Illinois Department of Transportation

District 4 ● 401 Main Street ● Peoria, IL 61602

Structure Geotechnical Report

Bridge Replacement
Illinois Route 17 over Edwards River
Mercer County, Illinois

Region:	Three
District:	Four
Route:	F.A.P. 639 (IL 17)
Section:	(123B) BR-1
Structure Number:	066 - 0006 (Existing) 066 - 0021 (Proposed)
Project Number:	P-94-011-07
Contract Number:	68663 - PTB 147/023
Revised Date:	February 26, 2015
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Prepared For: Homer L. Chastain & Assoc.
Jeremy Buening, P.E., S.E.
5 North Country Club Road
Decatur, IL 62521
(217) 429-8800

Prepared By: Ray Seneca, P.E.
Lindsey Jones, P.E.
309-999-0123 Ext. 228
ljones@terraengineering.com

QAQC By: George Ghareeb, P.E.

GEORGE A. GHAREEB
062-047473
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

TERRA ENGINEERING LTD.

401 Main Street ● Suite 1130 ● Peoria, IL 61602
309.999.0123 ● 309.999.0120 (fax)
www.terraengineering.com

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BRIDGE REPLACEMENT
IL 17 OVER EDWARDS RIVER
MERCER COUNTY, ILLINOIS
FAP 669 (IL 17)
SECTION: (123B)BR-1
CONTRACT NO.: 68663
STRUCTURE NO.: 066-0006 (EXISTING)
066-0021 (PROPOSED)

SITE INVESTIGATION

A site investigation was done by TERRA Engineering, Ltd. personnel in November 2010 and there were no signs of distress or deformation in the existing substructure foundation, nor distress in the existing embankment and pavement. Appendix A includes a project location map and pictures taken at the time of the investigation.

1.0 PROJECT DESCRIPTION

The geotechnical study summarized in this report was performed for the proposed replacement of the bridge carrying FAP 639 (IL 17) over Edwards River at station 154+39.31 in Mercer County, Illinois. The purpose of our study was to explore the subsurface conditions and develop design and construction recommendations for the bridge replacement.

The plans dated 1927 show that the original truss structure was erected with 7 cast-in-place approach spans on S.B.I. Route 83 in section 123 B & C. The plans dated 1971 show that the superstructure was replaced with 9 spans of PPC deck beams on a widened substructure and one additional pier. The plans from 1994 show the removal of the asphalt overlay and installation of a 5.5 inch concrete overlay with epoxy coated reinforcement. In addition some bearing pads were adjusted, a few deck beams were patched, and selected keyways were repaired. In 2008 three (3) PPC deck beams were replaced.

The proposed bridge is a five (5) span structure consisting of steel beams on pile supported stub abutments. The piers are to be solid wall supported by two rows of pile. The total structure length is 609.56 feet from back to back of abutments and the width is 35.17 feet out to out of deck. The superstructure consists of 42 inch web plate girders (composite) with an 8 inch thick reinforced concrete slab.

2.0 SUBSURFACE CONDITIONS

The project site is located approximately five miles west of Joy in Mercer County. Physiographically the project is located in the Galesburg Plain. Six standard penetration tests (SPT) borings were proposed, one at each abutments and one at each of the four piers. See Appendix B for the Boring Location Site Plan. The borings were drilled to elevations of 471.0 (B-WA), 471.0 (B-P1), 425.0 (B-P2), 470.5 (B-P3), 470.0 (B-P4), and 478.5 (B-EA). Boring B-P2 was drilled to a depth of 126.0 feet, which was the deepest

of the borings. Bedrock was not encountered at any of the locations. Detailed information regarding the nature and thickness of the soil and rock layers encountered, and the results of the field sampling and laboratory testing are shown on the Boring Logs in Appendix C. The field exploration was performed in general accordance with the procedures outlined in the 1999 IDOT Geotechnical Manual. The borings were staked by Homer L. Chastain and drilled by Terracon Consultants, Inc. An experienced technician from Terracon was with the drill rig to monitor drilling, log borings, and perform unconfined compressive strength tests.

An ATV-mounted rotary drill with hydraulic head was used to advance the borings. SPT's were performed with a split spoon sampler at 2.0 to 3.0 foot intervals to a depth of 30 feet, and then at 5.0 foot intervals to the boring termination depths. Unconfined compression strengths of cohesive samples were measured with a Rimac testing apparatus.

The first layer encountered in borings B-P1, B-P3, B-P4, and B-EA was Loam. Loam was discovered between elevations 546.00 and 558.50 at these locations with blow counts between 5 and 17 blows per foot and moisture content ranging from 12.0 to 16.0 percent. Unconfined Compressive Strength (UCS) values varied from 0.6 to 2.2 tons per foot. The first layer of boring B-WA was comprised of Fine Sand with Clay and had a blow count of 12 and moisture content of 8.0 percent. Fine Sand with Silt was the first layer of boring B-P2. The characteristic of this layer was moisture content of 9.0 percent and a blow count of 5 blows per foot. The layer of Loam in boring B-P-1 is followed by a layer of Clay with moisture content of 36 percent, UCS of 0.2, and a blow count of 1 blow per foot.

The second layer of borings B-WA, B-P1, B-P2, B-P4, and B-EA was Silty Clay. This layer had UCS values ranging from 0.2 to 1.1 tons per foot, moisture content between 18 and 32 percent, blow counts varying from 2 to 6 and was located between elevations 536.00 and 552.00. Following the Loam top layer, boring B-P3 had a Fine to Medium Sand with Silt layer between the elevations of 539.00 and 547.50. Fine to Medium Sand with Silt is also present in boring B-P2 from elevation 536.00 to 539.50 following the Silty Clay layer. The Fine to Medium Sand with Silt layer exhibited characteristics such as blow counts between 1 and 5, moisture content between 13 and 22 percent, and an estimated friction angle of 27.0. A Sandy Clay Loam layer from elevation 542.00 to 550.50 followed the Silty Clay layer in boring B-EA. The Sandy Clay Loam had a friction angle of an estimated 28.0 degrees, blow counts between 2 and 6 blows per foot, and moisture content that varied from 16 to 24 percent.

Following the above listed layers, borings B-WA, B-P1, B-P3, B-P4, and B-EA encountered Fine to Medium Sand and Medium Sand layers between the elevations of 531.00 and 542.00. Blow counts for this layer ranged from 1 to 7 blows per foot, moisture content was between 16 and 23 percent, and the estimated friction angle varied from 27 to 29 degrees. Boring B-WA had organics present at an approximate elevation of 532.50 feet.

Medium to Coarse Sand with Trace Gravel was the next layer for all of the borings. The top elevation of this layer varied from 531.00 to 537.50 feet. Friction angle for this layer ranged from an estimated 29.0 to 35.0 degrees, blow counts were between 4 and 46 blows per foot, and moisture content ranged from 14.0 to 23.0 percent. Medium to Coarse Sand with Trace Gravel was the last layer encountered before the boring was terminated for borings B-P3, B-P4, and B-EA. Borings B-WA, B-P1, and B-P2 had a Clay Loam layer between elevations 494.00 and 504.00 feet. Characteristics of this layer were blow counts between 23 and 34 blows per foot, moisture content that ranged from 11 to 16 percent and UCS that varied from 3.2 to 4.1 tons per foot. After this layer borings B-WA, B-P1, and B-P2 returned to the Medium to Coarse Sand with Trace Gravel material described above.

Ground water encountered during drilling and at completion are shown on the boring logs (Appendix C) and in the Subsurface Data Profile in Appendix D. Based on the boring log data, the expected ground water elevation for the bridge site is approximately 540.0 feet.

The uppermost bedrock at this site in Mercer County consists of Devonian-aged shales and sandstones.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

The east abutment is being raised approximately 0.5 feet and will be located behind the existing abutment. Using the Geotechnical Manual's recommendation for settlement evaluation (Section 1.2.5.2), settlement should not be a concern at this site for the grade raise at the east abutment and approach slab.

The proposed west abutment is being raised approximately 1.0 foot, however it is being placed in front of the existing abutment. The proposed pavement at the west abutment will sit approximately 10.2 ft above the existing ground. The boring taken closest to the west abutment (B-WA) shows a 10 ft thick Silty Clay layer with unconfined compressive strengths (Qu) between 0.2 to 1.1 tons per square foot and moisture content between 26 to 32 percent just below the surface. The compression index (Cc) for this material was estimated using Section 3.1.1 of the IDOT Geotechnical Manual and the moisture content of each layer. With the proposed improvements it is estimated that there will be approximately 1.98 inches of settlement with a primary consolidation time (t_{90}) of approximately 45 days (See Appendix I for calculations). The structure is to be constructed utilizing staged construction, so remedial action to reduce the settlement time should be considered.

One option to address this is to allow settlement to occur and account for downdrag on the abutment foundation since it is expected that the piles will be driven prior to the settlement occurring. The 30 ft approach slab will span from the proposed west abutment to behind the existing west abutment. With the

approach slab resting on material behind the existing abutment, the settlement due to the weak material should not affect the approach slab. Downdrag on the abutment foundation is further discussed in Section 3.6

If pile foundation is chosen and it is undesirable to account for downdrag in the pile design, then precoring could be performed to approximately elevation 538.0 and the piles could be placed inside precored holes from approximately 538.0 to the bottom of the abutment. A diameter of 18 inches should be used for precoring and the precored holes should be back filled with dry loose sand after the piles have been installed. This would eliminate the downdrag on the piles. It should be noted that it may be difficult to keep the holes open due to the weak saturated nature of the soil at the west abutment.

Another alternative would be to remove and replace all or part of the weak layer. Removal and replacement of the Silty Clay layer will reduce the settlement time. If the existing soil is removed and replaced with sand from elevation 543.0 to 551.0 ft. (8 ft of removal) and the proposed embankment is placed on top of the sand, the anticipated settlement is reduced to 0.91 inches with a t_{90} of 6 days. With a t_{90} of 6 days it is expected that less than 0.4 inches of settlement will remain upon completion of constructing the embankment. If desired, the Silty Clay layer could be completely removed (to elevation 538.0 ft), however this is not necessary to achieve an acceptable settlement amount and time. Settlement is not a concern in locations where 5 ft or less of fill material is proposed. Removal limits can be estimated by determining the area that will be beneath 5 ft or more of fill material. The replacement sand material can be FA-1 Sand Class A or a similar granular material.

3.2 Slope Stability

Slope stability analysis was performed on the end slope for both the east and the west abutment. Both end slopes have a proposed inclination of 2 horizontal to 1 vertical. Static and seismic conditions were both considered during the analysis. After removal and replacement of the weak material at the west abutment, the results of the stability analysis (Appendix E) indicate that the new slopes will be stable under both static and seismic condition. The minimum safety factor for the west abutment under static conditions was 1.581 and the minimum for the east abutment was 2.707. Both static values meet the minimum allowable safety factor of 1.5. The minimum safety factor for the west abutment under seismic conditions was 1.466 and the minimum for the east abutment was 2.509. Both seismic values meet the minimum allowable safety factor of 1.0.

3.3 Seismic Considerations

According to the AASHTO LRFD Bridge Design Specifications (Fourth Edition), a site coefficient, which is a function of the soil profile types, is required for the calculation of minimum earthquake design forces. Based on the soils encountered and the depth to bedrock, the seismic performance zone is 1 and the soil site class is D. The global site class definition is based on the results of IDOT Bureau of Bridges and

Structures Seismic Site Class Determination spreadsheet (Appendix F). The AASHTO specifications also indicate that the site has a Design Spectral Acceleration at 1.0 second (S_{D1}) of 0.089 g, and a Design Spectral Acceleration (S_{DS}) at 0.2 second of 0.125 g.

According to the USGS Earthquake Hazards Program website, the design earthquake at the site, which has a 5 percent probability of exceedance in 50 years, is 7.70 on the Richter scale with a peak horizontal ground acceleration of 0.02936 g. The peak seismic ground surface acceleration (A_s) is 0.053 g. Since A_s is less than 0.15g (as stated in All Geotechnical Manual Users Design Guide 10.1) and the performance zone is 1, then no liquefaction analysis is required.

3.4 Scour

Borings B-P1 and B-P2 both have a 9 to 10 ft thick hard Clay Loam layer approximately 50 ft below ground surface. However, due to the inconsistency of this layer in other borings and the unknown nature of the soil between borings, no reduction was made to the scour depth for the presence of this layer. Based on the overall granular nature of the site no reduction in scour was made per IDOT 2012 Bridge Manual Section 2.3.6.3.2. Also, according to this section of the Bridge Manual the scour elevation for bridge abutments are to be set at the bottom of abutment elevation if the proposed slope is protected by riprap. The scour elevations for Pier 1 and Pier 2 were calculated by deducting the scour depth from the streambed elevation. The scour elevations for Pier 3 and 4 were calculated by deducting the scour depth from the ground surface elevation at each respective pier. Scour for 100 year design at Pier 1 and Pier 2 is estimated to be 33 ft, and Pier 3 and Pier 4 is estimated to be 9 feet. Table 3.4.1 presents the 100 year design scour elevations.

Table 3.4.1 – 100 Year Design Scour Elevations

Abutment/Pier	Design Scour Elevation (ft)
West Abutment	552.0
Pier 1	505.0
Pier 2	505.0
Pier 3	541.2
Pier 4	540.5
East Abutment	552.0

Scour for 500 year design at Pier 1 and Pier 2 is estimated to be 38 ft, and Pier 3 and Pier 4 is estimated to be 11 feet. Table 3.4.2 presents the 500 year design scour elevations.

Table 3.4.2 – 500 Year Design Scour Elevations

Abutment/Pier	Design Scour Elevation (ft)
West Abutment	552.0
Pier 1	500.0
Pier 2	500.0
Pier 3	539.2
Pier 4	538.5
East Abutment	552.0

3.5 Mining Activity

According to the Directory of Coal Mines in Illinois – Mercer County, dated July 20, 2011, the subject site was not undermined. The listed disclaimer did indicate that the locations of some features on the mine map may be offset by 500 or more feet due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors. The subject site is more than 6 miles away from the closest mining area shown on the map.

3.6 Bridge Foundations

The foundation supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loads. Since a Stub Abutment was selected for this bridge, the permitted substructure types at the abutments include spread footings (abutments), drilled shaft, and metal shell pile and H-pile below a concrete cap block.

The Modified IDOT Static Method of Estimating Pile Length spreadsheet (See Appendix G) was used to analyze the various pile types and available resistance for the abutments and piers. The factored substructure loads were provided by Homer L. Chastain and Associates (Chastain). The total factored substructure load for each abutment was 920 kips. The piers were analyzed with an estimated loading of 2535 kips (Pier 1 and Pier 2), 1940 kips (Pier 3) and 1960 kips (Pier 4). For analysis, boring B-WA was used for the West Abutment, boring B-EA for the East Abutment, boring B-P1 for Pier 1, boring B-P2 for Pier 2, boring B-P3 for Pier 3, and boring B-P4 for Pier 4. Based on the Type Size and Location (TSL) plan provided by Chastain on 12/15/14, the cut off elevation was assumed to be embedded 1 foot into the abutments and Piers 3 and 4. The cut off elevation was assumed to be embedded 2 foot into Piers 1 and 2. Pile cutoff elevations are 553.0 (West and East Abut.), 536.0 (Pier 1 and Pier 2), 547.2 (Pier 3), and 546.5 (Pier 4).

Spread footings are not a plausible option due to scour and soil strengths present at the site. Drilled shafts are feasible, however present some construction challenges due to the granular nature of the site. Friction H-Pile and metal shell pile are feasible options, however it should be noted that bedrock was not encountered during exploratory drilling. H-pile lengths estimated by the IDOT Pile Length spreadsheets in Appendix G could require more length then anticipated to achieve desired capacity. Due to the unknown bedrock depth and lack of a hard layer to provide substantial end bearing resistance, there is no certain stopping point for H-pile. In comparison to metal shell pile, H-pile carries very little capacity for the length of pile estimated by the Pile Length spreadsheet. Metal shell can carry a higher capacity at a shorter length than H-pile due to its efficiency as a friction pile. Metal shell appears to be the more favorable driven pile type given the soil conditions on site.

It is recommended that one test pile be driven at the west abutment, Pier 2, and Pier 4. The pile lengths used in construction should be longer than the estimated length to ensure sufficient depth is achieved. If

metal shell is selected, conical tips are recommended at Pier 2 in order to prevent potential damage from boulders (see boring B-P2 for boulder encountered during exploratory drilling). Pile tips should not be used on H-pile to aid in achieving as much resistance from end bearing as possible.

3.6.1 Driven Metal Shell Pile

Metal shell piles appear feasible at the abutments and the piers, however due to deep scour at Piers 1 and 2 the metal shell sizes are limited. The metal shell piles will need to be driven to the depth required to provide stability during a design scour event. Metal shell with 12 inch diameter and wall thickness of 0.179 inches is only able to penetrate approximately 33-38 ft of material below the proposed bottom pier footing elevations at Piers 1 and 2 before reaching its maximum required bearing capacity. Metal shell sizes 12 inch with 0.25 inch wall and 14 inch with 0.25 inch are anticipated to perform similarly. If Q100 scour elevation were to occur, this would only leave approximately 3-8 ft of metal shell embedded in soil. Therefore, metal shell sizes 12 inch with 0.179 inch wall, 12 inch with 0.25 inch wall, and 14 inch with 0.25 inch wall are not recommended at Piers 1 and 2 due to the deep scour elevations. Metal shell size 14 inch with 0.312 inch wall, per estimations with IDOT's Static Method of Estimating Pile Length spreadsheet, appear capable of being driven to the required depth for stability at design scour, however it will require that the piles are driven to, or near, their maximum capacity. The metal shell capacity tables below reflect this. In conjunction with lateral pile analyses (LPILE) conducted by Chastain (assuming 2 ft of pile embedment into the footings), a minimum embedment of 16 feet of below the bottom of the 100 year scour elevation of 505.0 will be required for both Pier 1 and Pier 2. Thus, the minimum tip elevation to satisfy lateral loading shall be 489.0 for both Pier 1 and Pier 2. This evaluation is based upon preliminary loads and shall be verified during final design with the final loads. The maximum nominal required bearing of the pile should not be exceeded during driving.

Due to the large unbraced length at Piers 1 and 2 in a design scour event, the structural designer should verify structural adequacy of metal shell piles under design scour conditions before selecting metal shell piles for those locations. Embedment of the piles 2 ft into the pile cap and making Piers 1 and 2 expansion piers will aid in minimizing movement of the piers.

Jetting or vibratory methods are used in some cases as an alternative installation method to driving piles or to assist pile driving in order to prevent damage to piles. If it is desirable to use these methods at the site, then the effect of vibrations caused by the method should be taken into consideration. Vibration can travel through the granular soil and cause settlement of adjacent substructures, which is a concern due to the proposed staged construction. Vibration monitoring could be one way to measure the effects of vibration at the site. If traffic is detoured for the construction of this bridge, then vibrations are less of a concern.

Pile bearing capacity reductions due to negative skin friction, liquefaction, and scour have been considered. Scour has been taken into account and included in the analysis at the piers in the tables below. To address settlement concerns of the Silty Clay layer (as discussed in Section 3.1), the West Abutment pile data in the tables below consider either: precoring [Core] to approximately elevation 538.0 ft; accounting for downdrag [DD] to elevation 538.0 ft.; or the removal and replacement [R&R] of material to elevation 543.0 ft. Tables 3.6.1 to 3.6.4 summarize the metal shell pile capacities.

Table 3.6.1 – Metal Shell Pile Capacities – 12" Diameter with 0.179" Walls

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
West Abut.-CORE	150	0	83	33
West Abut.-CORE	254	0	140	37
West Abut.-DD	150	45 (Downdrag)	38	32
West Abut.-DD	254	45 (Downdrag)	95	37
West Abut.-R&R	150	0	83	32
West Abut.-R&R	254	0	140	37
East Abut.	100	0	55	27
East Abut.	150	0	83	36
East Abut.	200	0	110	41
East Abut.	254	0	140	49
Pier 3	100	3 (Scour)	52	27
Pier 3	150	3 (Scour)	80	36
Pier 3	200	3 (Scour)	107	42
Pier 3	254	3 (Scour)	137	48
Pier 4	100	1 (Scour)	54	24
Pier 4	150	1 (Scour)	82	26
Pier 4	200	1 (Scour)	109	32
Pier 4	254	1(Scour)	139	39

Table 3.6.2 – Metal Shell Pile Capacities – 12" Diameter with 0.25" Walls

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
West Abut.-CORE	150	0	83	33
West Abut.-CORE	353	0	194	60
West Abut.-DD	150	45 (Downdrag)	38	32
West Abut.-DD	353	45 (Downdrag)	150	60
West Abut.-R&R	150	0	83	32
West Abut.-R&R	353	0	194	60
East Abut.	100	0	55	27
East Abut.	150	0	83	36
East Abut.	250	0	138	49
East Abut.	353	0	194	55
Pier 3	150	3 (Scour)	80	36
Pier 3	200	3 (Scour)	107	42
Pier 3	250	3 (Scour)	135	47
Pier 3	353	3 (Scour)	191	53
Pier 4	150	1 (Scour)	82	25
Pier 4	200	1 (Scour)	109	32
Pier 4	250	1 (Scour)	137	39
Pier 4	353	1 (Scour)	193	50

Table 3.6.3 – Metal Shell Pile Capacities – 14" Diameter with 0.25" Walls

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
West Abut.-CORE	150	0	83	32
West Abut.-CORE	413	0	227	60
West Abut.-DD	150	53 (Downdrag)	30	32
West Abut.-DD	413	53 (Downdrag)	175	58
West Abut.-R&R	150	0	83	32
West Abut.-R&R	413	0	227	58
East Abut.	150	0	83	31
East Abut.	250	0	138	41
East Abut.	350	0	193	51
East Abut.	413	0	227	55
Pier 3	150	3 (Scour)	80	30
Pier 3	250	3 (Scour)	135	42
Pier 3	350	3 (Scour)	190	51
Pier 3	413	3 (Scour)	224	52
Pier 4	150	2 (Scour)	80	25
Pier 4	250	2 (Scour)	136	32
Pier 4	350	2 (Scour)	191	42
Pier 4	413	2 (Scour)	225	47

Table 3.6.4 – Metal Shell Pile Capacities – 14" Diameter with 0.312" Walls

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
West Abut.-CORE	150	0	83	32
West Abut.-CORE	513	0	282	66
West Abut.-DD	150	53 (Downdrag)	30	32
West Abut.-DD	513	53 (Downdrag)	230	66
West Abut.-R&R	150	0	83	32
West Abut.-R&R	513	0	282	64
East Abut.	150	0	83	31
East Abut.	250	0	138	41
East Abut.	350	0	193	51
East Abut.	513	0	282	62
Pier 1*	513	88 (Scour)	195	47*
Pier 2*[1]	513	81 (Scour)	201	48*
Pier 3	200	3 (Scour)	107	38
Pier 3	350	3 (Scour)	190	51
Pier 3	450	3 (Scour)	245	54
Pier 3	513	3 (Scour)	279	58
Pier 4	200	2 (Scour)	108	25
Pier 4	350	2 (Scour)	191	42
Pier 4	450	2 (Scour)	246	50
Pier 4	513	2 (Scour)	280	52

Note: 1 – Blow count at elevation 512.00 feet was excluded due to note in the boring log about boulder encountered.
* – Minimum tip elevation of 489.0 needed to satisfy lateral design. Elevation to be verified in Final Design. The maximum nominal required bearing of the pile should not be exceeded during driving.

3.6.2 Driven H-Pile

Due to the large unbraced length at Piers 1 and 2 in a design scour event, the structural designer should verify structural adequacy of H-piles under design scour conditions before selecting H-piles for those locations. Embedment of the piles 2 ft into the pile cap and making Piers 1 and 2 expansion piers will aid in minimizing movement of the piers.

Pile bearing capacity reductions due to negative skin friction, liquefaction, and scour have been considered. Scour has been taken into account and included in the analysis at the piers in the tables below. To address settlement concerns of the Silty Clay layer (as discussed in Section 3.1), the West Abutment pile data in the tables below consider either: precoring [Core] to approximately elevation 538.0 ft; accounting for downdrag [DD] to elevation 538.0 ft.; or the removal and replacement [R&R] of material to elevation 543.0 ft. Tables 3.6.5 to 3.6.9 summarize the H- pile capacities.

Table 3.6.5 – H-Pile Capacities – 10 X 42

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
West Abut.-CORE	*126	0	*70	*77
West Abut.-DD	*148	24 (Downdrag)	*57	*77
West Abut.-R&R	*140	0	*77	*77
East Abut.	*117	0	*64	*70
Pier 1	*154	17 (Scour)	*68	*60
Pier 2[1]	150	15 (Scour)	68	69
Pier 2[1]	*274	15 (Scour)	*136	*109
Pier 3	*122	1 (Scour)	*67	*72
Pier 4	*140	1 (Scour)	*77	*73

Note: 1 – Blow count at elevation 512.00 feet was excluded due to note in the boring log about boulder encountered.
* – Resistance available at the bottom of the boring. Maximum nominal required bearing can be achieved, but unable to estimate length.

Table 3.6.6 – H-Pile Capacities – 12 X 53

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
West Abut.-CORE	*151	0	*83	*77
West Abut.-DD	*178	30 (Downdrag)	*68	*77
West Abut.-R&R	*168	0	*92	*77
East Abut.	*140	0	*77	*70
Pier 1	*186	20 (Scour)	*83	*60
Pier 2[1]	150	18 (Scour)	65	62
Pier 2[1]	*347	18 (Scour)	*173	*109
Pier 3	*146	1 (Scour)	*80	*72
Pier 4	*168	1 (Scour)	*92	*73

Note: 1 – Blow count at elevation 512.00 feet was excluded due to note in the boring log about boulder encountered.
* – Resistance available at the bottom of the boring. Maximum nominal required bearing can be achieved, but unable to estimate length.

Table 3.6.7 – H-Pile Capacities – 12 X 63

Substructure	Maximum Nominal Required Bearing (kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
West Abut.-CORE	*155	0	*85	*77
West Abut.-DD	*182	30 (Downdrag)	*70	*77
West Abut.-R&R	*172	0	*94	*77
East Abut.	*143	0	*79	*70
Pier 1	*191	20 (Scour)	*85	*60
Pier 2[1]	150	18 (Scour)	65	62
Pier 2[1]	*350	18 (Scour)	*175	*109
Pier 3	*150	1 (Scour)	*82	*72
Pier 4	*172	1 (Scour)	*94	*73

Note: 1 – Blow count at elevation 512.00 feet was excluded due to note in the boring log about boulder encountered.
* – Resistance available at the bottom of the boring. Maximum nominal required bearing can be achieved, but unable to estimate length.

3.6.3 Drilled Shaft

Piles may not be feasible at Piers 1 and 2 due to the large scour depth and horizontal forces acting upon the structure in this design state, even though the piers are expansion piers. Therefore drilled shafts have been evaluated for piers 1 and 2. The evaluation does not assume permanent casing. Temporary casing or slurry will be required as the water table is above the sand and gravel layers where the drilled shafts will be installed. Vibrating the casing is discouraged since the vibration can travel through the granular soil and cause settlement of adjacent substructures. The structural engineer will need to evaluate the construction methods as part of the final design. If permanent casing is used a 50% reduction in the side resistance values is required. The estimated top of shaft elevation is 555.0 feet for Pier 1 and 557.0 feet for Pier 2.

The effects of group reduction for tip resistance have been considered in accordance with Table 10.8.3.6.3-1 of the AASHTO LRFD code by applying a reduction factor of 0.9. The computations also neglect the soil above the 500 scour elevation. The structural engineer provided total factored load of 2535 kips per pier for Piers 1 and 2. The boring at Pier 1 (B-P1) is not as deep as the calculated preliminary tip elevation so soil parameters from the boring at Pier 2 (B-P2) were used to estimate resistance for deeper elevations at Pier 1. If drilled shafts are selected for the design and the tip elevation is deeper than the boring at Pier 2, an additional deeper boring is recommended.

Because the mobilization of tip resistance and side resistance occur at significantly different movements in granular soil, the analysis considered this effect in accordance with Section 10.8.2.2.2 of the AASHTO LRFD code. A service limit state tolerable movement of ½" was assumed which results in applying 30% of the ultimate tip resistance with 100% of the ultimate side resistance.

The following tables show preliminary tip elevations based on the assumptions listed above. The values should be re-evaluated based upon final design loads and structure configuration.

Table 3.6.8 – Pier 1 Drilled Shaft Preliminary Tip Elevations

Drilled Shaft Option	Preliminary Factored Load per Drilled Shaft (kips)	Tip Elev. Needed for Prelim. Load (ft)	Estimated Shaft Length based on top elev. 555 (ft)
6-48" dia. @ 8'-0' o.c. spa.	423	455	100
5-54" dia. @ 9'-0" o.c. spa.	507	451	104
4-60" dia. @ 12'-0" o.c. spa.	634	447	108

Table 3.6.9 – Pier 2 Drilled Shaft Estimated Tip Elevation

Drilled Shaft Option	Preliminary Factored Load per Drilled Shaft (kips)	Tip Elev. Needed for Prelim. Load (ft)	Estimated Shaft Length based on top elev. 557 (ft)
6-48" dia. @ 8'-0' o.c. spa.	423	457	100
5-54" dia. @ 9'-0" o.c. spa.	507	456	101
4-60" dia. @ 12'-0" o.c. spa.	634	452	105

The following tables show design values for use in final design calculations for each pier respectively:

Table 3.6.10 – Pier 1 Drilled Shaft Resistance

Layer Thickness (ft)	Bottom of Layer Elev. (ft)	Abbreviated Soil Description	Blow Counts (N)	Factored Unit Side Resistance Available (ksf)	Factored Unit Tip Resistance Available (ksf)
5.0	500.0	Clay Loam	28		
5.0	495.0	Sand	24	0.28	
5.0	490.0	Sand	24	0.42	
4.0	486.0	Sand	27	0.54	
6.0	480.0	Sand	31	0.64	
5.0	475.0	Sand	30	0.72	4.9
4.0	471.0	Sand	31	0.78	5.0
3.5	467.5	Sand	*32	*0.81	*5.2
5.0	462.5	Sand	*34	*0.85	*5.5
5.0	457.5	Sand	*35	*0.88	*5.7
5.0	452.5	Sand	*32	*0.90	*5.2
5.0	447.5	Sand	*26	*0.91	*4.2
5.0	442.5	Sand	*33	*0.90	*5.3
5.0	437.5	Sand	*39	*0.88	*6.3
5.0	432.5	Sand	*43	*0.86	*7.0
7.5	425.0	Sand	*41	*0.82	*6.6

Note: A resistance factor of 0.55 has been applied to Factored Unit Side Resistance Available.
A resistance factor of 0.50 and a group effect factor of 0.90 have been applied to Factored Unit Tip Resistance Available.
A factor of 0.3 has been applied to Factored Unit Tip Resistance Available to limit the resistance per AASHTO 10.8.2.2.2 (1/2" tolerable movement used).
*B-P1 boring log terminates at elevation 471.0. Soil parameters from boring B-P2 were used to estimate values below this elevation.

Table 3.6.11 – Pier 2 Drilled Shaft Resistance

Layer Thickness (ft)	Bottom of Layer Elev. (ft)	Abbreviated Soil Description	Blow Counts (N)	Factored Unit Side Resistance Available (ksf)	Factored Unit Tip Resistance Available (ksf)
1.0	504.0	Sandy Gravel			
4.0	500.0	Clay Loam	24	0.20	
5.0	495.0	Clay Loam	23	0.28	
7.5	487.5	Sand	33	0.48	
5.0	482.5	Sand	27	0.59	
5.0	477.5	Sand	26	0.68	4.2
5.0	472.5	Sand	35	0.75	5.7
5.0	467.5	Sand	32	0.81	5.2
5.0	462.5	Sand	34	0.85	5.5
5.0	457.5	Sand	35	0.88	5.7
5.0	452.5	Sand	32	0.90	5.2
5.0	447.5	Sand	26	0.91	4.2
5.0	442.5	Sand	33	0.90	5.3
5.0	437.5	Sand	39	0.88	6.3
5.0	432.5	Sand	43	0.86	7.0
7.5	425.0	Sand	41	0.82	6.6

Note: A resistance factor of 0.55 has been applied to Factored Unit Side Resistance Available.
A resistance factor of 0.50 and a group effect factor of 0.90 have been applied to Factored Unit Tip Resistance Available.
A factor of 0.3 has been applied to Factored Unit Tip Resistance Available to limit the resistance per AASHTO 10.8.2.2.2 (1/2" tolerable movement used).

3.7 Lateral Pile Response

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

Based on the encountered subsurface conditions, tables for B-WA, B-P1, B-P2, B-P3, B-P4 and B-EA summarizing appropriate soil parameters ø, c, γ wet and saturated soil until weights for the LPILE analysis, are included in Appendix H (Reference: LPILE User's Manual, Ensoft, Inc., October 2000). When pile design details and load information are available LPILE analyses can be performed.

4.0 CONSTRUCTION CONSIDERATIONS

Staged construction is anticipated for the replacement of the structure. During construction the foundation supporting the existing structure should be isolated from the pressures generated by the proposed embankment. This should be done to protect the existing foundation from negative skin friction that could be caused by the construction of the new embankment.

The Estimated Water Surface Elevation (ESWE) is 544.95 feet. The EWSE elevation is lower than the bottom of substructure elevation for Piers 3 and 4, so the use of cofferdams is not required during construction (See ABD Memo 11.2). However at Piers 1 and 2 the EWSE is greater than 6 ft above the bottom of the pier footings, therefore a Cofferdam Type 2 will be required. Due to the granular nature of the soil at this location, it is anticipated that a seal coat will be required. In general, stream related work should not occur during periods of flooding.

Per Design Guide 3.13.1 it is anticipated that Temporary Sheet Piling can be used to aid in staged construction. If the existing abutments and related foundation are not completely removed, they may conflict with the location of the Temporary Sheet Piling. The amount of fill material required at the west abutment may also limit the use of Temporary Sheet Piling. If Temporary Sheet Piling is insufficient, then Temporary Soil Retention System should be used.

Piles should be spaced to miss existing substructures if they are to remain in place. 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.

Appendix A

Location Map

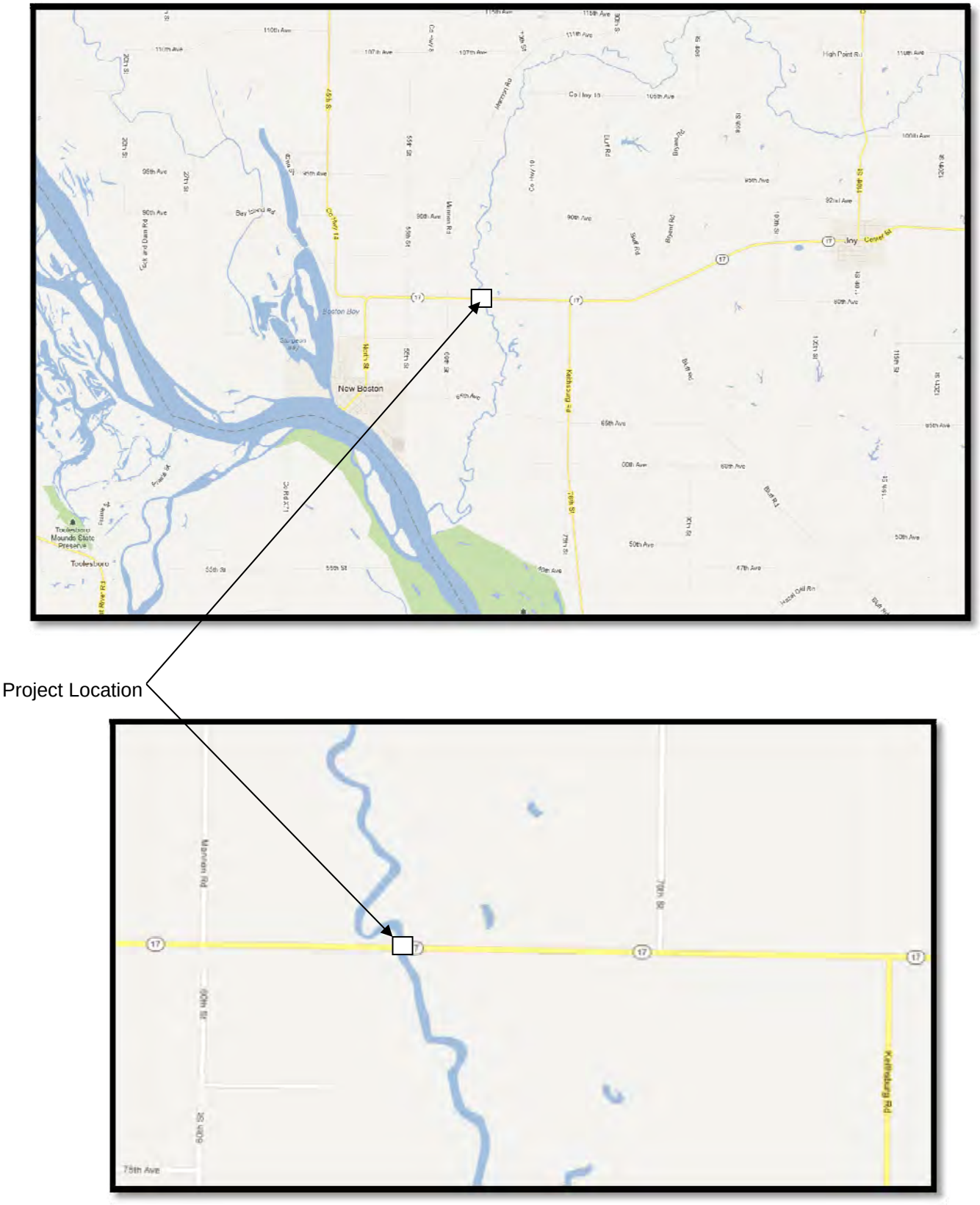


Photo 1
East Abutment Slope – South Side

Photo 2
Looking East from River – South Side

Photo 3
Looking East from West End – North Side

Photo 4
Looking West from East end – North Side

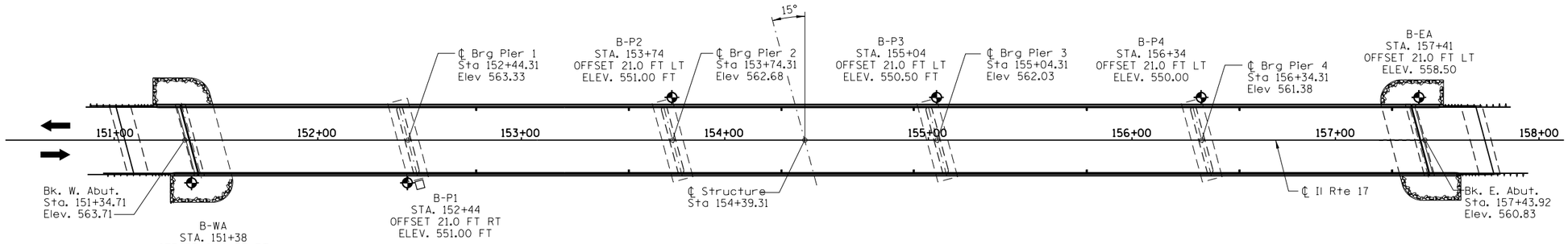
Photo 5
North Side of River Crossing

Photo 6
West Abutment Slope – South Side

Photo 7
West Abutment Slope – North Side

Photo 8
East River Bank – North Side

Appendix B



IL 17 OVER EDWARDS RIVER

F.A.P. ROUTE 639 SECTION (123B)BR-1

MERCER COUNTY

STATION 154+76.19

STRUCTURE NO. 066-0021

N

15 0 30

TERRA ENGINEERING LTD.	USER NAME = LNF	DESIGNED -	REVISED -
		DRAWN -	REVISED -
	PLOT SCALE = 60.0000 ' / in.	CHECKED -	REVISED -
	PLOT DATE = 3/15/2012	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 17 OVER EDWARDS RIVER
BORING LOCATION PLAN

SCALE: | SHEET NO. 1 OF 1 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
639	(123B)BR-1	MERCER		
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT		

T:\Projects\08-223-04-IDOT-Edwards River-HLC-PTB 147-23\Calculations\SGR\Boring Plots\IL17_PlanView B-WA to B-EA.dgn

Appendix C

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** JT

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** ION, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-WA
Station 151+38
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.0 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 12" Topsoil
550.00				
				FINE SAND WITH CLAY
	3		8	Brown, Medium Dense
	6			
548.00	6			
				SILTY CLAY
	2	1.1	26	Brown
	3			Medium Stiff
-5	3			
	1	0.2	29	
	2			
	3			
				Gray below about 8 feet
	1	0.2	32	Soft at 8½ feet
	1			
-10	2			
	1	0.7	29	Soft to Medium Stiff at 11½ feet
	2			
538.00 ▼	2			
				MEDIUM SAND
	3		18	Brown
	3			Loose
-15	2			
	2		16	
	3			
	3			
	2		60	Organics at 18½ feet
	3			
531.00 -20	4			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL
				Gray
	3		16	Loose
	2			
	3			
	4		23	
	4			
-25	4			
	4		18	
	4			
	5			
	3		18	
	4			
-30	5			
518.50				
				MEDIUM TO COARSE SAND, TRACE GRAVEL
	11		20	Gray
	11			Medium Dense
-35	11			
	15			Dense at 38½ feet
	22			
-40	24			

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY JT

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-WA
Station 151+38
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*
509.00				
				CLAY LOAM Gray Very Stiff
	9 12 12		12	
-45				
	7 12 15		16	
-50				
	10 12 13			
-55				
495.00				
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense
	5 8 10		16	
-60				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*
	7 10 13		18	
-65				
	9 12 16		14	
-70				
	11 15 17		19	Dense at Samples 21 and 22
-75				
	12 16 18		19	
471.00 -80				

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
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SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY JT

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-WA
Station 151+38
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
BOTTOM OF BORING				
End of Boring				
-85				
-90				
-95				
-100				

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** JT

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** 10N, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P1
Station 152+44
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 536.0 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 12" Root Zone
550.00				**LOAM**
	2 2 3		14	Brown Medium Stiff Dry Density = 88
	4 4 4		12	Medium Stiff to Stiff at about 3½ feet Dry Density = 81
546.00 -5				**CLAY**
	1 0 1	0.2	36	Dark Gray-Brown Very Soft Dry Density = 85
543.00				**SILTY CLAY**
-10	0 1 1		18	Gray-Brown Soft
	0 1 1	0.3	29	
	1 1 2	0.4	30	
536.00 ▼ -15				**MEDIUM SAND**
	3 1 3		21	Brown Loose
	2 3 3		21	
531.00 -20				**MEDIUM TO COARSE SAND, TRACE GRAVEL**
	3 3 3		17	Gray Loose
	1 2 4			
-25				
	3 4 4		17	
522.50				**MEDIUM TO COARSE SAND, TRACE GRAVEL**
-30	4 5 7		18	Gray Medium Dense
	10 8 12		18	
-35				
	8 8 9		22	
-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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY JT

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P1
Station 152+44
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 536.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*				
509.00				
CLAY LOAM Gray Hard				
		10 15 19		11
Dry Density = 127	-45			
Very Stiff at about 48½ feet		9 12 16		14
	-50			
500.00				
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense				
		8 11 13		17
	-55			
		7 10 14		17
	-60			

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*				
		12 13 14		19
486.00	-65			
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense				
		10 16 15		17
	-70			
		8 14 16		18
	-75			
		11 13 18		18
471.00	-80			

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)

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Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/11/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY JT

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P1
Station 152+44
Offset 21.0 ft RT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 536.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
BOTTOM OF BORING			
End of Boring			
-85			
-90			
-95			
-100			

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** RP

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** 10N, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P2
Station 153+74
Offset 21.0 ft LT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.5 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 4" Root Zone
550.68				**FINE SAND WITH SILT**
				Brown
	4		9	Loose
	3			
	2			
547.50				
	2		25	**SILTY CLAY**
	2			Dark Gray-Brown
-5	2			Soft to Medium Stiff
	2	0.7	31	
	2			
	2			
	1			Soft at about 8½ feet
	1			
-10	1			
539.50				
	0		21	**FINE TO MEDIUM SAND WITH SILT**
▼	0			Brown, Very Loose
	2			
	2		21	
	1			
536.00 -15	2			
				MEDIUM TO COARSE SAND, TRACE GRAVEL
				Gray
				Loose
	2		18	
	2			
	3			
	2		15	
	3			
-20	4			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL
				Gray
				Loose *(continued)*
	3		19	
	3			
	3			
	4		18	Medium Dense at about 23½ feet
	5			
-25	6			
	3		20	
	4			
	4			
	4		20	
	5			
-30	4			
518.50				
				MEDIUM TO COARSE SAND, TRACE GRAVEL
	9		21	Gray
	12			Medium Dense
-35	12			
	50/1"		17	Possible Cobble or Boulder at about 38½ feet
-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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P2
Station 153+74
Offset 21.0 ft LT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*			
-45	5 7 7		19
504.00			
CLAY LOAM Gray Very Stiff			
-50	5 12 12		15
-55	8 11 12		16
494.00			
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense			
-60	12 15 18		17
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense *(continued)*			
487.50			
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense			
-65	9 11 16		20
-70	10 12 14		20
477.50			
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense			
-75	13 17 18		19
-80	13 15 17		17

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P2
Station 153+74
Offset 21.0 ft LT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense *(continued)*				**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Dense *(continued)*			
-85	14 15 17		17	Medium Dense at about 103½ feet -105	12 12 14		17
-90	12 16 18		19	-110	15 16 17		20
-95	11 16 19		19	-115	14 18 21		18
-100	13 15 17		20	-120	14 20 23		18

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. 10N, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P2
Station 153+74
Offset 21.0 ft LT
Ground Surface Elev. 551.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 538.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense *(continued)*				
	-125	16 19 22		18
425.00				
BOTTOM OF BORING End of Boring				
	-130			
	-135			
	-140			

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** RP

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** ION, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P3
Station 155+04
Offset 21.0 ft LT
Ground Surface Elev. 550.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.5 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 4" Root Zone 550.18
				LOAM
				Brown, Medium Stiff to Stiff
	6 5 3		12	
				547.50
				FINE TO MEDIUM SAND WITH SILT
	2 2 2		13	Brown
-5				Loose
	3 2 3		14	
				Very Loose at 8½ feet ▼
	1 0 1		22	
-10				
				539.00
	1 2 2		19	**FINE TO MEDIUM SAND** Brown-Gray, Loose
				537.00
	2 3 2		18	**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Loose
-15				
	2 2 2		18	
	2 3 3		19	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Loose *(continued)*
	3 2 3		18	
	3 4 4		19	
-25				
	3 4 5		19	
				522.00
	4 4 6		20	**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Medium Dense
-30				
	4 5 7		19	
-35				
	6 6 7		19	
-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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** RP

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** ION, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P3
Station 155+04
Offset 21.0 ft LT
Ground Surface Elev. 550.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.5 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*
-45	4 6 8		21	
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense
-50	8 9 11		19	
-55	8 10 10		20	
492.00				
-60	10 14 16		18	
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Dense *(continued)*
485.50 -65	10 12 17		18	
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense
-70	9 13 16		17	
-75	12 18 20		21	Dense at 73½ and 78½ feet
470.50 -80	12 14 18		20	

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P3
Station 155+04
Offset 21.0 ft LT
Ground Surface Elev. 550.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
BOTTOM OF BORING End of Boring			
-85			
-90			
-95			
-100			

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) **DESCRIPTION** Edwards River Bridge **LOGGED BY** RP

SECTION 123B **LOCATION** , **SEC.** 21, **TWP.** ION, **RNG.** 9W,
Latitude 41.1871, **Longitude** -90.9678

COUNTY Mercer **DRILLING METHOD** HOLLOW STEM/WASH BORING **HAMMER TYPE** AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P4
Station 156+34
Offset 21.0 ft LT
Ground Surface Elev. 550.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.0 ft ▼
Upon Completion NA ft
After ____ **Hrs.** NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 4" Root Zone 549.68
				LOAM
				Brown, Very Stiff
	6 10 7		13	Dry Density = 101
				547.00
				SILTY CLAY
	2 2 3		22	Dark Gray-Brown Medium Stiff Dry Density = 99
-5				
				543.50
	3 1 3		20	**SANDY LOAM** Gray Loose
	0 0 1		26	Very Loose at about 8½ feet ▼
-10				
				539.00
	0 0 1		20	**FINE TO MEDIUM SAND** Brown-Gray Very Loose
	1 1 2		21	Loose at about 13½ feet
-15				
				533.50
	2 3 3		18	**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Loose
	2 3 4		19	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Loose *(continued)*
	3 3 4		18	
	4 4 5		18	
-25				
				523.50
	4 5 5		19	**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Medium Dense
	4 5 6		19	
-30				
	10 11 12		20	
-35				
	9 10 10		19	
-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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. 10N, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P4
Station 156+34
Offset 21.0 ft LT
Ground Surface Elev. 550.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*			
-45	8 9 11		19
-50	8 10 12		18
-55	9 10 13		18
Dense at about 58½ feet			
-60	13 14 17		17
MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Medium Dense *(continued)*			
-65	10 13 15		19
-70	11 14 15		18
-75	12 16 20		17
Dense at about 73½ to 78½ feet			
470.00 -80	12 15 17		18

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
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Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/10/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-P4
Station 156+34
Offset 21.0 ft LT
Ground Surface Elev. 550.00 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 541.0 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
BOTTOM OF BORING End of Boring	-85 -90 -95 -100			

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. ION, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-EA
Station 157+41
Offset 21.0 ft LT
Ground Surface Elev. 558.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 544.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Approx. 4" Root Zone 558.18
				LOAM Dark Brown Stiff
	5 4 3		15	
				Very Stiff at about 3½ feet Dry Density = 118
-5	4 7 8		16	
				552.00
				SILTY CLAY Gray, Soft to Medium Stiff
	1 2 2		26	
				550.50
				SANDY CLAY LOAM
	2 2 3		16	Brown-Gray Loose
-10				
	3 3 3		19	
				Very Loose at about 13½ feet ▼
	1 1 1		24	
-15				
				542.00
				FINE TO MEDIUM SAND Brown Loose
	2 2 3		18	
	1 2 2		23	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				537.50
				MEDIUM TO COARSE SAND, TRACE GRAVEL Gray Loose
	3 3 3		17	
	3 4 3		18	
-25				
	3 4 4		18	
				530.00
	4 5 6		18	**MEDIUM TO COARSE SAND, TRACE GRAVEL** Gray Medium Dense
-30				
	4 5 6		18	
-35				
	5 6 6		17	
-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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. 10N, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-EA
Station 157+41
Offset 21.0 ft LT
Ground Surface Elev. 558.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

Groundwater Elev.:
First Encounter 544.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-45	5 6 7		16
-50	7 8 10		18
-55	8 9 9		17
-60	9 11 13		18

MEDIUM TO COARSE SAND, TRACE GRAVEL
Gray
Medium Dense *(continued)*

Dry Density = 127

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-65	12 13 15		19
493.50			
-70	10 14 17		18
-75	13 16 18		18
-80	14 16 20		18
478.50			

MEDIUM TO COARSE SAND, TRACE GRAVEL
Gray
Medium Dense *(continued)*

MEDIUM TO COARSE SAND, TRACE GRAVEL
Gray
Dense

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon Consultants, Inc.

SOIL BORING LOG

Date 10/7/11

ROUTE FAP639 (IL 17) DESCRIPTION Edwards River Bridge LOGGED BY RP

SECTION 123B LOCATION , SEC. 21, TWP. 10N, RNG. 9W,
Latitude 41.1871, Longitude -90.9678

COUNTY Mercer DRILLING METHOD HOLLOW STEM/WASH BORING HAMMER TYPE AUTO

STRUCT. NO. 066-0006
Station 154+76.17

BORING NO. B-EA
Station 157+41
Offset 21.0 ft LT
Ground Surface Elev. 558.50 ft

Surface Water Elev. 541.80 ft
Stream Bed Elev. 538.00 ft

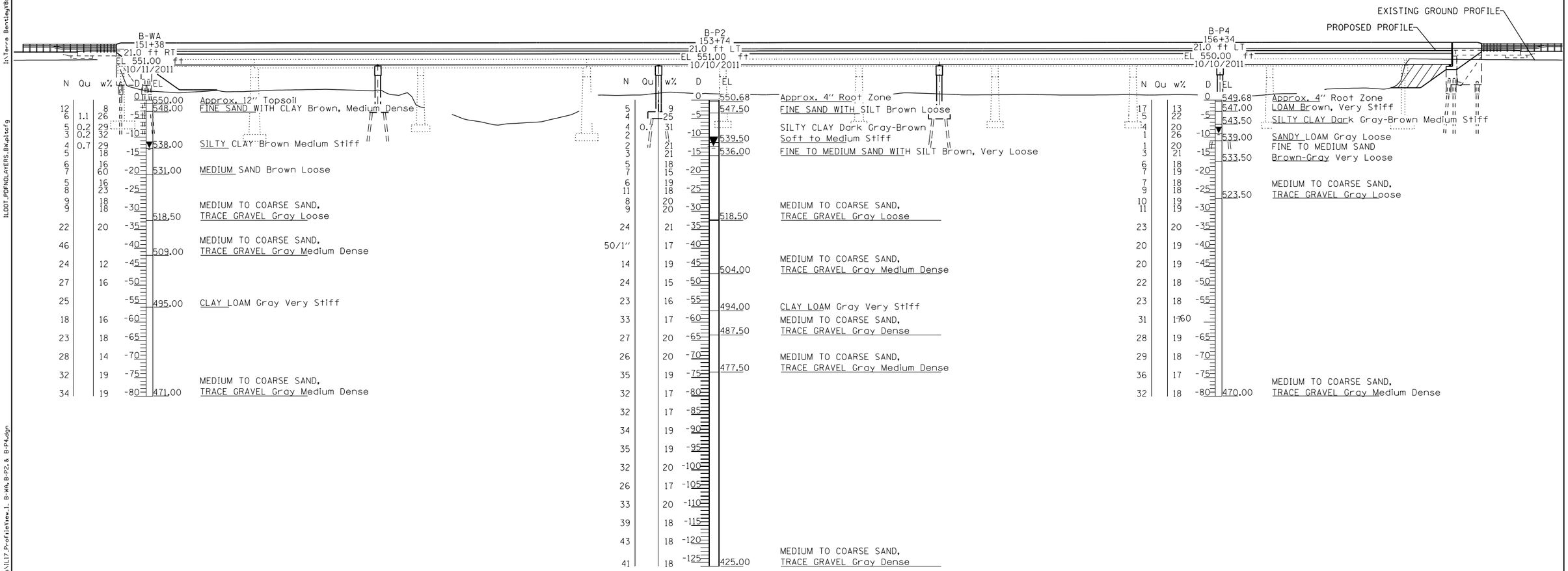
Groundwater Elev.:
First Encounter 544.5 ft ▼
Upon Completion NA ft
After ____ Hrs. NA ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
End of Boring			
-85			
-90			
-95			
-100			

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)

BBS, form 137 (Rev. 8-99)

Appendix D



NOT TO SCALE

LEGEND

EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND

▼ = Groundwater Level First Encountered
▽ = Groundwater Level Upon Completion
⧩ = Groundwater Level After __ hours

IL 17 OVER EDWARDS RIVER

F.A.P. ROUTE 639 SECTION (123B)BR-1

MERCER COUNTY

STATION 154+76.19

STRUCTURE NO. 066-0021

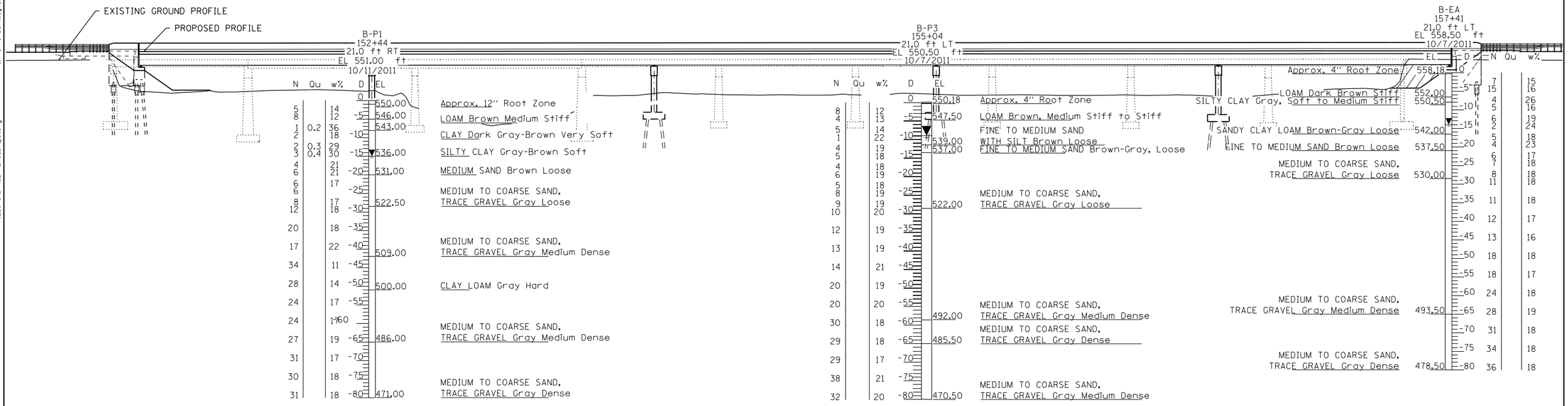
TERRA ENGINEERING LTD.	USER NAME = LNF	DESIGNED -	REVISED -
		DRAWN -	REVISED -
	PLOT SCALE = 80.0000 ' / in.	CHECKED -	REVISED -
	PLOT DATE = 3/15/2012	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 17 OVER EDWARDS RIVER
SUBSURFACE PROFILES – B-WA, B-P2, & B-P4

SCALE: | SHEET NO. 1 OF 2 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
639	(123B)BR-1	MERCER		
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			



NOT TO SCALE

LEGEND

EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND

▼ = Groundwater Level First Encountered
▽ = Groundwater Level Upon Completion
▽ = Groundwater Level After __ hours

IL 17 OVER EDWARDS RIVER

F.A.P. ROUTE 639 SECTION (123B)BR-1

MERCER COUNTY

STATION 154+76.19

STRUCTURE NO. 066-0021

TERRA ENGINEERING LTD.	USER NAME = LNF	DESIGNED -	REVISED -
		DRAWN -	REVISED -
	PLOT SCALE = 80.0000 ' / in.	CHECKED -	REVISED -
	PLOT DATE = 3/15/2012	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 17 OVER EDWARDS RIVER
SUBSURFACE PROFILES – B–P1, B–P3, & B–EA

SCALE: | SHEET NO. 2 OF 2 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
639	(123B)BR-1	MERCER		
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

Appendix E

Slide Analysis Information

Document Name

File Name: West Abut_Seismic_SLIDE_IL 17.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.02936

Material Properties

Material: Embankment
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Fine Sand w/ Clay
Strength Type: Mohr-Coulomb
Unit Weight: 102.5 lb/ft3
Cohesion: 0 psf
Friction Angle: 31 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 121 lb/ft3
Cohesion: 1100 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Silty Clay-2
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 115.2 lb/ft3
Saturated Unit Weight: 125.28 lb/ft3
Cohesion: 200 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Silty Clay-3
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 115.2 lb/ft3
Saturated Unit Weight: 123.8 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 111.24 lb/ft3
Saturated Unit Weight: 120.5 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand-1
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 112.32 lb/ft3
Saturated Unit Weight: 123.5 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand-2
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 114.48 lb/ft3
Saturated Unit Weight: 127.2 lb/ft3

Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Loam
Strength Type: Mohr-Coulomb
Unit Weight: 109.4 lb/ft3
Cohesion: 3500 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand-3
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 114.48 lb/ft3
Saturated Unit Weight: 124.6 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

List of All Coordinates

Material Boundary
0.000	551.000
125.460	551.000

Material Boundary
0.000	548.000
131.460	548.000

Material Boundary
0.000	547.000
133.460	547.000

Material Boundary
0.000	542.000
143.460	542.000

Material Boundary
0.000	538.000
151.460	538.000

Material Boundary
0.000	531.000
251.460	531.000

Material Boundary
0.000	518.500
251.450	518.500

Material Boundary
0.000	509.000
251.460	509.000

Material Boundary

0.000	495.000
251.460	495.000

External Boundary

0.000	563.730
0.000	551.000
0.000	548.000
0.000	547.000
0.000	542.000
0.000	538.000
0.000	531.000
0.000	518.500
0.000	509.000
0.000	495.000
0.000	445.000
251.460	445.000
251.460	495.000
251.460	509.000
251.450	518.500
251.460	531.000
251.460	538.000
151.460	538.000
143.460	542.000
133.460	547.000
131.460	548.000
125.460	551.000
100.000	563.730

Water Table

0.000	538.000
251.460	538.000

Search Grid

-10.729	572.230
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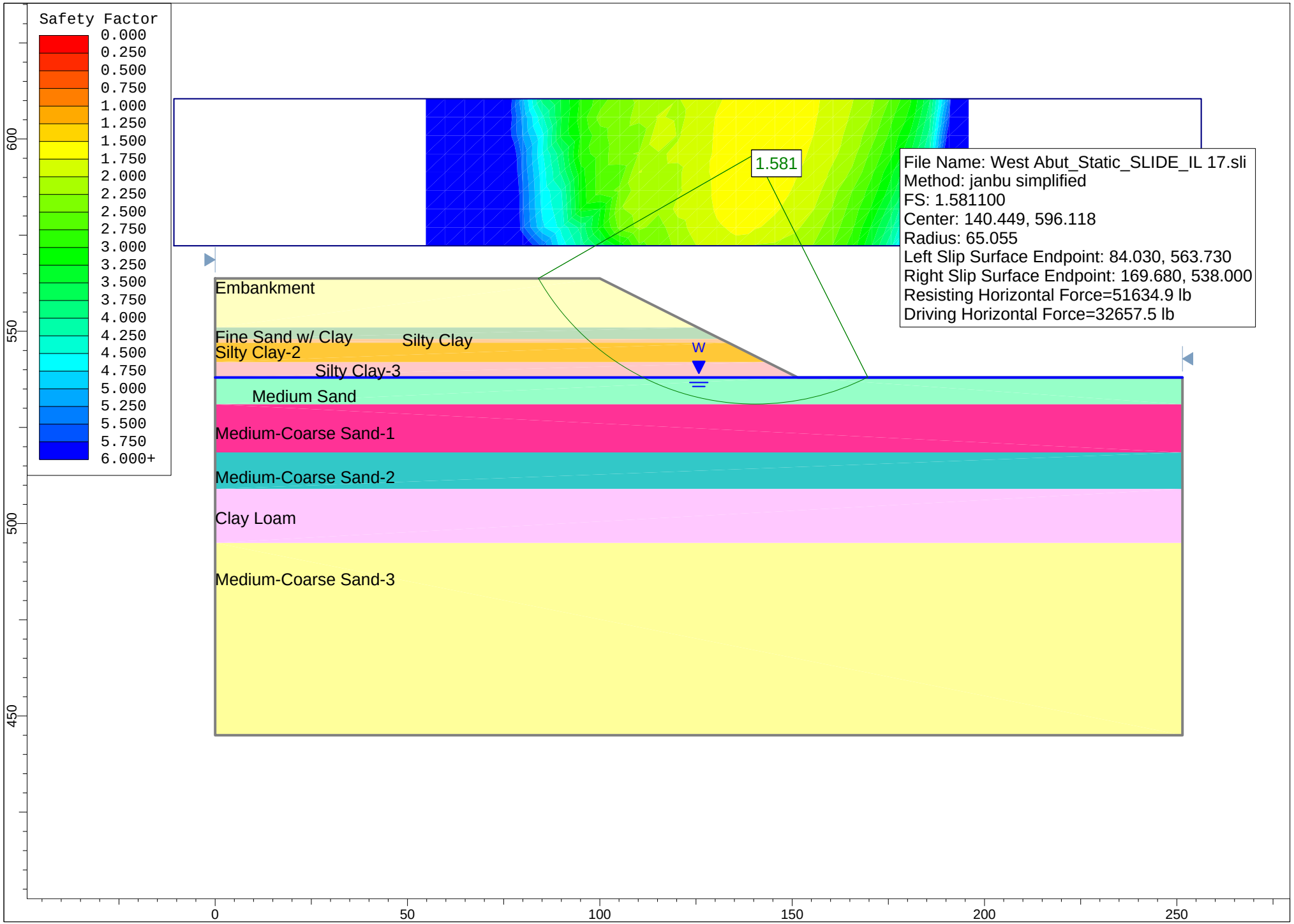
256.353	610.451
-10.729	610.451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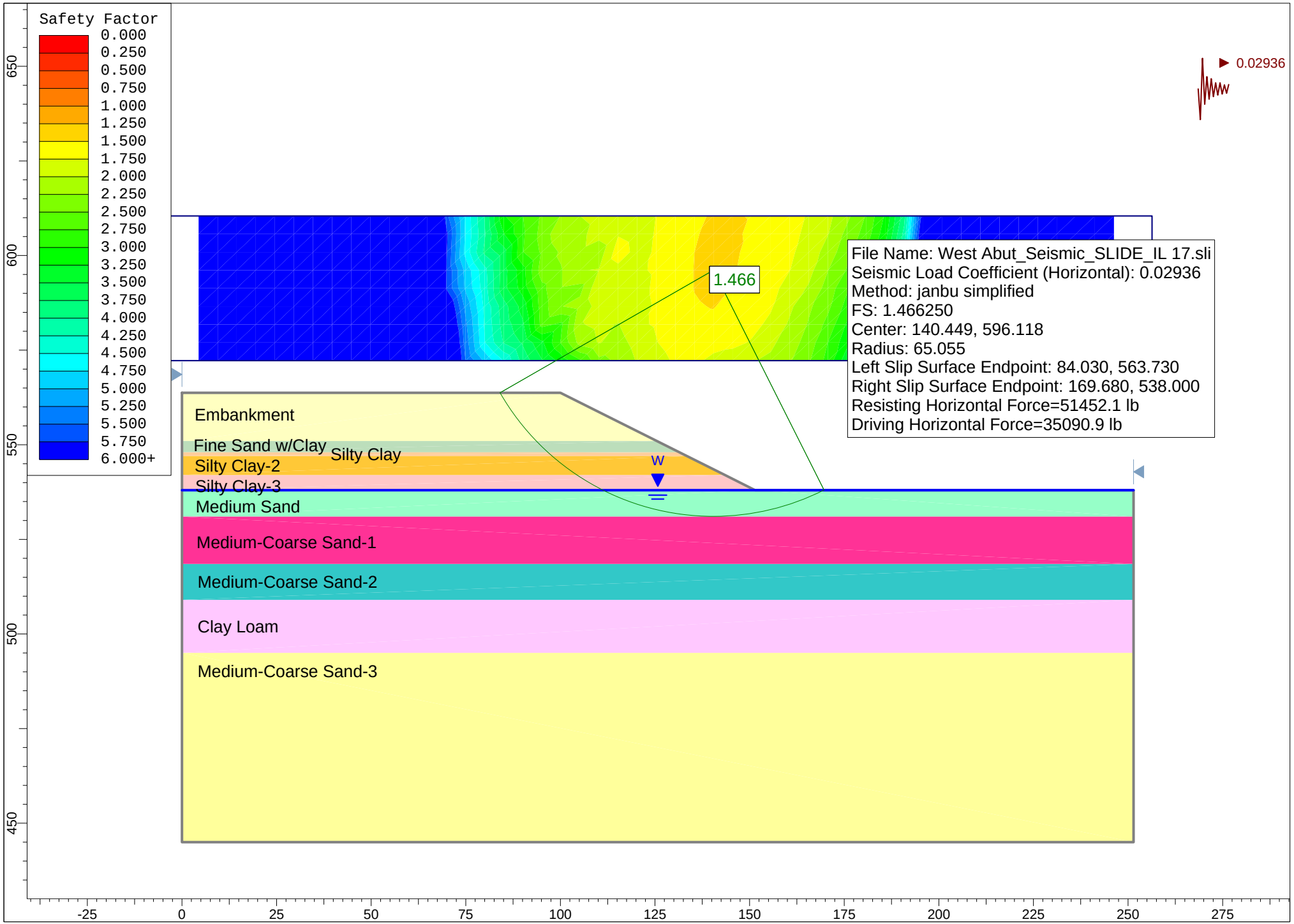
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.581
File Name: West Abut_Static_SLIDE_IL 17.sli
Method: janbu simplified
FS: 1.581100
Center: 140.449, 596.118
Radius: 65.055
Left Slip Surface Endpoint: 84.030, 563.730
Right Slip Surface Endpoint: 169.680, 538.000
Resisting Horizontal Force=51634.9 lb
Driving Horizontal Force=32657.5 lb
Embankment
Fine Sand w/ Clay
Silty Clay
Silty Clay-2
Silty Clay-3
W
Medium Sand
Medium-Coarse Sand-1
Medium-Coarse Sand-2
Clay Loam
Medium-Coarse Sand-3
600
550
500
450
0
50
100
150
200
250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1.750
2.000
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3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.02936
1.466
File Name: West Abut_Seismic_SLIDE_IL 17.sli
Seismic Load Coefficient (Horizontal): 0.02936
Method: janbu simplified
FS: 1.466250
Center: 140.449, 596.118
Radius: 65.055
Left Slip Surface Endpoint: 84.030, 563.730
Right Slip Surface Endpoint: 169.680, 538.000
Resisting Horizontal Force=51452.1 lb
Driving Horizontal Force=35090.9 lb
Embankment
Fine Sand w/Clay
Silty Clay
Silty Clay-2
Silty Clay-3
Medium Sand
W
Medium-Coarse Sand-1
Medium-Coarse Sand-2
Clay Loam
Medium-Coarse Sand-3
650
600
550
500
450
-25
0
25
50
75
100
125
150
175
200
225
250
275

Slide Analysis Information

Document Name

File Name: East Abut_Seismic_SLIDE_IL 17.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified
Janbu simplified
Janbu corrected

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.02936

Material Properties

Material: Embankment
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Loam
Strength Type: Mohr-Coulomb
Unit Weight: 136.88 lb/ft3
Cohesion: 2000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 120.96 lb/ft3
Cohesion: 500 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Sandy Clay Loam
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 117.3 lb/ft3
Saturated Unit Weight: 121.5 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Fine-Medium Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 109.08 lb/ft3
Saturated Unit Weight: 121.7 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 112.32 lb/ft3
Saturated Unit Weight: 122.4 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand-2
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 114.48 lb/ft3
Saturated Unit Weight: 124.7 lb/ft3
Cohesion: 0 psf
Friction Angle: 32 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium-Coarse Sand-3
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 115.56 lb/ft3

Saturated Unit Weight: 126.3 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Loam-1
Strength Type: Mohr-Coulomb
Unit Weight: 135.7 lb/ft3
Cohesion: 900 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

List of All Coordinates

Material Boundary

0.000	558.500
104.660	558.500

Material Boundary

0.000	552.000
117.660	552.000

Material Boundary

0.000	550.500
120.660	550.500

Material Boundary

0.000	542.000
137.660	542.000

Material Boundary

0.000	537.500
245.660	537.500

Material Boundary

0.000	530.000
245.660	530.000

Material Boundary

0.000	493.500
245.660	493.500

Material Boundary

0.000	556.500
108.660	556.500

External Boundary

0.000	560.830
0.000	558.500
0.000	556.500
0.000	552.000
0.000	550.500
0.000	542.000

0.000	537.500
0.000	530.000
0.000	493.500
0.000	453.500
245.660	453.500
245.660	493.500
245.660	530.000
245.660	537.500
245.660	538.000
145.660	538.000
137.660	542.000
120.660	550.500
117.660	552.000
108.660	556.500
104.660	558.500
100.000	560.830

Water Table

0.000	544.500
132.660	544.500

Search Grid

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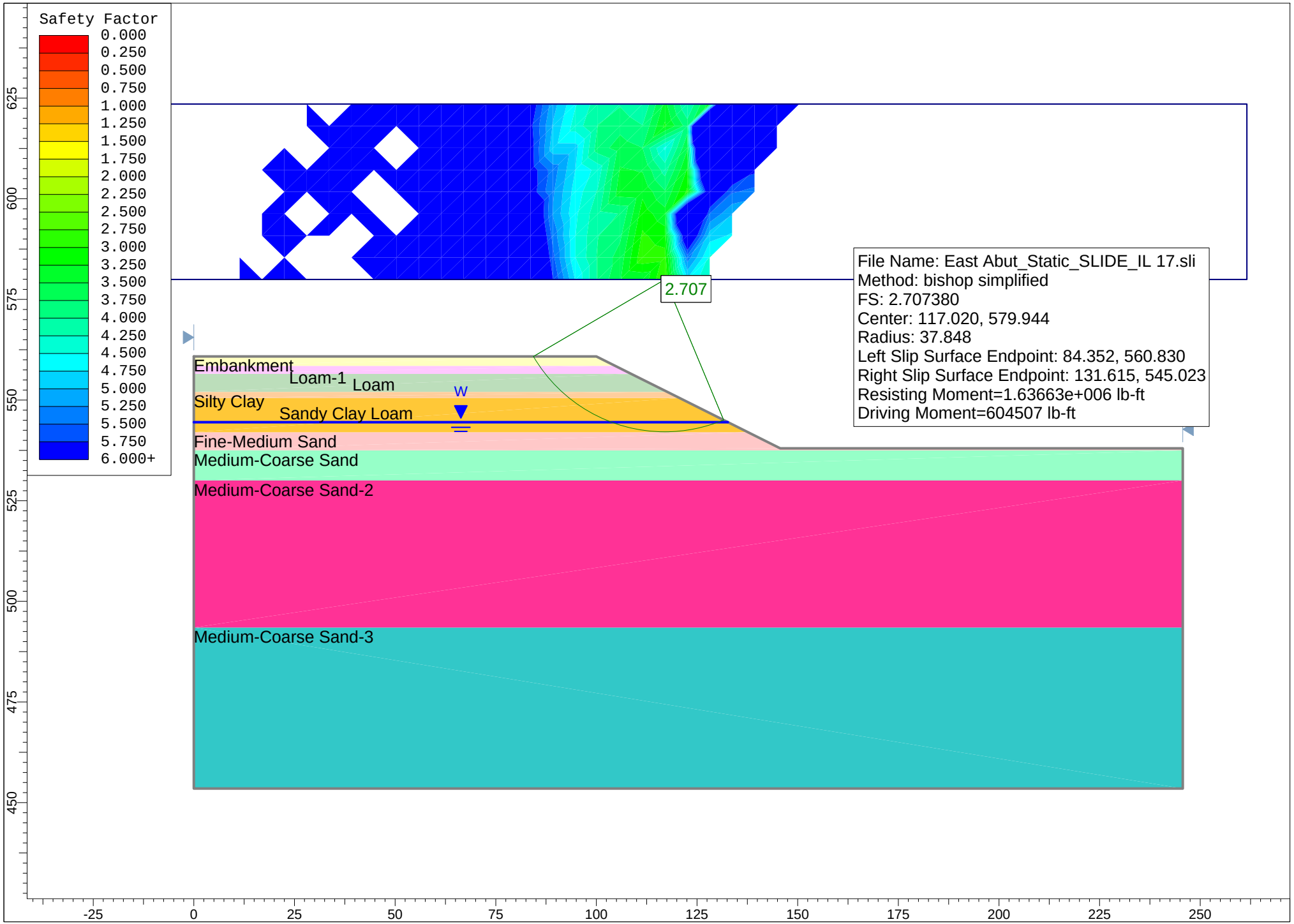
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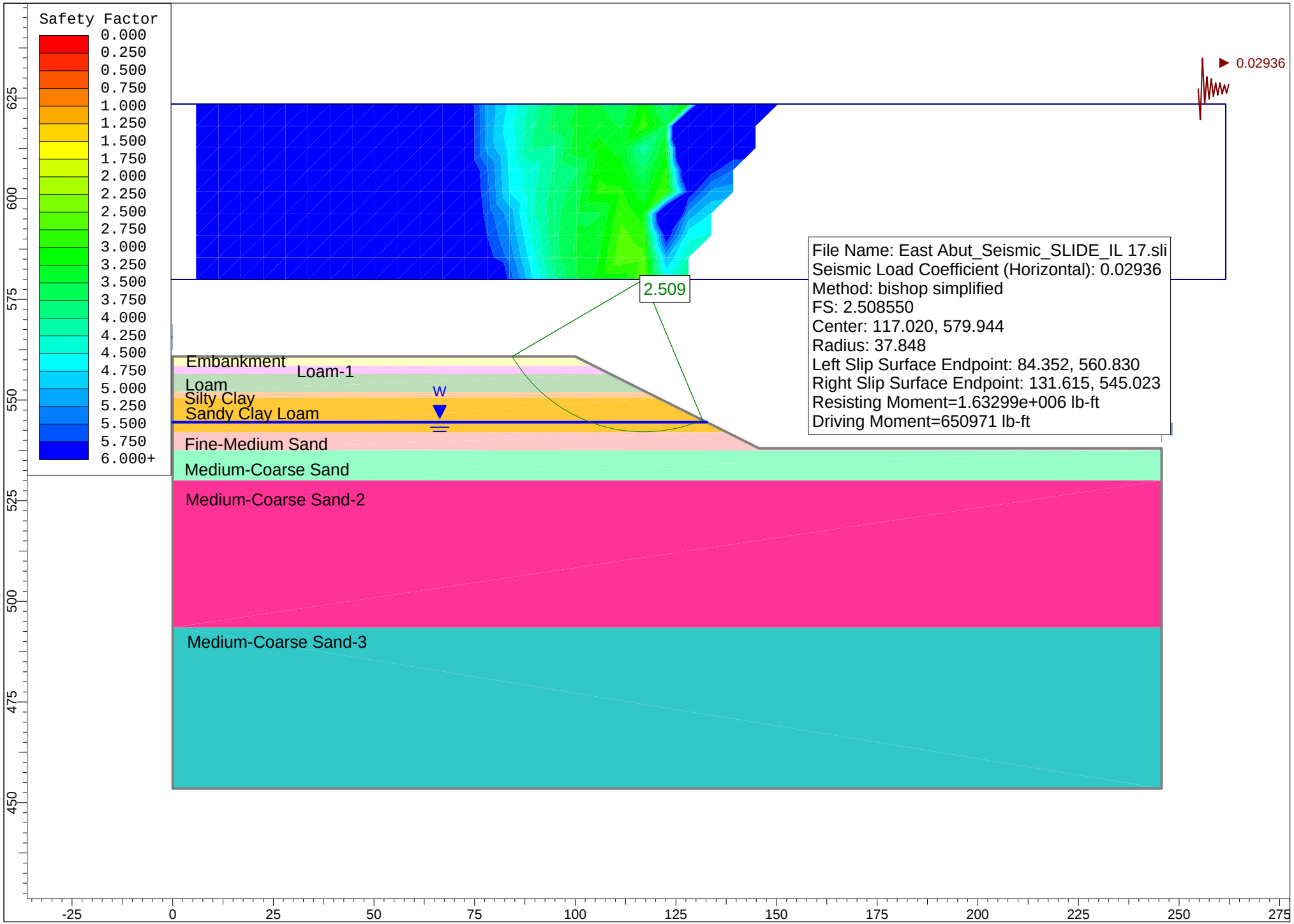
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.707
File Name: East Abut_Static_SLIDE_IL 17.sli
Method: bishop simplified
FS: 2.707380
Center: 117.020, 579.944
Radius: 37.848
Left Slip Surface Endpoint: 84.352, 560.830
Right Slip Surface Endpoint: 131.615, 545.023
Resisting Moment=1.63663e+006 lb-ft
Driving Moment=604507 lb-ft
Embankment
Loam-1
Loam
Silty Clay
Sandy Clay Loam
W
Fine-Medium Sand
Medium-Coarse Sand
Medium-Coarse Sand-2
Medium-Coarse Sand-3
625
600
575
550
525
500
475
450
-25
0
25
50
75
100
125
150
175
200
225
250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1.000
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1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.02936
2.509
File Name: East Abut_Seismic_SLIDE_IL 17.sli
Seismic Load Coefficient (Horizontal): 0.02936
Method: bishop simplified
FS: 2.508550
Center: 117.020, 579.944
Radius: 37.848
Left Slip Surface Endpoint: 84.352, 560.830
Right Slip Surface Endpoint: 131.615, 545.023
Resisting Moment=1.63299e+006 lb-ft
Driving Moment=650971 lb-ft
Embankment
Loam-1
Loam
Silty Clay
Sandy Clay Loam
W
Fine-Medium Sand
Medium-Coarse Sand
Medium-Coarse Sand-2
Medium-Coarse Sand-3
625
600
575
550
525
500
475
450
-25
0
25
50
75
100
125
150
175
200
225
250
275

Appendix F

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====IL Route 17 over Edwards River

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	552.5 ft.
Pile or Shaft Dia.	12 inches
Boring Number	B-WA
Top of Boring Elev.	551 ft.
Approximate Fixity Elev.	546.5 ft.

Individual Site Class Definition:

N (bar): 14 (Blows/ft.) Soil Site Class E
N_{ch} (bar): 18 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): (ksf) NA, H < 0.1*H (Soil)

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	549.0	2.00	12		B
	547.0	2.00	6	1.10	B
2.5	544.0	3.00	5	0.20	
4.5	542.0	2.00	3	0.20	B
7.5	539.0	3.00	4	0.70	B
9.5	537.0	2.00	5		
12.5	534.0	3.00	6		
14.5	532.0	2.00	7		B
17.5	529.0	3.00	5		
19.5	527.0	2.00	8		
22.5	524.0	3.00	9		
24.5	522.0	2.00	9		B
29.5	517.0	5.00	22		
34.5	512.0	5.00	46		B
39.5	507.0	5.00	24		
44.5	502.0	5.00	27		
49.5	497.0	5.00	25		B
54.5	492.0	5.00	18		
59.5	487.0	5.00	23		
64.5	482.0	5.00	28		
69.5	477.0	5.00	32		
100.0	446.5	30.50	34		B

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	534 ft.
Pile or Shaft Dia.	12 inches
Boring Number	B-P1
Top of Boring Elev.	551 ft.
Approximate Fixity Elev.	528 ft.

Individual Site Class Definition:

N (bar): 24 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 24 (Blows/ft.) Soil Site Class D
s_u (bar): 3.95 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	549.0	2.00	5	0.60	
	547.0	2.00	8	1.00	B
	544.0	3.00	1	0.20	B
	542.0	2.00	2	0.30	
	539.0	3.00	2	0.30	
	537.0	2.00	3	0.40	B
	534.0	3.00	4		
	532.0	2.00	6		B
	529.0	3.00	6		
1.0	527.0	2.00	6		
4.0	524.0	3.00	8		B
6.0	522.0	2.00	12		
11.0	517.0	5.00	20		
16.0	512.0	5.00	17		B
21.0	507.0	5.00	34	4.10	
26.0	502.0	5.00	28	3.80	B
31.0	497.0	5.00	24		
36.0	492.0	5.00	24		
41.0	487.0	5.00	27		B
46.0	482.0	5.00	31		
51.0	477.0	5.00	30		
100.0	428.0	49.00	31		B

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	534 ft.
Pile or Shaft Dia.	12 inches
Boring Number	B-P2
Top of Boring Elev.	551 ft.
Approximate Fixity Elev.	528 ft.

Individual Site Class Definition:

N (bar): 24 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 24 (Blows/ft.) Soil Site Class D
s_u (bar): 3.25 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	549.0	2.00	5		B
	547.0	2.00	4	0.50	
	544.0	3.00	4	0.70	B
	542.0	2.00	2	0.25	B
	539.0	3.00	2		
	537.0	2.00	3		B
	534.0	3.00	5		
	532.0	2.00	7		
	529.0	3.00	6		
1.0	527.0	2.00	11		
4.0	524.0	3.00	8		
6.0	522.0	2.00	9		B
11.0	517.0	5.00	24		B
21.0	507.0	10.00	14		B
26.0	502.0	5.00	24	3.30	
31.0	497.0	5.00	23	3.20	B
36.0	492.0	5.00	33		B
41.0	487.0	5.00	27		
46.0	482.0	5.00	26		B
51.0	477.0	5.00	35		
56.0	472.0	5.00	32		
61.0	467.0	5.00	32		
66.0	462.0	5.00	34		
71.0	457.0	5.00	35		
76.0	452.0	5.00	32		
81.0	447.0	5.00	26		
86.0	442.0	5.00	33		
100.0	428.0	14.00	39		

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)	546.2 ft.
Pile or Shaft Dia.	12 inches
Boring Number	B-P3
Top of Boring Elev.	550.5 ft.
Approximate Fixity Elev.	540.2 ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 15 (Blows/ft.) Soil Site Class D
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	548.5	2.00	8		B
	546.5	2.00	4		
	543.5	3.00	5		
	541.5	2.00	1		B
1.7	538.5	3.00	4		B
3.7	536.5	2.00	5		
6.7	533.5	3.00	4		
8.7	531.5	2.00	6		
11.7	528.5	3.00	5		
13.7	526.5	2.00	8		
16.7	523.5	3.00	9		B
18.7	521.5	2.00	10		
23.7	516.5	5.00	12		
28.7	511.5	5.00	13		
33.7	506.5	5.00	14		
38.7	501.5	5.00	20		
43.7	496.5	5.00	20		B
48.7	491.5	5.00	30		
53.7	486.5	5.00	29		B
58.7	481.5	5.00	29		
63.7	476.5	5.00	38		
100.0	440.2	36.30	32		B

Global Site Class Definition: Substructures 1 through 6

N (bar): 18 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 18 (Blows/ft.) Soil Site Class D
s_u (bar): (ksf) NA, H < 0.1*H (Total)

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====IL Route 17 over Edwards River

Substructure 5

Base of Substruct. Elev. (or ground surf for bents)	545.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-P4	
Top of Boring Elev.	550	ft.
Approximate Fixity Elev.	539.5	ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 15 (Blows/ft.) Soil Site Class D
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	548.0	2.00	17	2.20	B
	546.0	2.00	5	0.60	B
	543.0	3.00	4		
	541.0	2.00	1		B
1.5	538.0	3.00	1		
3.5	536.0	2.00	3		B
6.5	533.0	3.00	6		
8.5	531.0	2.00	7		
11.5	528.0	3.00	7		
13.5	526.0	2.00	9		B
16.5	523.0	3.00	10		
18.5	521.0	2.00	11		
23.5	516.0	5.00	23		
28.5	511.0	5.00	20		
33.5	506.0	5.00	20		
38.5	501.0	5.00	22		
43.5	496.0	5.00	23		
48.5	491.0	5.00	31		
53.5	486.0	5.00	28		
58.5	481.0	5.00	29		
63.5	476.0	5.00	36		
100.0	439.5	36.50	32		B

Substructure 6

Base of Substruct. Elev. (or ground surf for bents)	553	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-EA	
Top of Boring Elev.	558.5	ft.
Approximate Fixity Elev.	547	ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 15 (Blows/ft.) Soil Site Class D
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	556.5	2.00	7	0.90	B
	554.5	2.00	15	2.00	B
	551.5	3.00	4	0.50	B
	549.5	2.00	5		
0.5	546.5	3.00	6		
2.5	544.5	2.00	2		B
5.5	541.5	3.00	5		
7.5	539.5	2.00	4		B
10.5	536.5	3.00	6		
12.5	534.5	2.00	7		
15.5	531.5	3.00	8		B
17.5	529.5	2.00	11		
22.5	524.5	5.00	11		
27.5	519.5	5.00	12		
32.5	514.5	5.00	13		
37.5	509.5	5.00	18		
42.5	504.5	5.00	18		
47.5	499.5	5.00	24		
52.5	494.5	5.00	28		
57.5	489.5	5.00	31		
62.5	484.5	5.00	34		
100.0	447.0	37.50	36		B

Substructure 7

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): (Blows/ft.) NA
N_{ch} (bar): (Blows/ft.) NA
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 8

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): (Blows/ft.) NA
N_{ch} (bar): (Blows/ft.) NA
s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Appendix G

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== West Abut (Precore)
REFERENCE BORING ========== B-WA
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 553.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 552.00 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 ========= 920 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 101.07 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 37.90 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**445** KIPS	**245** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
551.00	1.00		0	Fine Sand	0.0		***0.0***				0	0	0	0	2
548.00	3.00		0	Fine Sand	0.0	0.0	***0.0***				0	0	0	0	5
545.50	2.50	0.00			0.0	0.0	***0.0***				0	0	0	0	8
543.00	2.50	0.00			0.0	0.0	***0.0***				0	0	0	0	10
540.50	2.50	0.00			0.0	0.0	***0.0***				0	0	0	0	13
538.00	2.50	0.00			0.0	0.0	***33.6***				34	0	0	19	15
536.00	2.00		5	Medium Sand	3.4	33.6	***43.8***				44	0	0	24	17
533.00	3.00		6	Medium Sand	6.1	40.4	***56.6***				57	0	0	31	20
531.00	2.00		7	Medium Sand	4.7	47.1	***47.8***				48	0	0	26	22
528.00	3.00		5	Medium Sand	5.1	33.6	***73.1***				73	0	0	40	25
526.00	2.00		8	Medium Sand	5.4	53.8	***85.2***				85	0	0	47	27
523.00	3.00		9	Medium Sand	9.1	60.6	***94.3***				94	0	0	52	30
522.00	1.00		9	Medium Sand	3.0	60.6	***97.3***				97	0	0	54	31
521.00	1.00		9	Medium Sand	3.0	60.6	***187.9***				188	0	0	103	32
520.00	1.00		22	Clean Coarse Sand	8.1	148.0	***196.0***				196	0	0	108	33
519.00	1.00		22	Clean Coarse Sand	8.1	148.0	***204.1***				204	0	0	112	34
518.00	1.00		22	Clean Coarse Sand	8.1	148.0	***212.2***				212	0	0	117	35
517.00	1.00		22	Clean Coarse Sand	8.1	148.0	***220.3***				220	0	0	121	36
516.00	1.00		22	Clean Coarse Sand	8.1	148.0	***390.0***				390	0	0	214	37
515.00	1.00		46	Clean Coarse Sand	25.3	309.6	***415.3***				415	0	0	228	38
514.00	1.00		46	Clean Coarse Sand	25.3	309.6	***440.5***				441	0	0	242	39
513.00	1.00		46	Clean Coarse Sand	25.3	309.6	***358.1***				358	0	0	197	40
512.00	1.00		30	Clean Coarse Sand	12.1	201.9	***370.2***				370	0	0	204	41
511.00	1.00		30	Clean Coarse Sand	12.1	201.9	***301.5***				302	0	0	166	42
506.00	5.00		24	Hard Till	24.2	121.1	***340.9***				341	0	0	187	47
501.00	5.00		27	Hard Till	27.3	136.3	***358.0***				358	0	0	197	52
496.00	5.00		25	Hard Till	25.2	126.2	***378.2***				378	0	0	208	57
491.00	5.00		18	Clean Coarse Sand	33.2	121.1	***445.1***				445	0	0	245	62
486.00	5.00		23	Clean Coarse Sand	42.5	154.8	***521.2***				~~521~~	~~0~~	~~0~~	~~287~~	~~67~~
477.00	9.00		28	Clean Coarse Sand	98.1	188.4	***646.2***				~~646~~	~~0~~	~~0~~	~~355~~	~~76~~
399.00	78.00		32	Clean Coarse Sand	1040.4	215.3	***1700.0***				~~1700~~	~~0~~	~~0~~	~~935~~	~~154~~
299.00	100.00		34	Clean Coarse Sand		228.8									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== West Abut (Downdrag)
REFERENCE BORING ========== B-WA
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 553.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 552.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD DD
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 538.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 920 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 101.07 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 37.90 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**477** KIPS	**209** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
551.00	1.00		7	Fine Sand	2.2		***18.4***				18	1	2	6	2
548.00	3.00		7	Fine Sand	6.7	16.2	***21.8***				22	5	10	-3	5
545.50	2.50	1.10			11.0	12.9	***22.2***				22	11	22	-21	8
543.00	2.50	0.20			2.4	2.3	***24.6***				25	12	25	-23	10
540.50	2.50	0.20			2.4	2.3	***32.8***				33	14	27	-23	13
538.00	2.50	0.70			7.6	8.2	***65.8***				66	18	35	-17	15
536.00	2.00		5	Medium Sand	3.4	33.6	***75.9***				76	18	35	-11	17
533.00	3.00		6	Medium Sand	6.1	40.4	***88.7***				89	18	35	-4	20
531.00	2.00		7	Medium Sand	4.7	47.1	***80.0***				80	18	35	-9	22
528.00	3.00		5	Medium Sand	5.1	33.6	***105.2***				105	18	35	5	25
526.00	2.00		8	Medium Sand	5.4	53.8	***117.3***				117	18	35	11	27
523.00	3.00		9	Medium Sand	9.1	60.6	***126.4***				126	18	35	16	30
522.00	1.00		9	Medium Sand	3.0	60.6	***129.5***				129	18	35	18	31
521.00	1.00		9	Medium Sand	3.0	60.6	***220.0***				220	18	35	68	32
520.00	1.00		22	Clean Coarse Sand	8.1	148.0	***228.1***				228	18	35	72	33
519.00	1.00		22	Clean Coarse Sand	8.1	148.0	***236.2***				236	18	35	77	34
518.00	1.00		22	Clean Coarse Sand	8.1	148.0	***244.4***				244	18	35	81	35
517.00	1.00		22	Clean Coarse Sand	8.1	148.0	***252.5***				252	18	35	86	36
516.00	1.00		22	Clean Coarse Sand	8.1	148.0	***422.1***				422	18	35	179	37
515.00	1.00		46	Clean Coarse Sand	25.3	309.6	***447.4***				447	18	35	193	38
514.00	1.00		46	Clean Coarse Sand	25.3	309.6	***472.7***				473	18	35	207	39
513.00	1.00		46	Clean Coarse Sand	25.3	309.6	***390.3***				390	18	35	162	40
512.00	1.00		30	Clean Coarse Sand	12.1	201.9	***402.3***				402	18	35	168	41
511.00	1.00		30	Clean Coarse Sand	12.1	201.9	***333.7***				334	18	35	130	42
506.00	5.00		24	Hard Till	24.2	121.1	***373.0***				373	18	35	152	47
501.00	5.00		27	Hard Till	27.3	136.3	***390.2***				390	18	35	161	52
496.00	5.00		25	Hard Till	25.2	126.2	***410.4***				410	18	35	173	57
491.00	5.00		18	Clean Coarse Sand	33.2	121.1	***477.2***				477	18	35	209	62
486.00	5.00		23	Clean Coarse Sand	42.5	154.8	***553.3***				~~553~~	~~18~~	~~35~~	~~251~~	~~67~~
477.00	9.00		28	Clean Coarse Sand	98.1	188.4	***678.3***				~~678~~	~~18~~	~~35~~	~~320~~	~~76~~
399.00	78.00		32	Clean Coarse Sand	1040.4	215.3	***1732.2***				~~1732~~	~~18~~	~~35~~	~~900~~	~~154~~
299.00	100.00		34	Clean Coarse Sand		228.8									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== West Abut (Remove & Replac
REFERENCE BORING ========== B-WA
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 553.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 552.00 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 ========= 920 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 101.07 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 37.90 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**475** KIPS	**261** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
551.00	1.00		7	Fine Sand	2.2		***14.3***				14	0	0	8	2
549.00	2.00		7	Fine Sand	4.4	12.1	***26.9***				27	0	0	15	4
547.00	2.00		7	Fine Sand	4.4	20.2	***47.4***				47	0	0	26	6
543.00	4.00		7	Fine Sand	8.9	36.3	***22.3***				22	0	0	12	10
540.50	2.50	0.20			2.4	2.3	***30.5***				31	0	0	17	13
538.00	2.50	0.70			7.6	8.2	***63.5***				64	0	0	35	15
536.00	2.00		5	Medium Sand	3.4	33.6	***73.6***				74	0	0	41	17
533.00	3.00		6	Medium Sand	6.1	40.4	***86.4***				86	0	0	48	20
531.00	2.00		7	Medium Sand	4.7	47.1	***77.7***				78	0	0	43	22
528.00	3.00		5	Medium Sand	5.1	33.6	***103.0***				103	0	0	57	25
526.00	2.00		8	Medium Sand	5.4	53.8	***115.1***				115	0	0	63	27
523.00	3.00		9	Medium Sand	9.1	60.6	***124.2***				124	0	0	68	30
522.00	1.00		9	Medium Sand	3.0	60.6	***127.2***				127	0	0	70	31
521.00	1.00		9	Medium Sand	3.0	60.6	***217.8***				218	0	0	120	32
520.00	1.00		22	Clean Coarse Sand	8.1	148.0	***225.9***				226	0	0	124	33
519.00	1.00		22	Clean Coarse Sand	8.1	148.0	***234.0***				234	0	0	129	34
518.00	1.00		22	Clean Coarse Sand	8.1	148.0	***242.1***				242	0	0	133	35
517.00	1.00		22	Clean Coarse Sand	8.1	148.0	***250.2***				250	0	0	138	36
516.00	1.00		22	Clean Coarse Sand	8.1	148.0	***419.9***				420	0	0	231	37
515.00	1.00		46	Clean Coarse Sand	25.3	309.6	***445.1***				445	0	0	245	38
514.00	1.00		46	Clean Coarse Sand	25.3	309.6	***470.4***				470	0	0	259	39
513.00	1.00		46	Clean Coarse Sand	25.3	309.6	***388.0***				388	0	0	213	40
512.00	1.00		30	Clean Coarse Sand	12.1	201.9	***400.1***				400	0	0	220	41
511.00	1.00		30	Clean Coarse Sand	12.1	201.9	***331.4***				331	0	0	182	42
506.00	5.00		24	Hard Till	24.2	121.1	***370.8***				371	0	0	204	47
501.00	5.00		27	Hard Till	27.3	136.3	***387.9***				388	0	0	213	52
496.00	5.00		25	Hard Till	25.2	126.2	***408.1***				408	0	0	224	57
491.00	5.00		18	Clean Coarse Sand	33.2	121.1	***475.0***				475	0	0	261	62
486.00	5.00		23	Clean Coarse Sand	42.5	154.8	***551.1***				~~551~~	~~0~~	~~0~~	~~303~~	~~67~~
477.00	9.00		28	Clean Coarse Sand	98.1	188.4	***676.1***				~~676~~	~~0~~	~~0~~	~~372~~	~~76~~
399.00	78.00		32	Clean Coarse Sand	1040.4	215.3	***1729.9***				~~1730~~	~~0~~	~~0~~	~~951~~	~~154~~
299.00	100.00		34	Clean Coarse Sand		228.8									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== East Abut
REFERENCE BORING ========== B-EA
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 553.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 552.00 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 ========= 920 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 101.07 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 37.90 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**487** KIPS	**268** KIPS	**60** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
550.50	1.50		4	Very Fine Silty Sand	1.7		***11.8***				12	0	0	7	3
548.50	2.00		5	Fine Sand	3.2	10.1	***27.4***				27	0	0	15	5
545.50	3.00		6	Fine Sand	5.7	22.5	***20.4***				20	0	0	11	8
543.50	2.00		2	Fine Sand	1.3	9.8	***45.0***				45	0	0	25	10
540.50	3.00		5	Fine Sand	4.8	33.2	***43.6***				44	0	0	24	13
538.50	2.00		4	Fine Sand	2.5	26.9	***59.6***				60	0	0	33	15
535.50	3.00		6	Medium Sand	6.1	40.4	***72.4***				72	0	0	40	18
533.50	2.00		7	Medium Sand	4.7	47.1	***83.8***				84	0	0	46	20
530.50	3.00		8	Medium Sand	8.1	53.8	***112.1***				112	0	0	62	23
528.50	2.00		11	Clean Coarse Sand	8.1	74.0	***120.2***				120	0	0	66	25
526.00	2.50		11	Clean Coarse Sand	10.2	74.0	***130.4***				130	0	0	72	27
523.50	2.50		11	Clean Coarse Sand	10.2	74.0	***147.3***				147	0	0	81	30
521.00	2.50		12	Clean Coarse Sand	11.1	80.8	***158.3***				158	0	0	87	32
518.50	2.50		12	Clean Coarse Sand	11.1	80.8	***176.1***				176	0	0	97	35
517.50	1.00		13	Clean Coarse Sand	4.8	87.5	***180.9***				181	0	0	100	36
516.50	1.00		13	Clean Coarse Sand	4.8	87.5	***185.7***				186	0	0	102	37
515.50	1.00		13	Clean Coarse Sand	4.8	87.5	***190.5***				191	0	0	105	38
514.50	1.00		13	Clean Coarse Sand	4.8	87.5	***195.3***				195	0	0	107	39
513.50	1.00		13	Clean Coarse Sand	4.8	87.5	***233.8***				234	0	0	129	40
511.00	2.50		18	Clean Coarse Sand	16.6	121.1	***250.4***				250	0	0	138	42
508.50	2.50		18	Clean Coarse Sand	16.6	121.1	***267.0***				267	0	0	147	45
507.50	1.00		18	Clean Coarse Sand	6.6	121.1	***273.6***				274	0	0	151	46
506.50	1.00		18	Clean Coarse Sand	6.6	121.1	***280.3***				280	0	0	154	47
505.50	1.00		18	Clean Coarse Sand	6.6	121.1	***286.9***				287	0	0	158	48
504.50	1.00		18	Clean Coarse Sand	6.6	121.1	***293.6***				294	0	0	161	49
503.50	1.00		18	Clean Coarse Sand	6.6	121.1	***340.6***				341	0	0	187	50
502.50	1.00		24	Clean Coarse Sand	8.9	161.5	***349.5***				349	0	0	192	51
501.50	1.00		24	Clean Coarse Sand	8.9	161.5	***358.4***				358	0	0	197	52
500.50	1.00		24	Clean Coarse Sand	8.9	161.5	***367.3***				367	0	0	202	53
499.50	1.00		24	Clean Coarse Sand	8.9	161.5	***376.2***				376	0	0	207	54
498.50	1.00		24	Clean Coarse Sand	8.9	161.5	***412.0***				412	0	0	227	55
493.50	5.00		28	Clean Coarse Sand	54.5	188.4	***486.6***				487	0	0	268	60
475.50	18.00		31	Clean Coarse Sand	228.4	208.6	***735.2***				~~735~~	~~0~~	~~0~~	~~404~~	~~78~~
407.50	68.00		34	Clean Coarse Sand	1001.0	228.8	***1749.6***				~~1750~~	~~0~~	~~0~~	~~962~~	~~146~~
307.50	100.00		36	Clean Coarse Sand		242.3									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== B-P1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 536.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 534.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 505.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1900 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 208.73 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 78.28 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**477** KIPS	**182** KIPS	**47** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
533.00	1.00		4	Medium Sand	1.3		***11.7***				12	1	0	6	3
531.00	2.00		6	Medium Sand	4.0	10.4	***26.2***				26	3	0	11	5
528.00	3.00		6	Medium Sand	6.1	20.8	***39.2***				39	6	0	15	8
526.00	2.00		6	Medium Sand	4.0	27.7	***66.3***				66	9	0	28	10
523.00	3.00		8	Medium Sand	8.1	50.8	***104.4***				104	13	0	44	13
521.00	2.00		12	Clean Coarse Sand	8.9	80.8	***167.1***				167	18	0	74	15
516.00	5.00		20	Clean Coarse Sand	36.9	134.6	***183.8***				184	38	0	63	20
511.00	5.00		17	Clean Coarse Sand	31.4	114.4	***272.4***				272	55	0	94	25
510.00	1.00		34	Hard Till	6.9	171.6	***279.3***				279	59	0	94	26
509.00	1.00		34	Hard Till	6.9	171.6	***286.2***				286	63	0	94	27
508.00	1.00		34	Hard Till	6.9	171.6	***293.1***				293	67	0	94	28
507.00	1.00		34	Hard Till	6.9	171.6	***300.1***				300	71	0	94	29
506.00	1.00		34	Hard Till	6.9	171.6	***179.9***				180	74	0	25	30
505.00	1.00	3.80	28		10.5	44.6	***190.4***				190	80	0	25	31
504.00	1.00	3.80	28		10.5	44.6	***200.9***				201	80	0	30	32
503.00	1.00	3.80	28		10.5	44.6	***211.3***				211	80	0	36	33
502.00	1.00	3.80	28		10.5	44.6	***221.8***				222	80	0	42	34
501.00	1.00	3.80	28		10.5	44.6	***349.2***				349	80	0	112	35
500.00	1.00		24	Clean Coarse Sand	8.9	161.5	***358.1***				358	80	0	117	36
499.00	1.00		24	Clean Coarse Sand	8.9	161.5	***367.0***				367	80	0	122	37
498.00	1.00		24	Clean Coarse Sand	8.9	161.5	***375.8***				376	80	0	127	38
497.00	1.00		24	Clean Coarse Sand	8.9	161.5	***384.7***				385	80	0	131	39
496.00	1.00		24	Clean Coarse Sand	8.9	161.5	***393.6***				394	80	0	136	40
495.00	1.00		24	Clean Coarse Sand	8.9	161.5	***402.5***				403	80	0	141	41
494.20	0.80		24	Clean Coarse Sand	7.1	161.5	***409.6***				410	80	0	145	42
493.20	1.00		24	Clean Coarse Sand	8.9	161.5	***418.5***				419	80	0	150	43
492.20	1.00		24	Clean Coarse Sand	8.9	161.5	***427.4***				427	80	0	155	44
491.20	1.00		24	Clean Coarse Sand	8.9	161.5	***456.5***				456	80	0	171	45
489.20	2.00		27	Clean Coarse Sand	20.7	181.7	***477.2***				477	80	0	182	47
486.70	2.50		27	Clean Coarse Sand	25.9	181.7	***530.0***				~~530~~	~~80~~	~~0~~	~~211~~	~~49~~
477.70	9.00		31	Clean Coarse Sand	114.2	208.6	***637.5***				~~637~~	~~80~~	~~0~~	~~270~~	~~58~~
388.70	89.00		30	Clean Coarse Sand	1073.7	201.9	***1717.9***				~~1718~~	~~80~~	~~0~~	~~865~~	~~147~~
288.70	100.00		31	Clean Coarse Sand		208.6									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== B-P2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 536.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 534.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 505.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1940 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 213.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 79.92 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**465** KIPS	**184** KIPS	**49** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
533.00	1.00		5	Medium Sand	1.7		***13.8***				14	1	0	7	3
531.00	2.00		7	Medium Sand	4.7	12.1	***27.2***				27	4	0	11	5
528.00	3.00		6	Medium Sand	6.1	20.8	***63.2***				63	7	0	28	8
526.00	2.00		11	Medium Sand	7.4	50.8	***70.7***				71	11	0	28	10
523.00	3.00		8	Medium Sand	8.1	50.8	***88.6***				89	15	0	33	13
521.00	2.00		9	Medium Sand	6.1	60.6	***195.6***				196	19	0	89	15
518.50	2.50		24	Clean Coarse Sand	22.2	161.5	***217.8***				218	31	0	89	18
516.00	2.50		24	Clean Coarse Sand	22.2	161.5	***172.7***				173	43	0	52	20
514.00	2.00		14	Clean Coarse Sand	10.3	94.2	***183.1***				183	49	0	52	22
512.00	2.00		14	Clean Coarse Sand	10.3	94.2	***193.4***				193	55	0	52	24
510.00	2.00		14	Clean Coarse Sand	10.3	94.2	***203.8***				204	60	0	52	26
508.00	2.00		14	Clean Coarse Sand	10.3	94.2	***214.1***				214	66	0	52	28
506.00	2.00		14	Clean Coarse Sand	10.3	94.2	***251.3***				251	72	0	67	30
503.50	2.50		24	Hard Till	12.1	121.1	***263.5***				263	72	0	73	33
501.00	2.50		24	Hard Till	12.1	121.1	***270.5***				271	72	0	77	35
500.00	1.00		23	Hard Till	4.6	116.1	***275.2***				275	72	0	80	36
499.00	1.00		23	Hard Till	4.6	116.1	***279.8***				280	72	0	82	37
498.00	1.00		23	Hard Till	4.6	116.1	***284.5***				284	72	0	85	38
497.00	1.00		23	Hard Till	4.6	116.1	***289.1***				289	72	0	87	39
496.90	0.10		23	Hard Till	0.5	116.1	***395.5***				396	72	0	146	39
495.40	1.50		33	Clean Coarse Sand	21.0	222.1	***416.6***				417	72	0	157	41
491.90	3.50		33	Clean Coarse Sand	49.1	222.1	***425.2***				425	72	0	162	44
487.40	4.50		27	Clean Coarse Sand	46.6	181.7	***465.1***				465	72	0	184	49
482.40	5.00		26	Clean Coarse Sand	49.2	175.0	***574.9***				~~575~~	~~72~~	~~0~~	~~245~~	~~54~~
477.40	5.00		35	Clean Coarse Sand	77.3	235.5	***632.0***				~~632~~	~~72~~	~~0~~	~~276~~	~~59~~
472.40	5.00		32	Clean Coarse Sand	66.7	215.3	***698.6***				~~699~~	~~72~~	~~0~~	~~313~~	~~64~~
467.40	5.00		32	Clean Coarse Sand	66.7	215.3	***778.8***				~~779~~	~~72~~	~~0~~	~~357~~	~~69~~
462.40	5.00		34	Clean Coarse Sand	73.6	228.8	***859.1***				~~859~~	~~72~~	~~0~~	~~401~~	~~74~~
457.40	5.00		35	Clean Coarse Sand	77.3	235.5	***916.2***				~~916~~	~~72~~	~~0~~	~~432~~	~~79~~
452.40	5.00		32	Clean Coarse Sand	66.7	215.3	***942.5***				~~942~~	~~72~~	~~0~~	~~447~~	~~84~~
447.40	5.00		26	Clean Coarse Sand	49.2	175.0	***1038.8***				~~1039~~	~~72~~	~~0~~	~~500~~	~~89~~
444.90	2.50		33	Clean Coarse Sand	35.0	222.1	***1073.8***				~~1074~~	~~72~~	~~0~~	~~519~~	~~91~~
442.40	2.50		33	Clean Coarse Sand	35.0	222.1	***1149.3***				~~1149~~	~~72~~	~~0~~	~~560~~	~~94~~
437.40	5.00		39	Clean Coarse Sand	93.2	262.4	***1269.4***				~~1269~~	~~72~~	~~0~~	~~627~~	~~99~~
429.40	8.00		43	Clean Coarse Sand	178.2	289.4	***1434.1***				~~1434~~	~~72~~	~~0~~	~~717~~	~~107~~
329.40	100.00		41	Clean Coarse Sand		275.9									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier 3
REFERENCE BORING ========== B-P3
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 547.20 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 546.20 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 541.20 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1940 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 213.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 79.92 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**467** KIPS	**254** 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 SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
542.50	3.70		5	Very Fine Silty Sand	5.3		***8.6***				9	3	0	2	5
540.50	2.00		1	Very Fine Silty Sand	0.6	3.3	***26.0***				26	3	0	11	7
537.50	3.00		4	Fine Sand	3.8	20.1	***40.6***				41	3	0	19	10
535.50	2.00		5	Medium Sand	3.4	30.9	***40.0***				40	3	0	19	12
532.50	3.00		4	Medium Sand	4.0	26.9	***57.5***				58	3	0	29	15
530.50	2.00		6	Medium Sand	4.0	40.4	***54.8***				55	3	0	27	17
527.50	3.00		5	Medium Sand	5.1	33.6	***80.1***				80	3	0	41	20
525.50	2.00		8	Medium Sand	5.4	53.8	***92.2***				92	3	0	48	22
522.50	3.00		9	Medium Sand	9.1	60.6	***108.1***				108	3	0	56	25
520.50	2.00		10	Clean Coarse Sand	7.4	67.3	***128.9***				129	3	0	68	27
518.00	2.50		12	Clean Coarse Sand	11.1	80.8	***140.0***				140	3	0	74	29
515.50	2.50		12	Clean Coarse Sand	11.1	80.8	***157.8***				158	3	0	84	32
513.00	2.50		13	Clean Coarse Sand	12.0	87.5	***169.8***				170	3	0	90	34
510.50	2.50		13	Clean Coarse Sand	12.0	87.5	***188.5***				189	3	0	101	37
509.50	1.00		14	Clean Coarse Sand	5.2	94.2	***193.7***				194	3	0	104	38
508.50	1.00		14	Clean Coarse Sand	5.2	94.2	***198.8***				199	3	0	106	39
507.50	1.00		14	Clean Coarse Sand	5.2	94.2	***204.0***				204	3	0	109	40
506.50	1.00		14	Clean Coarse Sand	5.2	94.2	***209.2***				209	3	0	112	41
505.50	1.00		14	Clean Coarse Sand	5.2	94.2	***254.7***				255	3	0	137	42
503.00	2.50		20	Clean Coarse Sand	18.5	134.6	***273.2***				273	3	0	147	44
500.50	2.50		20	Clean Coarse Sand	18.5	134.6	***291.6***				292	3	0	157	47
499.50	1.00		20	Clean Coarse Sand	7.4	134.6	***299.0***				299	3	0	162	48
498.50	1.00		20	Clean Coarse Sand	7.4	134.6	***306.4***				306	3	0	166	49
497.50	1.00		20	Clean Coarse Sand	7.4	134.6	***313.8***				314	3	0	170	50
496.50	1.00		20	Clean Coarse Sand	7.4	134.6	***321.2***				321	3	0	174	51
495.50	1.00		20	Clean Coarse Sand	7.4	134.6	***395.8***				396	3	0	215	52
494.50	1.00		30	Clean Coarse Sand	12.1	201.9	***407.9***				408	3	0	221	53
493.50	1.00		30	Clean Coarse Sand	12.1	201.9	***420.0***				420	3	0	228	54
490.50	3.00		30	Clean Coarse Sand	36.2	201.9	***449.4***				449	3	0	244	57
489.00	1.50		29	Clean Coarse Sand	17.2	195.2	***466.6***				467	3	0	254	58
469.00	20.00		29	Clean Coarse Sand	229.4	195.2	***756.6***				~~757~~	~~3~~	~~0~~	~~413~~	~~78~~
412.00	57.00		38	Clean Coarse Sand	1015.0	255.7	***1731.2***				~~1731~~	~~3~~	~~0~~	~~949~~	~~135~~
312.00	100.00		32	Clean Coarse Sand		215.3									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

SUBSTRUCTURE========== Pier 4
REFERENCE BORING ========== B-P4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 546.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 545.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 540.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1960 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)=== 36.41 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 215.33 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 80.75 KIPS

PILE TYPE AND SIZE ========== Metal Shell 14"Φ w/.312" walls
Pile Perimeter========== 3.665 FT.
Pile End Bearing Area========== 1.069 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
513 KIPS	**500** KIPS	**273** 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 SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
543.80	1.70		4	Fine Sand	2.2		***4.3***				4	1	0	1	3
541.80	2.00		1	Fine Sand	0.6	2.1	***6.7***				7	2	0	2	5
538.80	3.00		1	Fine Sand	1.0	3.9	***18.8***				19	2	0	9	8
536.80	2.00		3	Fine Sand	1.9	15.1	***46.0***				46	2	0	24	10
533.80	3.00		6	Medium Sand	6.1	40.4	***58.8***				59	2	0	31	13
531.80	2.00		7	Medium Sand	4.7	47.1	***63.6***				64	2	0	33	15
528.80	3.00		7	Medium Sand	7.1	47.1	***84.1***				84	2	0	45	18
526.80	2.00		9	Medium Sand	6.1	60.6	***96.9***				97	2	0	52	20
525.30	1.50		10	Clean Coarse Sand	5.5	67.3	***102.4***				102	2	0	55	21
523.80	1.50		10	Clean Coarse Sand	5.5	67.3	***114.7***				115	2	0	62	23
522.80	1.00		11	Clean Coarse Sand	4.1	74.0	***118.8***				119	2	0	64	24
521.80	1.00		11	Clean Coarse Sand	4.1	74.0	***203.6***				204	2	0	110	25
519.30	2.50		23	Clean Coarse Sand	21.2	154.8	***224.8***				225	2	0	122	27
516.80	2.50		23	Clean Coarse Sand	21.2	154.8	***225.8***				226	2	0	123	30
514.30	2.50		20	Clean Coarse Sand	18.5	134.6	***244.3***				244	2	0	133	32
511.80	2.50		20	Clean Coarse Sand	18.5	134.6	***262.8***				263	2	0	143	35
510.80	1.00		20	Clean Coarse Sand	7.4	134.6	***270.1***				270	2	0	147	36
509.80	1.00		20	Clean Coarse Sand	7.4	134.6	***277.5***				278	2	0	151	37
508.80	1.00		20	Clean Coarse Sand	7.4	134.6	***284.9***				285	2	0	155	38
507.80	1.00		20	Clean Coarse Sand	7.4	134.6	***292.3***				292	2	0	159	39
506.80	1.00		20	Clean Coarse Sand	7.4	134.6	***313.1***				313	2	0	171	40
505.80	1.00		22	Clean Coarse Sand	8.1	148.0	***321.3***				321	2	0	175	41
504.80	1.00		22	Clean Coarse Sand	8.1	148.0	***329.4***				329	2	0	180	42
503.80	1.00		22	Clean Coarse Sand	8.1	148.0	***337.5***				337	2	0	184	43
502.80	1.00		22	Clean Coarse Sand	8.1	148.0	***345.6***				346	2	0	189	44
501.80	1.00		22	Clean Coarse Sand	8.1	148.0	***360.5***				360	2	0	197	45
500.80	1.00		23	Clean Coarse Sand	8.5	154.8	***369.0***				369	2	0	201	46
499.80	1.00		23	Clean Coarse Sand	8.5	154.8	***377.5***				377	2	0	206	47
498.80	1.00		23	Clean Coarse Sand	8.5	154.8	***385.9***				386	2	0	211	48
497.80	1.00		23	Clean Coarse Sand	8.5	154.8	***394.4***				394	2	0	215	49
496.80	1.00		23	Clean Coarse Sand	8.5	154.8	***456.8***				457	2	0	250	50
495.80	1.00		31	Clean Coarse Sand	12.7	208.6	***469.4***				469	2	0	257	51
494.80	1.00		31	Clean Coarse Sand	12.7	208.6	***482.1***				482	2	0	264	52
491.80	3.00		31	Clean Coarse Sand	38.1	208.6	***500.0***				500	2	0	273	55
486.80	5.00		28	Clean Coarse Sand	54.5	188.4	***561.2***				~~561~~	~~2~~	~~0~~	~~307~~	~~60~~
474.80	12.00		29	Clean Coarse Sand	137.6	195.2	***745.9***				~~746~~	~~2~~	~~0~~	~~409~~	~~72~~
411.80	63.00		36	Clean Coarse Sand	1021.2	242.3	***1740.2***				~~1740~~	~~2~~	~~0~~	~~956~~	~~135~~
311.80	100.00		32	Clean Coarse Sand		215.3									

Appendix H

L-pile Input for Boring B-WA
Station 151+38.00
Offset 21.0 Ft Right
Water Table Elevation 538.0 Ft

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
					γ_{wet}	γ_{sat}
3.0	551.0 to 548.0	Fine Sand with Clay	31.0		102.50	
4.0	548.0 to 547.0	Silty Clay		0.55	121.00	
9.0	547.0 to 542.0	Silty Clay		0.10		125.28
13.0	542.0 to 538.0	Silty Clay		0.35		123.80
20.0	538.0 to 531.0	Medium Sand	29.0			120.50
32.5	531.0 to 518.5	Medium to Coarse Sand with Trace Gravel	29.0			123.50
42.0	518.5 to 509.0	Medium to Coarse Sand with Trace Gravel	35.0			127.20
56.0	509.0 to 495.0	Clay Loam		1.75	109.40	
80.0	495.0 to 471.0	Medium to Coarse Sand with Trace Gravel	34.0			124.60

L-pile Input for Boring B-P1
Station 152+44.00
Offset 21.0 Ft Right
Water Table Elevation 538.0 Ft

Depth (Ft)	Elevation (Ft)			Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
							γ_{wet}	γ_{sat}
5.0	551.0	to	546.0	Loam		0.40	95.50	
8.0	546.0	to	543.0	Clay		0.10		115.60
15.0	543.0	to	536.0	Silty Clay		0.18		115.60
20.0	536.0	to	531.0	Medium Sand	28.0			124.60
28.5	531.0	to	522.5	Medium to Coarse Sand with Trace Gravel	29.0			121.70
42.0	522.5	to	509.0	Medium to Coarse Sand with Trace Gravel	32.0			126.50
51.0	509.0	to	500.0	Clay Loam		2.00	142.88	
65.0	500.0	to	486.0	Medium to Coarse Sand with Trace Gravel	34.0			124.80
80.0	486.0	to	471.0	Medium to Coarse Sand with Trace Gravel	35.0			125.90

L-pile Input for Boring B-P2
Station 153+74.00
Offset 21.0 Ft Left
Water Table Elevation 538.0 Ft

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
					γ_{wet}	γ_{sat}
3.5	551.0 to 547.5	Fine Sand with Silt	28.0		110.10	
7.0	547.5 to 544.0	Silty Clay		0.30	122.90	
11.5	544.0 to 539.5	Silty Clay		0.13		129.60
15.0	539.5 to 536.0	Fine to Medium Sand with Sild	27.0			128.30
32.5	536.0 to 518.5	Medium to Coarse Sand with Trace Gravel	29.0			123.00
47.0	518.5 to 504.0	Medium to Coarse Sand with Trace Gravel	33.0			126.10
57.0	504.0 to 494.0	Clay Loam		1.60	110.90	
63.5	494.0 to 487.5	Medium to Coarse Sand with Trace Gravel	35.0			125.20
73.5	487.5 to 477.5	Medium to Coarse Sand with Trace Gravel	34.0			127.20
126.0	477.5 to 425.0	Medium to Coarse Sand with Trace Gravel	37.0			126.70

L-pile Input for Boring B-P3
Station 155+04.00
Offset 21.0 Ft Left
Water Table Elevation 541.5 Ft

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
					γ_{wet}	γ_{sat}
3.0	550.5 to 547.5	Loam		0.50	117.6	
11.5	547.5 to 539.0	Fine to Medium Sand with Silt	27.0			117.50
13.5	539.0 to 537.0	Fine to Medium Sand	28.0			121.40
28.5	537.0 to 522.0	Medium to Coarse Sand with Trace Gravel	29.0			123.20
58.5	522.0 to 492.0	Medium to Coarse Sand with Trace Gravel	32.0			126.90
65.0	492.0 to 485.5	Medium to Coarse Sand with Trace Gravel	35.0			126.30
80.0	485.5 to 470.5	Medium to Coarse Sand with Trace Gravel	35.0			126.50

L-pile Input for Boring B-P4
Station 156+34.00
Offset 21.0 Ft Left
Water Table Elevation 541.0 Ft

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
					γ_{wet}	γ_{sat}
3.0	550.0 to 547.0	Loam		1.10	114.13	
6.5	547.0 to 543.5	Silty Clay		0.30	120.78	
11.0	543.5 to 539.0	Sandy Loam	27.0			123.00
16.5	539.0 to 533.5	Fine to Medium Sand	27.0			121.70
26.5	533.5 to 523.5	Medium to Coarse Sand with Trace Gravel	29.0			123.00
80.0	523.5 to 470.0	Medium to Coarse Sand with Trace Gravel	34.0			125.50

L-pile Input for Boring B-EA
Station 157+41.00
Offset 21.0 Ft Left
Water Table Elevation 544.5 Ft

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)	
					γ_{wet}	γ_{sat}
2.0	558.5 to 556.5	Loam		0.45	135.70	
6.5	556.5 to 552.0	Loam		1.00	136.88	
8.0	552.0 to 550.5	Silty Clay		0.25	120.96	
16.5	550.5 to 542.0	Sandy Clay Loam	28.0		117.30	
21.0	542.0 to 537.5	Fine to Medium Sand	28.0			121.70
28.5	537.5 to 530.0	Medium to Coarse Sand with Trace Gravel	29.0			122.40
65.0	530.0 to 493.5	Medium to Coarse Sand with Trace Gravel	32.0			124.70
80.0	493.5 to 478.5	Medium to Coarse Sand with Trace Gravel	35.0			126.30

Appendix I

TERRA ENGINEERING LTD.

Estimated Settlement
Using Soil Properties from Boring Log

Proposed SN: 066-0021
Calced By: LNJ Date: 8/4/14
Checked By: ____ Date: _____

Estimated settlement as per Geotechnical Manual Section 3.1.1 (1999 version)

Eq. 3-1: $C_c = 0.009 (W_n - 10)$

Where:

C_c = Compression Index (dim.)

W_n = Natural Moisture Content (%)

Eq. 3-2: $S = [(C_c*H)/(1+e_o)]*Log[(P'_o+\Delta P')/P'_o]$

Where:

S = Settlement (ft)

H = Thickness of Compressible Layer (ft)

$e_o = (W_n*2.65)/100$ = Initial Void Ratio (dim.)

P'_o = Effective Overburden Pressure to Center of Layer of Existing Conditions (psf)

P' = Effective Overburden Pressure to Center of Layer of Proposed Conditions (psf)

$\Delta P' = P' - P'_o$ = Increase in Stress from Embankment or Foundation Loads at Center of Layer (psf)

Assumptions:

1. Soil is saturated.
2. Soil is normally consolidated.
3. Soil is an insensitive clay.

Adjustments for Equation 3-2:

Qu (tsf) Range		Adjustment Factor (i)	
Lower	Upper	Lower	Upper
0	0.25	1.00	0.625
0.25	0.50	0.625	0.25
0.50	1.00	0.25	0.20
1.00	1.50	0.20	0.15
1.50	2.00	0.15	0.10

Soil Profile:

Boring Log: B-WA Bottom of Substructure Elevation: 561.22 ft

Column #	A	B	C	D	E	F	G	I
Layer #	Bot. Elev.	H	N	Qu	W_n	Description	C_c	e_o
	(ft)	(ft)	(blows/12")	(tsf)	(%)		dim.	dim.
1	551.00	10.22			10.00	New Fill	0	0.265
2	548.00	3.00	12	0.00	8.00	Sand w/Clay	0	0.212
3	545.50	2.50	6	1.10	26.00	Silty Clay	0.144	0.689
4	543.00	2.50	5	0.20	29.00	Silty Clay	0.171	0.7685
5	540.50	2.50	3	0.20	32.00	Silty Clay	0.198	0.848
6	538.00	2.50	4	0.70	29.00	Silty Clay	0.171	0.7685
7	536.00	2.00	5	0.00	18.00	Med. Sand	0.072	0.477
8	533.50	2.50	6	0.00	16.00	Med. Sand	0.054	0.424
9	531.00	2.50	7	0.00	60.00	Med. Sand	0.45	1.59

Column #	A	B	J	K	L	M	N	P
Layer #	Bot. Elev.	H	Layer Center	γ	$P'_{o\ Layer\ Center}$	P'_o	P'	$\Delta P'$
	(ft)	(ft)	(ft)	(pcf)	(psf)	(psf)	(psf)	(psf)
1	551.00	10.22	5.11	120	613.20	0.00	613.20	613.20
2	548.00	3.00	1.50	120	360.00	180.00	1406.40	1226.40
3	545.50	2.50	1.25	120	300.00	510.00	1736.40	1226.40
4	543.00	2.50	1.25	120	300.00	810.00	2036.40	1226.40
5	540.50	2.50	1.25	120	300.00	1110.00	2336.40	1226.40
6	538.00	2.50	1.25	120	300.00	1410.00	2636.40	1226.40
7	536.00	2.00	1.00	120	240.00	1680.00	2906.40	1226.40
8	533.50	2.50	1.25	120	300.00	1950.00	3176.40	1226.40
9	531.00	2.50	1.25	120	300.00	2250.00	3476.40	1226.40

Column #	A	B	Q	R	T	D	U	V	W
Layer #	Bot. Elev.	H	S	S	ΣS	Qu	i	S_{Adj}	ΣS_{Adj}
	(ft)	(ft)	(ft)	(in)	(in)	(tsf)	dim.	(in)	(in)
1	551.00	10.22	0.00	0.00	0.00				0.00
2	548.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
3	545.50	2.50	0.11	1.36	1.36	1.10	0.19	0.26	0.26
4	543.00	2.50	0.10	1.16	2.52	0.20	0.70	0.81	1.07
5	540.50	2.50	0.09	1.04	3.56	0.20	0.70	0.73	1.80
6	538.00	2.50	0.07	0.79	4.35	0.70	0.23	0.18	1.98
7	536.00	2.00	0.00	0.00	4.35	0.00	1.00	0.00	1.98
8	533.50	2.50	0.00	0.00	4.35	0.00	1.00	0.00	1.98
9	531.00	2.50	0.00	0.00	4.35	0.00	1.00	0.00	1.98

Unadjusted Settlement = 4.35 inches Adj. Settlement = **1.98** inches

Note: Granular layers (ie Qu = 0 tsf) are assumed to settle during construction, therefore settlement is zero

Settlement Equations by Column #

Column A: Bottom of Substructure Elevation - H
or
Bottom of Previous Layer Elevation - H
[Column A - Column B]

Column B: Raw Input Data

Column C: Raw Input Data

Column D: Raw Input Data

Column E: Raw Input Data

Column F: Raw Input Data

Column G: $C_c = 0.009 (W_n - 10)$
0.009 (Column E - 10)

Column H: Not Used

Column I: $e_o = (W_n*2.65)/100$
(Column E *2.65)/100

Column J: H/2
Column B/2

Column K: Soil Unit Weight assumed to be 120 pcf unless overridden

Column L: Pressure to Center of Each Individual Soil Layer
Soil Unit Weight * Depth to Center of Layer
Column K * Column J

Column M: Cumulative Overburden Pressure to Center of Layer under Existing Conditions

Column N: Cumulative Overburden Pressure to Center of Layer under Proposed Conditions

Column O: Not Used

Column P: Cumulative Proposed Overburden Pressure - Cumulative Existing Overburden Pressure
Column N - Column M

Column Q: $S = [(C_c*H)/(1+e_o)]*Log[(P'_o+\Delta P')/P'_o]$
[(Column G*Column B)/(1+Column I)]*Log[(Column M + Column P)/Column M]

Column R: Conversion of Settlement from feet to inches
Column Q * 12

Column S: Not Used

Column T: Cumulative Settlement

Column U: Adjustment Factor based on Qu of Layer and Value in Chart called "Adjustments for Equation 3-2"
Interpolation is used to calculate the adjustment factor when Qu value is in between the upper and lower bounds of the range.

Column V: Settlement in inches * Adjustment Factor
Column R*Column U

Column W: Cumulative Adjusted Settlement

Appendix J

Existing Structure (SN 066-0006):
The plans dated 1927 show that the original truss structure was erected with 7 cast-in-place approach spans on S.B.I. Route 83 in Sections 123 B & C. The plans dated 1971 show the superstructure was replaced with 9 spans of PPC deck beams on a widened substructure and one additional pier. The plans from 1994 show the removal of the asphalt overlay and installation of a 5½ inch concrete overlay with epoxy coated reinforcement.

Traffic Control:
Staged Construction will be utilized by maintaining one lane of traffic during construction.

No Salvage

Bench Mark: RM 6
Chiseled square on top of the northeast corner of the concrete gage structure.
Elev. 563.386

Bench Mark: RM 8
Lag bolt in telephone pole 30 ft. upstream and 100 ft. landward of gage.
Elev. 555.378

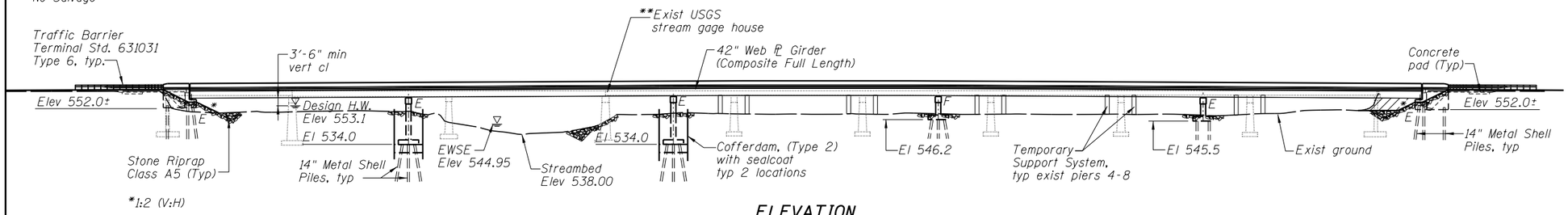
LOADING HL-93
Allow 50#/sq. ft. for future wearing surface.

DESIGN SPECIFICATIONS
2014 AASHTO LRFD Bridge Design Specifications
7th Edition

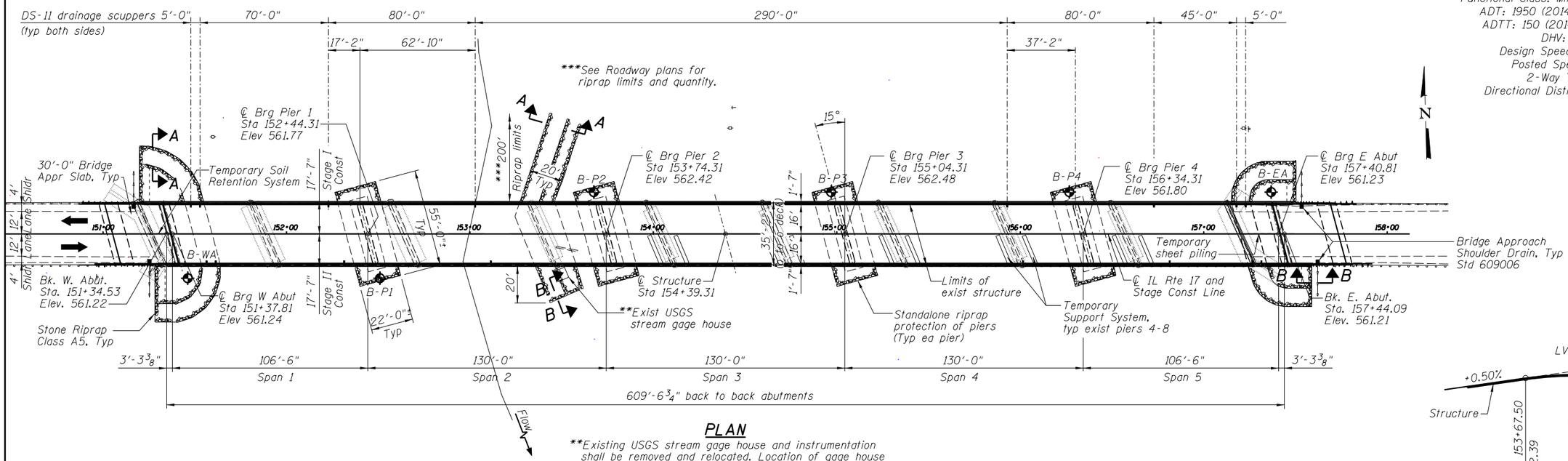
DESIGN STRESSES
FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50W)

SEISMIC DATA
Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.089g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.125g
Soil Site Class = D

HIGHWAY CLASSIFICATION
Il Rte. 17 (FAP 639)
Functional Class: Minor Arterial (Rural)
ADT: 1950 (2014); 3699 (2035)
ADTT: 150 (2014); 407 (2035)
DHV: 195
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
2-Way Traffic
Directional Distribution: 50:50



ELEVATION



PLAN
**Existing USGS stream gage house and instrumentation shall be removed and relocated. Location of gage house pad to be determined by USGS and the Engineer.

WATERWAY INFORMATION

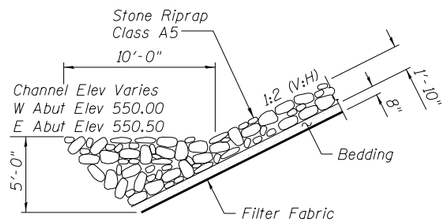
Drainage Area = 445 sq mi Low Grade Elev. 558.00 @ Sta. 167+92

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	8,230	1,895	2,017	552.2	2.1	1.5	554.3	553.7
Design	50	11,700	2,405	2,534	553.1	2.8	1.9	555.9	555.0
Base	100	13,200	2,576	2,706	553.4	3.0	2.1	556.4	555.5
Max. Calc.	500	16,700	2,975	3,112	554.1	3.6	2.4	557.7	556.5

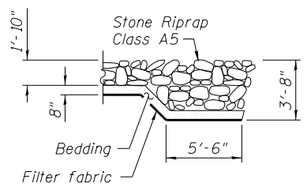
10 Year Velocity through Existing Structure = 4.3 ft/s
10 Year Velocity through Proposed Structure = 4.1 ft/s

DESIGN SCOUR ELEVATION TABLE

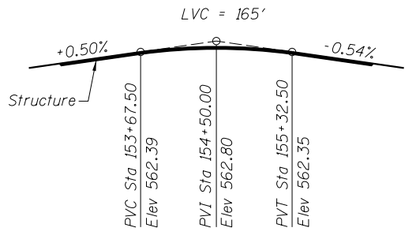
Design Scour Elev (ft.)	W Abut	Pier 1	Pier 2	Pier 3	Pier 4	E Abut
Q100	552.0	505.0	505.0	541.2	540.5	552.0
Q500	552.0	500.0	500.0	539.2	538.5	552.0



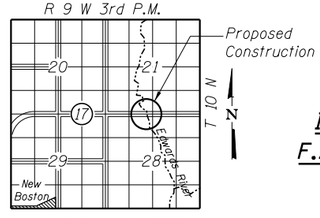
SECTION A-A



SECTION B-B



PROFILE GRADE
(Along ℄ Rdwy.)



LOCATION SKETCH

GENERAL PLAN
IL. RT. 17 OVER EDWARDS RIVER
F.A.P. RT. 639 SECTION (123B)BR-1
MERCER COUNTY
STATION 154+39.31
STRUCTURE NO. 066-0021

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CHASTAIN & ASSOCIATES LLC
CONSULTING ENGINEERS
184-001397

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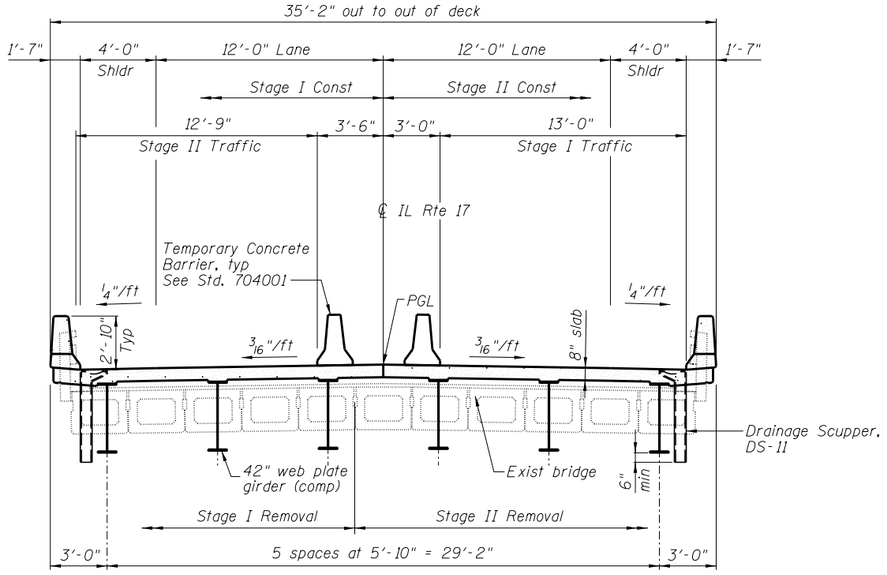
PLOT DATE = 12/15/2014	CHECKED - JMB	REVISED -	

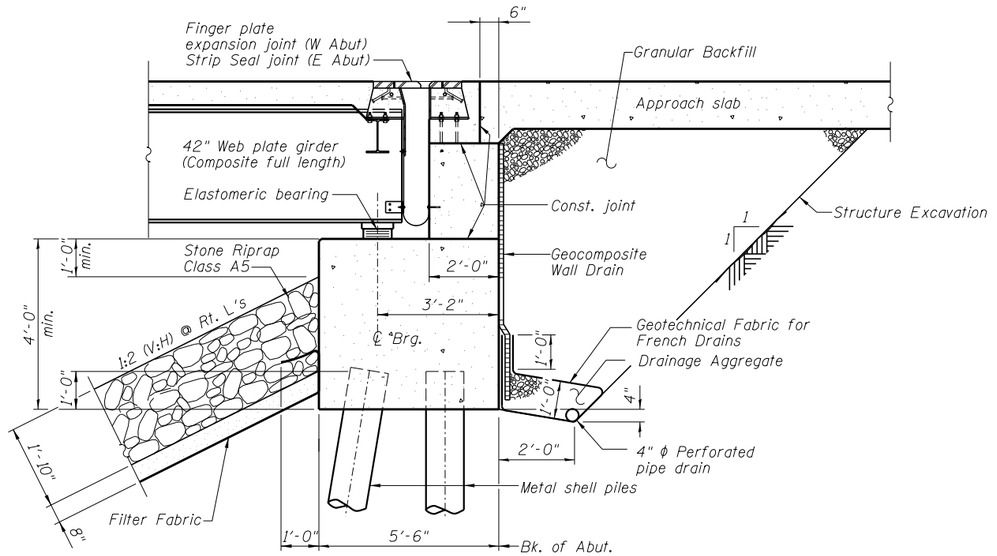
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
SHEET NO. OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
639	(123B)BR-1	MERCER		
		CONTRACT NO. 68663		
	ILLINOIS FED. AID PROJECT			



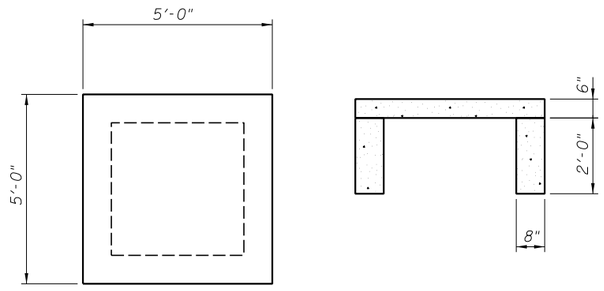
CROSS SECTION THRU DECK



SECTION THRU PILE SUPPORTED STUB ABUTMENT

(Horiz. dim. @ Rt. L's)

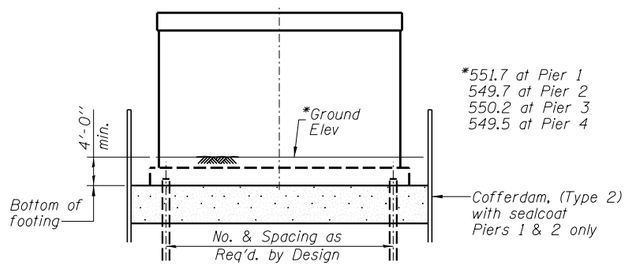
Note:
All drainage system components shall extend parallel to the abutment back wall until they intersect the wingwalls or 2'-0" from the end of the wingwalls when the wings are parallel to the abutment. The pipe shall extend under the wingwall, if necessary, until intersecting the side slopes. The pipes shall drain into concrete headwalls. (See Article 601.05 of the Standard Specifications and Highway Standard 601101).



PLAN SECTION

GAGE HOUSE PAD DETAIL

Existing USGS stream gage house and instrumentation shall be removed and relocated. Location of gage house pad to be determined by USGS and the Engineer.



PIER SKETCH

DETAILS
IL. RT. 17 OVER EDWARDS RIVER
F.A.P. RT. 639 SECTION (123B)BR-1
MERCER COUNTY
STATION 154+76.19
STRUCTURE NO. 066-0021

FILE NAME = I:\IDOT\5375.ILRte17\C400.Structural\ts812.dgn

CHASTAIN & ASSOCIATES LLC
CONSULTING ENGINEERS
184-001397

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

DETAILS

SHEET NO. OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
639	(123B)BR-1	MERCER		
		CONTRACT NO. 68663		
	ILLINOIS FED. AID PROJECT			