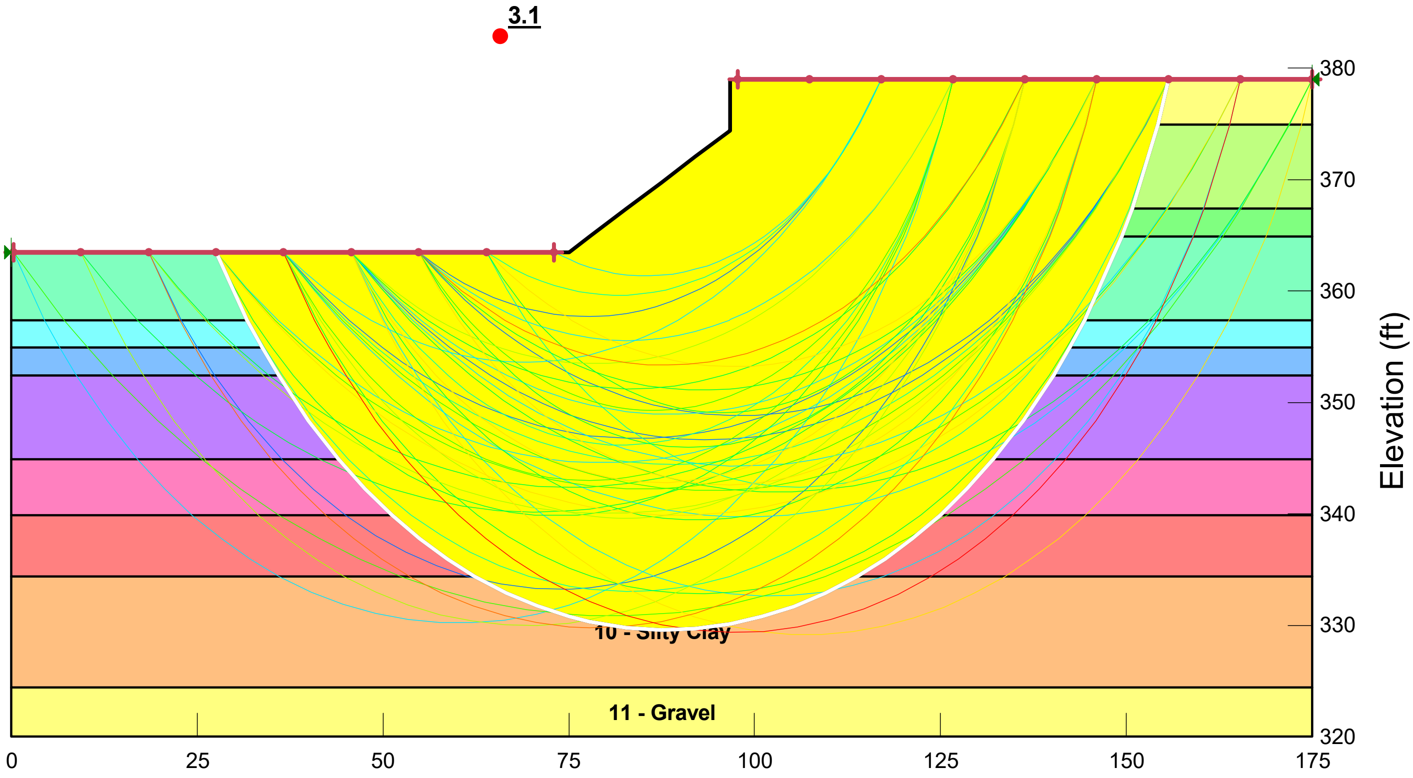
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay	Mohr-Coulomb	120	850	0
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silty Clay Loam	Mohr-Coulomb	120	500	0
🟩	4 - Gravelly Clay	Mohr-Coulomb	125	800	0
🟦	5 - Silty Clay Loam	Mohr-Coulomb	120	800	0
🟦	6 - Gravelly Clay	Mohr-Coulomb	125	825	0
🟪	7 - Gravel	Mohr-Coulomb	125	0	38
⬛	8 - Clay Shale	Mohr-Coulomb	135	4,000	12

IL 127 over Hartline Creek
North Abutment
Boring 1-S (1V:2H)
Seismic (Ks=0.362) with Abut. Pier



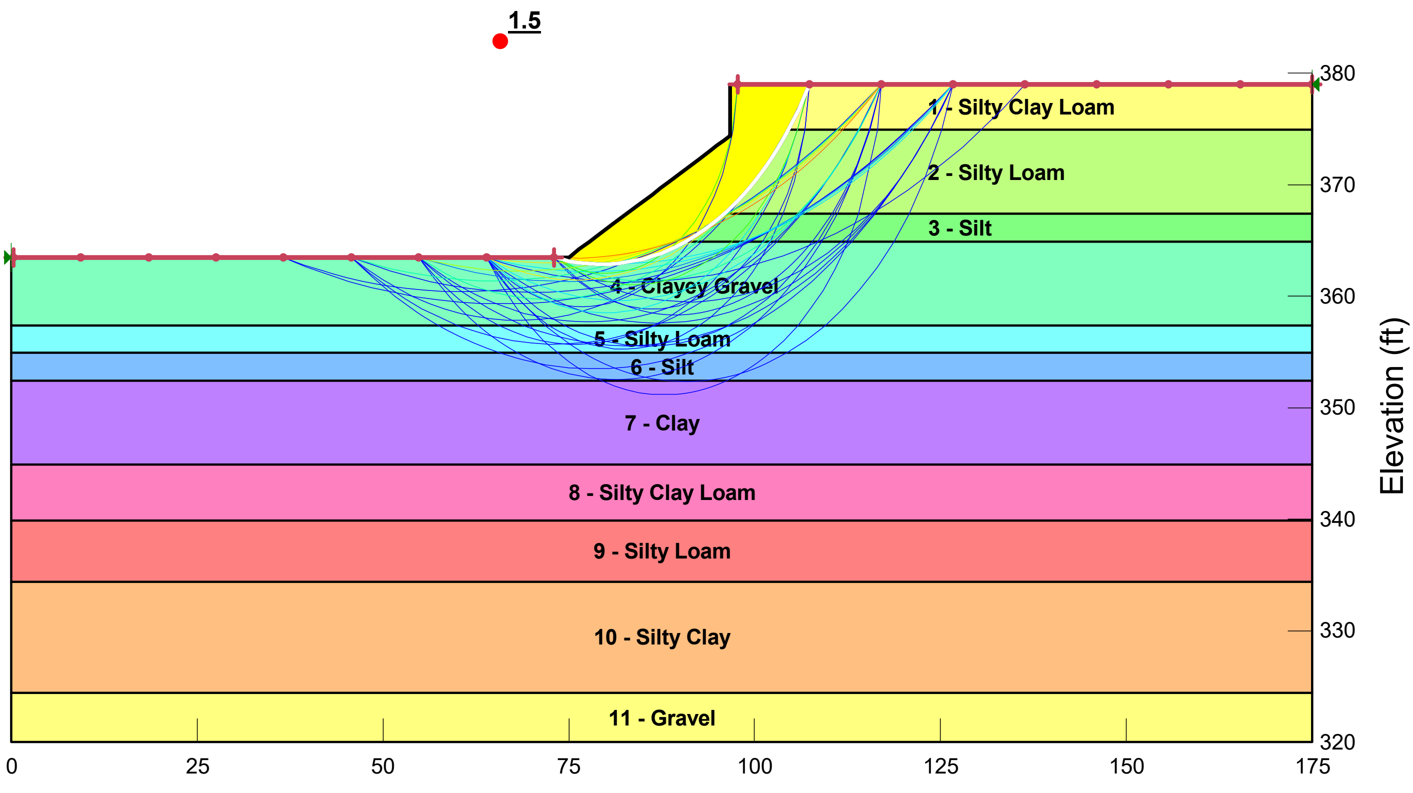
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay	Mohr-Coulomb	120	850	0
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silty Clay Loam	Mohr-Coulomb	120	500	0
🟩	4 - Gravelly Clay	Mohr-Coulomb	125	800	0
🟦	5 - Silty Clay Loam	Mohr-Coulomb	120	800	0
🟦	6 - Gravelly Clay	Mohr-Coulomb	125	825	0
🟪	7 - Gravel	Mohr-Coulomb	125	0	38
⬛	8 - Clay Shale	Mohr-Coulomb	135	4,000	12

IL 127 over Hartline Creek
South Abutment
Boring 2-S (1V:2H)
End of Construction (Undrained Condition)



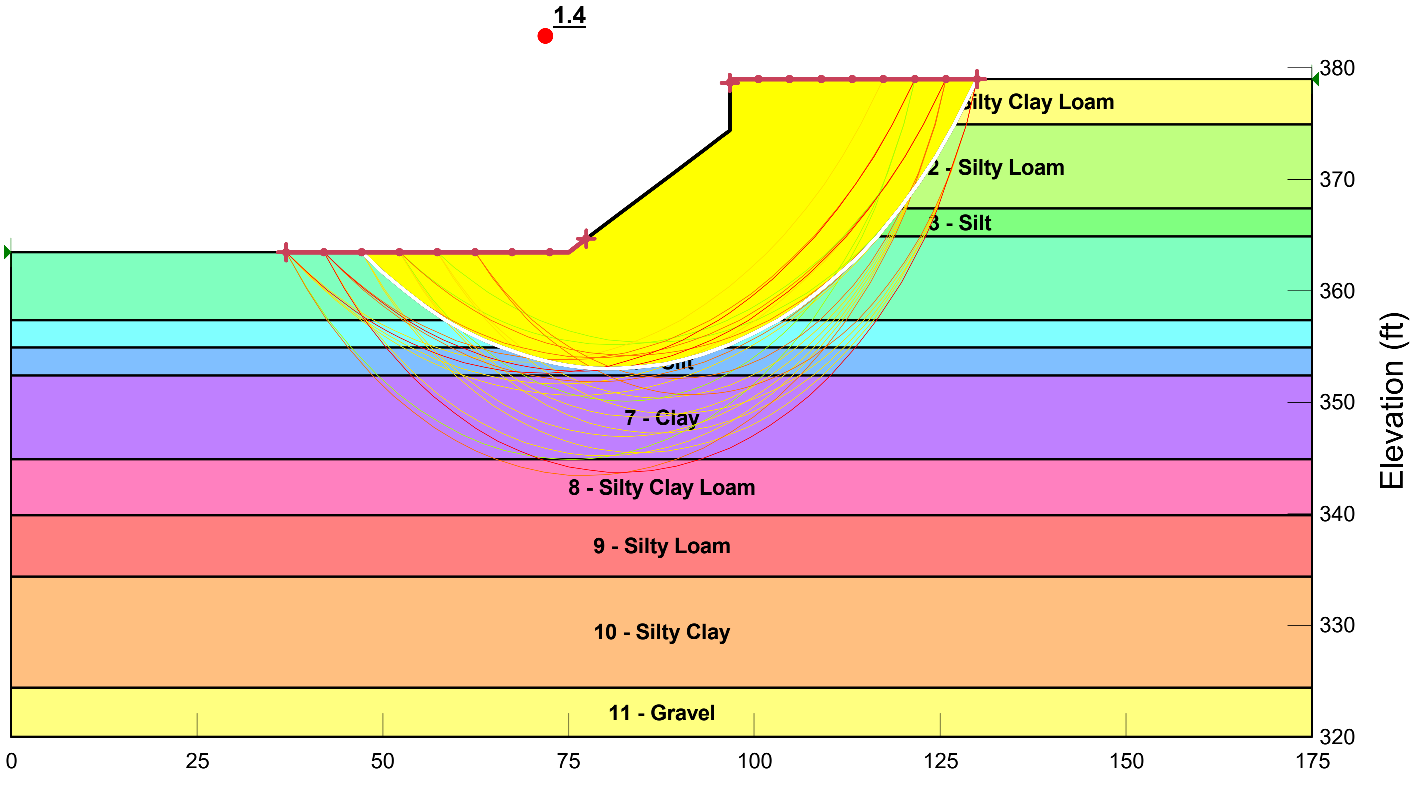
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay Loam	Mohr-Coulomb	120	4,950	0
🟧	10 - Silty Clay	Mohr-Coulomb	120	300	0
🟨	11 - Gravel	Mohr-Coulomb	125	0	38
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silt	Mohr-Coulomb	110	400	0
🟩	4 - Clayey Gravel	Mohr-Coulomb	125	0	38
🟦	5 - Silty Loam	Mohr-Coulomb	120	0	29
🟦	6 - Silt	Mohr-Coulomb	110	400	0
🟪	7 - Clay	Mohr-Coulomb	120	1,300	0
🟪	8 - Silty Clay Loam	Mohr-Coulomb	120	800	0
🟥	9 - Silty Loam	Mohr-Coulomb	120	0	30

IL 127 over Hartline Creek
South Abutment
Boring 2-S (1V:2H)
Long Term (Drained Condition)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay Loam	Mohr-Coulomb	120	100	28
🟧	10 - Silty Clay	Mohr-Coulomb	120	50	26
🟨	11 - Gravel	Mohr-Coulomb	125	0	38
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silt	Mohr-Coulomb	110	50	26
🟩	4 - Clayey Gravel	Mohr-Coulomb	125	0	38
🟦	5 - Silty Loam	Mohr-Coulomb	120	0	29
🟦	6 - Silt	Mohr-Coulomb	110	50	26
🟪	7 - Clay	Mohr-Coulomb	120	100	26
🟥	8 - Silty Clay Loam	Mohr-Coulomb	120	100	28
🟥	9 - Silty Loam	Mohr-Coulomb	120	0	30

IL 127 over Hartline Creek
South Abutment
Boring 2-S (1V:2H)
Seismic (Ks=0.362)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
🟨	1 - Silty Clay Loam	Mohr-Coulomb	120	4,950	0
🟧	10 - Silty Clay	Mohr-Coulomb	120	300	0
🟨	11 - Gravel	Mohr-Coulomb	125	0	38
🟩	2 - Silty Loam	Mohr-Coulomb	120	0	30
🟩	3 - Silt	Mohr-Coulomb	110	400	0
🟩	4 - Clayey Gravel	Mohr-Coulomb	125	0	38
🟦	5 - Silty Loam	Mohr-Coulomb	120	0	29
🟦	6 - Silt	Mohr-Coulomb	110	400	0
🟪	7 - Clay	Mohr-Coulomb	120	1,300	0
🟪	8 - Silty Clay Loam	Mohr-Coulomb	120	800	0
🟥	9 - Silty Loam	Mohr-Coulomb	120	0	30

EXHIBIT F

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ====================================== 1-S
ELEVATION OF BORING GROUND SURFACE ========================= 379.40 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ======================= 19.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==================== 19.50 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.535
EARTHQUAKE MOMENT MAGNITUDE ================================= 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===================== FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 2.5 to 4.5 IN.
SAMPLING METHOD== Sampler w/out Liners

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

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **413** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 30
Ground Motion Prediction Equations = NMSZ
PGA = **0.535**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
374.9	4.5	7	1.25				24	0.124	0.558	10.615	10.615	0.119	0.124	0.558	0.558	1.369	**0.162**	0.944	**0.328**	**N.L. (1)**
372.4	7	9	0.45				24	0.113	0.841	12.721	12.721	0.138	0.113	0.841	0.841	1.258	**0.174**	0.906	**0.315**	**N.L. (1)**
369.9	9.5	4	0.6				22	0.116	1.131	5.465	5.465	0.076	0.116	1.131	1.131	1.136	**0.086**	0.864	**0.301**	**N.L. (1)**
367.4	12	11					24	0.119	1.428	15.118	15.118	0.161	0.119	1.428	1.428	1.110	**0.179**	0.819	**0.285**	**N.L. (1)**
364.9	14.5	2						0.101	1.681	2.622	2.622	0.056	0.101	1.681	1.681	1.048	**0.059**	0.772	**0.269**	**N.L. (1)**
362.4	17	6	0.6				28	0.116	1.971	7.574	7.574	0.092	0.116	1.971	1.971	1.016	**0.094**	0.725	**0.252**	**N.L. (1)**
359.9	19.5	5	1				46	0.122	2.276	6.033	6.033	0.080	0.122	2.276	2.276	0.985	**0.079**	0.679	**0.236**	**N.L. (1)**
357.4	22	1	0.2		6	42	28	0.042	2.381	1.198	1.198	0.050	0.042	2.381	2.537	0.977	**0.049**	0.636	**0.236**	**N.L. (2)**
354.9	24.5	4	0.45		12	32	27	0.050	2.506	4.719	4.719	0.070	0.050	2.506	2.818	0.967	**0.068**	0.597	**0.233**	**N.L. (2)**
352.4	27	5	0.85		6	42	24	0.057	2.648	5.779	5.779	0.078	0.057	2.648	3.116	0.955	**0.074**	0.561	**0.230**	**N.L. (2)**
349.9	29.5	13	0.8		6	42	18	0.057	2.791	14.886	14.886	0.159	0.057	2.791	3.415	0.931	**0.148**	0.531	**0.226**	**N.L. (2)**
347.4	32	14	0.8		6	42	20	0.057	2.933	15.760	15.760	0.168	0.057	2.933	3.713	0.917	**0.154**	0.505	**0.222**	**N.L. (2)**
344.9	34.5	24	0.8				26	0.057	3.076	28.317	28.317	0.381	0.057	3.076	4.012	0.879	**0.335**	0.484	**0.219**	**N.L. (3)**
342.4	37	22					21	0.068	3.246	24.816	24.816	0.288	0.068	3.246	4.338	0.871	**0.251**	0.466	**0.217**	**1.157 (D)**
339.9	39.5	6	0.65		6	42	22	0.054	3.381	6.199	6.199	0.081	0.054	3.381	4.629	0.908	**0.074**	0.452	**0.215**	**N.L. (2)**
334.9	44.5	80	7.8				19	0.085	3.806	91.659	91.659	0.657	0.085	3.806	5.366	0.791	**0.520**	0.431	**0.212**	**N.L. (3)**
332.4	47	31	4					0.076	3.996	32.476	32.476	0.892	0.076	3.996	5.712	0.790	**0.705**	0.424	**0.211**	**N.L. (3)**
329.9	49.5	26	6.2				15	0.082	4.201	25.575	25.575	0.304	0.082	4.201	6.073	0.799	**0.243**	0.419	**0.210**	**N.L. (3)**
327.4	52	56	11.1				17	0.090	4.426	58.854	58.854	0.391	0.090	4.426	6.454	0.745	**0.291**	0.414	**0.210**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

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

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===================================== 2-S
ELEVATION OF BORING GROUND SURFACE ========================== 379.40 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 14.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE =================== 14.50 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.535
EARTHQUAKE MOMENT MAGNITUDE ================================= 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==================== FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 2.5 to 4.5 IN.
SAMPLING METHOD== Sampler w/out Liners

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

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **388** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 30
Ground Motion Prediction Equations = NMZS
PGA = **0.535**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
374.9	4.5	19	4.95				15	0.141	0.635	32.533	32.533	0.918	0.141	0.635	0.635	1.500	**1.377**	0.933	**0.325**	**N.L. (1)**
372.4	7	5	0.8				22	0.119	0.932	6.734	6.734	0.086	0.119	0.932	0.932	1.189	**0.102**	0.890	**0.309**	**N.L. (1)**
369.9	9.5	6	0.95				21	0.121	1.235	7.972	7.972	0.096	0.121	1.235	1.235	1.126	**0.108**	0.842	**0.293**	**N.L. (1)**
367.4	12	7	0.45				22	0.113	1.517	9.167	9.167	0.106	0.113	1.517	1.517	1.079	**0.114**	0.793	**0.276**	**N.L. (1)**
364.9	14.5	1					28	0.095	1.755	1.288	1.288	0.050	0.095	1.755	1.755	1.039	**0.052**	0.743	**0.258**	**N.L. (1)**
362.4	17	18		20			25	0.066	1.920	24.823	30.409	0.499	0.066	1.920	2.076	1.036	**0.517**	0.693	**0.261**	**1.981 (D)**
359.9	19.5	13		20			25	0.063	2.077	16.823	21.774	0.239	0.063	2.077	2.389	1.006	**0.240**	0.646	**0.259**	0.927 **(D)**
357.4	22	15		20			25	0.065	2.240	19.272	24.418	0.281	0.065	2.240	2.708	0.983	**0.276**	0.603	**0.254**	**1.087 (D)**
354.9	24.5	5	0.4		28	48	28	0.049	2.362	6.071	6.071	0.080	0.049	2.362	2.986	0.978	**0.078**	0.565	**0.248**	**N.L. (2)**
352.4	27	1	0.4		12	28	30	0.049	2.485	1.193	1.193	0.050	0.049	2.485	3.265	0.969	**0.048**	0.531	**0.243**	**N.L. (2)**
349.9	29.5	4	1.3		20	55	29	0.062	2.640	4.656	4.656	0.070	0.062	2.640	3.576	0.957	**0.067**	0.502	**0.237**	**N.L. (2)**
347.4	32	5	0.8		28	48	29	0.057	2.782	5.689	5.689	0.077	0.057	2.782	3.874	0.946	**0.073**	0.478	**0.232**	**N.L. (2)**
344.9	34.5	6	0.8		28	48	26	0.057	2.925	6.673	6.673	0.085	0.057	2.925	4.173	0.934	**0.079**	0.458	**0.227**	**N.L. (2)**
342.4	37	6	0.3		13	35	27	0.046	3.040	6.557	6.557	0.084	0.046	3.040	4.444	0.927	**0.078**	0.442	**0.225**	**N.L. (2)**
337.4	42	6	0.8		13	35	26	0.057	3.325	6.276	6.276	0.082	0.057	3.325	5.041	0.911	**0.075**	0.419	**0.221**	**N.L. (2)**
334.4	45	5	0.8		13	35	26	0.057	3.496	5.099	5.099	0.073	0.057	3.496	5.399	0.904	**0.066**	0.410	**0.220**	**N.L. (2)**
329.4	50	3	0.45		20	40	28	0.050	3.746	2.952	2.952	0.058	0.050	3.746	5.961	0.892	**0.052**	0.399	**0.221**	**N.L. (2)**
324.4	55	1	0.15		20	40	25	0.039	3.941	0.958	0.958	0.049	0.039	3.941	6.468	0.883	**0.043**	0.392	**0.224**	**N.L. (2)**
319.4	60	15	0.1		6	42	19	0.035	4.116	14.078	14.078	0.151	0.035	4.116	6.955	0.843	**0.127**	0.389	**0.228**	**N.L. (2)**
314.4	65	47	0.1				19	0.035	4.291	50.597	50.597	0.310	0.035	4.291	7.442	0.754	**0.234**	0.383	**0.231**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

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

Illinois Department
of Transportation

LIQUEFACTION ANALYSIS

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

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **242** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 30
Ground Motion Prediction Equations = NMSZ
PGA = **0.535**

REFERENCE BORING NUMBER ====================================== 3-S
ELEVATION OF BORING GROUND SURFACE ========================== 370.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 8.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==================== 8.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.535
EARTHQUAKE MOMENT MAGNITUDE ================================= 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===================== FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 2.5 to 4.5 IN.
SAMPLING METHOD== Sampler w/out Liners

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
366.9	4	3	0.4				26	0.111	0.444	4.700	4.700	0.070	0.111	0.444	0.444	1.367	**0.095**	0.866	**0.301**	**N.L. (1)**
365.4	5.5	2	0.5				28	0.114	0.615	2.964	2.964	0.058	0.114	0.615	0.615	1.281	**0.074**	0.816	**0.284**	**N.L. (1)**
362.9	8	1	0.2				31	0.104	0.875	1.403	1.403	0.050	0.104	0.875	0.875	1.194	**0.060**	0.738	**0.257**	**N.L. (1)**
360.4	10.5	4	0.1		20	40	42	0.035	0.963	5.875	5.875	0.079	0.035	0.963	1.119	1.176	**0.093**	0.665	**0.269**	**N.L. (2)**
357.9	13	2	0.1		20	40	28	0.035	1.050	3.013	3.013	0.058	0.035	1.050	1.362	1.151	**0.067**	0.601	**0.271**	**N.L. (2)**
355.4	15.5	1	0.5		20	40	29	0.051	1.178	1.507	1.507	0.051	0.051	1.178	1.646	1.125	**0.057**	0.545	**0.265**	**N.L. (2)**
352.9	18	1	0.1		20	40	32	0.035	1.265	1.510	1.510	0.051	0.035	1.265	1.889	1.109	**0.056**	0.497	**0.258**	**N.L. (2)**
350.4	20.5	3	0.1		20	40	26	0.035	1.353	4.505	4.505	0.068	0.035	1.353	2.133	1.094	**0.075**	0.456	**0.250**	**N.L. (2)**
347.9	23	2	0.3		20	40	30	0.046	1.468	2.954	2.954	0.058	0.046	1.468	2.404	1.076	**0.063**	0.423	**0.241**	**N.L. (2)**
345.4	25.5	4	0.4		20	40	25	0.049	1.590	5.783	5.783	0.078	0.049	1.590	2.682	1.061	**0.083**	0.397	**0.233**	**N.L. (2)**
342.9	28	1	0.6		40	65	31	0.053	1.723	1.410	1.410	0.050	0.053	1.723	2.971	1.042	**0.053**	0.375	**0.225**	**N.L. (2)**
340.4	30.5	1	0.3		20	40	32	0.046	1.838	1.380	1.380	0.050	0.046	1.838	3.242	1.029	**0.052**	0.358	**0.220**	**N.L. (2)**
337.9	33	5	0.6		20	40	27	0.053	1.970	6.722	6.722	0.085	0.053	1.970	3.530	1.016	**0.087**	0.345	**0.215**	**N.L. (2)**
335.4	35.5	4	0.7		20	40	26	0.055	2.108	5.237	5.237	0.074	0.055	2.108	3.824	1.001	**0.074**	0.334	**0.211**	**N.L. (2)**
332.9	38	5	0.6		20	40	26	0.053	2.240	6.385	6.385	0.083	0.053	2.240	4.112	0.989	**0.082**	0.326	**0.208**	**N.L. (2)**
330.9	40	2	0.5		20	40	28	0.051	2.342	2.507	2.507	0.056	0.051	2.342	4.339	0.980	**0.054**	0.320	**0.206**	**N.L. (2)**
323.4	47.5	11	0.4		20	40	22	0.049	2.710	12.928	12.928	0.140	0.049	2.710	5.174	0.941	**0.132**	0.308	**0.204**	**N.L. (2)**
320.9	50	47					17	0.075	2.897	63.174	63.174	0.429	0.075	2.897	5.518	0.883	**0.378**	0.305	**0.202**	**N.L. (3)**
315.9	55	28					16	0.070	3.247	33.450	33.450	2.060	0.070	3.247	6.180	0.851	**1.753**	0.302	**0.200**	**N.L. (3)**
310.9	60	21					18	0.068	3.587	22.468	22.468	0.249	0.068	3.587	6.832	0.850	**0.211**	0.300	**0.199**	**1.060 (D)**
303.9	67	34					14	0.072	4.091	35.936	35.936	-0.255	0.072	4.091	7.773	0.772	**-0.197**	0.294	**0.194**	**N.L. (3)**
301.9	69	52	4.5				20	0.078	4.247	56.343	56.343	0.368	0.078	4.247	8.053	0.757	**0.279**	0.291	**0.192**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

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

EXHIBIT G

PILE LENGTH/PILE TYPE

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== North Abutment
REFERENCE BORING ================================ 1-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 374.05 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 372.05 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 372.05 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

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
335 KIPS	**335** KIPS	**184** KIPS	**45** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD =============== 860 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 35.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 196.57 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 73.71 KIPS

PILE TYPE AND SIZE ============= Steel HP 10 X 42
Plugged Pile Perimeter========================== 3.300 FT. Unplugged Pile Perimeter=============== 4.858 FT.
Plugged Pile End Bearing Area==================== 0.680 SQFT. Unplugged Pile End Bearing Area========= 0.086 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
369.55	2.50	0.45	9		2.9		8.6	4.3		***5.0***	5	0	0	3	5
367.05	2.50	0.60	4		3.8	5.7	20.7	5.6	0.7	***11.6***	12	0	0	6	7
364.55	2.50		11	Very Fine Silty Sand	1.4	14.0	***10.7***	2.1	1.8	12.3	11	0	0	6	10
362.05	2.50		2	Very Fine Silty Sand	0.3	2.5	14.1	0.4	0.3	***13.1***	13	0	0	7	12
359.55	2.50	0.60	6		3.8	5.7	21.7	5.6	0.7	***19.1***	19	0	0	11	15
357.05	2.50	1.00	5		5.9	9.5	***19.9***	8.6	1.2	26.8	20	0	0	11	17
354.55	2.50	0.20	0		1.4	1.9	***23.7***	2.0	0.2	29.1	24	0	0	13	20
352.05	2.50	0.45	4		2.9	4.3	***30.4***	4.3	0.5	33.9	30	0	0	17	22
349.55	2.50	0.85	5		5.1	8.1	49.5	7.5	1.0	***43.2***	43	0	0	24	25
347.05	2.50		13	Sandy Gravel	2.5	22.0	53.7	3.7	2.8	***47.1***	47	0	0	26	27
344.55	2.50		14	Sandy Gravel	2.7	23.7	***40.3***	4.0	3.0	49.0	40	0	0	22	30
342.05	2.50	0.80	24		4.9	7.6	74.8	7.2	1.0	***59.9***	60	0	0	33	32
339.55	2.50		22	Sandy Gravel	4.2	37.3	***51.9***	6.2	4.7	62.8	52	0	0	29	35
337.05	2.50		6	Sandy Gravel	1.2	10.2	178.5	1.7	1.3	***80.3***	80	0	0	44	37
332.05	5.00		80	Sandy Gravel	84.8	135.6	212.4	124.8	17.2	***198.7***	199	0	0	109	42
331.05	1.00			Shale	41.1	84.8	***253.6***	60.5	10.7	259.2	254	0	0	139	43
330.05	1.00			Shale	41.1	84.8	***294.7***	60.5	10.7	319.8	295	0	0	162	44
329.05	1.00			Shale	41.1	84.8	***335.8***	60.5	10.7	380.3	~~336~~	~~*0*~~	~~*0*~~	~~*185*~~	~~*45*~~
328.05	1.00			Shale	41.1	84.8	***376.9***	60.5	10.7	440.8	~~377~~	~~*0*~~	~~*0*~~	~~*207*~~	~~*46*~~
327.05	1.00			Shale	41.1	84.8	***418.0***	60.5	10.7	501.3	~~418~~	~~*0*~~	~~*0*~~	~~*230*~~	~~*47*~~
326.05	1.00			Shale	41.1	84.8	***459.1***	60.5	10.7	561.9	~~459~~	~~*0*~~	~~*0*~~	~~*253*~~	~~*48*~~
325.05	1.00			Shale	41.1	84.8	***500.2***	60.5	10.7	622.4	~~500~~	~~*0*~~	~~*0*~~	~~*275*~~	~~*49*~~
324.05	1.00			Shale	41.1	84.8	***541.3***	60.5	10.7	682.9	~~541~~	~~*0*~~	~~*0*~~	~~*298*~~	~~*50*~~
323.05	1.00			Shale	41.1	84.8	***582.4***	60.5	10.7	743.4	~~582~~	~~*0*~~	~~*0*~~	~~*320*~~	~~*51*~~
322.05	1.00			Shale	41.1	84.8	***623.5***	60.5	10.7	803.9	~~624~~	~~*0*~~	~~*0*~~	~~*343*~~	~~*52*~~
321.05	1.00			Shale	41.1	84.8	***664.6***	60.5	10.7	864.5	~~665~~	~~*0*~~	~~*0*~~	~~*366*~~	~~*53*~~
320.05	1.00			Shale	41.1	84.8	***705.8***	60.5	10.7	925.0	~~706~~	~~*0*~~	~~*0*~~	~~*388*~~	~~*54*~~
319.05	1.00			Shale	41.1	84.8	***746.9***	60.5	10.7	985.5	~~747~~	~~*0*~~	~~*0*~~	~~*411*~~	~~*55*~~
318.05	1.00			Shale	41.1	84.8	***788.0***	60.5	10.7	1046.0	~~788~~	~~*0*~~	~~*0*~~	~~*433*~~	~~*56*~~
317.05	1.00			Shale	41.1	84.8	***829.1***	60.5	10.7	1106.5	~~829~~	~~*0*~~	~~*0*~~	~~*456*~~	~~*57*~~
316.05	1.00			Shale	41.1	84.8	***870.2***	60.5	10.7	1167.1	~~870~~	~~*0*~~	~~*0*~~	~~*479*~~	~~*58*~~
315.05	1.00			Shale	41.1	84.8	***911.3***	60.5	10.7	1227.6	~~911~~	~~*0*~~	~~*0*~~	~~*501*~~	~~*59*~~
314.05	1.00			Shale	41.1	84.8	***952.4***	60.5	10.7	1288.1	~~952~~	~~*0*~~	~~*0*~~	~~*524*~~	~~*60*~~
313.05	1.00			Shale	41.1	84.8	***993.5***	60.5	10.7	1348.6	~~994~~	~~*0*~~	~~*0*~~	~~*546*~~	~~*61*~~
312.05	1.00			Shale	41.1	84.8	***1034.6***	60.5	10.7	1409.1	~~1035~~	~~*0*~~	~~*0*~~	~~*569*~~	~~*62*~~
311.05	1.00			Shale	41.1	84.8	***1075.7***	60.5	10.7	1469.7	~~1076~~	~~*0*~~	~~*0*~~	~~*592*~~	~~*63*~~
310.05	1.00			Shale	41.1	84.8	***1116.8***	60.5	10.7	1530.2	~~1117~~	~~*0*~~	~~*0*~~	~~*614*~~	~~*64*~~
309.05	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== Pier 1 & Pier 2
REFERENCE BORING ================================ 3-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 376.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 361.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 361.10 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD =============== 1240 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 35.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 283.43 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 106.29 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	**304** KIPS	**167** KIPS	**65** 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						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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)								
358.50	2.50	0.20			2.0		11.9				12	0	0	7	18
356.00	2.50		4	Sandy Gravel	3.7	9.9	6.6				7	0	0	4	20
353.50	2.50	0.10			1.0	0.9	11.1				11	0	0	6	23
351.00	2.50	0.50			4.8	4.3	12.4				12	0	0	7	25
348.50	2.50	0.10			1.0	0.9	13.4				13	0	0	7	28
346.00	2.50	0.10			1.0	0.9	16.2				16	0	0	9	30
343.50	2.50	0.30			3.0	2.6	20.0				20	0	0	11	33
341.00	2.50	0.40			3.9	3.4	25.6				26	0	0	14	35
338.50	2.50	0.60			5.6	5.2	28.7				29	0	0	16	38
336.00	2.50	0.30			3.0	2.6	34.3				34	0	0	19	40
333.50	2.50	0.60			5.6	5.2	40.8				41	0	0	22	43
331.00	2.50	0.70			6.5	6.0	46.4				46	0	0	26	45
328.50	2.50	0.60			5.6	5.2	51.2				51	0	0	28	48
326.50	2.00	0.50			3.8	4.3	54.2				54	0	0	30	50
319.00	7.50	0.40			11.7	3.4	294.8				295	0	0	162	57
316.50	2.50		47	Sandy Gravel	81.6	232.4	282.4				282	0	0	155	60
311.50	5.00		28	Sandy Gravel	56.7	138.4	304.5				304	0	0	167	65
306.50	5.00		21	Sandy Gravel	38.9	103.8	407.7				~~408~~	~~0~~	~~0~~	~~224~~	~~70~~
299.50	7.00		34	Sandy Gravel	112.2	168.1	544.6				~~545~~	~~0~~	~~0~~	~~300~~	~~77~~
294.50	5.00		52	Hard Till	53.7	192.8	598.3				~~598~~	~~0~~	~~0~~	~~329~~	~~82~~
289.50	5.00		52	Hard Till	53.7	192.8	652.1				~~652~~	~~0~~	~~0~~	~~359~~	~~87~~
284.50	5.00		52	Hard Till	53.7	192.8	705.8				~~706~~	~~0~~	~~0~~	~~388~~	~~92~~
279.50	5.00		52	Hard Till	53.7	192.8	759.5				~~759~~	~~0~~	~~0~~	~~418~~	~~97~~
274.50	5.00		52	Hard Till	53.7	192.8	813.2				~~813~~	~~0~~	~~0~~	~~447~~	~~102~~
269.50	5.00		52	Hard Till	53.7	192.8	866.9				~~867~~	~~0~~	~~0~~	~~477~~	~~107~~
264.50	5.00		52	Hard Till	53.7	192.8	920.6				~~921~~	~~0~~	~~0~~	~~506~~	~~112~~
259.50	5.00		52	Hard Till	53.7	192.8	974.3				~~974~~	~~0~~	~~0~~	~~536~~	~~117~~
254.50	5.00		52	Hard Till	53.7	192.8	1028.1				~~1028~~	~~0~~	~~0~~	~~565~~	~~122~~
249.50	5.00		52	Hard Till	53.7	192.8	1081.8				~~1082~~	~~0~~	~~0~~	~~595~~	~~127~~
244.50	5.00		52	Hard Till	53.7	192.8	1135.5				~~1135~~	~~0~~	~~0~~	~~625~~	~~132~~
239.50	5.00		52	Hard Till	53.7	192.8	1189.2				~~1189~~	~~0~~	~~0~~	~~654~~	~~137~~
234.50	5.00		52	Hard Till	53.7	192.8	1242.9				~~1243~~	~~0~~	~~0~~	~~684~~	~~142~~
229.50	5.00		52	Hard Till	53.7	192.8	1296.6				~~1297~~	~~0~~	~~0~~	~~713~~	~~147~~
224.50	5.00		52	Hard Till	53.7	192.8	1350.3				~~1350~~	~~0~~	~~0~~	~~743~~	~~152~~
219.50	5.00		52	Hard Till	53.7	192.8	1404.0				~~1404~~	~~0~~	~~0~~	~~772~~	~~157~~
214.50	5.00		52	Hard Till	53.7	192.8	1457.8				~~1458~~	~~0~~	~~0~~	~~802~~	~~162~~
209.50	5.00		52	Hard Till		192.8									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE====================================== South Abutment
REFERENCE BORING ================================= 2-S
LRFD or ASD or SEISMIC ============================== SEISMIC
PILE CUTOFF ELEV. ================================== 373.85 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 371.85 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Liquef.
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 359.90 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== 362.40 ft

TOTAL SEISMIC SUBSTRUCTURE LOAD ================== 860 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 35.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ======= 196.57 KIPS
Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ======= 73.71 KIPS

PILE TYPE AND SIZE ============= Steel HP 10 X 42
Plugged Pile Perimeter========================== 3.300 FT.
Unplugged Pile Perimeter=============== 4.858 FT.
Plugged Pile End Bearing Area==================== 0.680 SQFT.
Unplugged Pile End Bearing Area======== 0.086 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 Seismic Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**335** KIPS	**306** KIPS	**67** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			ULTIMATE UNPLUGGED			NOMINAL REQ'D BEARING (KIPS)	NOMINAL GEOTECH. LOSS FROM LIQUEF. & DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	SEISMIC RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
369.35	2.50	0.80	5		4.9		13.9	7.2		***8.3***	8	5	5	-2	5
366.85	2.50	0.95	6		5.6	9.1	***14.8***	8.3	1.1	16.0	15	10	12	-7	7
364.35	2.50	0.45	7		2.9	4.3	***14.7***	4.3	0.5	19.9	15	13	15	-14	10
361.85	2.50		1	Very Fine Silty Sand	0.1	1.3	44.1	0.2	0.2	***23.8***	24	14	15	-5	12
359.35	2.50		18	Sandy Gravel	3.5	30.5	39.0	5.1	3.9	***27.8***	28	14	15	0	15
356.85	2.50		13	Sandy Gravel	2.5	22.0	44.9	3.7	2.8	***32.0***	32	14	15	4	17
354.35	2.50		15	Sandy Gravel	2.9	25.4	***26.2***	4.3	3.2	33.5	26	14	15	-2	20
351.85	2.50	0.40	5		2.6	3.8	***25.0***	3.9	0.5	36.8	25	14	15	-3	22
349.35	2.50		0	Very Fine Silty Sand	0.0	0.0	***37.4***	0.0	0.0	38.4	37	14	15	9	25
346.85	2.50	1.30	4		7.2	12.4	***39.8***	10.6	1.6	48.4	40	14	15	11	27
344.35	2.50	0.80	5		4.9	7.6	***44.7***	7.2	1.0	55.5	45	14	15	16	30
341.85	2.50	0.80	6		4.9	7.6	***44.8***	7.2	1.0	62.1	45	14	15	16	32
339.35	2.50	0.30	6		2.0	2.9	***51.6***	2.9	0.4	65.7	52	14	15	23	35
334.35	5.00	0.80	6		9.7	7.6	***61.3***	14.3	1.0	80.0	61	14	15	33	40
331.35	3.00	0.80	5		5.8	7.6	***63.8***	8.6	1.0	88.2	64	14	15	35	43
326.35	5.00	0.45	3		5.8	4.3	***66.8***	8.6	0.5	96.4	67	14	15	38	48
321.35	5.00	0.15	0		2.0	1.4	***92.8***	3.0	0.2	102.5	93	14	15	65	53
316.35	5.00		15	Sandy Gravel	5.8	25.4	152.9	8.5	3.2	***117.9***	118	14	15	90	58
311.35	5.00		47	Sandy Gravel	33.9	79.7	191.9	49.9	10.1	***168.4***	168	14	15	140	63
310.35	1.00			Shale	41.1	84.8	233.0	60.5	10.7	***228.9***	229	14	15	201	63.5
309.35	1.00			Shale	41.1	84.8	***274.1***	60.5	10.7	289.5	274	14	15	246	64.5
308.35	1.00			Shale	41.1	84.8	***315.2***	60.5	10.7	350.0	315	14	15	287	65.5
307.35	1.00			Shale	41.1	84.8	***356.3***	60.5	10.7	410.5	~~356~~	~~14~~	~~15~~	~~328~~	~~66.5~~
306.35	1.00			Shale	41.1	84.8	***397.4***	60.5	10.7	471.0	~~397~~	~~14~~	~~15~~	~~369~~	~~67.5~~
305.35	1.00			Shale	41.1	84.8	***438.5***	60.5	10.7	531.6	~~439~~	~~14~~	~~15~~	~~410~~	~~68.5~~
304.35	1.00			Shale	41.1	84.8	***479.6***	60.5	10.7	592.1	~~480~~	~~14~~	~~15~~	~~451~~	~~69.5~~
303.35	1.00			Shale	41.1	84.8	***520.7***	60.5	10.7	652.6	~~521~~	~~14~~	~~15~~	~~492~~	~~70.5~~
302.35	1.00			Shale	41.1	84.8	***561.8***	60.5	10.7	713.1	~~562~~	~~14~~	~~15~~	~~534~~	~~71.5~~
301.35	1.00			Shale	41.1	84.8	***603.0***	60.5	10.7	773.6	~~603~~	~~14~~	~~15~~	~~575~~	~~72.5~~
300.35	1.00			Shale	41.1	84.8	***644.1***	60.5	10.7	834.2	~~644~~	~~14~~	~~15~~	~~616~~	~~73.5~~
299.35	1.00			Shale	41.1	84.8	***685.2***	60.5	10.7	894.7	~~685~~	~~14~~	~~15~~	~~657~~	~~74.5~~
298.35	1.00			Shale	41.1	84.8	***726.3***	60.5	10.7	955.2	~~726~~	~~14~~	~~15~~	~~698~~	~~75.5~~
297.35	1.00			Shale	41.1	84.8	***767.4***	60.5	10.7	1015.7	~~767~~	~~14~~	~~15~~	~~739~~	~~76.5~~
296.35	1.00			Shale	41.1	84.8	***808.5***	60.5	10.7	1076.2	~~808~~	~~14~~	~~15~~	~~780~~	~~77.5~~
295.35	1.00			Shale	41.1	84.8	***849.6***	60.5	10.7	1136.8	~~850~~	~~14~~	~~15~~	~~821~~	~~78.5~~
294.35	1.00			Shale	41.1	84.8	***890.7***	60.5	10.7	1197.3	~~891~~	~~14~~	~~15~~	~~862~~	~~79.5~~
293.35	1.00			Shale	41.1	84.8	***931.8***	60.5	10.7	1257.8	~~932~~	~~14~~	~~15~~	~~903~~	~~80.5~~
292.35	1.00			Shale		84.8			10.7						