STRUCTURE GEOTECHNICAL REPORT

Proposed SN 037-0177

Existing SN 037-0072

IL Route 78 over Indian Creek
Route: FAP 22 (IL 78)
Section: (14BR-1)BR
Henry County

PTB 146 - ITEM 26
P-94-004-01
Contract 68637

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Date: November 2010 (REVISED January 2011)

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Exhibits:
A) Location Map
B) Boring Locations
C) Subsurface Data Profile
D) Boring Logs
E) Pile Design Table
F) Slope Stability Graph

Project Description and Proposed Structure Information

The project consists of replacing an existing 113.5' long and 35.7' wide three-span bridge with a new 120.0' long and 39.2' wide three-span structure. The proposed bridge includes integral abutments and solid wall encased pile bent piers which are skewed left ahead 15 degrees.

The project site lies on the dividing line of Section 27 and 28, Range 5E, Township 14N, in the 4th Principal Meridian about 4 miles south of Kewanee. A *Location Map* is included in Exhibit A.

The new bridge abutments and piers will be located beyond the limits of the existing bridge footprint in order to avoid conflict between existing and proposed foundations. Traffic will be maintained utilizing staged construction. The proposed profile grade is slightly changed from existing conditions from -0.20% to -0.30%.

Existing Information

SN 037-0072 was originally constructed in 1958. Substructure elements include stub abutments on concrete piles and solid wall piers with a pile cap and untreated timber piles. Primary superstructure elements include five reinforced concrete T-beams that have a haunched web over the piers and a reinforced concrete deck. In 1984, repairs were made to the bridge which included: replacing deck joints, deck patching, new bituminous overlay, and new tubular steel thrie beam railing. Existing IL Route 78 over the structure has a horizontal tangent alignment and a constant -0.20% grade looking upstation.

The 1958 original design plans show that untreated timber piles with 20 ton capacity were used at the piers and the estimated pile length was 18 feet. Also, 32 ton capacity concrete piles approximately 37 feet long were used at the abutments. According to the boring logs provided in the same design plans the piles terminated in a layer of dense gray sand with a trace of gravel at an approximate elevation of ±700. A similarly described and located layer exists in the new boring logs.

Site Investigation, Subsurface Exploration and Generalized Subsurface Conditions

The site is located in a rural setting primarily surrounded by agricultural fields. The channel is a natural drainage way and has a brush/timber lining on either side. Flow in the channel is generally from west to east. There are no known utilities that would conflict with construction.

The subsurface investigation consisted of four borings (B-1 through B-4) drilled by Testing Service Corporation, in September 2010. B-1 and B-4 were taken near the proposed north and south abutment locations respectively; B-2 and B-3 were taken near the proposed pier locations. *Boring Locations* can be found in Exhibit B.

Boring B-1 was taken 29 feet right of the centerline at station 93+35, B-2 was taken 30 feet left of the centerline at the station 94+20, B-3 was drilled at station 94+65 and 35 feet right of centerline, and B-4 was taken 35 feet left of centerline at station 95+15.

Beginning at the ground surface, standard penetration tests (SPT) were conducted every 2.5 feet to a depth of 30 feet and at 5 foot intervals thereafter according to AASHTO T 206 and the IDOT Geotechnical Manual. All four borings were terminated in shale bedrock approximately 53 to 58 feet below the ground surface. The three borings from the original bridge design plans stopped about 36 to 41 feet below the surface; therefore, the shale bedrock layer was not originally encountered. The borings from the original bridge design plans and the new borings are relatively consistent.

The borings generally encountered about 8 to 16 feet of silty clay loam layers having Q_u values of less than 0.25 to 2.75 tsf, SPT (N) values ranging from 2 to 12 blows per foot, and moisture contents ranging between 13% and 33%. Then approximately 31 to 39 feet of sand and silty loam layers were met with N values ranging from 0 to 46 blows per foot. Lastly the borings encountered the shale layer with N values over 100 and moisture contents ranging between 8% and 15%.

Further descriptions of the soil conditions encountered in the borings are presented in the *Boring Logs* attached in Exhibit D and the *Subsurface Data Profile* in Exhibit C.

Geotechnical Evaluations

Settlement. There are no existing settlement issues at the site. Since there is only a miniscule profile grade change and given the use of driven pile foundations it is not expected that settlement issues will be present.

Approach Slab. Based on the available boring data, the approach slab will rest on adequate material with bearing capacities above the required 2 k.s.f.

Slope Stability. Stability analyses using Bishop's Method were performed for both the abutments using a 22 ft high 2H:1V end slope model which rendered a factor of safety of 3.1. No slope stability problems are expected.

Seismic Considerations. Based on the method described in the IDOT AGMU Memo 09.1 (LRFD Seismic Soil Site Class Definition), Soil Site Class D controls. The Design Spectral Acceleration at 1.0 sec (S_{D1}) is 0.098g and at 0.2 sec (S_{Ds}) is 0.151g. These values are based on a 1000 year design return period earthquake. According to AASHTO LRFD 3.10.6 the Seismic Performance Zone is 1 based on the 1.0 second design spectral acceleration.

Liquefaction. A liquefaction analysis was performed using the worksheet provided by IDOT BBS Central Geotechnical Unit. A design earthquake mean magnitude of 6.26 was realized using the USGS data and deaggregation methods provided at http://eqint.cr.usgs.gov/deaggint/2008/. The soil profiles were analyzed using the IDOT liquefaction spreadsheet and the results indicated that the factor of safety against liquefiable soil layers was adequate. As a result, there are no capacity reductions for pile design due to liquefaction.

Scour. The design scour elevations are presented in the table below and are subject to refinement in the final design. Design scour elevation at the abutments is equal to the proposed bottom of abutment elevation. Pier scour was checked using the 100 year

condition considering a proposed ground elevation of 728.7 with a total pier scour of 7.26 feet, however, the controlling elevation is the bottom of encasement at 716.99. Streambed material consists of Silty Clay Loam with Q_u < 0.50 TSF and Sandy soils below. Following the IDOT BM Section 2.3.6.3.2 the scour depth should be taken as 100% and no reductions are recommended. Appropriately sized riprap end slope protection should be utilized.

Design Scour Elevation (ft.)	North Abutment	Pier 1	Pier 2	South Abutment
	736.4	716.99	716.99	736.0

Mining Activity. A review of The Illinois State Geological Survey (ISGS) "Directory of Coal Mines in Illinois" for Henry County indicates that no mining activity has been present at the project location.

Foundation Evaluations and Design Recommendations

At each substructure location the preliminary factored loads are estimated to be:

Abutments	Piers
Vertical = 908 kips	Vertical = 1800 kips
Longitudinal = 78 kips	Longitudinal = 113 kips
Lateral = 21 kips	Lateral = 31 kips

Abutments. It is planned that integral abutments will be used since they are highly desired in order to eliminate bridge joints. Driven pile foundations are required for integral abutments. Closed abutments are typically not cost effective, especially on stream crossing situations. Shallow foundations with closed or semi-integral abutments would be cost-prohibitive and undesirable due to the soil conditions. Drilled shafts would cause the integral abutment option to get replaced with stub abutments which would introduce unwanted expansion joints to the bridge.

Given the above loadings and the desire to have a jointless bridge, integral abutments with driven H-piles or Metal Shell Piles is the most appropriate foundation type for this structure. Section 2.3.6.2.1 of the IDOT Bridge Manual permits the use of 14" Metal Shell and H-piles for bridges between 90 and 200 feet long. Since it is not certain that friction piles can achieve adequate resistance prior to encountering rock it is recommended that H-Piles driven to rock be utilized. Pile types and estimated lengths are presented in Exhibit E. The estimated lengths include a 2 foot embedment into the abutment and are based on top of pile elevations of 738.4 at the north abutment, and 738.0 at the south abutment. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance.

Pile response to lateral loads was examined using a fixed connection to the abutment and a range of lateral loads was applied with a maximum of 15 kips. The estimated maximum deflections are 0.38" and 0.22" at the north and south abutments respectively. See Exhibit C for the appropriate soil parameters to be applied in the soil-structure interaction model. P-multipliers were not used in the preliminary design; the designer may elect to perform a more detailed lateral load analysis as necessary. Liquefaction, and scour reductions are not considered and are not included in the pile capacities given in the Pile Design Table.

Piers. It is planned that solid wall pile bent piers will be used. Shallow foundations would be cost-prohibitive and undesirable due to the soil conditions. Drilled shafts were not considered because the amount of drilling and construction makes them uneconomical when compared to driven piles. Driven H-piles or Metal Shell Piles are the most appropriate foundation type for this type of pier. Since it is not certain that friction piles can achieve adequate resistance prior to encountering rock it is recommended that H-Piles driven to rock be utilized. Pile types and estimated lengths are presented in Exhibit E. The estimated lengths include a 1 foot embedment into the pier cap and are based on top of pile elevations of 738.2. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance.

Pile response to lateral loads was examined using a range of lateral loads with a maximum of 15 kips. The estimated maximum deflections are 0.68" at the piers. See Exhibit C for the appropriate soil parameters to be applied in the soil-structure interaction model. P-multipliers were not used in the preliminary design; the designer may elect to perform a more detailed lateral load analysis as necessary. Liquefaction, and scour reductions are not considered and are not included in the pile capacities given in the Pile Design Table.

Construction Considerations

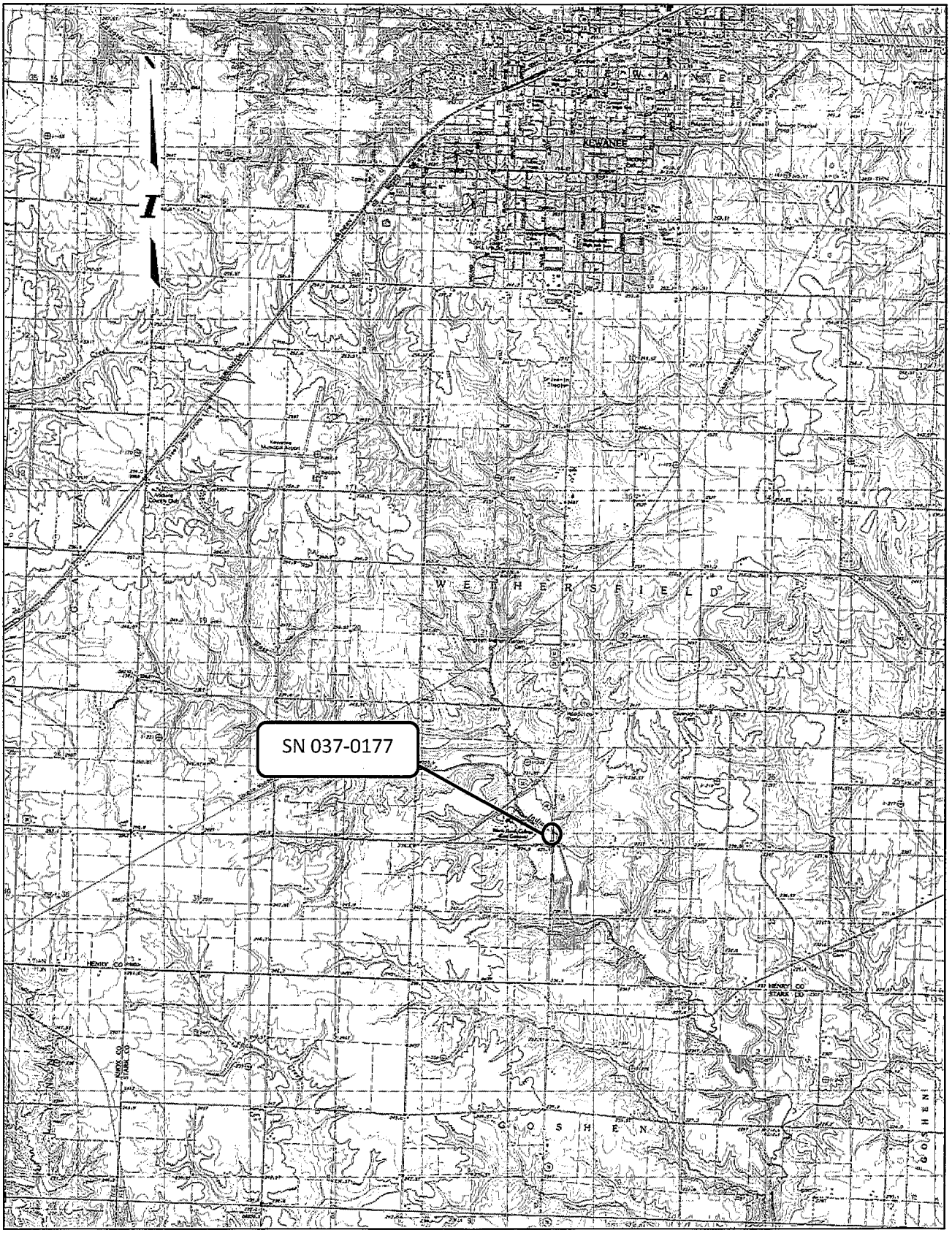
Stage Construction. Traffic is expected to be maintained using stage construction. The new structure will be constructed beyond the limits of the existing bridge. Temporary sheet piling is determined to be feasible, IDOT Design Guide 3.13.1 shall be used to compute the minimum required section modulus and embedment depth. The estimated retained height is 7 feet with an approximate dredge line elevation of 736.

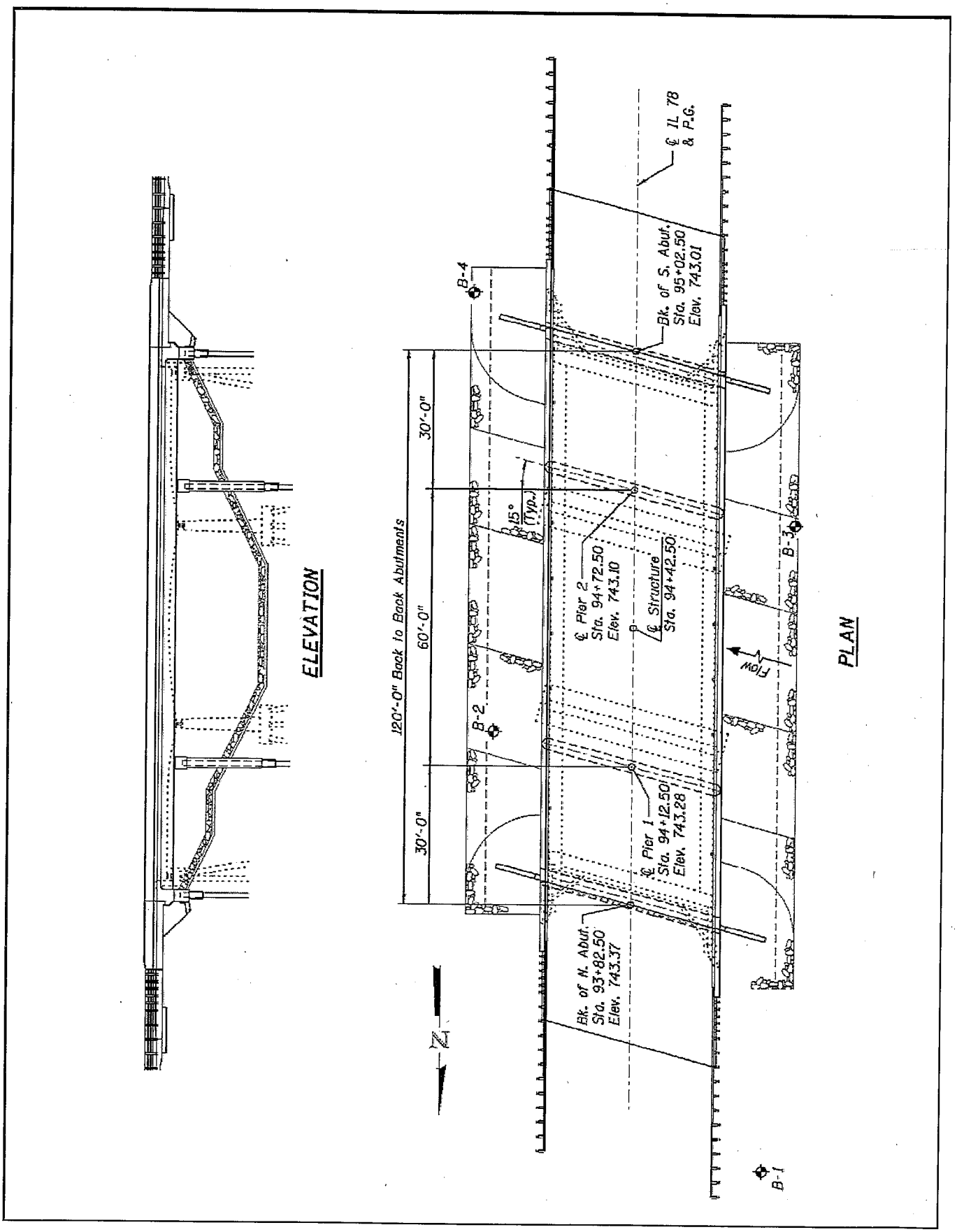
Cofferdams and Underwater Structure Excavation Protection. While drilling, groundwater was encountered near elevation 718 at the pier borings, and about 721 at the abutment borings. The local water surface elevation was recorded as elevation 720.8. Following Section 2.3.6.4.2 of 2009 IDOT Bridge Manual the estimated water surface elevation (EWSE) is computed to be around 723.38 for the assumed construction season. It is recommended that underwater structure excavation protection be utilized at the pier locations to divert water during high flow conditions.

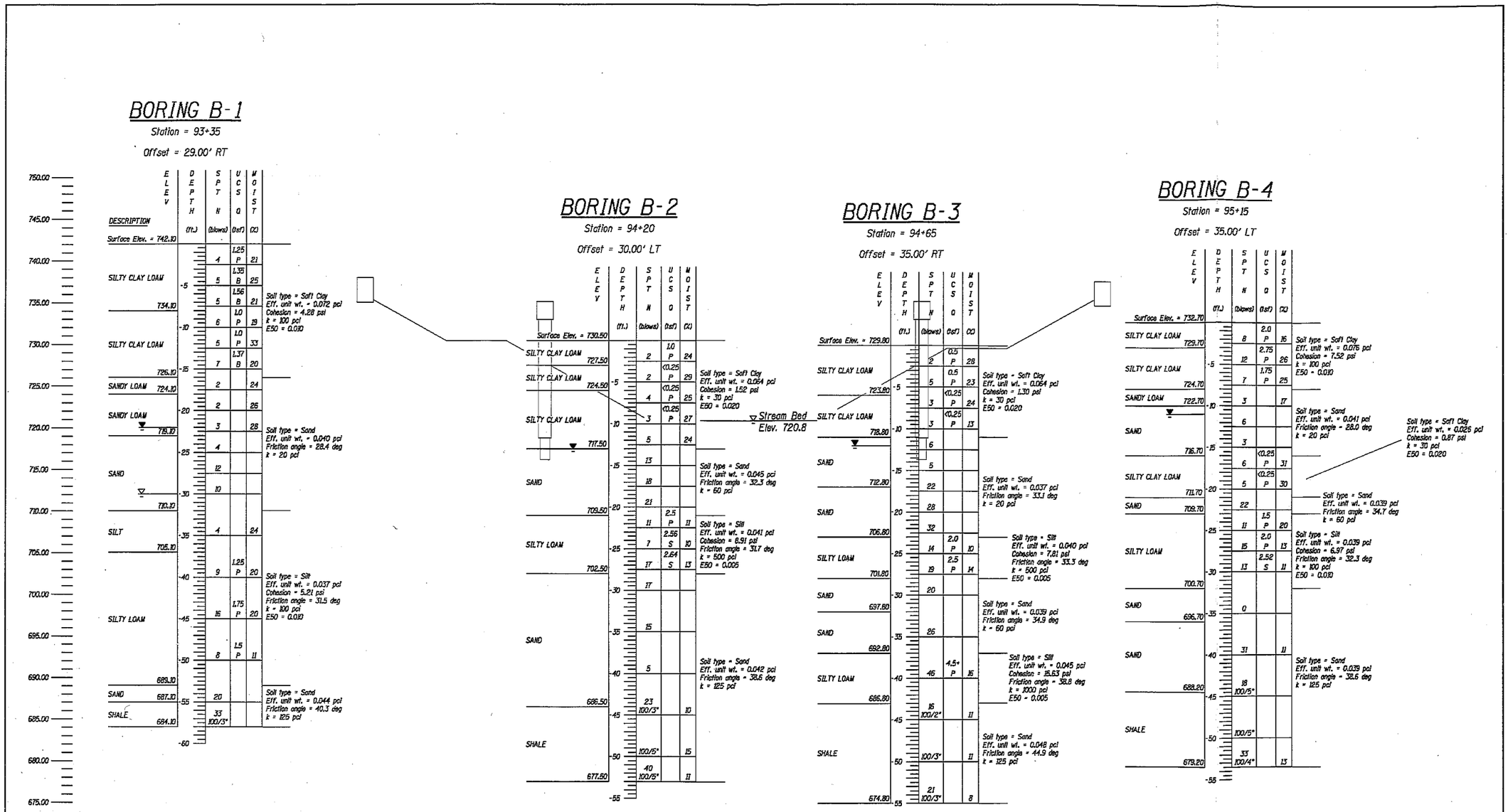
Foundation Construction. It is anticipated that the solid wall encased bent piers will require underwater structure excavation protection systems. Each substructure unit should utilize pile encasements. Bottom of abutment elevations are estimated to be 736.4 for the north abutment and 736.0 for the south abutment, and bottom of pier wall elevations are around 720 for each pier. The rock line is pretty well defined in the boring logs so only one test pile at one abutment and one test pile at one pier is recommended. To prevent the risk of damage from hard driving pile shoes are recommended.

Limitations

The recommendations provided herein are for the exclusive use of IDOT and Maurer-Stutz Inc. They are specific only to the project described, and are based on subsurface information obtained at boring locations within the bridge area, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. Lin Engineering should be contacted if conditions encountered during construction are not consistent with those described.


KEWANEE
WETHERSFIELD
SN 037-0177
HENRY CO
STARK CO
GOSHEN


ELEVATION
PLAN
120'-0" Back to Back Abutments
30'-0"
60'-0"
30'-0"
15° (Typ.)
B-4
B-2
B-3
B-1
℄ IL 78 & P.G.
Bk. of S. Abut. Sta. 95+02.50 Elev. 743.01
℄ Pier 2 Sta. 94+72.50 Elev. 743.10
℄ Structure Sta. 94+42.50
℄ Pier 1 Sta. 94+12.50 Elev. 743.28
Bk. of N. Abut. Sta. 93+82.50 Elev. 743.37
FLOW
N


BORING B-1
Station = 93+35
Offset = 29.00' RT
ELEV
DEPTH (ft.)
SPT N (blows)
UCS Q (tsf)
MOIST (%)
DESCRIPTION
Surface Elev. = 742.10
SILTY CLAY LOAM
734.10
SILTY CLAY LOAM
726.10
SANDY LOAM
724.10
SANDY LOAM
715.10
SAND
710.10
SILT
705.10
SILTY LOAM
689.10
SAND
687.10
SHALE
684.10
Soil type = Soft Clay
Eff. unit wt. = 0.072 pci
Cohesion = 4.28 psi
k = 100 pci
E50 = 0.010
Soil type = Sand
Eff. unit wt. = 0.040 pci
Friction angle = 28.4 deg
k = 20 pci
Soil type = Silt
Eff. unit wt. = 0.037 pci
Cohesion = 5.21 psi
Friction angle = 31.5 deg
k = 100 pci
E50 = 0.010
Soil type = Sand
Eff. unit wt. = 0.044 pci
Friction angle = 40.3 deg
k = 125 pci
BORING B-2
Station = 94+20
Offset = 30.00' LT
Surface Elev. = 730.50
SILTY CLAY LOAM
727.50
SILTY CLAY LOAM
724.50
SILTY CLAY LOAM
717.50
SAND
709.50
SILTY LOAM
702.50
SAND
686.50
SHALE
677.50
Stream Bed
Elev. 720.8
Soil type = Soft Clay
Eff. unit wt. = 0.064 pci
Cohesion = 1.52 psi
k = 30 pci
E50 = 0.020
Soil type = Sand
Eff. unit wt. = 0.045 pci
Friction angle = 32.3 deg
k = 60 pci
Soil type = Silt
Eff. unit wt. = 0.041 pci
Cohesion = 6.91 psi
Friction angle = 31.7 deg
k = 500 pci
E50 = 0.005
Soil type = Sand
Eff. unit wt. = 0.042 pci
Friction angle = 38.6 deg
k = 125 pci
BORING B-3
Station = 94+65
Offset = 35.00' RT
Surface Elev. = 729.80
SILTY CLAY LOAM
723.80
SILTY CLAY LOAM
718.80
SAND
712.80
SAND
706.80
SILTY LOAM
701.80
SAND
697.80
SAND
692.80
SILTY LOAM
686.80
SHALE
674.80
Soil type = Soft Clay
Eff. unit wt. = 0.064 pci
Cohesion = 1.30 psi
k = 30 pci
E50 = 0.020
Soil type = Sand
Eff. unit wt. = 0.037 pci
Friction angle = 33.1 deg
k = 20 pci
Soil type = Silt
Eff. unit wt. = 0.040 pci
Cohesion = 7.81 psi
Friction angle = 33.3 deg
k = 500 pci
E50 = 0.005
Soil type = Sand
Eff. unit wt. = 0.039 pci
Friction angle = 34.9 deg
k = 60 pci
Soil type = Silt
Eff. unit wt. = 0.045 pci
Cohesion = 15.63 psi
Friction angle = 38.8 deg
k = 1000 pci
E50 = 0.005
Soil type = Sand
Eff. unit wt. = 0.048 pci
Friction angle = 44.9 deg
k = 125 pci
BORING B-4
Station = 95+15
Offset = 35.00' LT
Surface Elev. = 732.70
SILTY CLAY LOAM
729.70
SILTY CLAY LOAM
724.70
SANDY LOAM
722.70
SAND
716.70
SILTY CLAY LOAM
711.70
SAND
709.70
SILTY LOAM
700.70
SAND
696.70
SAND
688.20
SHALE
679.20
Soil type = Soft Clay
Eff. unit wt. = 0.076 pci
Cohesion = 7.52 psi
k = 100 pci
E50 = 0.010
Soil type = Sand
Eff. unit wt. = 0.041 pci
Friction angle = 28.0 deg
k = 20 pci
Soil type = Soft Clay
Eff. unit wt. = 0.026 pci
Cohesion = 0.87 psi
k = 30 pci
E50 = 0.020
Soil type = Sand
Eff. unit wt. = 0.039 pci
Friction angle = 34.7 deg
k = 60 pci
Soil type = Silt
Eff. unit wt. = 0.039 pci
Cohesion = 6.97 psi
Friction angle = 32.3 deg
k = 100 pci
E50 = 0.010
Soil type = Sand
Eff. unit wt. = 0.039 pci
Friction angle = 32.6 deg
k = 125 pci
Groundwater elevation encountered while drilling
Groundwater elevation upon completion

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Page 1 of 2
Date 9/8/10

ROUTE IL 78 DESCRIPTION Bridge Over Indian Creek

SECT. (14-BR-1)BR STRUCT. NO. 037-0177 DRILLED BY B. Williamson

COUNTY Henry LOCATION S.27/28, TWP. 14N, RNG. 5E

Boring No. B-1 N. Abutment
Station 93+35
Offset 29.00ft RT
Surface Elev. 742.10 ft

Surface Water Elev. 720.8
Groundwater Elev.:
when drilling 720.1
at Completion 712.1
after ____ Hrs. ____

DEPTH	BLOWS	Qu tsf	W %
	Stiff brown SILTY CLAY LOAM, moist		
	2 2 2	P 1.25	21
	2 2 3	B 1.35	25
-5			
	2 2 3	B 1.56	21
	734.10 Stiff dark brown SILTY CLAY LOAM, moist to very moist		
	2 3 3	P 1.0	19
-10			
	0 2 3	P 1.0	33
	1 2 5	B 1.37	20
-15			
	726.10 Very loose dark brown SANDY LOAM, moist		
	1 1 1		24
	724.10 Very loose gray SANDY LOAM, very moist to wet		
	0 1 1		26
-20			
	1 2 1		28
	719.10 Loose to medium dense gray fine to medium SAND, saturated		
	0 2 2		
-25			
	Medium dense gray fine to medium SAND, saturated		
	4 6 6		
	6 5 5		
-30			
	710.10 Loose gray SILT, very moist		
	4 2 2		24
-35			
	705.10 Stiff gray SILTY LOAM, moist		
	3 4 5	P 1.25	20
-40			
	3 6 10	P 1.75	20
-45			
	4 4 4	P 1.5	11
-50			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

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Date 9/8/10

STRUCTURE NO. 037-0177
ROUTE IL 78
SECTION (14-BR-1)BR
COUNTY Henry

Boring No. B-1 N. Abutment
Station 93+35
Offset 29.00ft RT
Elevation 692.10 ft

	DEPTH	BLOWS	Qu tsf	W %
Stiff gray SILTY LOAM, moist				
689.10				
Medium dense gray fine to medium SAND, saturated		4 10 10		
687.10	-55			
Very dense gray SHALE with limestone fragments		33 100/3"		
684.10				
End of Boring at 58.0' - Auger Refusal	-60			
	-65			
	-70			
	-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
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ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Page 1 of 2
Date 9/7/10

ROUTE IL 78 DESCRIPTION Bridge Over Indian Creek

SECT. (14-BR-1)BR STRUCT. NO. 037-0177 DRILLED BY B. Williamson

COUNTY Henry LOCATION S27/28, TWP. 14N, RNG. 5E

Boring No. B-2 N. Pier
Station 94+20
Offset 30.00ft LT
Surface Elev. 730.50 ft

Surface Water Elev. 720.8
Groundwater Elev.:
when drilling 717.5
at Completion
after ____ Hrs.

DEPTH	BLOWS	Qu tsf	W %
	Medium stiff dark brown SILTY CLAY LOAM, moist		
	1 1 1	P 1.0	24
727.50			
	Soft dark brown SILTY CLAY LOAM, very moist		
	1 1 1	P <0.25	29
-5			
724.50			
	Very soft brown-gray SILTY CLAY LOAM, moist to very moist		
	1 2 2	P <0.25	25
	1 1 2	P <0.25	27
-10			
	Tree root in Sample 5.		
	1 2 3		24
717.50			
	Medium dense brown fine to medium SAND, saturated		
	2 7 6		
-15			
	12" Blow-in sand at 16' - Washed out.		
	4 7 11		
	12" Blow-in sand at 18.5' - Washed out.		
	4 10 11		
-20			
709.50			
	Very stiff gray SILTY LOAM, moist		
	3 4 7	P 2.5	11
	3 3 4	S 2.56	10
-25			

DEPTH	BLOWS	Qu tsf	W %
	Very stiff gray SILTY LOAM, moist		
	3 7 10	S 2.64	13
702.50			
	Medium dense to loose gray fine to medium SAND, saturated		
	3 6 11		
-30			
	3 6 9		
-35			
	3 1 4		
-40			
	11' Blow-in sand at 43.5' - Washed out.		
686.50			
	Very dense gray SHALE with limestone fragments		
	23 100/3"		10
-45			
	100/5"		15
-50			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Page 2 of 2
Date 9/7/10

STRUCTURE NO. 037-0177
ROUTE IL 78
SECTION (14-BR-1)BR
COUNTY Henry

Boring No. B-2 N. Pier
Station 94+20
Offset 30.00ft LT
Elevation 680.50 ft

	DEPTH	BLOWS	Qu tsf	W %
Very dense gray SHALE with limestone fragments				
		40 100/5"		11
677.50				
End of Boring at 53.0' - Auger Refusal	-55			
	-60			
	-65			
	-70			
	-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

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ROUTE IL 78 DESCRIPTION Bridge Over Indian Creek

SECT. (14-BR-1)BR STRUCT. NO. 037-0177 DRILLED BY B. Williamson

COUNTY Henry LOCATION S27/28, TWP. 14N , RNG. 5E

Boring No. B-3 S. Pier
Station 94+65
Offset 35.00ft RT
Surface Elev. 729.80 ft

Surface Water Elev. 720.8
Groundwater Elev.:
when drilling 717.8
at Completion
after ____ Hrs.

DEPTH	BLOWS	Qu tsf	W %
	Soft dark brown SILTY CLAY LOAM, moist		
	1	P	28
	1	0.5	
	1		
	3	P	23
	2	0.5	
-5	3		
723.80			
	Very soft brown-gray SILTY CLAY LOAM, moist		
	0	P	24
	2	<0.25	
	1		
	1	P	13
	1	<0.25	
-10	2		
718.80			
	Loose brown fine to medium SAND, saturated		
	0		
	3		
	3		
	1		
	2		
-15	3		
	9" Blow-in sand at 16.0' - Washed out.		
	4		
712.80	10		
	12		
	Medium dense to dense brown fine to coarse SAND, saturated		
	12" Blow-in sand at 18.5' - Washed out.		
	10		
	13		
-20	15		
	12" Blow-in sand at 21' - Washed out.		
	15		
	15		
	17		
706.80			
	Very stiff gray SILTY LOAM, moist		
	5	P	10
	7	2.0	
-25	7		

DEPTH	BLOWS	Qu tsf	W %
	Very stiff gray SILTY LOAM, moist		
	3	P	14
	9	2.5	
	10		
	12" Blow-in sand at 26' - Washed out.		
701.80			
	Medium dense gray fine to coarse SAND, saturated		
	5		
	36" Blow-in sand at 28.5' - Washed out.		
	6		
-30	14		
697.80			
	Medium dense gray fine SAND, saturated		
	13		
	14		
-35	12		
692.80			
	Hard gray SILTY LOAM, moist		
	13	P	16
	20	4.5+	
-40	26		
686.80			
	Very dense gray SHALE		
	16		11
	~~100/2"~~		
-45			
	~~100/3"~~		11
-50			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

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STRUCTURE NO. 037-0177
ROUTE IL 78
SECTION (14-BR-1)BR
COUNTY Henry

Boring No. B-3 S. Pier
Station 94+65
Offset 35.00ft RT
Elevation 679.80 ft

	DEPTH	BLOWS	Qu tsf	W %
Very dense gray SHALE				
		21 100/3"		8
674.80	-55			
End of Boring at 55.0' - Auger Refusal				
	-60			
	-65			
	-70			
	-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Page 1 of 2
Date 9/8/10

ROUTE IL 78 DESCRIPTION Bridge Over Indian Creek

SECT. (14-BR-1)BR STRUCT. NO. 037-0177 DRILLED BY B. Williamson

COUNTY Henry LOCATION S27/28, TWP. 14N, RNG. 5E

Boring No. B-4 S. Abutment
Station 95+15
Offset 35.00ft LT
Surface Elev. 732.70 ft

Surface Water Elev. 720.8
Groundwater Elev.:
when drilling 721.7
at Completion
after ____ Hrs.

DEPTH	BLOWS	Qu tsf	W %
Very stiff brown SILTY CLAY LOAM, moist			
	4 4 4	P 2.0	16
729.70			
Very stiff to stiff dark brown SILTY CLAY LOAM, moist			
	3 5 7	P 2.75	26
-5			
	2 3 4	P 1.75	25
724.70			
Very loose brown-gray SANDY LOAM, moist			
	1 1 2		17
722.70 -10			
Loose to very loose gray fine to medium SAND, saturated			
	1 3 3		
	1 1 2		
-15			
716.70			
Very soft gray SILTY CLAY LOAM, very moist			
	2 3 3	P <0.25	31
	2 2 3	P <0.25	30
-20			
711.70			
Medium dense gray fine to medium SAND, saturated			
	6 10 12		
709.70			
Stiff to very stiff gray SILTY LOAM, moist			
	5 5 6	P 1.5	20
-25			

DEPTH	BLOWS	Qu tsf	W %
Very stiff gray SILTY LOAM, moist			
	7 7 8	P 2.0	13
12" Blow-in sand at 28.5' - Washed out.			
-30	6 6 7	S 2.52	11
700.70			
Very loose gray fine to medium SAND, saturated			
12" Blow-in sand at 33.5' - Washed out.			
-35	0 0 0		
696.70			
Dense gray fine to coarse SAND, saturated			
	7 15 16		11
-40			
	3 18 100/5"		
688.20			
Very dense gray SHALE			
36" Blow-in sand at 48.5' - Washed out.	100/5"		
-50			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Page 2 of 2
Date 9/8/10

STRUCTURE NO. 037-0177
ROUTE IL 78
SECTION (14-BR-1)BR
COUNTY Henry

Boring No. B-4 S. Abutment
Station 95+15
Offset 35.00ft LT
Elevation 682.70 ft

DEPTH	BLOWS	Qu tsf	W %
Very dense gray SHALE			
679.20	33 100/4"		13
End of Boring at 53.5' - Auger Refusal			
-55			
-60			
-65			
-70			
-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

MODIFIED IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/3/2010

SUBSTRUCTURE========== North Abutment
REFERENCE BORING ========== B-1
GROUND SURFACE ELEV. AT BORING ========== 742.10 FT.
PILE CUTOFF ELEV. ========== 736.40 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 733.40 FT.
GROUND WATER ELEVATION========== 722.10 FT.
HAMMER EFFICIENCY========== 73 %
LRFD or ASD or SEISMIC ========== LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 908 KIPS
TOTAL WIDTH OF SUBSTRUCTURE ========== 40.55 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 179.14 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 67.18 KIPS

PILE TYPE AND SIZE ========== Steel HP 10 X 57
Plugged Pile Perimeter========== 3.365 FT. Unplugged Pile Perimeter========== 4.883 FT.
Plugged Pile End Bearing Area====== 0.708 SQFT. Unplugged Pile End Bearing Area==== 0.117 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 0.00 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 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
454 KIPS	454 KIPS	250 KIPS	53 Below Boring

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.)
730.90	2.50	1.00			12.0		21.1	17.4		***18.9***	19	0	0	10	8
727.40	3.50	1.37			21.3	9.1	***35.9***	30.9	1.5	48.7	36	0	0	20	11
725.40	2.00		2	Very Fine Silty Sand	0.4	2.6	***36.4***	0.6	0.4	49.4	36	0	0	20	13
722.90	2.50		3	Very Fine Silty Sand	0.5	2.6	***38.2***	0.8	0.4	50.3	38	0	0	21	16
720.40	2.50		3	Very Fine Silty Sand	0.8	4.0	***42.1***	1.1	0.7	52.0	42	0	0	23	18
717.90	2.50		4	Medium Sand	1.2	7.1	59.2	1.8	1.2	***56.4***	56	0	0	31	21
715.40	2.50		12	Medium Sand	4.0	23.0	***59.7***	5.8	3.8	61.6	60	0	0	33	23
711.40	4.00		10	Medium Sand	5.4	19.4	***50.9***	7.8	3.2	67.1	51	0	0	28	27
706.40	5.00		4	Very Fine Silty Sand	2.1	5.3	***56.0***	3.0	0.9	70.7	56	0	0	31	32
701.40	5.00	1.25			28.5	8.3	***87.8***	41.3	1.4	112.5	88	0	0	48	37
696.40	5.00	1.75			36.0	11.6	***122.2***	52.2	1.9	164.5	122	0	0	67	42
690.40	6.00	1.50			38.9	9.9	***182.9***	56.5	1.6	224.6	183	0	0	101	48
688.40	2.00		20	Medium Sand	4.4	31.8	243.9	6.4	5.2	***240.3***	240	0	0	132	50
687.40	1.00			Shale	42.0	88.3	***285.9***	60.9	14.6	301.2	286	0	0	157	51
686.40	1.00			Shale	42.0	88.3	***327.9***	60.9	14.6	362.2	328	0	0	180	52
685.40	1.00			Shale		88.3			14.6						

10/22/2010 — *Pile Length vs. Capacity Analysis* — B-1_Modified IDOT Pile Length.xls

MODIFIED IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/3/2010

SUBSTRUCTURE = Pier 1
REFERENCE BORING = B-2
GROUND SURFACE ELEV. AT BORING = 730.50 FT.
PILE CUTOFF ELEV. = 738.30 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 716.99 FT.
GROUND WATER ELEVATION = 722.10 FT.
HAMMER EFFICIENCY = 73 %
LRFD or ASD or SEISMIC = LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD = 1800 KIPS
TOTAL WIDTH OF SUBSTRUCTURE = 40.55 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts = 355.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts = 133.17 KIPS

PILE TYPE AND SIZE = Steel HP 10 X 57
Plugged Pile Perimeter = 3.365 FT. Unplugged Pile Perimeter = 4.883 FT.
Plugged Pile End Bearing Area = 0.708 SQFT. Unplugged Pile End Bearing Area = 0.117 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD = 0.00 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) = 0.00 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
454 KIPS	447 KIPS	246 KIPS	57 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.)
714.49	2.50		18	Fine Sand	6.9		41.0	10.1		***15.7***	16	0	0	9	24
710.80	3.69		21	Fine Sand	11.1	34.1	34.6	16.1	5.6	***28.9***	29	0	0	16	28
708.30	2.50	2.50			22.7	16.6	***57.7***	32.9	2.7	61.9	58	0	0	32	30
705.80	2.50	2.56			23.1	17.0	***81.3***	33.5	2.8	95.5	81	0	0	45	33
703.80	2.00	2.64			18.9	17.5	***116.2***	27.4	2.9	125.5	116	0	0	64	35
698.80	5.00		17	Fine Sand	11.0	33.6	***121.9***	15.9	5.5	140.5	122	0	0	67	40
693.80	5.00		15	Fine Sand	9.2	28.3	***111.7***	13.4	4.7	150.7	112	0	0	61	45
687.80	6.00		5	Fine Sand	3.5	8.8	194.6	5.0	1.5	***168.8***	169	0	0	93	51
686.80	1.00			Shale	42.0	88.3	236.6	60.9	14.6	***229.8***	230	0	0	126	51.5
685.80	1.00			Shale	42.0	88.3	***278.6***	60.9	14.6	290.7	279	0	0	153	52.5
684.80	1.00			Shale	42.0	88.3	***320.6***	60.9	14.6	351.7	321	0	0	176	53.5
683.80	1.00			Shale	42.0	88.3	***362.6***	60.9	14.6	412.6	363	0	0	199	54.5
682.80	1.00			Shale	42.0	88.3	***404.6***	60.9	14.6	473.6	405	0	0	223	55.5
681.80	1.00			Shale	42.0	88.3	***446.6***	60.9	14.6	534.5	447	0	0	246	56.5
680.80	1.00			Shale	42.0	88.3	***488.6***	60.9	14.6	595.5	~~439~~	~~0~~	~~0~~	~~269~~	~~57.5~~
679.80	1.00			Shale	42.0	88.3	***530.6***	60.9	14.6	656.4	~~531~~	~~0~~	~~0~~	~~292~~	~~58.5~~
678.80	1.00			Shale		88.3			14.6						

10/22/2010 — *'Pile Length vs. Capacity Analysis* — B-2_Modified IDOT Pile Length.xls

MODIFIED IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/3/2010

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== B-3
GROUND SURFACE ELEV. AT BORING ========== 729.60 FT.
PILE CUTOFF ELEV. ========== 738.30 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 716.99 FT.
GROUND WATER ELEVATION========== 722.10 FT.
HAMMER EFFICIENCY========== 73 %
LRFD or ASD or SEISMIC ========== LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1800 KIPS
TOTAL WIDTH OF SUBSTRUCTURE ========== 40.55 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 355.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 133.17 KIPS

PILE TYPE AND SIZE ========== Steel HP 10 X 57
Plugged Pile Perimeter========== 3.365 FT. Unplugged Pile Perimeter========== 4.883 FT.
Plugged Pile End Bearing Area====== 0.708 SQFT. Unplugged Pile End Bearing Area==== 0.117 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 0.00 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 FT.

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 Drivable Length in Boring
454 KIPS	441 KIPS	243 KIPS	55 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.)
714.20	2.79		22	Medium Sand	10.3		50.6	14.9		***21.6***	22	0	0	12	24
711.70	2.50		28	Clean Medium to Coarse San	14.8	40.4	93.9	21.4	6.7	***47.7***	48	0	0	26	27
708.20	3.50		32	Clean Medium to Coarse San	23.8	68.9	***62.0***	34.5	11.4	73.0	62	0	0	34	30
705.70	2.50	2.00			19.6	13.2	***85.0***	28.5	2.2	102.0	85	0	0	47	33
703.20	2.50	2.50			22.7	16.6	***130.0***	32.9	2.7	138.6	130	0	0	71	35
699.20	4.00		20	Clean Medium to Coarse San	11.8	38.9	***152.4***	17.2	6.4	157.5	152	0	0	84	39
694.20	5.00		25	Medium Sand	17.6	49.5	***181.4***	25.5	8.2	184.9	181	0	0	100	44
688.20	6.00		46	Hard Till	22.7	60.9	231.5	32.9	10.0	***222.3***	222	0	0	122	50
687.20	1.00			Shale	42.0	88.3	***273.5***	60.9	14.6	283.3	273	0	0	150	51.1
686.20	1.00			Shale	42.0	88.3	***315.5***	60.9	14.6	344.2	315	0	0	174	52.1
685.20	1.00			Shale	42.0	88.3	***357.5***	60.9	14.6	405.2	357	0	0	197	53.1
684.20	1.00			Shale	42.0	88.3	***399.5***	60.9	14.6	466.1	399	0	0	220	54.1
683.20	1.00			Shale	42.0	88.3	***441.5***	60.9	14.6	527.0	441	0	0	243	55.1
682.20	1.00			Shale	42.0	88.3	***483.4***	60.9	14.6	588.0	~~483~~	~~0~~	~~0~~	~~266~~	~~56.1~~
681.20	1.00			Shale	42.0	88.3	***525.4***	60.9	14.6	648.9	~~525~~	~~0~~	~~0~~	~~289~~	~~57.1~~
680.20	1.00			Shale	42.0	88.3	***567.4***	60.9	14.6	709.9	~~567~~	~~0~~	~~0~~	~~312~~	~~58.1~~
679.20	1.00			Shale	42.0	88.3	***609.4***	60.9	14.6	770.8	~~609~~	~~0~~	~~0~~	~~335~~	~~59.1~~
678.20	1.00			Shale	42.0	88.3	***651.4***	60.9	14.6	831.8	~~651~~	~~0~~	~~0~~	~~358~~	~~60.1~~
677.20	1.00			Shale	42.0	88.3	***693.4***	60.9	14.6	892.7	~~693~~	~~0~~	~~0~~	~~381~~	~~61.1~~
676.20	1.00			Shale		88.3			14.6						

10/22/2010 — *Pile Length vs. Capacity Analysis* — B-3_Modified IDOT Pile Length.xls

MODIFIED IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/3/2010

SUBSTRUCTURE = South Abutment
REFERENCE BORING = B-4
GROUND SURFACE ELEV. AT BORING = 732.70 FT.
PILE CUTOFF ELEV. = 738.00 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV = 733.00 FT.
GROUND WATER ELEVATION = 722.10 FT.
HAMMER EFFICIENCY = 73 %
LRFD or ASD or SEISMIC = LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD = 908 KIPS
TOTAL WIDTH OF SUBSTRUCTURE = 40.55 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts = 179.14 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts = 67.18 KIPS

PILE TYPE AND SIZE = Steel HP 10 X 57
Plugged Pile Perimeter = 3.365 FT. Unplugged Pile Perimeter = 4.883 FT.
Plugged Pile End Bearing Area = 0.708 SQFT. Unplugged Pile End Bearing Area = 0.117 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD = 0.00 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) = 0.00 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
454 KIPS	454 KIPS	250 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.)
731.00	2.00	2.00			15.7		33.9	22.8		***25.8***	26	0	0	14	7
728.50	2.50	2.75			24.2	18.2	***51.5***	35.2	3.0	59.9	52	0	0	28	10
726.00	2.50	1.75			18.0	11.6	***63.2***	26.1	1.9	84.9	63	0	0	35	12
724.00	2.00		3	Very Fine Silty Sand	0.8	5.3	***72.9***	1.2	0.9	87.6	73	0	0	40	14
721.50	2.50		6	Fine Sand	2.3	14.1	***68.1***	3.4	2.3	89.8	68	0	0	37	17
718.00	3.50		3	Fine Sand	1.6	7.1	***64.4***	2.3	1.2	91.3	64	0	0	35	20
715.50	2.50	0.25			3.4	1.7	***67.8***	5.0	0.3	96.2	68	0	0	37	23
713.00	2.50	0.25			3.4	1.7	117.3	5.0	0.3	***108.8***	109	0	0	60	25
711.00	2.00		22	Medium Sand	6.7	47.7	***86.2***	9.7	7.9	112.3	86	0	0	47	27
708.50	2.50	1.50			16.2	9.9	***105.7***	23.5	1.5	136.4	106	0	0	58	30
706.00	2.50	2.00			19.6	13.2	***128.8***	28.5	2.2	165.4	129	0	0	71	32
702.00	4.00	2.52			36.5	16.7	***148.6***	53.0	2.8	215.7	149	0	0	82	36
698.00	4.00		0	Fine Sand	0.0	0.0	***208.9***	0.0	0.0	225.3	207	0	0	114	40
689.50	8.50		31	Fine Sand	33.5	56.3	***270.4***	48.6	9.6	278.8	270	0	0	149	49
688.50	1.00			Shale	42.0	88.3	***312.4***	60.9	14.6	339.8	312	0	0	172	49.5
687.50	1.00			Shale	42.0	88.3	***354.4***	60.9	14.6	400.7	354	0	0	195	50.5
686.50	1.00			Shale	42.0	88.3	***396.4***	60.9	14.6	451.6	396	0	0	218	51.5
685.50	1.00			Shale	42.0	88.3	***438.4***	60.9	14.6	522.6	438	0	0	241	52.5
684.50	1.00			Shale	42.0	88.3	***480.4***	60.9	14.6	583.5	~~480~~	~~0~~	~~0~~	~~264~~	~~53.5~~
683.50	1.00			Shale	42.0	88.3	***522.4***	60.9	14.6	644.5	~~522~~	~~0~~	~~0~~	~~287~~	~~54.5~~
682.50	1.00			Shale	42.0	88.3	***564.4***	60.9	14.6	705.4	~~564~~	~~0~~	~~0~~	~~310~~	~~55.5~~
681.50	1.00			Shale	42.0	88.3	***606.4***	60.9	14.6	766.4	~~606~~	~~0~~	~~0~~	~~333~~	~~56.5~~
680.50	1.00			Shale		88.3			14.6						

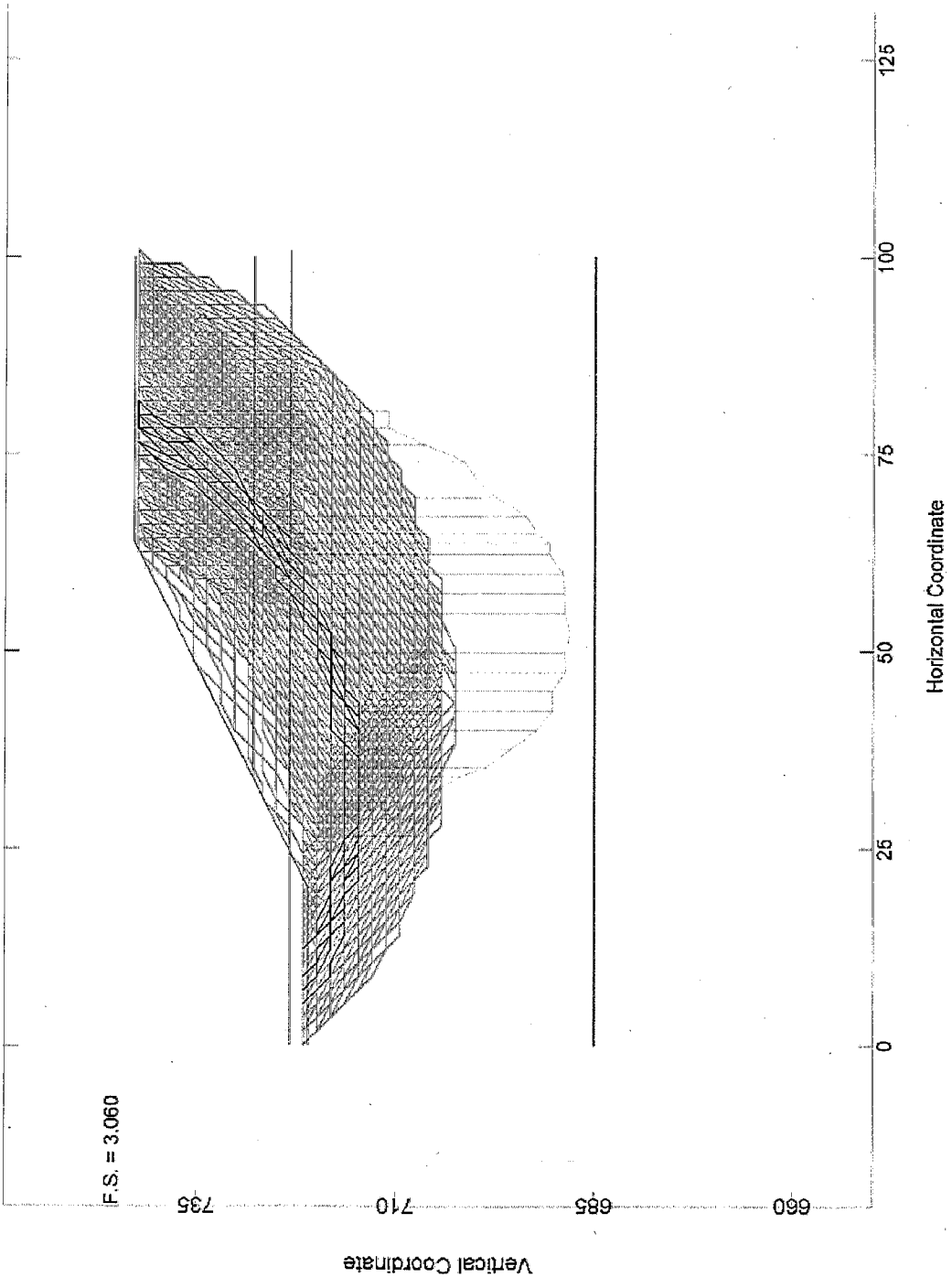
10/22/2010 — *Pile Length vs. Capacity Analysis* — B-4_Modified IDOT Pile Length.xls

Pile Design Table for North Abutment utilizing Boring #B-1							
Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation
Steel HP 10 X 42				**Steel HP 14 X 73**			
120	66	53	685.4	83	46	53	685.4
179	98	53	685.4	129	71	53	685.4
235	129	53	685.4	176	97	53	685.4
335	184	53	685.4	273	150	53	685.4
Steel HP 10 X 57				341	188	53	685.4
122	67	53	685.4	578	318	53	685.4
183	101	53	685.4	**Steel HP 14 X 89**			
240	132	53	685.4	84	46	53	685.4
454	250	53	685.4	131	72	53	685.4
Steel HP 12 X 53				178	98	53	685.4
106	58	53	685.4	277	152	53	685.4
146	80	53	685.4	348	191	53	685.4
222	122	53	685.4	705	388	53	685.4
282	155	53	685.4	**Steel HP 14 X 102**			
418	230	53	685.4	85	47	53	685.4
Steel HP 12 X 63				132	73	53	685.4
107	60	53	685.4	180	99	53	685.4
147	82	53	685.4	280	154	53	685.4
225	124	53	685.4	352	194	53	685.4
288	158	53	685.4	810	445	53	685.4
497	273	53	685.4	**Steel HP 14 X 117**			
Steel HP 12 X 74				86	47	53	685.4
109	60	53	685.4	134	74	53	685.4
149	82	53	685.4	182	100	53	685.4
228	125	53	685.4	284	156	53	685.4
292	161	53	685.4	359	197	53	685.4
589	324	53	685.4	929	511	53	685.4
Steel HP 12 X 84							
110	61	53	685.4				
151	83	53	685.4				
231	127	53	685.4				
296	163	53	685.4				
664	365	53	685.4				

Pile Design Table for Pier 1 utilizing Boring #B-2							
Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation
Steel HP 10 X 42				**Steel HP 14 X 89**			
313	172	60	678.2	163	90	60	678.2
Steel HP 10 X 57				245	135	60	678.2
447	246	60	678.2	705	388	60	678.2
Steel HP 12 X 53				**Steel HP 14 X 102**			
397	218	60	678.2	165	91	60	678.2
Steel HP 12 X 63				249	137	60	678.2
451	248	60	678.2	810	445	60	678.2
Steel HP 12 X 74				**Steel HP 14 X 117**			
559	308	60	678.2	167	92	60	678.2
Steel HP 12 X 84				255	140	60	678.2
619	340	60	678.2	929	511	60	678.2
Steel HP 14 X 73							
555	305	60	678.2				

Pile Design Table for Pier 2 utilizing Boring #B-3							
Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation
Steel HP 10 X 42				**Steel HP 14 X 73**			
308	169	60	678.2	224	123	60	678.2
Steel HP 10 X 57				263	144	60	678.2
441	243	60	678.2	315	173	60	678.2
Steel HP 12 X 53				578	318	60	678.2
217	119	60	678.2	**Steel HP 14 X 89**			
260	143	60	678.2	228	125	60	678.2
418	230	60	678.2	267	147	60	678.2
Steel HP 12 X 63				322	177	60	678.2
222	122	60	678.2	705	388	60	678.2
266	146	60	678.2	**Steel HP 14 X 102**			
497	273	60	678.2	230	127	60	678.2
Steel HP 12 X 74				271	149	60	678.2
225	124	60	678.2	326	179	60	678.2
270	149	60	678.2	810	445	60	678.2
589	324	60	678.2	**Steel HP 14 X 117**			
Steel HP 12 X 84				234	129	60	678.2
227	125	60	678.2	275	151	60	678.2
274	151	60	678.2	333	183	60	678.2
664	365	60	678.2	929	511	60	678.2

Pile Design Table for South Abutment utilizing Boring #B-4								
	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Estimated Pile Tip Elevation
Steel HP 10 X 42					**Steel HP 12 X 84**				
	103	57	57	681.0		108	59	57	681.0
	126	69	57	681.0		132	73	57	681.0
	146	80	57	681.0		161	89	57	681.0
	202	111	57	681.0		181	100	57	681.0
	263	145	57	681.0		268	147	57	681.0
	335	184	57	681.0		343	189	57	681.0
Steel HP 10 X 57						664	365	57	681.0
	106	58	57	681.0	**Steel HP 14 X 73**				
	129	71	57	681.0		96	53	57	681.0
	149	82	57	681.0		126	69	57	681.0
	207	114	57	681.0		155	85	57	681.0
	270	149	57	681.0		189	104	57	681.0
	454	250	57	681.0		208	114	57	681.0
Steel HP 12 X 53						320	176	57	681.0
	104	57	57	681.0		396	218	57	681.0
	127	70	57	681.0		578	318	57	681.0
	155	85	57	681.0	**Steel HP 14 X 89**				
	175	96	57	681.0		97	53	57	681.0
	256	141	57	681.0		127	70	57	681.0
	327	180	57	681.0		157	86	57	681.0
	418	230	57	681.0		191	105	57	681.0
Steel HP 12 X 63						210	115	57	681.0
	105	58	57	681.0		326	179	57	681.0
	129	71	57	681.0		403	222	57	681.0
	157	86	57	681.0		705	388	57	681.0
	177	97	57	681.0	**Steel HP 14 X 102**				
	259	142	57	681.0		98	54	57	681.0
	334	184	57	681.0		129	71	57	681.0
	497	273	57	681.0		159	87	57	681.0
Steel HP 12 X 74						194	107	57	681.0
	106	58	57	681.0		212	117	57	681.0
	130	72	57	681.0		329	181	57	681.0
	159	88	57	681.0		408	224	57	681.0
	179	98	57	681.0		810	445	57	681.0
	263	145	57	681.0	**Steel HP 14 X 117**				
	339	186	57	681.0		99	54	57	681.0
	589	324	57	681.0		131	72	57	681.0
						161	88	57	681.0
						196	108	57	681.0
						214	118	57	681.0
						334	184	57	681.0
						415	228	57	681.0
						929	511	57	681.0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