STRUCTURE GEOTECHNICAL REPORT

Route: FAI 74 (I-74)
Section: 48-(24B)I,I-1
County: Knox
Job No.: D-94-070-00
Contract No.: Not assigned
Structure No.: 048-0104 (Proposed)
048-0001 (Existing)

Description: Replacement of 3-span bridge structure carrying eastbound I-74 over Pope Creek in Knox County, Illinois

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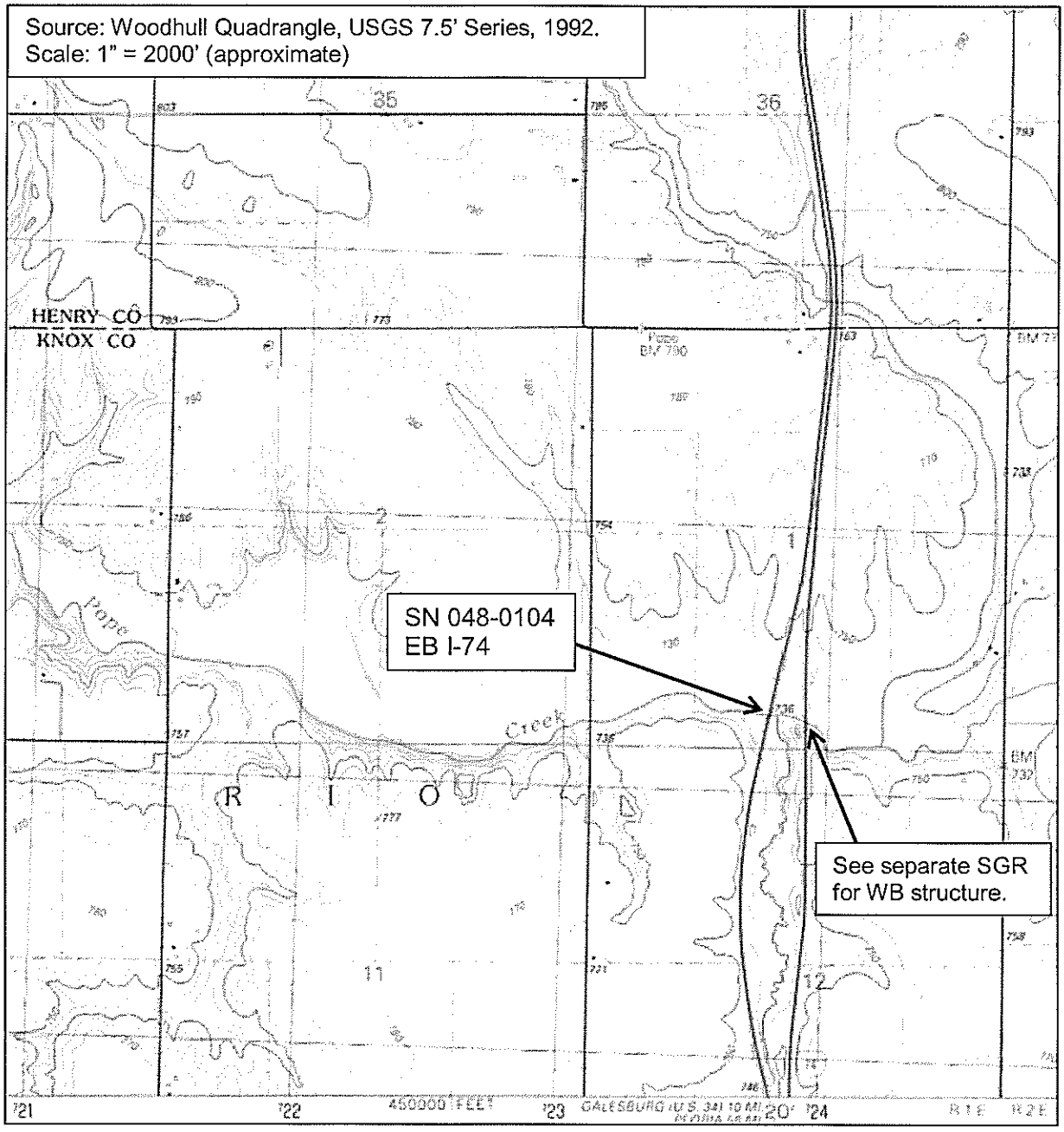
1) Project Description and Proposed Structure Information

The geotechnical study summarized in this report was performed for the proposed replacement of a 3-span bridge structure that carries eastbound I-74 over Pope Creek in Knox County, Illinois. As shown below, the bridge is located approximately one mile south of the Henry County line, in Section 1, Township 13 North, Range 1 East of the Fourth Principal Meridian, in the Galesburg Plain of the Till Plains Section.



Superstructure replacement was recommended for the bridge in a March 2012 Bridge Condition Report prepared by Epstein. In September 2012, Epstein submitted a memorandum documenting the cost benefit of a full structure replacement that reduced the number of spans and incorporated integral abutments. In June 2014, IDOT approved the Hydraulic Report which included the recommendation for full structure replacement for the bridge.

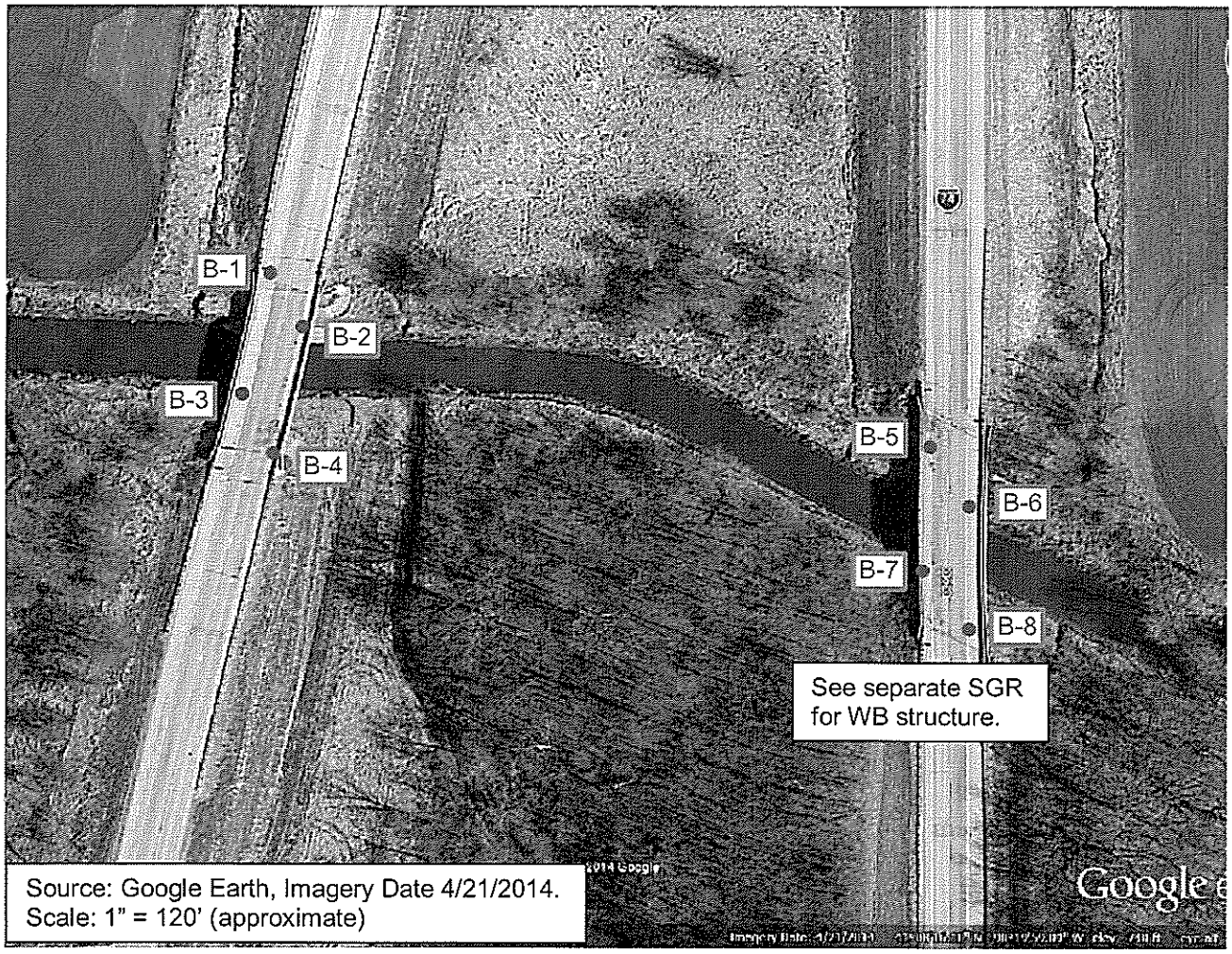
Based on the preliminary Type, Size, and Location (TS&L) plan and other information prepared by Epstein, the existing bridge will be replaced by a two-span structure with an 8-inch concrete deck supported by wide flange steel girders. The new structure will have a back to back abutment length of 131'-8", out to out deck width of 43'-2", and a 7-degree skew. The superstructure will be set on integral abutments and a pier at the channel centerline. Piles are planned for foundation support of the abutments and pier. Epstein calculated factored loads of 1,100 kips per abutment and 2,100 kips at the pier. Appendix A contains the preliminary TS&L plan.

Structure replacement is expected to include removal of existing concrete abutments. Existing concrete piles will be removed to a minimum depth of 1.0 foot below the excavation line at the existing abutments and 1.0 foot below streambed for the existing pier piles. The end-slopes will be cut back to a 2 horizontal to 1 vertical (2H:1V) slope. Staged construction will be required for the new structure.

2) Subsurface Conditions

a) Geotechnical Borings

Four standard penetration test (SPT) borings B-1 through B-4 were drilled by IDOT in a June 1961 subsurface investigation for the design of the existing bridge (SN 048-0001). The boring locations are shown on the following aerial photo.



B-1 and B-4 were abutment borings, and B-2, B-3, B-6, and B-7 were pier borings. Each boring was advanced into hard, light gray shaley clay that exhibited SPT N-values exceeding 100 blows per foot (bpf). The borings were terminated at the following elevations: B-1 at 687.8, B-2 at 688.4, B-3 at 688.3, and B-4 at 685.5. Detailed information regarding the nature and thickness of the soils encountered, and the results of field sampling and laboratory testing are shown on the boring logs included in Appendix B.

A subsurface data profile is included in Appendix C. The reliability of this subsurface information and the performance of the existing substructure are such that additional exploration is not warranted.

The natural soils beneath the eastbound structure consist of silty clay, sandy loam, sandy clay loam, clay, and shaley clay. The subsurface investigation revealed a soft to stiff silty clay that extended from the natural ground surface to depths ranging from 6.5 to 11.5 feet (Elev. 719.5 to 714.3). Moisture contents of the silty clay ranged from 22% to 41%, with an average of 31%. Unconfined compressive strengths ranged from 0.3 to 1.5 tons per square foot (tsf) with an average of 0.9 tsf. SPT N-values in the silty clay ranged from 3 to 15 bpf, with an average of 6 bpf. Beneath the silty clay, a soft to medium sandy to sandy clay loam was encountered that extended to depths ranging from 14.0 to 16.5 feet (Elev. 712.4 to 710.3). Only one sample of the sandy loam was tested for moisture content, yielding a result of 22%. Unconfined compressive strengths ranged from 0.4 to 0.7 tsf with an average of 0.5 tsf. SPT N-values ranged from 2 to 11 bpf, with an average of 4 bpf. Beneath the sandy to sandy clay loam was a very stiff to hard clay that extended to depths of 29.0 to 36.5 feet (Elev. 696.8 to 689.5). Moisture contents of the clay ranged from 16% to 19%, with an average of 17.5%. Unconfined compressive strengths ranged from 2.0 to 5.5 tons per square foot (tsf) with an average of 2.7 tsf. SPT N-values ranged from 16 to 78 bpf, with an average of 37 bpf.

Beneath the hard clay was a hard shaley clay that extended to the termination depth of each boring, which ranged from 38.0 to 40.5 feet (Elev. 688.4 to 685.5). Only one sample of the shaley clay was tested for moisture content, yielding a result of 16%. Unconfined compressive strengths ranged from 2.0 to 6.8 tsf with an average of 4.3 tsf. SPT N-values ranged from 62 to 100+ bpf.

Table 1 summarizes the locations and elevations for B-1 through B-4, including the top of the shaley clay where SPT N-values exceeded 100 bpf. Also listed are groundwater elevations measured after drilling. Except for B-4, the groundwater elevations are delayed readings taken at least 16 hours after drilling. The groundwater level for B-4 was obtained upon completion of the hole. Groundwater levels will often vary due to seasonal and climatic variations, the water level in Pope Creek, and other factors. In addition, these levels

were measured in 1961 before construction of the embankments and bridge. Based on these variables, groundwater may be present at different depths now and in the future.

Table 1 – Summary of Soil Boring Data

Eastbound I-74

Boring	Location	Station	Offset	Ground Elevation[1]	Top of Shaley Clay Elevation	Groundwater Elevation
B-1	N Abutment	177+69	12 ft RT	725.8 ft	696.8 ft	719.8 ft
B-2	Pier 1 (North)	178+04	12 ft LT	728.9 ft	694.9 ft	721.9 ft
B-3	Pier 2 (South)	178+42	12 ft RT	726.3 ft	694.8 ft	720.8 ft
B-4	S Abutment	178+77	12 ft LT	726.0 ft	689.5 ft	720.5 ft

[1] At the time of drilling in 1961, prior to bridge and embankment construction.

b) Pile Driving Data

The existing bridge was built in 1966 and consists of a three-span structure with a cast-in-place concrete slab on continuous wide flange steel beams. The superstructure is set on concrete open abutments and pile bent piers. Concrete piles provide foundation support for the abutments and piers. Creosote timber piles support the approach slabs. Pile data from the 1966 construction was obtained from the IDOT records center and is included in Appendix C. Table 2 summarizes the concrete pile data.

Table 2 – Summary of Pile Data (1966)

Eastbound I-74

Location	Required Bearing	Average Actual Bearing	Estimated Bearing Elevation
N. Abutment	25 tons	32 tons	702
S. Abutment	25 tons	37 tons	702
Piers	27 tons	52 tons	704

3) Geotechnical Evaluations

The following evaluations are based on the 1961 subsurface investigation performed by IDOT, the existing bridge plans, preliminary TS&L plans for the replacement structure, conversations with Epstein personnel familiar with the project, the Bridge Condition Report, and the Hydraulic Report. Appendix A includes the TS&L plans provided by Epstein.

a) Settlement

Settlement due to increased loading from new embankments or structures is expected to be negligible. The grade raise for the eastbound structure is less than two feet and the natural soils encountered during the subsurface investigation do not appear to be highly compressible. Settlement of the natural soils caused by the existing embankments and structures occurred many years ago. Similarly, settlement within the existing embankment would also be complete. Based on this information, a rigorous settlement analysis was not performed for soils underlying the new abutments or approach slabs. The effects of downdrag on axial pile capacity have also been neglected.

b) Slope Stability

The construction of the replacement structure should have minimal impact on the existing sideslopes and bridge approaches. The backslopes at the new abutments are proposed at 2 horizontal to 1 vertical (2H:1V). Proposed backslope heights appear to be within 1 foot of existing heights. The natural soils above channel elevation appear to be of sufficient shear strength to maintain slope stability with the structure replacement. No evidence of instability has been observed in the existing slopes. Based on this information, slope stability analyses have not been performed.

c) Seismic Considerations

The seismic site soil classification for the bridge site was determined from design earthquake data, subsurface data, and the procedures described in AGMU Memo 09.1 – Seismic Site Class Definition of the IDOT Bridge Manual Design Guides. The "Seismic Site Class Determination" spreadsheet developed by the IDOT BBS Foundations and Geotechnical Unit was also utilized. Since the proposed structure size is less than 750 feet and has span lengths less than 200 feet, the global site class definition applies to this site.

Based on the evaluations described above, Site Class C is recommended for the proposed structure.

Based on Figure 2.3.10-2 of the IDOT Bridge Manual, the Seismic Performance Zone (SPZ) for this site is 1. A seismic design parameters program by the USGS was used to determine the site's seismic parameters for a 1000 year design return period earthquake (7% probability of exceedance in 75 years). Seismic design parameters for the site are summarized in Table 3.

Table 3 – Seismic Design Parameters

Parameter	Value
Site Class	C
Design Spectral Acceleration at 0.2 sec (S_{DS})	0.107g
Design Spectral Acceleration at 1.0 sec (S_{D1})	0.068g
Seismic Performance Zone	SPZ 1

Liquefaction analyses are not required for sites classified as SPZ 1. Since liquefaction is not a concern, the effects of liquefaction with respect to axial pile capacity are neglected.

d) Scour

Foundations for the abutments and the pile bent pier are areas of primary concern for damage from scour. In accordance with IDOT Bridge Manual Section 2.3.6.3.2, the design scour elevation for open abutments protected with riprap is typically set at the bottom of the abutment. The proposed replacement structure contains integral abutments protected by Class A4, Stone Riprap. Table 4 summarizes the design scour for the proposed eastbound structure.

Table 4 – Design Scour Elevations

Eastbound I-74, SN 048-0104

Event/Limit State	Design Scour Elevations (ft.)			Item 113
	N. Abut.	Pier	S. Abut	
Q100	729.89	706.9	729.25	5
Q200	729.89	706.4	729.25	
Design	729.89	706.9	729.25	
Check	729.89	706.4	729.25	

e) Mining Activity

According to the Knox County Mine Map dated September 18, 2013, obtained from the Illinois State Geological Survey (ISGS) website at https://www.isgs.illinois.edu/ilmines, the project site was not undermined. The Map Explanation indicates locations of some features on the Mine Map may be offset by 500 feet or more due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors. The location of this bridge is approximately 2.5 miles away from the closest mining area shown on the map. Based on the distance to the nearest mapped underground mine, a study of mining impacts on the project is not warranted.

4) Foundation Design Recommendations

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loading. The factored loads calculated by Epstein for the two-span, eastbound structure are 1,100 kips per abutment and 2,100 kips at the pier. Integral abutments are planned for the replacement structure, limiting the abutment foundation alternatives to steel H-piles or metal shell piles. Metal shell piles are not feasible based on concerns that the high blow count material reported in the soil borings may cause piles to overstress before reaching the Nominal Required Bearing. Although each boring was terminated in a hard shaley clay (hard till) layer, auger refusal was not achieved and unconfined compressive strengths of the shaley clay sometimes fell below 4 tons per square foot. This leads to the conclusion that a hard bedrock unit is not present within a reasonable depth below the boring termination depths. Based on the pile design spreadsheets, H-piles must extend below the boring depths to achieve their maximum capacity and meet the required capacities for the replacement structure. Therefore, it is assumed that piles will be founded in hard till material and must rely on side friction in addition to end resistance.

General consideration was given to the use of shallow foundations and drilled shafts for the pier. However, spread footings and drilled shafts are not recommended because of the depths that may be required to achieve suitable bearing. In addition, constructability issues related to staged construction, retaining systems, and groundwater make shallow foundations or drilled shafts unfeasible.

For H-pile foundations, it is recommended that two test piles be driven for the proposed structure to verify the length of the piles. One test pile should be installed at an abutment, and one test pile should be installed at the pier. Further recommendations are provided below.

a) Steel H-Piles

The structural capacity of driven piles depends on the allowable stress and cross sectional areas of steel. The pile recommendations in this report assume that steel H-piles will conform to AASHTO M270 Grade 50 (ASTM 709 Gr 50) or equivalent with a minimum yield stress of 50 kips per square inch (ksi). Based on the current IDOT Bridge Manual, a geotechnical resistance factor (φ_G) of 0.55 was used for the design of the driven pile

foundations. As liquefaction and settlement are not concerns at the site, geotechnical losses due to liquefaction and down-drag were not considered necessary in the static or seismic pile design. Geotechnical losses associated with scour were considered for the pier only. It is anticipated that scour will be reduced to above the proposed soil surface by using class A4 riprap at the abutments.

All estimates of capacity were calculated using the "Modified IDOT Static Method" spreadsheet associated with the IDOT Bridge Manual, and assume construction verification will follow the "WSDOT" formula outlined in Section 512 of the current IDOT Standard Specifications for Road and Bridge Construction. For each structure, the top of pile elevations were obtained from the TS&L plans provided by Epstein. Ground surface elevations during driving were assumed to be equal to the bottom elevation of the proposed abutment. Table 5 provides these elevations as well as the average Q_u within the critical pile depth for each integral abutment.

Table 5 – Steel H-Pile Design Information

Eastbound I-74, SN 048-0104

Location	Top of Pile Elevation (ft)	Ground Elevation During Driving (ft)	Average Q_u Within Critical Pile Depth (psf)
N. Abutment	731.89	729.89	1.1
S. Abutment	731.25	729.89	1.3

For the bridge pier, Epstein provided a top of pile elevation of 731.0. The ground surface elevation during driving was assumed to be 718.3, which is equal to the channel centerline elevation shown on the TS&L.

A summary of the design capacities, or factored resistance available (R_F), and nominal required bearing (R_N) is presented in Appendix F for each H-pile size. Recommended pile lengths were calculated from the embedment depth estimates from the IDOT design spreadsheet and the top elevations estimated from the preliminary TS&L plan. Table 6 summarizes the recommended pile lengths and corresponding bottom of pile elevation. It is important to note that pile tips may extend below the termination depths of soil borings. If so, it is assumed that piles will be founded in soil conditions similar to those identified at the end of the corresponding boring.

Table 6 – Recommended Pile Lengths

Eastbound I-74, SN 048-0104

Location	Pile Type & Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Length (ft)
North Abutment	HP 10 x 57	365	201	57
		387	213	59
		405	223	62
		442	243	67
	HP 12 x 53	272	150	44
		334	184	49
		366	201	52
		397	218	54
	HP 12 x 63	343	189	49
		374	206	52
		406	223	54
		438	241	57
		470	258	59
	HP 12 x 74	380	209	52
		412	227	54
		444	244	57
		476	262	59
		586	322	69
	HP 12 x 84	386	212	52
		418	230	54
		450	248	57
		482	265	59
		662	364	77
	HP 14 x 73	368	203	47
		406	223	49
		443	244	52
		481	265	54
		556	306	59
	HP 14 x 89	377	207	47
		453	249	52
		529	291	57
		567	312	59
		680	374	67

North Abutment continued	HP 14 x 102	383	211	47
		460	253	52
		498	274	54
		574	316	59
		788	433	74
	HP 14 x 117	392	216	47
		469	258	52
		507	279	54
		584	321	59
		903	497	84

Table 6 continues on the following page.

Table 6 continued – Recommended Pile Lengths

Eastbound I-74, SN 048-0104

Location	Pile Type & Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Length (ft)
Pier	HP 12 x 84	462	236	58
		494	253	60
		604	314	70
		626	326	73
		648	338	75
	HP 14 x 73	307	148	43
		345	168	45
		458	231	53
		495	251	55
		570	293	60
	HP 14 x 89	543	277	58
		581	298	60
		619	319	63
		657	340	65
		695	361	68
	HP 14 x 102	664	344	65
		702	365	68
		740	385	70
		772	403	73
		797	417	75
	HP 14 x 117	752	392	70
		783	409	73
		809	423	75
		887	466	83
		913	480	85

Table 6 continues on the following page.

Table 6 continued – Recommended Pile Lengths

Eastbound I-74, SN 048-0104

Location	Pile Type & Size	Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Length (ft)
South Abutment	HP 10 x 57	351	193	58
		377	207	61
		395	217	63
		432	237	68
		450	247	71
	HP 12 x 53	317	174	51
		348	192	53
		380	209	56
		411	226	58
	HP 12 x 63	357	196	53
		389	214	56
		420	231	58
		452	249	61
		484	266	63
	HP 12 x 74	363	200	53
		395	217	56
		426	235	58
		458	252	61
		574	315	71
	HP 12 x 84	368	203	53
		400	220	56
		432	238	58
		464	255	61
		649	357	78
	HP 14 x 73	385	212	51
		423	232	53
		498	274	58
		573	315	63
	HP 14 x 89	356	196	48
		394	217	51
		470	258	56
		508	279	58
		697	384	71

South Abutment continued	HP 14 x 102	362	199	48
		401	220	51
		477	262	56
		515	283	58
		799	440	78
	HP 14 x 117	371	204	48
		409	225	51
		486	267	56
		524	288	58
		915	503	88

b) Lateral Pile Response

A representation of the shaft response under lateral loading exceeding 3 kips per pile is required for design of the bridge superstructure per Section 3.10.1.10 of the current Bridge Manual. The lateral response can be developed by modeling the soil/shaft interaction with the computer program LPILE. Discrete elements are used in LPILE to represent the shaft and non-linear soil using springs. The non-linear soil springs are commonly referred to as P-Y curves.

Based on the encountered subsurface conditions, the approximate soil modulus parameters (k) for the LPILE analyses are presented in Table 7 (Reference: LPILE User's Manual, Ensoft, Inc., July 2004). Soils located above the 200-year design scour elevation (Q200) should not be considered during analysis. When pile/shaft design details and load information are refined in the development of the structure plans, LPILE analyses can be performed.

Table 7 – Soil Parameters for Lateral Pile Load Analysis

Eastbound I-74, SN 048-0104

Location	Expected Groundwater Elevation (ft)	Depth Below Natural Ground Surface (ft)	Elevation at Bottom of Layer (ft)	Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)	K (pci)	E_{50}
B-1 N Abutment	720	0.0-11.5	714.3	105	900	26	180	0.010
		11.5-15.5	710.3	120	500	30	50	0.015
		15.5-29.0	696.8	100	2000	26	670	0.006
		29.0-38.0	687.0	130	3500	12	1100	0.005
B-2 Pier	722	0.0-6.5	722.4	105	1250	26	370	0.008
		6.5-11.5	717.4	105	350	26	30	0.020
		11.5-16.5	712.4	120	550	30	50	0.015
		16.5-34.0	694.9	130	2500	26	800	0.006
		34.0-40.5	688.4	130	5500	12	1800	0.004
B-4 S Abutment	720	0-6.5	719.5	105	1500	26	500	0.007
		6.5-15.5	710.5	120	500	30	50	0.015
		15.5-36.5	689.5	100	3300	26	1100	0.005
		36.5-40.5	685.5	130	4400	12	1600	0.005

5) Wingwalls

In accordance with the current Bridge Manual, integral abutments should be provided with "dog-ear" type wingwalls. The length of the wingwalls should be limited to 10 feet, and if a wing extension is required, its length shall be retained by independent walls, gabions, or rip rap. If independent walls are designed for the wingwall extensions, the Bridge Manual recommends using an at rest earth pressure coefficient of 0.5 with an equivalent fluid pressure of 60 pcf. If an uncompacted, clean rock backfill is proposed for the wingwalls, the active earth pressure coefficient of 0.3 with an equivalent fluid pressure of 40 pcf could be used for design of the wall. Typically, active pressures can be used for design if the proposed wall can tolerate deflections of approximately 1% of the wall vertical height. If the proposed wall cannot tolerate the deflection as described, then at-rest pressures should be used for a more rigid design. Passive earth pressures can be ignored to provide a more conservative design.

6) Construction Considerations

a) Construction Activities

The 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.

b) Temporary Sheeting and Soil Retention

Because the construction will be staged, temporary shoring is recommended for the proposed abutments. Based on the IDOT Temporary Sheet Piling Design Guide and Charts, cantilevered temporary sheet piling is feasible for the north abutment. Temporary sheet piling is typically used for retaining soil in a "cut" situation. However, the south abutment will be built in front of the existing south abutment, resulting in a "fill" situation. Therefore, a Temporary Soil Retention System is recommended for the south abutment. An Illinois-licensed structural engineer must seal the design of such a system.

Nominal values for the embankment of Qu of about 1.0 tsf (cohesive soils) and N-value of 10 bpf (granular soils) should not be exceeded without field verification.

c) Cofferdam

A cofferdam will be required for construction of the pier. The EWSE was estimated at 722.4, which is more than 6 feet above the bottom elevation of the substructure (715.8). Therefore, a Type 2 cofferdam is needed and indicated on the TS&L. Based on the boring information, the recommended tip elevation for the cofferdam is at or below 712.

d) Site and Soil Conditions

Should any bridge or embankment design considerations assumed by IDOT change, the author of this SGR should be contacted to evaluate if the recommendations herein are still applicable.

Soils with high moisture content could complicate construction activities. Soft or disturbed areas should be undercut (typically 1 to 2 feet) and replaced with crushed rock, such as CA-6, to provide a working platform.

e) Foundation Construction

Conventional pile driving equipment and methodologies should be assumed. During construction and pile driving, it is likely that when the hard till material is encountered, resistance to the driven pile will increase rapidly. To limit damage to the pile, attention should be given in the field to terminate driving as soon as the maximum capacity of the pile is reached.

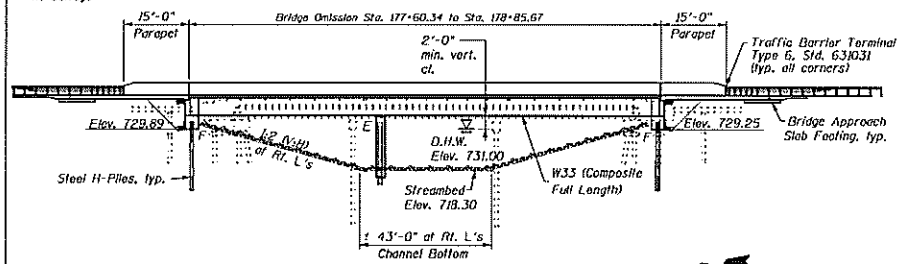
Appendix A

Type, Size and Location Plan

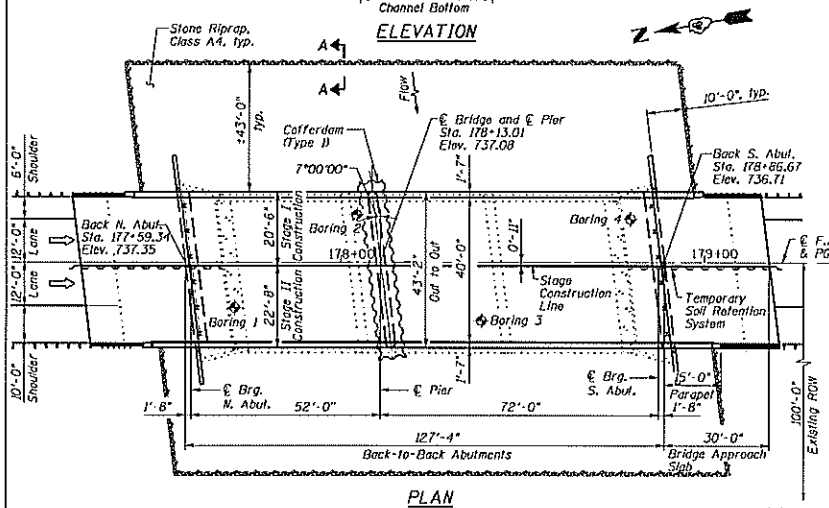
Bench Mark: #13 - Spike in post of fence 11 ft. right of ℄ EB I-74 Station ±182+70. Elevation 736.37.

Existing Structure: S.N. 048-0001 built in 1966 as F.A.I. Route 74 (EB), Section 48-24B at Sta. 178+23.
Existing structure consists of 3-span reinforced concrete cast in place deck on continuous steel WF beams and supported by spill-thru concrete abutments and concrete pile bent piers. Structure is 113'-2" long Bk. to Bk. of abutments. Width is 43'-2" Out to Out of deck.
Structure to be removed and replaced. Traffic to be maintained utilizing stage construction.

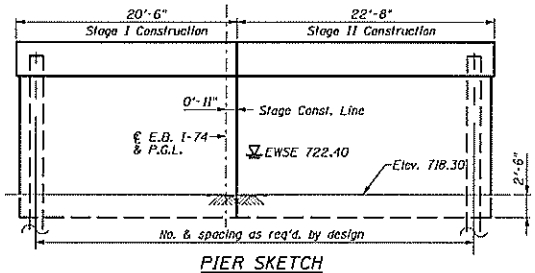
No salvage



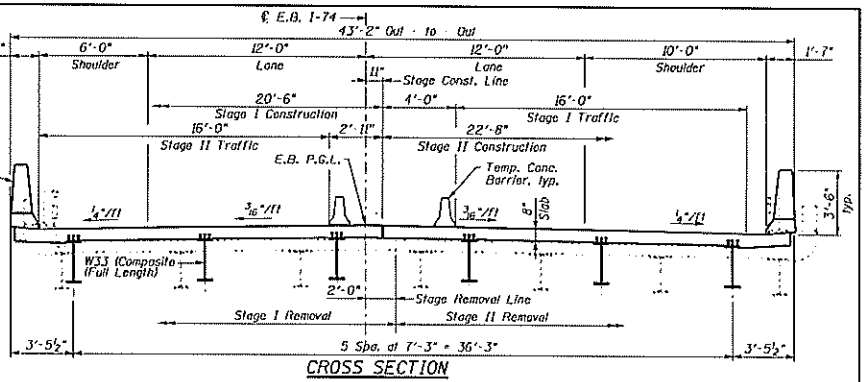
ELEVATION



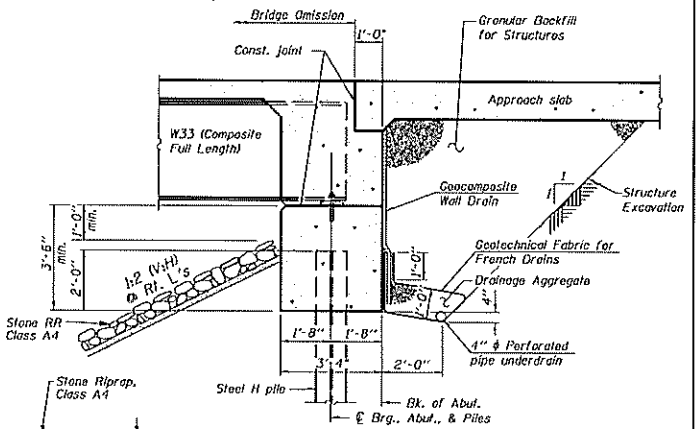
PLAN



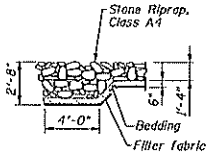
PIER SKETCH
(Looking South)



CROSS SECTION
(Looking South)



SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. L's)



SECTION A-A

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications 7th edition

LOADING HL-93

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

DESIGN STRESSES

FIELD UNITS

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

WATERWAY INFORMATION

Drainage Area = 33.4 sq. mi. Low Grade Elev. 736.45 @ Sta. 178+59.85

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	3580	547	656	730.0	1.6	1.4	731.6	731.4
Design	50	5750	633	773	731.0	2.7	2.3	733.7	733.3
Base	100	6750	669	820	731.4	3.3	2.8	734.7	734.2
Overtopping									
Existing	200	7770	708	869	731.8	3.8	3.5	735.6	735.3
Max. Calc.	500	9170	758	930	732.3	4.7	4.2	737.0	736.5

DESIGN SCOUR ELEVATION TABLE

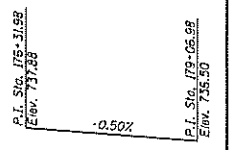
	Design Scour Elevations (ft.) N. Abut.	Pier	S. Abut.
0100	729.89	706.9	729.25
0200	729.89	706.4	729.25

SEISMIC DATA

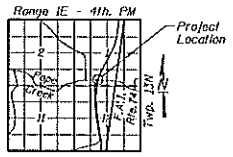
Seismic Performance Zone (SPZ) = C
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.107g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.068g
Soil Site Class = SPZ 1

HIGHWAY CLASSIFICATION

F.A.I. Rte. 74 - EB I-74
Functional Class: Interstate
ADT: 7150 (2009); 9014 (2020)
ADTT: 33%
DHV: 950
Design Speed: 65 m.p.h.
Posted Speed: 65 m.p.h.
One-Way Traffic



PROFILE GRADE



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
E.B. I-74 OVER POPE CREEK
F.A.I. RT. 74 SECTION 48-(24B)I,I-1
KNOX COUNTY
STATION 178+23.00
STRUCTURE NO. 048-0104

FILE NAME = ...\48104R1-SD01-ISL-EB Paperdgn	DESIGNED EV	REVISED -
	DRAWN PRD	REVISED -
PLOT TIME = 9:56:05 AM	CHECKED PC	REVISED -
PLOT DATE = 3/4/2015	DATE 10 10 2014	REVISED -

SEPSTEIN

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 048-0104
SHEET NO. 1 OF 1 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	48-124B)I,I-1	KNOX	*TOT	1
		CONTRACT NO. 68084		
		ILLINOIS FED. AID PROJECT		

Appendix B

Boring Logs

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/15/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-1 (N. ABUT)
Station 177+69
Offset 12.0 ft RT EB CL
Ground Surface Elev. 725.80 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 719.8 ft ▽
After 16 Hrs. 719.8 ft ▽

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
				Stiff Dark Brown SILTY CLAY
	9	1.5 E	27	
-5				
	6	1.0 B	38	
719.3				▽▽
				Soft Black SILTY CLAY
	3	0.4 B		
-10				
	4	0.8 B	41	
714.3				
				Soft Brown and Gray SANDY LOAM
	3		22	
711.8				
				Medium Gray Sandy Clay LOAM
-15				
710.3	4	0.5 B		
				Very Stiff Light Gray CLAY
	20	2.0 E	16	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
	25	2.6 S		Very Stiff Light Gray CLAY *(continued)*
703.8				
				Hard Light Gray CLAY
	37	2.0 E		
-25				
	52	2.0 S		
	78	2.0 E		
696.8				
				Hard Light Gray SHALEY CLAY
-30				
	50/6"	2.1 S	16	
	69	6.5 S		
-35				
	100/8"	2.9 S		
687.8	100/11"	2.5 E		
				End of Boring
-40				

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

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/14/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-2 (N. PIER)
Station 178+04
Offset 12.0 ft LT EB CL
Ground Surface Elev. 728.90 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 720.9 ft ▽
After 22 Hrs. 721.9 ft ▽

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff Dark Brown SILTY CLAY			
	7	1.5 E	
-5			
	11	1.0 E	
722.4			
Soft Black SILTY CLAY ▽			
	4	0.3 B	
-10			
	4	0.4 B	
717.4			
Soft Brown and Gray SANDY CLAY LOAM			
	3	0.4 B	
-15			
	4	0.7 B	
712.4			
Very Stiff Light Gray CLAY			
	16	2.8 S	
-20			
Very Stiff Light Gray CLAY *(continued)*			
	23	2.5 E	
	30	2.4 S	
-25			
	27	2.5 E	
702.4			
Hard Light Gray CLAY			
	56	2.8 S	
-30			
	44	2.5 E	
	42	2.2 S	
694.9			
Hard Light Gray SHALEY CLAY			
-35			
	50/5"	5.9 S	
	100/11"	3.9 S	
-40			

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

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/14/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-2 (N. PIER)
Station 178+04
Offset 12.0 ft LT EB CL
Ground Surface Elev. 728.90 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 720.9 ft
After 22 Hrs. 721.9 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
688.4	50/4"	6.8 S		
End of Boring Note: Water content comparable to B-1.				
-45				
-50				
-55				
-60				

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

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/21/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-3 (S. PIER)
Station 178+42
Offset 12.0 ft RT EB CL
Ground Surface Elev. 726.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 720.8 ft ▽
After 22 Hrs. 720.8 ft ▼

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				Stiff Dark Brown SILTY CLAY
	15	1.5 E		
722.3				
-5				Medium Dark Gray SILTY CLAY
▽▽	5	0.9 B		
718.3	5	0.5 B		
				Soft Dark Brown SILTY CLAY
716.8				
-10				Soft Gray SANDY LOAM
	3	0.4 B		
714.8				
				Very Soft Gray SANDY CLAY LOAM
	2			
712.3				
-15				Very Stiff Light Gray CLAY
	17	2.8 S		
	23	3.1 S		
-20				
	25	2.8 S		Very Stiff Light Gray CLAY *(continued)*
	22	2.8 E		
702.3				
-25				Hard Light Gray CLAY
	39	2.9 S		
	50	2.9 S		
-30				
	46	2.3 S		
694.8				
				Hard Light Gray SHALEY CLAY
	100/11"	5.3 S		
-35				
	100	4.4 S		
688.3	62	2.0 S		
				End of Boring Note: Water content comparable to B-1.
-40				

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

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/21/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-4 (S. ABUT)
Station 178+77
Offset 12.0 ft LT EB CL
Ground Surface Elev. 726.00 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 720.5 ft ▽
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff Dark Brown SILTY CLAY			
	7	1.5 E	
722.0			
Soft Dark Brown SILTY CLAY			
-5			
▽	3		
719.5			
Very Soft Dark Brown SANDY CLAY LOAM			
	2		
717.0			
Soft Dark Brown SANDY CLAY LOAM			
-10			
	4		
714.5			
Soft Brown and Gray SANDY CLAY LOAM			
	4		
712.0			
Medium Brown SANDY LOAM			
-15			
710.5	11		
Very Stiff Light Gray CLAY			
	19	2.0 S	
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff Light Gray CLAY *(continued)*	19	2.6 S	
	26	2.2 S	
702.0			
Layer of ROCK (No Recovery)			
701.0 -25	100/6"	3.1 S	
Hard Light Gray CLAY			
	74	5.5 S	
-30			
	43	3.7 S	
	64	4.2 S	
-35			
	50	2.8 S	
689.5			
Hard Light Gray SHALEY CLAY			
	83	3.3 S	
-40			

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

Illinois Department of Transportation
Division of Highways
idot

SOIL BORING LOG

Date 6/21/61

ROUTE FAI 74 DESCRIPTION EB I74 over Pope Creek (Rt. Lane) LOGGED BY A.E.Moine

SECTION 48-24B LOCATION SW¼, SE¼ SEC. 1, TWP. 13N, RNG. 1E, 4th PM,
Latitude , Longitude

COUNTY Knox DRILLING METHOD HSA HAMMER TYPE Cathead,Safety Hammer

STRUCT. NO. 048-0001 (EB)
Station 178+23

BORING NO. B-4 (S. ABUT)
Station 178+77
Offset 12.0 ft LT EB CL
Ground Surface Elev. 726.00 ft

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

Groundwater Elev.:
First Encounter _____ ft
Upon Completion 720.5 ft ▽
After _____ Hrs. _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
685.5		50/5"	5.5 S	
End of Boring	-45			
	-50			
	-55			
	-60			

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

Appendix C

Subsurface Data Profile

STATE OF ILLINOIS

DEPARTMENT OF PUBLIC WORKS AND BUILDINGS

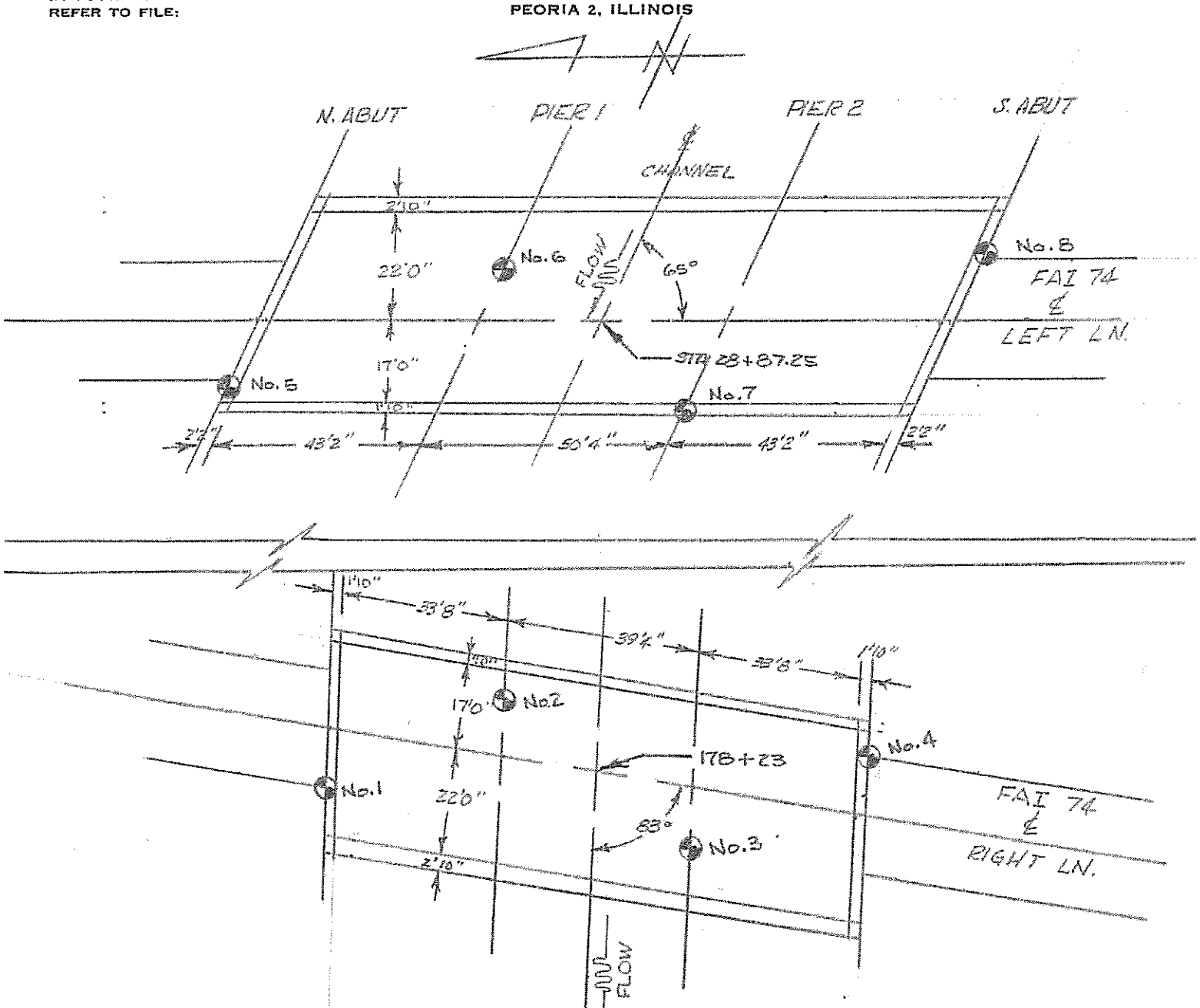
W.J. PAYES, JR., DIRECTOR

DIVISION OF HIGHWAYS

RALPH R. BARTELSMEYER
CHIEF HIGHWAY ENGINEER

OFFICE OF DISTRICT ENGINEER
6035 N. MOUNT HAWLEY ROAD, ROUTE 88
PEORIA 2, ILLINOIS

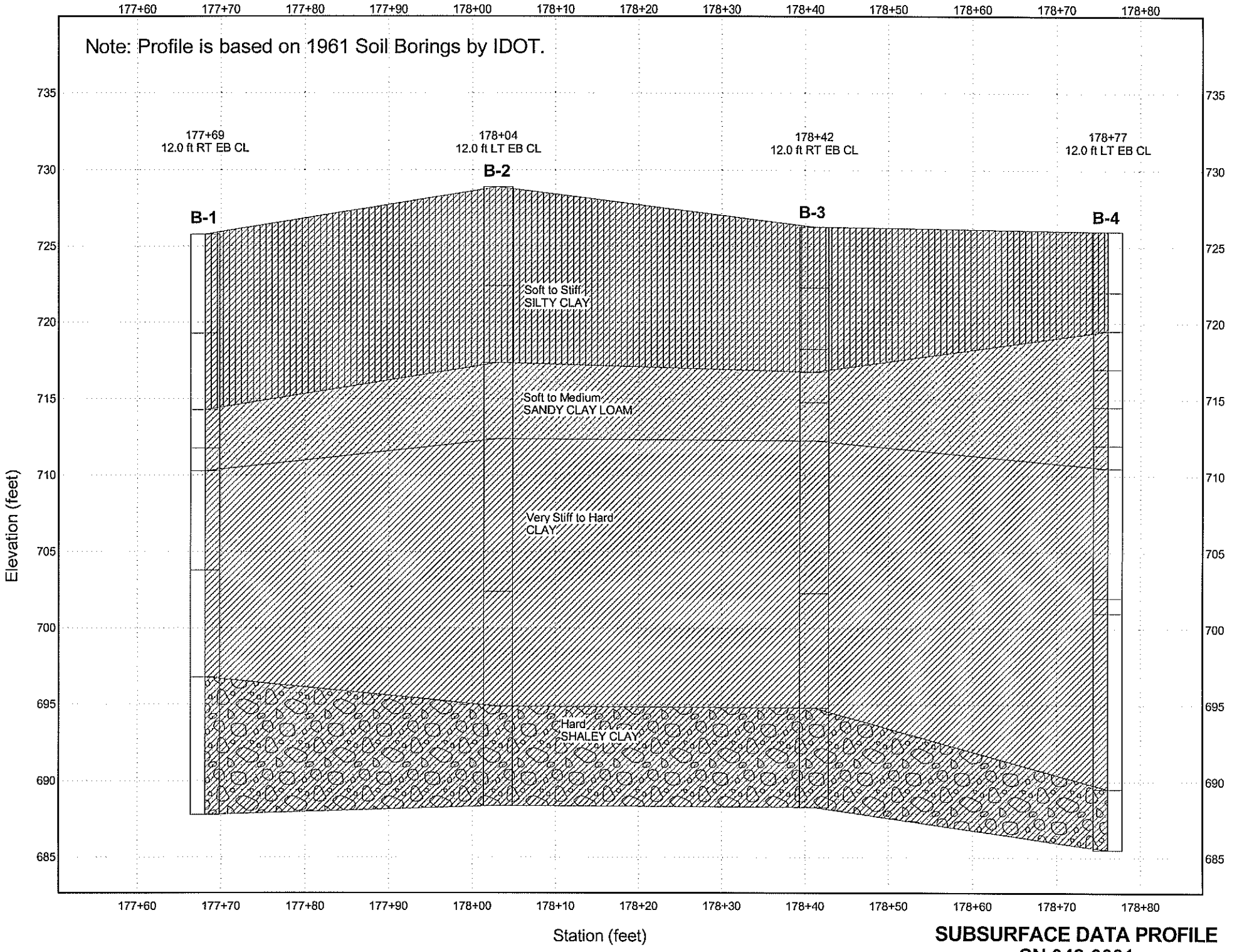
IN YOUR REPLY PLEASE
REFER TO FILE:



LOCATION: SE¼ OF SW¼ & SW¼ OF SE¼
SEC 1; NE¼ OF NW¼ & NW¼ OF NE¼
SEC 12 - T13N, R1E, 4TH P.M.

RTE:	FAI 74
SEC:	48-24-B
PROJ:	I-74-2( )34
COUNTY:	KNOX

FAI 74 OVER POPE CREEK
STA. 178+23 RT. LN.
STA. 28+87.25 LT. LN.



SUBSURFACE DATA PROFILE
SN 048-0001

Appendix D

Existing Pile Data

F. A. I. 74
Sec. 48-24B
Proj. I-74-2(45)34
Knox County

PILE DATA
Summary of Length

Precast Conc. Piling

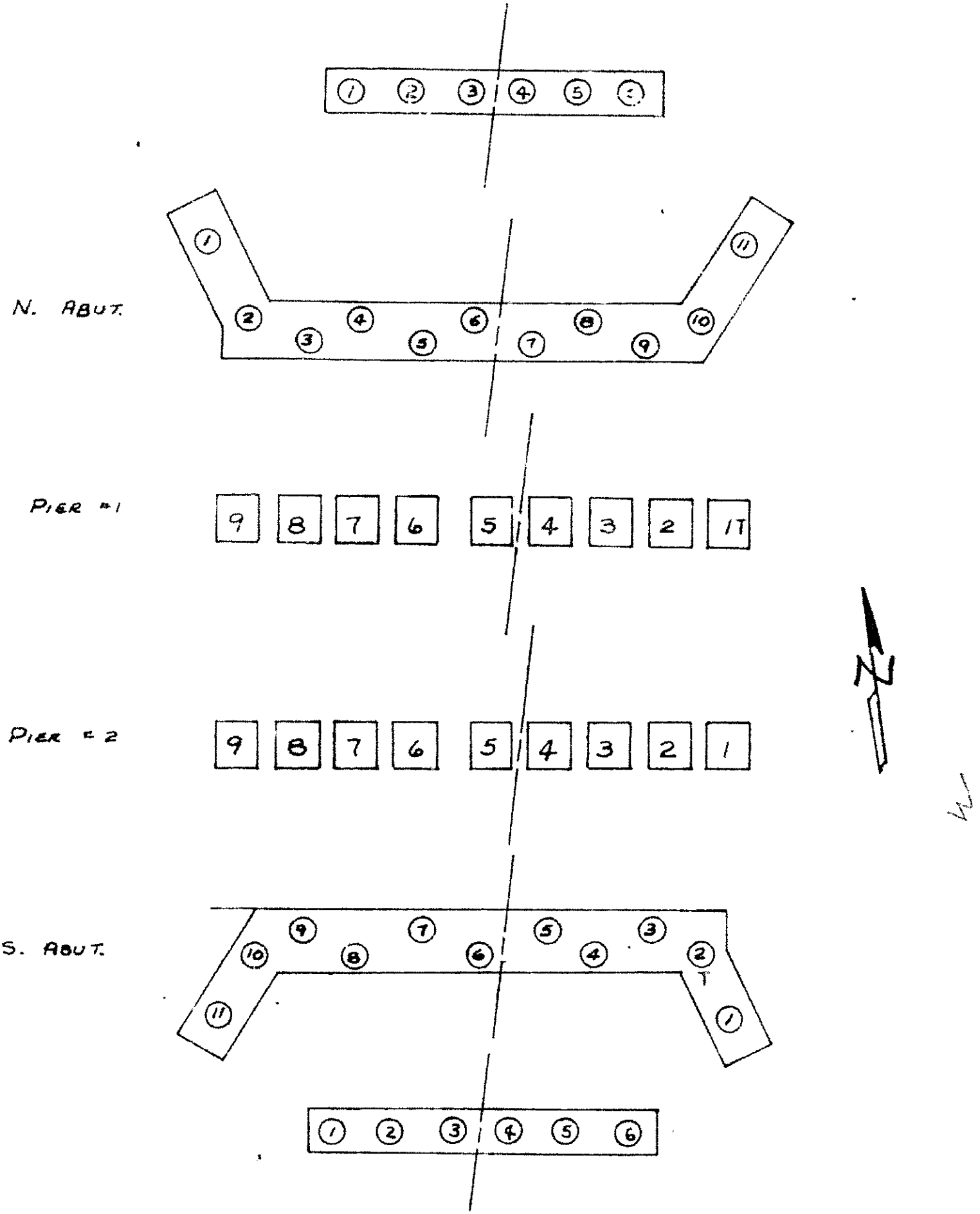
	Length Furnished	Cutoff Length	Length Driven
Left Lane-Pier #1	252.00	3.90	249.80
Pier #2	224.00	10.40	213.60
Right Lane-Pier #1	240.00	30.40	209.60
Pier #2	270.00	35.00	235.00
	986.00	79.70	908.00

Conc. Piling

	Length Furnished	Cutoff Length	Length Driven
Left Lane-N. Abut.	408.00	33.80	374.20
S. Abut.	195.00	34.10	160.90
Right Lane-N. Abut.	330.00	26.80	303.20
S. Abut.	325.00	22.80	302.20
	1258.00	117.50	1140.50

Creaos. Timber

	Length Furnished	Cutoff Length	Length Driven
Lt Lane-N. Approach	120.0	1.2	118.8
S. Approach	48.0	0.5	47.5
Rt Lane-N. Approach	90.0	0.0	90.0
S. Approach	90.0	0.0	90.0
	348.0	1.7	346.3



PILING DIAGRAM - RT. LANE

FAI-74

PILE DATA

Hammer:
Delmag D-12:2750#
H equals Variable
Req'd. Brg. is 27 Tons

FAI-74
Sec. 48-24B
Proj. I-74-2(45)34
Knox County

Rt. Lane-Pier #1 Prec. Conc. Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	Test Pile			
2	30.0'	3.5'	26.5'	56.8
3	30.0'	5.5'	24.5'	50.0
4	30.0'	4.0'	26.0'	52.1
5	30.0'	3.7'	26.3'	50.0
6	30.0'	3.6'	26.4'	54.4
7	30.0'	3.2'	26.8'	55.2
8	30.0'	4.1'	25.9'	51.5
9	30.0'	2.8'	27.2'	55.6
Total	240.0'	30.4'	209.6'	

Rt. Lane-Pier #2 Prec. Conc. Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	30.0'	4.1'	25.9'	51.5
2	30.0'	5.9'	24.1'	46.8
3	30.0'	4.8'	25.2'	49.4
4	30.0'	4.0'	26.0'	48.9
5	30.0'	3.0'	27.0'	54.2
6	30.0'	3.3'	26.7'	54.8
7	30.0'	3.2'	26.8'	52.1
8	30.0'	3.0'	27.0'	49.9
9	30.0'	3.7'	26.3'	
Total	270.0'	35.0'	235.0'	

PILE DATA

Hammer:
Delmag D-12: 2750#
H equals Variable
Req'd. Brg. is 25 Tons

FAI-74
Sec. 48-24B
Proj. I-74-2(45)34
Knox County

Rt. Lane- N. Abut. Conc. Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	30.0'	2.0'	27.0'	30.3
2	30.0'	1.0'	29.0'	28.4
3	30.0'	2.0'	28.0'	31.3
4	30.0'	2.0'	28.0'	32.0
5	30.0'	2.0'	28.0'	30.3
6	30.0'	3.0'	27.0'	30.3
7	30.0'	1.0'	29.0'	27.5
8	30.0'	3.0'	27.0'	30.3
9	30.0'	4.0'	26.0'	34.7
10	30.0'	2.0'	28.0'	33.0
11	30.0'	4.8'	25.2'	41.2
Total	330.0'	26.8'	303.2'	

PILE DATA

Hammer:
Delmag D-12: 2750#
H equals Variable
Req'd. Brg. 18 25 Tons

FAI-74
Sec. 48-24B
Proj. I-74-2(45)34
Knox County

Rt. Lane- S. Abut. Conc. Filling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	35.0'	0.3'	34.7'	28.4
2	Test Pile			45.2
3	35.0'	4.0'	31.0'	42.5
4	35.0'	0.0'	35.0'	29.9
5	35.0'	3.9'	31.1'	34.7
6	35.0'	3.8'	31.2'	33.0
7	30.0'	1.9'	28.1'	48.2
8	30.0'	2.8'	27.2'	33.0
9	30.0'	1.8'	28.2'	29.4
10	30.0'	2.0'	28.0'	41.2
11	30.0'	2.3'	27.7'	40.4
Total	325.0'	22.8'	302.2'	

Hammer:
Gravity
H equals 15 ft.
Req'd Brg. is 24 ton or Plan Length

FAI-74
Sec. 48-24B
Proj. I-74-2(45)34
Knox County

Rt. Lane- S. Abut. Creos. Timber Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	15.0'	0.0'	15.0'	16.6
2	15.0'	0.0'	15.0'	16.6
3	15.0'	0.0'	15.0'	18.0
4	15.0'	0.0'	15.0'	15.0
5	15.0'	0.0'	15.0'	16.6
6	15.0'	0.0'	15.0'	18.0
Total	90.0'	0.0'	90.0'	

Lt. Lane- N. Abut. Creos. Timber Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last Ft. Driven
1	20.0'	0.4'	19.6'	23.4
2	20.0'	0.0'	20.0'	20.8
3	20.0'	0.4'	19.6'	24.2
4	20.0'	0.0'	20.0'	21.5
5	20.0'	0.4'	19.6'	21.5
6	20.0'	0.0'	20.0'	16.6
Total	120.0'	1.2'	118.8'	

Lt. Lane- S. Abut. Creos. Timber Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last ft. Driven
1	8.0'	0.1'	7.9'	9.0
2	8.0'	0.1'	7.9'	9.0
3	8.0'	0.0'	8.0'	6.4
4	8.0'	0.1'	7.9'	11.3
5	8.0'	0.2'	7.8'	9.0
6	8.0'	0.0'	8.0'	9.0
Total	48.0'	0.5'	47.5'	

Rt. Lane- N. Abut. Creos. Timber Piling

Pile No.	Length Furnished	Cutoff Length	Length Driven	Ton Brg. Last ft. Driven
1	15.0'	0.0'	15.0'	16.6
2	15.0'	0.0'	15.0'	16.6
3	15.0'	0.0'	15.0'	15.0
4	15.0'	0.0'	15.0'	15.0
5	15.0'	0.0'	15.0'	13.2
6	15.0'	0.0'	15.0'	13.2
Total	90.0'	0.0'	90.0'	

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

TEST PILE DRIVING RECORD

6-15-65

PROJECT 1-74-2(45)34
ROUTE FAI 74
SECTION 48-24B
COUNTY KNOX
STATION OF STRUCTURE 178+23 RT LANE

STREAM BED ELEVATION = 719.3

STATION LOCATION AT WHICH PILE WAS DRIVEN PIER 1 - 16.87' LT ℄ STA. 178+03.34
ELEV. FROM WHICH PILE WAS DRIVEN 720.0
EAST PILE IN PIER 1

TYPE & WEIGHT OF HAMMER DELMAG D-12 2750#
LENGTH OF FALL VARIABLE
TYPE OF PILE 14" PRECAST CONC
REQUIRED BEARING 27 TONS
ELEV. TOP PILE 740.20
ELEV. TIP OF PILE 700.20
ELEV. CUTOFF 730.20
ESTIMATED PLAN LENGTH 30 FT
ORDERED LENGTH 30' PIER 1&2 RT LANE

R.D. PAGE, PROJ.ENGR.
J.R. ABBOTT, RES.ENGR.

ELEV.	FEET BELOW CUT OFF	BLOWS PER FOOT	HEIGHT OF FALL	BEARING IN TONS	REMARKS
	22-23	20	5	14.4	
	24	43	5½	24.0	
705.2	25	45	6	26.6	
	26	76	6	32.4	
	27	129	6½	40.2	
	28	167	7	45.6	
	29	157	7	45.0	
700.2	30	212	7½	50.8	END OF TEST.

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

TEST PILE DRIVING RECORD 8-19-65

PROJECT I-74-2(45)34
ROUTE FAI 74
SECTION 48-24B
COUNTY KNOX
STATION OF STRUCTURE 178+23 (RT LANE)
17.08' LT ℄

LT END PILE SO. ABUT. RT LANE STRUCTURE
STATION LOCATION AT WHICH PILE WAS DRIVEN 178+77.21
ELEV. FROM WHICH PILE WAS DRIVEN 721.0

TYPE & WEIGHT OF HAMMER DELMAG D-12 2750#
LENGTH OF FALL VARIABLE
TYPE OF PILE METAL SHELL
REQUIRED BEARING 25 TON
ELEV. TOP PILE 731.00
ELEV. TIP OF PILE 696.00
ELEV. CUTOFF 729.35
ESTIMATED PLAN LENGTH 25'
ORDERED LENGTH N ABUT 30' AFB
S ABUT 5@30'
5@35'

35' PILE FURNISHED

R.D. PAGE, PROJ.ENGR.; J.R. ABBOTT, RES.ENGR

ELEV.	FEET BELOW CUT OFF	BLOWS PER FOOT	HEIGHT OF FALL	BEARING IN TONS	REMARKS
709.35	20	9	4	7.7	
	21	8	4	6.9	
	22	9	4	7.7	
	23	7	4	6.1	
	24	9	4	7.7	
704.35	24-25	9	4½	8.6	
	26	12	4½	11.3	
	27	13	4½	12.1	
	28	16	5	16.2	
	29	18	5	18.0	
699.35	29-30	26	5½	21.6	
	31	18	5½	19.7	
	32	18	5½	19.7	
696.35	32-33	20	5½	21.6	
696.00	33	10	5½	29.1	END OF TEST DROVE 33.35 FT

DID NOT REACH REQUIRED TEST PILE BEARING, HOWEVER, THIS TEST PILE DATA WAS USED IN CONJUNCTION WITH BORING LOGS AND PILING DATA OBTAINED FROM PIERS IN DETERMINING THE LENGTHS OF ABUTMENT PILES.

Appendix E

Pile Length vs. Capacity Reports

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== N Abut - EB I-74 over Pope Ck
REFERENCE BORING ========== 1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 731.89 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 729.89 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1100 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 43.49 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 202.35 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.88 KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Borin	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**397** KIPS	**218** KIPS	**54** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
725.80	4.00	1.00			11.5		32.2	16.9		***19.1***	19	0	0	11	6
722.80	3.00	1.50			11.4	20.7	36.8	16.7	2.3	***35.1***	35	0	0	19	9
719.30	3.50	1.00			9.9	13.8	***38.4***	14.4	1.5	48.6	38	0	0	21	13
717.80	1.50	0.40			1.9	5.5	***45.8***	2.8	0.6	52.0	46	0	0	25	14
714.30	3.50	0.80			8.2	11.0	***50.3***	12.0	1.2	63.6	50	0	0	28	18
711.80	2.50		3	Fine Sand	0.5	7.3	***50.3***	0.7	0.8	64.3	50	0	0	28	20
710.30	1.50	0.50			2.3	6.9	73.3	3.4	0.8	***69.9***	70	0	0	38	22
707.80	2.50	2.00			11.5	27.6	93.1	16.9	3.0	***87.7***	88	0	0	48	24
703.80	4.00	2.60			22.0	35.8	***106.8***	32.1	3.9	118.9	107	0	0	59	28
702.80	1.00	2.00			4.6	27.6	***111.4***	6.8	3.0	125.6	111	0	0	61	29
700.30	2.50	2.00			11.5	27.6	***123.0***	16.9	3.0	142.5	123	0	0	68	32
696.80	3.50	2.00			16.2	27.6	***140.5***	23.6	3.0	166.3	141	0	0	77	35
695.30	1.50	2.10			7.1	28.9	245.5	10.4	3.2	***187.5***	187	0	0	103	37
692.80	2.50		69	Hard Till	10.8	126.8	313.3	15.8	13.9	***209.5***	209	0	0	115	39
690.30	2.50		100	Hard Till	21.4	183.7	334.6	31.3	20.1	***240.7***	241	0	0	132	42
687.80	2.50		100	Hard Till	21.4	183.7	356.0	31.3	20.1	***272.0***	272	0	0	150	44
685.30	2.50		100	Hard Till	21.4	183.7	377.4	31.3	20.1	***303.2***	303	0	0	167	47
682.80	2.50		100	Hard Till	21.4	183.7	398.7	31.3	20.1	***334.5***	334	0	0	184	49
680.30	2.50		100	Hard Till	21.4	183.7	420.1	31.3	20.1	***365.7***	366	0	0	201	52
677.80	2.50		100	Hard Till	21.4	183.7	441.5	31.3	20.1	***397.0***	397	0	0	218	54
675.30	2.50		100	Hard Till	21.4	183.7	462.9	31.3	20.1	***428.2***	428	0	0	236	57
672.80	2.50		100	Hard Till	21.4	183.7	484.2	31.3	20.1	***459.5***	459	0	0	254	59
670.30	2.50		100	Hard Till	21.4	183.7	505.6	31.3	20.1	***490.8***	491	0	0	270	62
667.80	2.50		100	Hard Till	21.4	183.7	527.0	31.3	20.1	***522.0***	522	0	0	287	64
665.30	2.50		100	Hard Till	21.4	183.7	***548.4***	31.3	20.1	553.3	548	0	0	304	67
662.80	2.50		100	Hard Till	21.4	183.7	***569.7***	31.3	20.1	584.5	579	0	0	321	69
660.30	2.50		100	Hard Till	21.4	183.7	***591.1***	31.3	20.1	615.8	591	0	0	325	72
657.80	2.50		100	Hard Till	21.4	183.7	***612.5***	31.3	20.1	647.0	642	0	0	337	74
655.30	2.50		100	Hard Till	21.4	183.7	***633.9***	31.3	20.1	678.3	654	0	0	349	77
652.80	2.50		100	Hard Till	21.4	183.7	***655.2***	31.3	20.1	709.5	655	0	0	361	79
650.30	2.50		100	Hard Till	21.4	183.7	***676.6***	31.3	20.1	740.8	677	0	0	372	82
647.80	2.50		100	Hard Till	21.4	183.7	***698.0***	31.3	20.1	772.0	698	0	0	384	84
645.30	2.50		100	Hard Till	21.4	183.7	***719.4***	31.3	20.1	803.3	719	0	0	395	87
640.30	5.00		100	Hard Till		183.7			20.1						

Pile Design Table for N Abut - EB I-74 over Pope Ck utilizing Boring #1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
137	75	32
158	87	35
Metal Shell 12"Φ w/.25" walls		
137	75	32
158	87	35
Metal Shell 14"Φ w/.25" walls		
115	63	24
140	77	28
146	81	29
163	90	32
188	103	35
Metal Shell 14"Φ w/.312" walls		
115	63	24
140	77	28
146	81	29
163	90	32
188	103	35
Steel HP 8 X 36		
126	69	37
141	77	39
162	89	42
183	101	44
204	112	47
225	124	49
245	135	52
260	143	54
274	151	57
Steel HP 10 X 42		
113	62	35
156	86	37
175	96	39
201	110	42
227	125	44
253	139	47
279	154	49
306	168	52
332	182	54

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
115	64	35
161	89	37
181	100	39
208	114	42
234	129	44
260	143	47
286	158	49
313	172	52
339	187	54
365	201	57
387	213	59
405	223	62
423	233	64
442	243	67
Steel HP 12 X 53		
123	68	32
141	77	35
187	103	37
209	115	39
241	132	42
272	150	44
303	167	47
334	184	49
366	201	52
397	218	54
Steel HP 12 X 63		
124	68	32
142	78	35
193	106	37
216	119	39
248	136	42
279	154	44
311	171	47
343	189	49
374	206	52
406	223	54
438	241	57
470	258	59
Steel HP 12 X 74		
126	69	32
144	79	35
196	108	37
221	122	39
253	139	42
285	157	44
317	174	47
349	192	49
380	209	52
412	227	54
444	244	57
476	262	59
508	279	62
540	297	64
564	310	67
586	322	69
Steel HP 12 X 84		
128	70	32
146	80	35
200	110	37
226	124	39
258	142	42
290	159	44
322	177	47
354	195	49
386	212	52
418	230	54
450	248	57
482	265	59
514	283	62
546	300	64
573	315	67
595	327	69
617	340	72
639	352	74
662	364	77

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
133	73	28
138	76	29
152	83	32
173	95	35
228	125	37
255	141	39
293	161	42
331	182	44
368	203	47
406	223	49
443	244	52
481	265	54
519	285	57
556	306	59
Steel HP 14 X 89		
134	74	28
140	77	29
154	85	32
175	96	35
234	129	37
264	145	39
301	166	42
339	187	44
377	207	47
415	228	49
453	249	52
491	270	54
529	291	57
567	312	59
605	333	62
643	353	64
680	374	67
Steel HP 14 X 102		
136	75	28
142	78	29
156	86	32
177	98	35
238	131	37
269	148	39
307	169	42
345	190	44
383	211	47
422	232	49
460	253	52
498	274	54
536	295	57
574	316	59
612	336	62
650	357	64
688	378	67
726	399	69
762	419	72
788	433	74
Steel HP 14 X 117		
112	61	24
138	76	28
144	79	29
158	87	32
180	99	35
244	134	37
277	152	39
315	173	42
354	195	44
392	216	47
430	237	49
469	258	52
507	279	54
545	300	57
584	321	59
622	342	62
660	363	64
699	384	67
737	405	69
773	425	72
799	439	74
825	454	77
851	468	79
877	482	82
903	497	84
Precast 14"x 14"		
116	64	22
148	81	24
178	98	28
186	103	29
208	114	32
239	131	35
Timber Pile		
126	69	32
146	80	35

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier - EB I-74 over Pope Ck
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 731.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 718.30 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 706.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 2100 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 43.49 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 386.30 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 144.86 KIPS

PILE TYPE AND SIZE ========== Steel HP 14 X 89
Plugged Pile Perimeter========== 4.750 FT. Unplugged Pile Perimeter========== 7.033 FT.
Plugged Pile End Bearing Area========== 1.409 SQFT. Unplugged Pile End Bearing Area===== 0.181 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Borin	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
705 KIPS	**695** KIPS	**361** KIPS	**68** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
717.30	1.00	0.40			1.5		9.4	2.2		***3.2***	3	1	0	1	14
715.80	1.50	0.40			2.3	7.9	17.6	3.3	1.0	***7.4***	7	2	0	2	15
712.30	3.50	0.70			8.8	13.8	67.8	13.0	1.8	***25.7***	26	7	0	7	19
710.80	1.50	2.80			10.4	55.3	72.3	15.4	7.1	***40.3***	40	13	0	10	20
708.30	2.50	2.50			16.0	49.4	86.3	23.7	6.4	***63.7***	64	21	0	14	23
705.80	2.50	2.40			15.6	47.4	103.8	23.0	6.1	***87.0***	87	21	0	26	25
702.30	3.50	2.50			22.4	49.4	132.1	33.2	6.4	***120.9***	121	21	0	45	29
700.80	1.50	2.80			10.4	55.3	136.6	15.4	7.1	***135.5***	136	21	0	53	30
698.30	2.50	2.50			16.0	49.4	***146.7***	23.7	6.4	158.4	147	21	0	59	33
694.80	3.50	2.20			20.6	43.4	387.0	30.5	5.6	***217.2***	217	21	0	98	36
693.30	1.50		100	Hard Till	15.4	263.2	402.4	22.7	33.9	***239.9***	240	21	0	111	38
690.80	2.50		100	Hard Till	25.6	263.2	428.0	37.9	33.9	***277.8***	278	21	0	131	40
688.30	2.50		100	Hard Till	25.6	263.2	453.6	37.9	33.9	***315.7***	316	21	0	152	43
685.80	2.50		100	Hard Till	25.6	263.2	479.2	37.9	33.9	***353.6***	354	21	0	173	45
683.30	2.50		100	Hard Till	25.6	263.2	504.8	37.9	33.9	***391.5***	392	21	0	194	48
680.80	2.50		100	Hard Till	25.6	263.2	530.4	37.9	33.9	***429.4***	429	21	0	215	50
678.30	2.50		100	Hard Till	25.6	263.2	556.0	37.9	33.9	***467.3***	467	21	0	236	53
675.80	2.50		100	Hard Till	25.6	263.2	581.5	37.9	33.9	***505.2***	505	21	0	256	55
673.30	2.50		100	Hard Till	25.6	263.2	607.1	37.9	33.9	***543.1***	543	21	0	277	58
670.80	2.50		100	Hard Till	25.6	263.2	632.7	37.9	33.9	***581.0***	581	21	0	298	60
668.30	2.50		100	Hard Till	25.6	263.2	658.3	37.9	33.9	***618.9***	619	21	0	319	63
665.80	2.50		100	Hard Till	25.6	263.2	683.9	37.9	33.9	***656.8***	657	21	0	340	65
663.30	2.50		100	Hard Till	25.6	263.2	709.5	37.9	33.9	***694.7***	695	21	0	361	68
660.80	2.50		100	Hard Till	25.6	263.2	735.1	37.9	33.9	***732.6***	733	21	0	382	70
658.30	2.50		100	Hard Till	25.6	263.2	***760.7***	37.9	33.9	770.5	771	21	0	397	73
655.80	2.50		100	Hard Till	25.6	263.2	***786.3***	37.9	33.9	808.4	808	21	0	444	75
653.30	2.50		100	Hard Till	25.6	263.2	***811.9***	37.9	33.9	846.3	846	21	0	425	78
650.80	2.50		100	Hard Till	25.6	263.2	***837.5***	37.9	33.9	884.2	884	21	0	439	80
648.30	2.50		100	Hard Till	25.6	263.2	***863.1***	37.9	33.9	922.1	922	21	0	453	83
645.80	2.50		100	Hard Till	25.6	263.2	***888.7***	37.9	33.9	960.0	960	21	0	467	85
643.30	2.50		100	Hard Till	25.6	263.2	***914.3***	37.9	33.9	997.9	998	21	0	481	88
640.80	2.50		100	Hard Till		263.2			33.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier - EB I-74 over Pope Ck
REFERENCE BORING ========== 2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 731.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 718.30 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 706.40 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 2100 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 43.49 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 386.30 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 144.86 KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Borin	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
810 KIPS	**797** KIPS	**417** KIPS	**75** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
717.30	1.00	0.40			1.5		9.6	2.2		***3.4***	3	1	0	1	14
715.80	1.50	0.40			2.3	8.1	17.9	3.4	1.2	***7.6***	8	2	0	2	15
712.30	3.50	0.70			8.8	14.1	69.1	13.0	2.0	***26.8***	27	7	0	8	19
710.80	1.50	2.80			10.5	56.5	73.6	15.4	8.2	***41.3***	41	13	0	10	20
708.30	2.50	2.50			16.2	50.4	87.7	23.8	7.3	***64.8***	65	22	0	14	23
705.80	2.50	2.40			15.7	48.4	105.4	23.1	7.0	***88.2***	88	22	0	27	25
702.30	3.50	2.50			22.6	50.4	134.1	33.3	7.3	***122.4***	122	22	0	46	29
700.80	1.50	2.80			10.5	56.5	138.6	15.4	8.2	***136.9***	137	22	0	54	30
698.30	2.50	2.50			16.2	50.4	***148.7***	23.8	7.3	159.8	149	22	0	60	33
694.80	3.50	2.20			20.8	44.4	394.0	30.6	6.4	***222.9***	223	22	0	101	36
693.30	1.50		100	Hard Till	15.5	268.9	409.5	22.8	38.9	***245.7***	246	22	0	114	38
690.80	2.50		100	Hard Till	25.9	268.9	435.3	38.0	38.9	***283.7***	284	22	0	134	40
688.30	2.50		100	Hard Till	25.9	268.9	461.2	38.0	38.9	***321.8***	322	22	0	155	43
685.80	2.50		100	Hard Till	25.9	268.9	487.1	38.0	38.9	***359.8***	360	22	0	176	45
683.30	2.50		100	Hard Till	25.9	268.9	512.9	38.0	38.9	***397.8***	398	22	0	197	48
680.80	2.50		100	Hard Till	25.9	268.9	538.8	38.0	38.9	***435.9***	436	22	0	218	50
678.30	2.50		100	Hard Till	25.9	268.9	564.7	38.0	38.9	***473.9***	474	22	0	239	53
675.80	2.50		100	Hard Till	25.9	268.9	590.5	38.0	38.9	***511.9***	512	22	0	260	55
673.30	2.50		100	Hard Till	25.9	268.9	616.4	38.0	38.9	***550.0***	550	22	0	281	58
670.80	2.50		100	Hard Till	25.9	268.9	642.3	38.0	38.9	***588.0***	588	22	0	302	60
668.30	2.50		100	Hard Till	25.9	268.9	668.1	38.0	38.9	***626.0***	626	22	0	323	63
665.80	2.50		100	Hard Till	25.9	268.9	694.0	38.0	38.9	***664.1***	664	22	0	344	65
663.30	2.50		100	Hard Till	25.9	268.9	719.9	38.0	38.9	***702.1***	702	22	0	365	68
660.80	2.50		100	Hard Till	25.9	268.9	745.7	38.0	38.9	***740.1***	740	22	0	385	70
658.30	2.50		100	Hard Till	25.9	268.9	***771.6***	38.0	38.9	778.2	772	22	0	403	73
655.80	2.50		100	Hard Till	25.9	268.9	***797.4***	38.0	38.9	816.2	797	22	0	417	75
653.30	2.50		100	Hard Till	25.9	268.9	***823.3***	38.0	38.9	854.2	823	22	0	431	78
650.80	2.50		100	Hard Till	25.9	268.9	***849.2***	38.0	38.9	892.3	849	22	0	446	80
648.30	2.50		100	Hard Till	25.9	268.9	***875.0***	38.0	38.9	930.3	875	22	0	460	83
645.80	2.50		100	Hard Till	25.9	268.9	***900.9***	38.0	38.9	968.3	901	22	0	474	86
643.30	2.50		100	Hard Till	25.9	268.9	***926.8***	38.0	38.9	1006.4	927	22	0	488	88
640.80	2.50		100	Hard Till		268.9			38.9						

Pile Design Table for Pier - EB I-74 over Pope Ck utilizing Boring #2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
126	47	33
Metal Shell 12"Φ w/.25" walls		
126	47	33
Metal Shell 14"Φ w/.25" walls		
150	57	33
Metal Shell 14"Φ w/.312" walls		
150	57	33
Steel HP 8 X 36		
280	142	58
Steel HP 10 X 42		
289	144	50
315	159	53

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
270	133	48
296	148	50
323	162	53
349	177	55
375	191	58
394	202	60
412	212	63
430	221	65
448	231	68
Steel HP 12 X 53		
284	138	45
315	155	48
346	173	50
378	190	53
409	207	55
Steel HP 12 X 63		
291	142	45
323	160	48
355	177	50
386	195	53
418	212	55
450	229	58
482	247	60
Steel HP 12 X 74		
265	128	43
297	145	45
329	163	48
361	180	50
392	198	53
424	215	55
456	233	58
488	250	60
520	268	63
550	284	65
572	296	68
Steel HP 12 X 84		
270	130	43
302	148	45
334	165	48
366	183	50
398	200	53
430	218	55
462	236	58
494	253	60
526	271	63
558	289	65
582	301	68
604	314	70
626	326	73
648	338	75

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
270	127	40
307	148	43
345	168	45
382	189	48
420	210	50
458	231	53
495	251	55
533	272	58
570	293	60
Steel HP 14 X 89		
278	131	40
316	152	43
354	173	45
392	194	48
429	215	50
467	236	53
505	256	55
543	277	58
581	298	60
619	319	63
657	340	65
695	361	68
Steel HP 14 X 102		
284	134	40
322	155	43
360	176	45
398	197	48
436	218	50
474	239	53
512	260	55
550	281	58
588	302	60
626	323	63
664	344	65
702	365	68
740	385	70
772	403	73
797	417	75
Steel HP 14 X 117		
291	138	40
330	160	43
368	181	45
407	202	48
445	223	50
483	244	53
522	265	55
560	286	58
598	307	60
637	328	63
675	349	65
713	370	68
752	392	70
783	409	73
809	423	75
835	437	78
861	452	80
887	466	83
913	480	85
Precast 14"x 14"		
192	72	33
Timber Pile		
113	40	33

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== S Abut - EB I-74 over Pope Ck
REFERENCE BORING ========== 4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 731.25 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 729.25 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======= 1100 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 43.49 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 202.35 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.88 KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Borin	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	411 KIPS	226 KIPS	58 FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
726.00	3.25	1.00			9.2		29.8	13.4		***15.7***	16	0	0	9	5
722.00	4.00	1.50			15.3	20.7	***31.6***	22.3	2.3	36.5	32	0	0	17	9
719.50	2.50		3	Fine Sand	0.5	7.2	***29.8***	0.7	0.8	37.0	30	0	0	16	12
717.00	2.50		2	Fine Sand	0.3	4.9	***35.1***	0.5	0.5	38.0	35	0	0	19	14
712.00	5.00		4	Fine Sand	1.4	9.8	53.6	2.0	1.1	***41.9***	42	0	0	23	19
710.50	1.50		11	Medium Sand	1.2	26.9	55.4	1.7	2.9	***43.7***	44	0	0	24	21
708.00	2.50	2.00			11.5	27.6	75.2	16.9	3.0	***61.5***	61	0	0	34	23
705.50	2.50	2.60			13.7	35.8	83.4	20.1	3.9	***80.9***	81	0	0	45	26
702.00	3.50	2.20			17.2	30.3	254.0	25.1	3.3	***122.8***	123	0	0	68	29
700.50	1.50		100	Hard Till	12.8	183.7	219.1	18.8	20.1	***136.4***	136	0	0	75	31
698.00	2.50		74	Hard Till	12.2	136.0	174.3	17.9	14.9	***148.0***	148	0	0	81	33
695.50	2.50		43	Hard Till	5.0	79.0	217.9	7.4	8.6	***159.6***	160	0	0	88	36
693.00	2.50		64	Hard Till	9.5	117.6	***148.4***	13.8	12.9	164.8	148	0	0	82	38
689.50	3.50	2.80			20.2	38.6	282.6	29.6	4.2	***206.8***	207	0	0	114	42
688.00	1.50		83	Hard Till	9.0	152.5	322.8	13.2	16.7	***223.5***	223	0	0	123	43
685.50	2.50		100	Hard Till	21.4	183.7	344.2	31.3	20.1	***254.7***	255	0	0	140	46
683.00	2.50		100	Hard Till	21.4	183.7	365.6	31.3	20.1	***286.0***	286	0	0	157	48
680.50	2.50		100	Hard Till	-21.4	183.7	387.0	31.3	20.1	***317.2***	317	0	0	174	51
678.00	2.50		100	Hard Till	21.4	183.7	408.3	31.3	20.1	***348.5***	348	0	0	192	53
675.50	2.50		100	Hard Till	21.4	183.7	429.7	31.3	20.1	***379.7***	380	0	0	209	56
673.00	2.50		100	Hard Till	21.4	183.7	451.1	31.3	20.1	***411.0***	411	0	0	226	58
670.50	2.50		100	Hard Till	21.4	183.7	472.5	31.3	20.1	***442.3***	442	0	0	243	61
668.00	2.50		100	Hard Till	21.4	183.7	493.8	31.3	20.1	***473.5***	474	0	0	260	63
665.50	2.50		100	Hard Till	21.4	183.7	515.2	31.3	20.1	***504.8***	505	0	0	278	66
663.00	2.50		100	Hard Till	21.4	183.7	536.6	31.3	20.1	***536.0***	536	0	0	295	68
660.50	2.50		100	Hard Till	21.4	183.7	***558.0***	31.3	20.1	567.3	566	0	0	312	71
658.00	2.50		100	Hard Till	21.4	183.7	***579.3***	31.3	20.1	598.5	579	0	0	319	73
655.50	2.50		100	Hard Till	21.4	183.7	***600.7***	31.3	20.1	629.8	604	0	0	330	76
653.00	2.50		100	Hard Till	21.4	183.7	***622.1***	31.3	20.1	661.0	622	0	0	342	78
650.50	2.50		100	Hard Till	21.4	183.7	***643.4***	31.3	20.1	692.3	645	0	0	354	81
648.00	2.50		100	Hard Till	21.4	183.7	***664.8***	31.3	20.1	723.5	665	0	0	366	83
645.50	2.50		100	Hard Till	21.4	183.7	***686.2***	31.3	20.1	754.8	686	0	0	377	86
643.00	2.50		100	Hard Till	21.4	183.7	***707.6***	31.3	20.1	786.0	706	0	0	389	88
640.50	2.50		100	Hard Till		183.7			20.1						

Pile Design Table for S Abut - EB I-74 over Pope Ck utilizing Boring #4

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
94	52	26
Metal Shell 12"Φ w/.25" walls		
94	52	26
Metal Shell 14"Φ w/.25" walls		
114	62	26
Metal Shell 14"Φ w/.312" walls		
114	62	26
Steel HP 8 X 36		
92	51	38
139	76	42
150	83	43
171	94	46
192	106	48
213	117	51
234	129	53
252	139	56
266	147	58
281	155	61
Steel HP 10 X 42		
118	65	38
173	95	42
186	103	43
213	117	46
239	131	48
265	146	51
291	160	53
317	175	56

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
121	67	38
178	98	42
193	106	43
219	121	46
246	135	48
272	150	51
298	164	53
325	179	56
351	193	58
377	207	61
395	217	63
413	227	66
432	237	68
450	247	71
Steel HP 12 X 53		
136	75	31
148	81	33
148	82	38
207	114	42
223	123	43
255	140	46
286	157	48
317	174	51
348	192	53
380	209	56
411	226	58
Steel HP 12 X 63		
128	70	29
141	77	31
150	82	38
213	117	42
230	127	43
262	144	46
294	161	48
325	179	51
357	196	53
389	214	56
420	231	58
452	249	61
484	266	63
Steel HP 12 X 74		
133	73	29
145	80	31
152	84	38
217	119	42
235	130	43
267	147	46
299	165	48
331	182	51
363	200	53
395	217	56
426	235	58
458	252	61
490	270	63
522	287	66
552	303	68
574	315	71
Steel HP 12 X 84		
137	75	29
148	81	31
155	85	38
221	122	42
240	132	43
272	150	46
304	167	48
336	185	51
368	203	53
400	220	56
432	238	58
464	255	61
496	273	63
528	291	66
560	308	68
583	321	71
605	333	73
627	345	76
649	357	78

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
98	54	26
151	83	29
167	92	31
180	99	33
184	101	38
252	138	42
272	150	43
310	170	46
348	191	48
385	212	51
423	232	53
460	253	56
498	274	58
535	294	61
573	315	63
Steel HP 14 X 89		
100	55	26
158	87	29
172	95	31
184	101	33
187	103	38
259	142	42
281	154	43
318	175	46
356	196	48
394	217	51
432	238	53
470	258	56
508	279	58
546	300	61
584	321	63
622	342	66
659	363	68
697	384	71
Steel HP 14 X 102		
101	55	26
164	90	29
177	97	31
186	102	33
189	104	38
264	145	42
286	158	43
324	178	46
362	199	48
401	220	51
439	241	53
477	262	56
515	283	58
553	304	61
591	325	63
629	346	66
667	367	68
705	388	71
743	409	73
773	425	76
799	440	78
Steel HP 14 X 117		
103	56	26
171	94	29
182	100	31
190	105	33
192	106	38
270	149	42
294	162	43
333	183	46
371	204	48
409	225	51
448	246	53
486	267	56
524	288	58
563	309	61
601	331	63
639	352	66
678	373	68
716	394	71
754	415	73
784	431	76
810	446	78
837	460	81
863	475	83
889	489	86
915	503	88
Precast 14"x 14"		
125	69	23
145	80	26
Timber Pile		
82	45	26