Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date:	4-24-18	**Proposed SN:**	053-0192	**Route:**	FAP 673 (IL 116)
Revised Date:	8-31-18	**Existing SN:**	053-0065	**Section:**	112-BR-2
Geotechnical Engineer:	Jacob A. Schaeffer, MPS			**County:**	Livingston
Structural Engineer:	Nathan Rick, GRAEF			**Contract:**	66E68

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed structure will be a 2-lane, 3-span girder bridge on open abutments, with an approximate length of 190.3 feet. The proposed structure width will be approximately 36 feet wide. The current Type, Size, and Location (TSL) drawing indicates that the abutments are proposed to be supported on driven piles and the interior piers will be supported on drilled shafts. Load information provided by GRAEF indicates factored loads of 891 kips at the abutments and 1,631 kips at the piers. Based on the preliminary information provided, it is our understanding that staged construction will be utilized for construction of the new bridge.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot): Three borings were drilled as part of a previous study that took place in October of 1966. It is unknown at this time the type of drill rig used to drill these borings.

Two additional borings were drilled on January 24 and 25, 2018. The borings were drilled using a CME-75 drill rig. The borings were advanced using hollow-stem auger drilling methods. Samples were obtained at 2.5-foot intervals in the 2018 borings until shale bedrock was encountered. The borings were then sampled using modified standard penetration tests (MSPT). Split-spoon samples were recovered using a 2-inch outside-diameter sampler, driven by a CME autohammer. This hammer has an energy efficiency rating of 93%.

Unconfined compression tests were performed on selected split-spoon samples using a Rimac field testing machine in the 1966 borings and pocket penetrometer readings were used on the 2018 borings. The resulting estimated unconfined compressive strengths are reported on the boring logs.

Approximately 9 to 13.5 feet of fill material was encountered at all of the boring locations, with the exception of Boring B-1 (1966). The fill generally consists of silty clay, silty clay loam, fine sand, and sandstone. Secondary materials consisting of construction debris was observed in Boring B-2 (2018). Moisture contents vary from 8 to 27%. The standard penetration test (N) values range from 5 to 18 blows per foot (bpf). Rimac unconfined compression test values on samples range from 0.2 to 2.0 tons per square foot (tsf). Pocket penetrometer values taken in the fill ranged from 2.0 to 4.0 tsf.

Natural soils consisting of silty clay loam, sandy loam, sandy clay loam, silty loam, silty clay, silt, and clay were observed beneath the fill and above the shale bedrock. Secondary materials consisting of gravel were observed within the strata. Moisture contents vary from 15 to 27%. The standard penetration test (N) values range 4 to 26 blows per foot (bpf). Rimac unconfined compression test values on samples range from 0.2 to 3.7 tons per square foot (tsf), with outlier values of 4.7 tsf. Pocket penetrometer values taken in the natural soil ranged from 1.5 to 4.0 tsf.

Shale or siltstone bedrock was encountered at all of the boring locations from depths ranging from 7.5 feet (Elev. 626.5) to 18.0 feet (Elev. 630.4) below the ground surface. A thin layer of shale-like clay was observed above the shale bedrock at boring B-3 (1966). N-values in the shale range from 153 blows for 6 inches of penetration to 100 blows for 1 inch of penetration. As previously mentioned, MSPT tests were performed on the shale samples at the borings drilled in 2018. The results of the tests are attached to this report.

Groundwater was encountered at all of the boring locations, with the exceptions of Borings B-3 (1966) and B-01 (2018) from Elev. 631.0 to 635 ft.

A review of undermining was made using the Illinois State Geological Survey (ISGS) website for mapped coal mines in Livingston County, Illinois. Based on this information, the project site is unlikely to be undermined.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary:
The roadway profile will be raised slightly, with no more than 2 feet of fill anticipated near the abutments. No significant increase in embankment loading should result from the replacement of the bridges, other than beneath the side slopes where minimal amounts of new fill will be placed to widen the embankments near the abutments. In our opinion, this should not result in a significant additional load or issues related to settlement. Downdrag on pile foundations is not a concern based on the anticipated depths of fill placement.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary: The existing slope walls will be removed and the end slopes will be graded back to a 2-horizontal to 1-vertical (2H:1V) slope inclination. Roadway side slopes will range from approximately 6H:1V to 3H:1V inclinations.
A slope stability analysis was performed for the new abutment slopes of the bridges utilizing the STABL, a computer program developed for the Federal Highway Administration. In accordance with the IDOT Geotechnical Manual, Section 6.10.3, the minimum factor of safety (FOS) required is 1.5 for end-of-construction of fill slopes. Based on the preliminary plans, it is our understanding that fills along the side slopes will not exceed approximately 3 feet, and cuts along the side slopes will be a maximum of 5 feet. Based on that information, it is our opinion that slope stability along the side slopes is not a concern and an analyses of the side slopes was not performed. Analyses of these conditions indicate the slopes as designed are presented below. The output sheets for these analyses are attached to this report.

CALCULATED CRITICAL FACTOR OF SAFETY

Location	Calculated Factor of Safety End-of-Construction
West Abutment	1.71
East Abutment	1.82

The seismic condition was not evaluated for the abutment slopes since the site is located within Seismic performance zone 1 and the effects of seismicity should have little impact on the stabiility of the slopes.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations: Due to the of shale observed near the streambed elevation (Elev. 628.75, determined from TSL drawing provided by GRAEF) at the borings in relation to the proposed center pier locations, the scour should be assumed to be taken as 100 percent (%) of the scour predicted in the Hydraulic Report (0% reduction in scour depth) within the overburden and 10 percent (%) of the scour predicted in the Hydraulic Report (90% reduction in scour depth within the shale. Abutment slope protection should be included to protect against scour potential. Countermeasure options for scour at bridge locations include webwalls to eliminate debris collection between columns, riprap, partially grouted riprap, geotextile sand containers, and sheet piling. We recommend that at a minimum, riprap be placed to provide some protection for the pier locations. Skin friction and lateral load design values for piers and driven piles should be ignored in the scour zone. Based on information provided by IDOT, the design scour elevations for the 100-year, and 200-year events for the bridges are shown in the table below.

SUMMARY OF DESIGN SCOUR ELEVATIONS

Event/Limit State	Design Scour Elevations (ft.)				Item
	W. Abut.	Pier 1	Pier 2	E. Abut.	113
Q100	643.00	625.92	625.92	643.00	8
Q200	643.00	625.28	625.28	643.00	
Design	643.00	625.92	625.92	643.00	
Check	643.00	625.28	625.28	643.00	

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable: Although several significant areas of seismic activity are present in the central United States, the site area is most directly affected by the Wabash Seismic Zone, located in south and east-central Illinois. An assessment of seismic criteria in accord with AASHTO 2009 Guide Specifications for LRFD Seismic Bridge Design has been performed for the site. The IDOT Spreadsheet “Seismic Site Class Determination” was used to determine a Soil Site Class C for the abutments and intermediate piers. The United States Geological Survey (USGS) Design Maps Summary Report website was used with the Site Class C classification to provide acceleration coefficient values Sds of 0.133 g and Sd1 of 0.078 g. The results of the Site

Class determination and the Design Maps Summary Report are attached to this abbreviated SGR. Based on the information provided in the boring logs, the soils on site are not considered to be potentially liquefiable.

Based on the guidelines in the IDOT All Geotechnical Manual Users (AGMU), including Table 3.15.2-1 in that manual, the Seismic Performance Zone is 1.

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed: Several potential foundation options were considered for the support of the new bridge structure, including steel H-piles, metal shell piles, drilled shafts, and shallow foundations. Metal shell piles are not recommended because of the proximity of bedrock and risks of pile damage. Based on the current TSL drawing, it is our understanding that steel H-piles are being considered to support the abutments and drilled shafts are being considered to support the interior piers. These options both appear to be suitable. In addition, shallow foundations may be considered as an alternative option for supporting the interior piers due to the elevation of shale bedrock being relatively shallow.

DRIVEN PILES
The bridge structure may be supported on driven pile foundations. Pile capacities and driving depths have been assessed using the IDOT pile design spreadsheet "Pile Capacity and Length Estimates," version 10/18/2011. Copies of a typical input spreadsheet giving the input parameters for each substructure, and the corresponding summary sheets for the various pile types that are analyzed by the spreadsheet, are attached to this report. These tables give the pile embedment length to develop various capacities, up to that approaching the factored design capacity of the pile. The tables were prepared for pile lengths corresponding to selected depths of the input stratigraphy. The piles exhibited in the tables are the piles that are readily available in accordance with the IDOT Geotechnical Manual. It should be noted that H-Piles driven into shale may run shorter than the IDOT pile design length spreadsheets estimate. Information regarding the elevation of ground surface against pile driving and pile cut off elevations were provided by GRAEF. MPS recommends a minimum driven pile spacing of three pile diameters, as recommended by the IDOT Bridge Manual. Due to the anticipated shallow depth of bedrock, as well as the boring indicating construction debris and gravel, we suggest using pile shoes when driving. We recommend at least one test pile at one of the abutments, preferrably at the location that will require greater pile lengths.

Based on the information provided in the All Bridge Designers Memorandum (ABD) 12.3 an integral abutment feasibility analysis shows that the following H-pile sizes may be utilized at the proposed abutments:
HP 10x42, HP 12x53, HP 10x57, HP 12x63, HP 12x74, HP 14x73, HP 12x84, HP 14x89, HP 14x102, and HP 14x117

SHALLOW FOUNDATIONS
The field and laboratory data was used to assess the mean values of compressive strength for the shale. On this basis, spread footings bearing on competent shale bedrock may be designed for a factored bearing resistance of 15.0 ksf, based on a resistance factor of 0.45. Top of shale elevation may vary between approximately Elev. 626 to 628. A resistance factor of 0.50 may be used in analyzing resistance to sliding. Shallow foundations should be embedded below the anticipated scour depths.

Conditions may vary away from the boring locations. If designed for stiff soil support and soft material is encountered in some areas, the soft soil should be removed until stiffer materials are encountered. If designed for bedrock support and soil is instead encountered in some areas, then the soil should be removed until the competent shale surface is exposed, and the removed materials replaced with lean concrete fill. It is also possible that shale could be encountered away from the boring locations at elevations higher than anticipated. The contract documents should be prepared so that unit rates to handle such a situation are part of the bid evaluation process.

If the foundations are to bear upon shale, or if shale is encountered in excavations away from the boring locations at higher elevations than encountered at the borings, the moisture content of the materials must be maintained as near the natural state as possible. Water introduced to the shale may induce swelling. Conversely, if the shale is allowed to dry, the material may shrink during construction, and later cause damaging swell if a water source becomes available during or after the construction period.

Immediately after exposure, the shale should be observed for "slaking" behavior, which is the rapid disintegration of the material from rock-like to soil-like behavior. Under such circumstances, the stability of an excavation can be short-lived, as the disintegrating shale particles can begin cascading and slumping into the excavation. This can often be controlled by applying shotcrete over the excavation wall and floor immediately upon exposure at the planned grades and elevations; however, greater effort is sometimes required in situations where the shotcrete does not successfully adhere to the shale.

DRILLED SHAFTS

MPS understands that drilled shafts have emerged as a possible option to support the new bridge structure at the pier locations. Drilled shafts may be designed to provide capacity from both side and tip resistance within the zone of the bedrock socket.

The contractor should be prepared to handle groundwater seepage into the pier excavations and the potential for sloughing or caving of the pier sidewalls. A temporary casing and pumps may be necessary for pier construction, as the fill soils are likely to cave if unsupported.

Each pier should be cast the same day it is completed and approved. For dry hole placement, the pier base should be continually pumped as necessary to prevent the accumulation of water. No more than 2 inches of water accumulation should be allowed at the time of concrete placement. Concrete should be placed in a manner to prevent segregation. If temporary casing is necessary to prevent caving or sloughing of the pier sides, it should be extended to the pier base and left in place until several feet of concrete is placed in the pier. A minimum of 5 feet of concrete should be maintained above the casing bottom as it is withdrawn during concrete placement.

It is important that the pier excavations be observed by an experienced representative to verify the bearing conditions before being filled with concrete. During concrete placement, the geotechnical representative would also observe for proper placement to reduce the potential for voids in the concrete.

A factored side resistance value for the bedrock socket of 6.2 ksf is recommended for competent shales below an approximate elevation of Elev. 626.5 at the site. As previously mentioned, conditions may vary between boring locations. This value includes a geotechnical resistance factor of 0.5. It should be assumed that the upper 2 feet of the socket will not contribute to side resistance in consideration of uncertainties caused by the potential for weathering of the upper bedrock surface. Uplift resistance of the shaft should only rely on the bedrock socket side friction. An uplift resistance factor of 0.40 is recommended based on AASHTO LRFD Bridge Design Specifications (2010). A factored tip resistance value for the bedrock of 40.0 ksf is recommended for the competent shales.

If drilled shafts are chosen as the foundation support for the piers of the new bridge, MPS can provide parameters for use in design of the lateral capacity of the drilled piers based on the boring information, using L-PILE Version 2012-06. Lateral load resistance and induced lateral deflection are typically assessed using finite difference computer models based on the lateral modulus-of-subgrade reaction, such as LPILE 2012-06. Piers should be maintained at a spacing no closer than three pier diameters, center-to-center, so that stress overlap at the bearing level can be avoided, to reduce lateral capacity interaction, and so that possible installation problems associated with one structural member do not impact the integrity of the adjacent member.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: Based on the understanding that drilled shafts with webwalls are planned, a cofferdam and seal coat are not needed at this time.

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: The construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction. Trenching, excavating, and bracing should be performed in accordance with Occupational Safety and Health Administration (OSHA) regulations, and other applicable regulatory agencies. In accordance with the OSHA excavation standards, the soil at the site is considered to be Type C, which requires a side slope for excavations no steeper than 1.5H:1.0V. However, worker safety and classification of the excavation soil is the responsibility of the contractor.

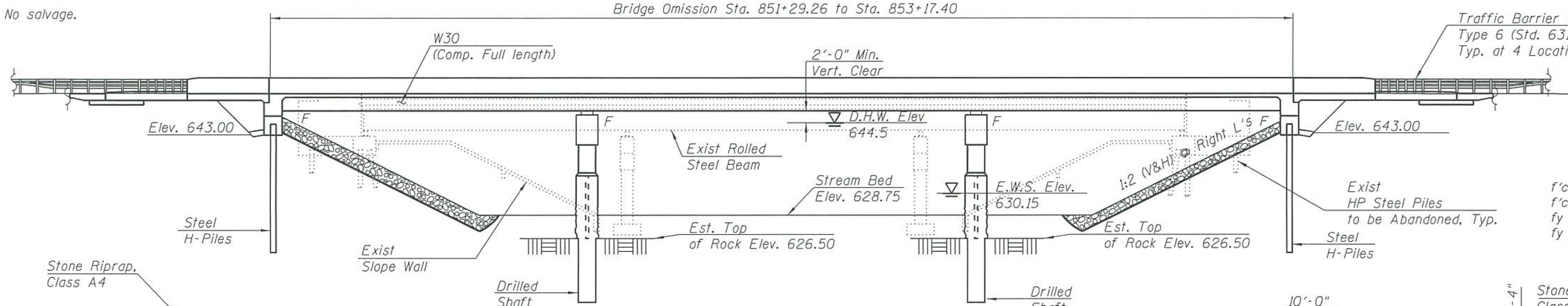
It is possible that the excavation side slopes for structure foundations may interfere with existing utilities in some areas, which could require a temporary soil retention system. In addition, temporary soil retention systems may be needed in front of the existing abutments. Cantilever sheet piling may be adequate where the height of the retained soil will be limited. However, because of the relatively shallow bedrock, sheet piles with tie-back anchors, soil nail walls, soil screw walls, or other potntial options may be needed for retained soil of greater heights. Selecting and designing the most appropriate retention methods for each specific situation is typically the responsibility of the contractor.

Traffic along IL-116 will be maintained by utilizing staged construction.

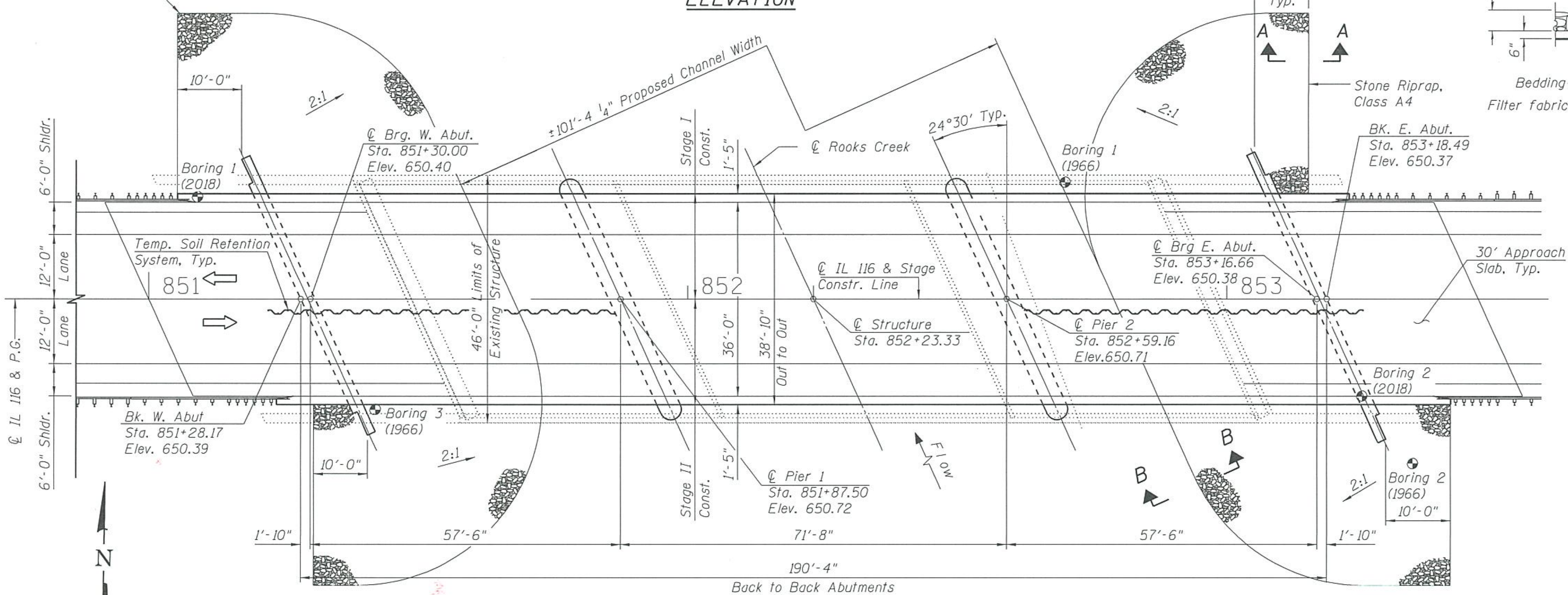
Bench Mark: BM #1. Chiseled "□" cut into top of S.E. wingwall of S.N 053-0065. Elev. 649.99.

Existing Structure: Structure Number 053-0065 built in 1970 as F.A. 395 (Illinois Route 116), Section 112-BR-2. Existing structure consists of three span, reinforced concrete deck supported on steel WF beams. The beams are supported on stub abutments supported on steel HP piles and modified hammerhead type piers supported by spread footings. The back to back abutments measure is 151'-8" and the out-to-out bridge deck dimension is 46'-0" in the existing conditions. Structure is to be removed and replaced. Traffic is to be maintained utilizing staged construction.

No salvage.



ELEVATION



PLAN

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 8th Edition

HIGHWAY CLASSIFICATION

Rte: F.A.P. 673 (Illinois Rte. 116)
Functional Class: Minor Arterial
ADT:3,360 (2020); 4,000 (2040)
ADTT: 390 (2020) ; 464 (2040)
DHV: 320
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

DESIGN STRESSES

FIELD UNITS

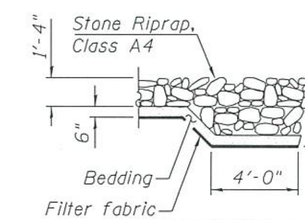
f'c = 3,500 psi
f'c = 4,000 psi (Superstructure)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50W)

LOADING HL-93

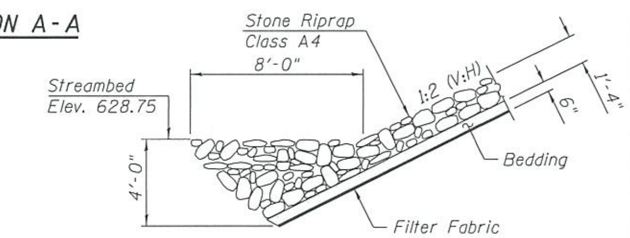
Allow 50#/sq. ft. for future wearing surface.

SEISMIC DATA

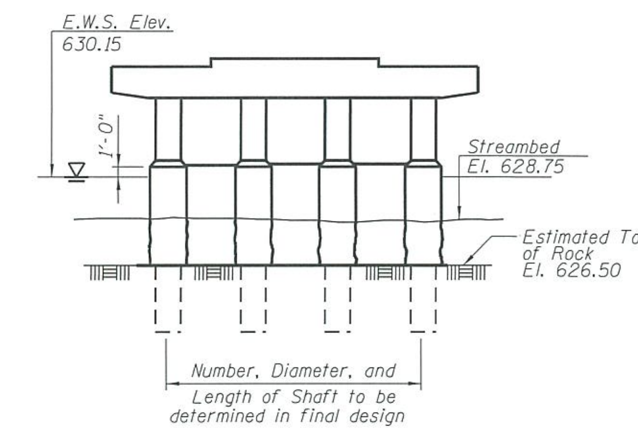
Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.078g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.133g
Soil Site Class = C



SECTION A-A

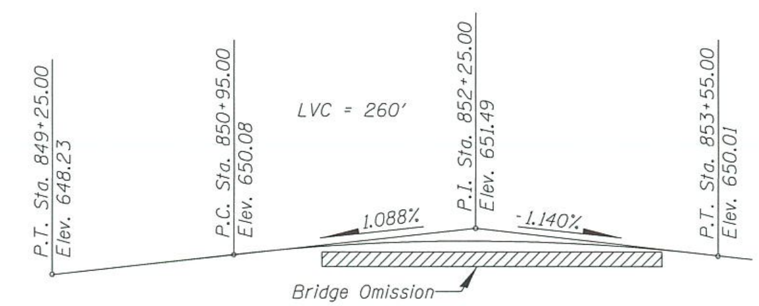


SECTION B-B

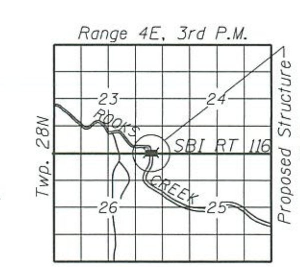


PIER SKETCH

APPROVED
AUG 17 2018
AS A BASIS FOR
PREPARATION OF DETAILED PLANS



PROFILE GRADE
(ALONG ℄ ROADWAY)



LOCATION SKETCH

GENERAL PLAN
IL. RTE. 116 OVER ROOKS CREEK
F.A.P. RTE. 673 - SEC. (112-BR-2)ES
LIVINGSTON COUNTY
STATION 852+23.33
STRUCTURE NO. 053-0192

GRAEF 8501 W. Higgins Road; Suite 280 Chicago, Illinois 60631; (773) 399-0112	USER NAME =	DESIGNED - NDR	REVISED -
		CHECKED -	REVISED -
	PLOT SCALE =	DRAWN - TCK	REVISED -
	PLOT DATE = 8/17/2018	DATE - 05/10/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
S.N. 053-0192

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
673	(112-BR-2)ES	LIVINGSTON	1	2
		CONTRACT NO. 66E68		
		ILLINOIS FED. AID PROJECT		

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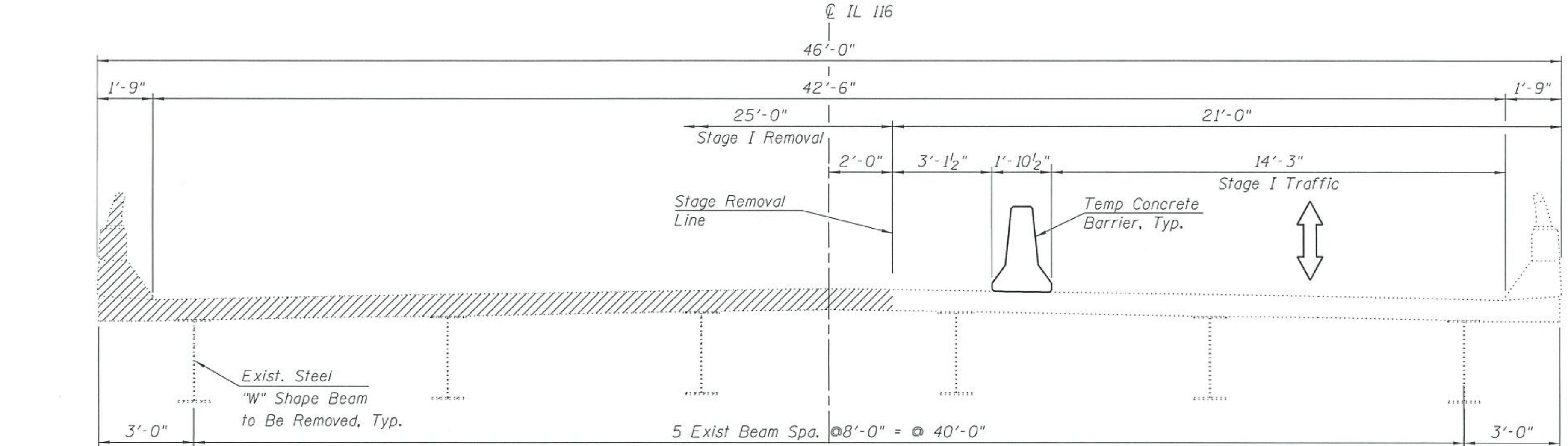
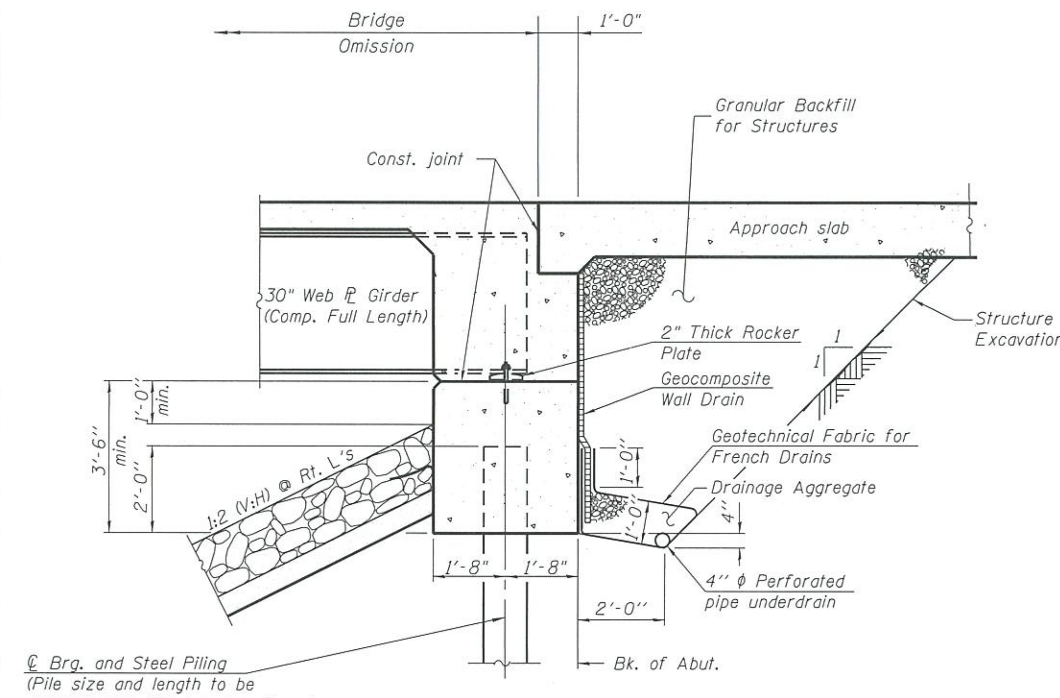


STAGE I REMOVAL
(LOOKING EAST)

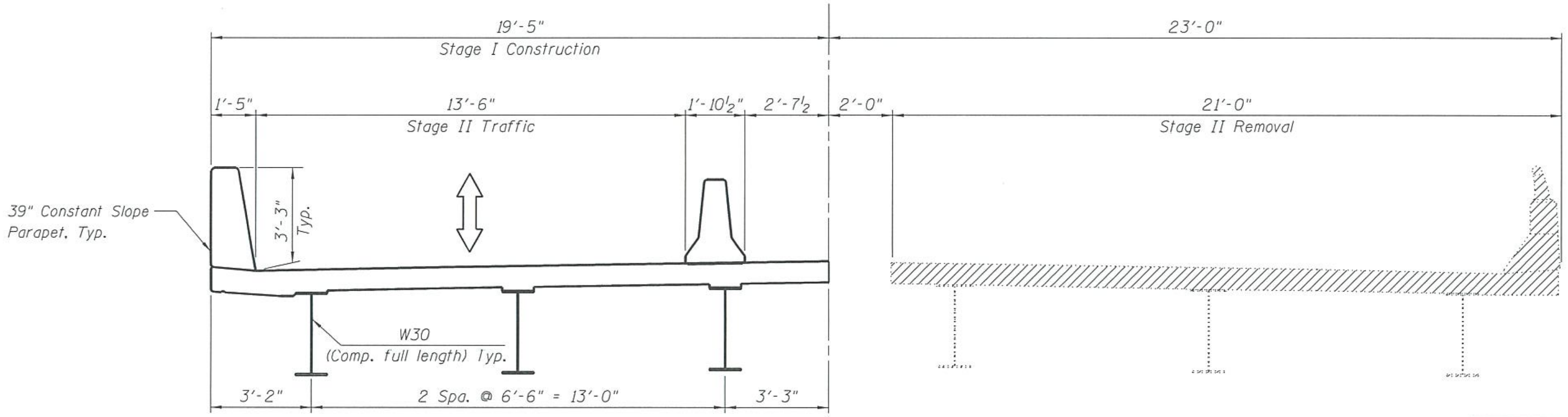
STAGE I TRAFFIC
(LOOKING EAST)

SCOPE OF WORK

1. Remove and replace existing bridge structure.
2. Remove and replace existing approach slab.
3. Construct embankment cone and place stone riprap at the abutments.



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

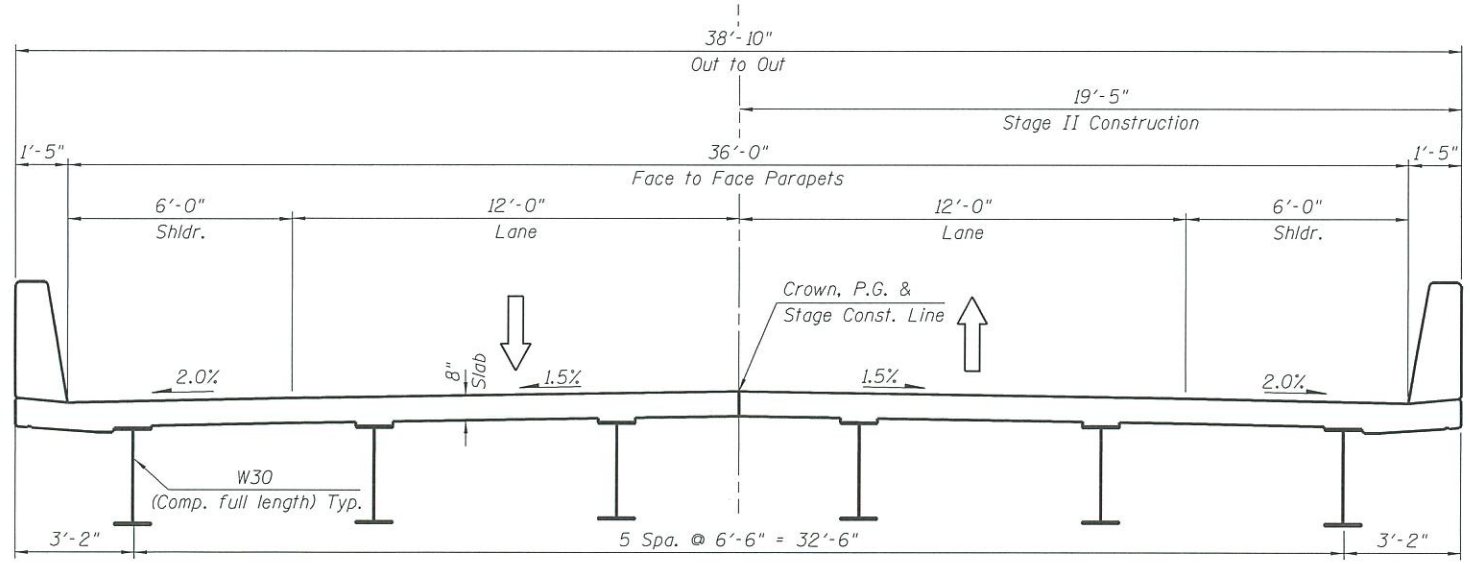


STAGE I CONSTRUCTION & STAGE II TRAFFIC

STAGE II REMOVAL

WATERWAY INFORMATION TABLE

Drainage Area =	109 Sq. Mi.	Exist. Low Grade El. =646.20 @ Sta. 845+00.00 Prop. Low Grade El.=646.20@Sta.845+00							
Flood	FREQUENCY (Yr.)	Q (cfs)	Opening - Sq. Ft.		Nat. H.W.E.	Head - Ft.		Head Water El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	5,520	1,047	1,431	641.6	0.5	0.5	642.1	642.1
Hydraulic Design	50	8,640	1,376	1,859	644.5	0.9	0.4	645.4	644.9
Base/Scour Des.	100	10,000	1,376	2,008	645.4	1.0	0.5	646.4	645.9
Scour Check	200	11,420	1,376	2,123	646.1	1.5	0.7	647.6	646.8
Ex. Overtopping	240	11,800	1,376	2,155	646.3	1.6	0.8	647.9	647.1
Max. Calc.	500	13,300	1,376	2,185	646.9	1.3	0.7	648.2	647.6



DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.)				
	W. Abut	Pier 1	Pier 2	E. Abut	Item 113
Q100	643.00	625.92	625.92	643.00	8
Q200	643.00	625.28	625.28	643.00	
Design	643.00	625.92	625.92	643.00	
Check	643.00	625.28	625.28	643.00	

APPROVED
AUG 17 2018
AS A BASIS FOR PREPARATION OF DETAILED PLANS

STAGE II CONSTRUCTION & FINAL CROSS SECTION
(LOOKING EAST)

GENERAL PLAN
IL. RTE. 116 OVER ROOKS CREEK
F.A.P. RTE. 673 - SEC. (112-BR-2)ES
LIVINGSTON COUNTY
STATION 852+23.33
STRUCTURE NO. 053-0192

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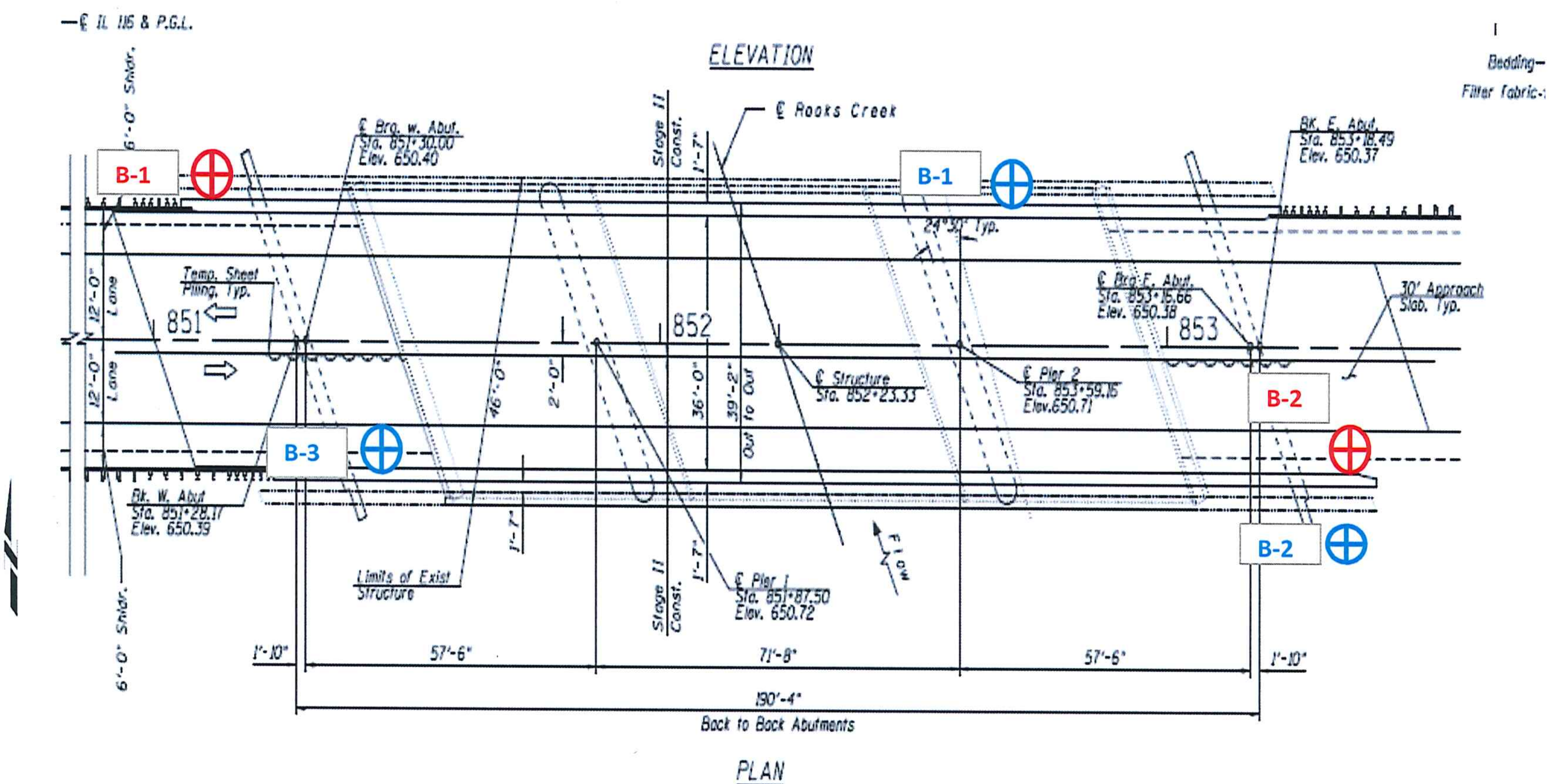
GRAEF 8501 W. Higgins Road; Suite 280 Chicago, Illinois 60631; (773) 399-0112	USER NAME =	DESIGNED - NDR	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	DECK CROSS SECTION AND DETAILS S.N. 053-0192	F.A.P. RTE. 673 / SECTION (112-BR-2)ES / COUNTY LIVINGSTON / TOTAL SHEETS 2 / SHEET NO. 2
		CHECKED -	REVISED -			CONTRACT NO. 66E68
	PLOT SCALE =	DRAWN - TCK	REVISED -			ILLINOIS FED. AID PROJECT
	PLOT DATE = 8/17/2018	DATE - 05/10/2018	REVISED -			



: APPROXIMATE BORING LOCATIONS 2018

: APPROXIMATE BORING LOCATIONS 1966

TSL IMAGE OBTAINED FROM GRAEF ON 2-28-18

NOT TO SCALE

FIGURE 1: BORING LOCATION PLAN	
IL RTE 116 OVER ROOKS CREEK FAP RTE 116 SEC 112-BR-3	
Drawn by: JAS	Checked by: JES
Project No.: ME17126	Date: 3-23-18

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 10/17/66

ROUTE SBI-116 (IL 116) DESCRIPTION IL 116 over Rooks Creek, 2.68 miles West of I-55 LOGGED BY

SECTION 112 BR-2 LOCATION SE 1/4, SEC. 23, TWP. 28N, RNG. 4E, 3rd PM,
Latitude , Longitude

COUNTY Livingston DRILLING METHOD Hollow Stem Auger HAMMER TYPE

STRUCT. NO. 053-0065
Station 852+21.59

BORING NO. 1
Station 852+70
Offset 21.5 ft Lt.
Ground Surface Elev. 634.00 ft

Surface Water Elev. 632.00 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter ft
Upon Completion 631.0 ft ▽
After 24 Hrs. 631.0 ft ▼

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Brownish Black to Buff Silty Clay to Clay Loam, Silt and Silty Loam (Silted In)				
		9	1.0 E	23
▽▼				
	-5	14		17
626.50		40		11 9
Very Dense Light Gray Silty Clay Shale & Clay Shale				
	-10	6"/153	0.5 S	9
		3"/200		6
	-15	3"/200		14
		1"/100		6
	-20	1"/100		6

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Dense Light Gray Silty Clay Shale & Clay Shale *(continued)*				
		1"/100		15
	-25	1"/100		13
		2"/100		7
604.50				
End of Boring	-30	1"/100		7
	-35			
	-40			

SOIL BORING 053-0065.GPJ IL_DOT.GDT 11/24/15

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

Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 10/19/66

ROUTE SBI-116 (IL 116) **DESCRIPTION** IL 116 over Rooks Creek, 2.68 miles West of I-55 **LOGGED BY** ____

SECTION 112 BR-2 **LOCATION** NE 1/4, **SEC.** 26, **TWP.** 28N, **RNG.** 4E, 3rd **PM,**
Latitude , Longitude

COUNTY Livingston **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** ____

STRUCT. NO. 053-0065
Station 852+21.59

BORING NO. 2
Station 853+34.5
Offset 30.5 ft Rt.
Ground Surface Elev. 644.40 ft

Surface Water Elev. 632.00 ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter ____ ft
Upon Completion 621.4 ft ▽
After 18 **Hrs.** 635.0 ft ▽

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Soft Brownish Black & Yellowish Gray Silty Clay & Clay (Backfill)					
			15	0.2 B	19
		-5	9	0.4 B	20
			5	0.4 B	19
	635.40				
Hard Gray & Reddish Brown Clay and Silty Clay		▽			
		-10	28	4.7 S	15
			24	4.7 S	13
		-15	35	2.1 S	13
	628.40				
Very Dense Light Gray Silty Clay Shale and Clay Shale					
			8"/200		5
		-20	1"/100		3
Very Dense Light Gray Silty Clay Shale and Clay Shale *(continued)*					
			2"/100		5
		▽			
	619.90				
End of Boring		-25	1"/100		5
		-30			
		-35			
		-40			

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

Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 10/20/66

ROUTE SBI-116 (IL 116) **DESCRIPTION** IL 116 over Rooks Creek, 2.68 miles West of I-55 **LOGGED BY** ________

SECTION 112 BR-2 **LOCATION** NE 1/4, **SEC.** 26, **TWP.** 28N, **RNG.** 4E, 3rd **PM,**
Latitude , Longitude

COUNTY Livingston **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** ________

STRUCT. NO. 053-0065
Station 852+21.59

BORING NO. 3
Station 851+42
Offset 20.5 ft Rt.
Ground Surface Elev. 644.40 ft

Surface Water Elev. 632.00 ft
Stream Bed Elev. ________ ft

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

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff Brownish Black Silty Clay (Backfill)					
			10	1.6 S	13
		-5	7	2.0 S	16
	637.90				
Medium Yellowish Brown and Gray Fine Sand and Sandstone (Backfill)			14		10
	635.90				
Medium Browish Black & Yellowish Brown Silty Clay Loam and Clay Loam (Backfill)		-10	9	0.4 S	26
			7	0.3 S	14
	630.90				
Dense Yellowish Brown Sandy Clay Loam to Shale-like Clay		-15	53		7
	628.40				
Very Dense Light Gray Silty Clay Shale and Clay Shale			1"/100		5
		-20	1"/100		6
Very Dense Light Gray Silty Clay Shale and Clay Shale *(continued)*			1"/100		1
	619.90				
End of Boring		-25	1"/100		4
		-30			
		-35			
		-40			

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

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 1/24/18

ROUTE FAP 673 (IL 116) **DESCRIPTION** IL 116 over Rooks Creek, 2.68 miles West of I-55 **LOGGED BY** Larry Myers

SECTION 112 BR-2 **LOCATION** SE 1/4, **SEC.** 23, **TWP.** 28N, **RNG.** 4E, 3rd **PM**, **Latitude** 40.872929, **Longitude** -88.722693

COUNTY Livingston **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 053-0065
Station 852+21.83

BORING NO. 01 (W. Abut.)
Station 851+09
Offset 19.0 ft Lt.
Ground Surface Elev. 647.54 ft

Surface Water Elev. 629.64 ft
Stream Bed Elev. 628.41 ft

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

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Stone, Black Silty Clay Loam Fill	645.04				
Very Stiff Black, Gray & Brown Silty Clay Loam Fill			5 6 6	3.5 P	21
		-5	4 4 4	4.0 P	25
			3 4 4	3.8 P	24
	635.54	-10	4 4 4	3.8 P	22
Stiff Black Silty Clay Loam / Silty Loam	632.54	-15	3 2 2	1.5 P	27
Stiff to Very Stiff Gray / Black Sandy Loam, Sandy Clay Loam, Sand Interbedded			3 5 7	2.0 P	15
	629.54		12 27 57		10
Buff Highly Weathered & Reworked Siltstone	627.54	-20			

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dense Gray Shale with Limestone Seams / Fingers around 25 ft. Modified Standard Penetration Test used from 20.0 ft. to end of boring. Results are on a separate log sheet.					6
					5
		-25			5
					5
		-30			5
	613.54				3
End of Boring		-35			
		-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)

Modified SPT Log

Illinois Department of Transportation

Route: IL 116 Structure No.: 053-0065 (Exist.) (Prop.) Date: 1/24/18 Page: 1 of 1

Section: 112-BR-2 Description: IL 116 over Rooks Creek, 2.68 miles West of I-55

County: Livingston Logged by: Larry Myers Sampler Tube Length: 24 in.

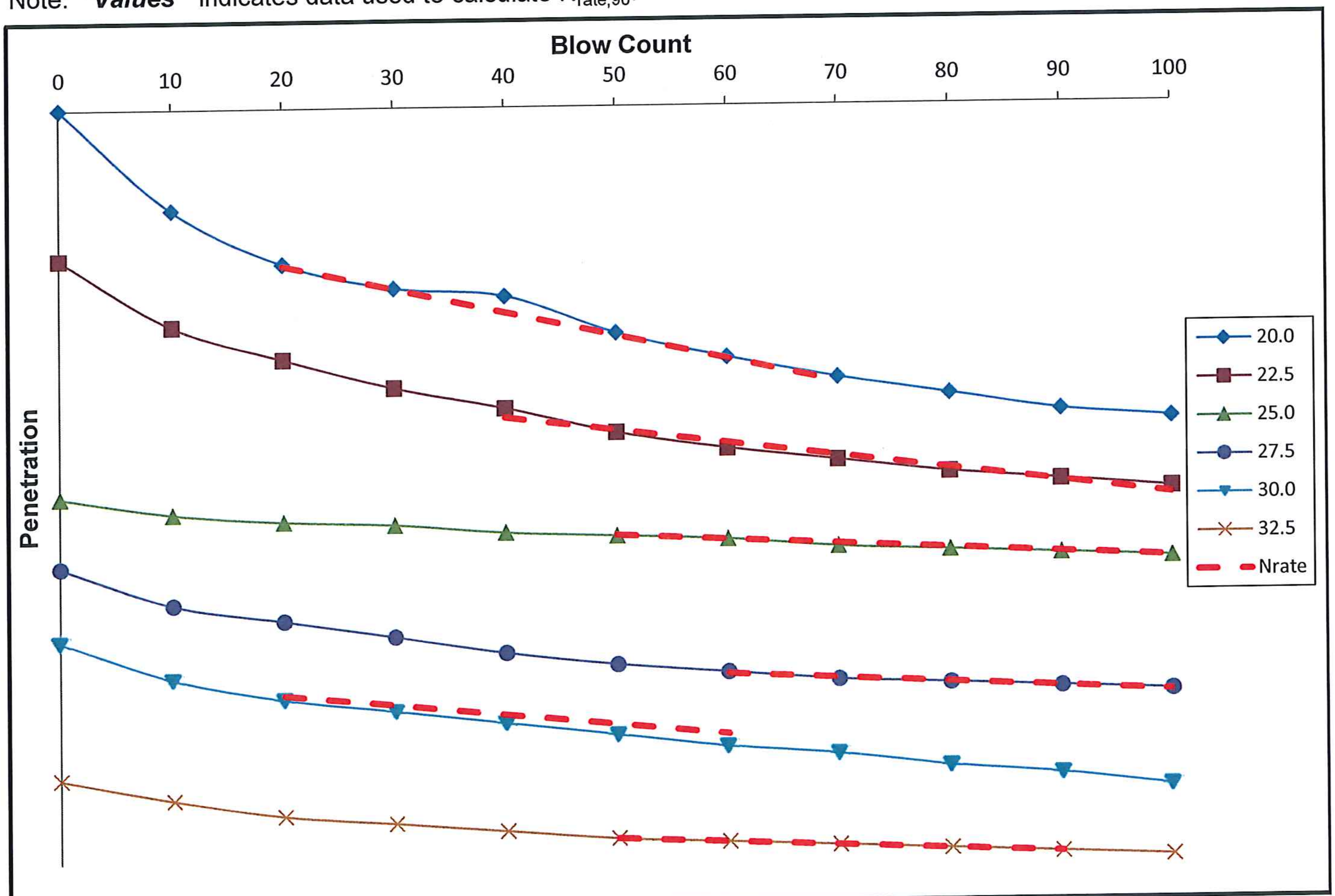
Boring No.: 1 Station: 851+92 Offset: 18' Lt. Latitude: Longitude:

Drill Rig: CME - 75 Hammer Type: Auto Hammer Efficiency (%): 93 Surface Elevation: 647.54

Borehole Diameter. (in.) 2.5 to 4.5 Split-barrel Sampler Description: 1.5-in. I.D. w/o Liner

Test Elevation – Measured Rod Length (ft)	Blows where exposed rod length is measured (blows) 0	10	20	30	40	50	60	70	80	90	100	$N_{rate,90}$ (bpf)	q_u (ksf)	Young's Modulus (ksi)
20.00	2.38	2.14	***2.01***	***1.95***	1.93	***1.84***	***1.78***	***1.73***	1.69	1.65	1.63	217.5	20.9	4.66
22.50	2.4	2.24	2.16	2.09	***2.04***	***1.98***	***1.94***	***1.91***	***1.88***	***1.86***	***1.84***	386.6	37.1	8.67
25.00	2.4	2.36	2.34	2.33	2.31	***2.3***	***2.29***	2.27	***2.26***	***2.25***	***2.24***	1023	98.2	32.19
27.50	2.39	2.3	2.26	2.22	2.18	2.15	***2.13***	***2.11***	***2.1***	***2.09***	***2.08***	1036	99.4	32.84
30.00	2.39	2.3	***2.25***	***2.22***	***2.19***	***2.16***	***2.13***	2.11	2.08	2.06	2.03	497.0	47.7	11.81
32.50	2.37	2.32	2.28	2.26	2.24	***2.22***	***2.21***	***2.2***	***2.19***	***2.18***	2.17	1243	119	47.09

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



Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 1/25/18

ROUTE FAP 673 (IL 116) **DESCRIPTION** IL 116 over Rooks Creek, 2.68 miles West of I-55 **LOGGED BY** Larry Myers

SECTION 112 BR-2 **LOCATION** NE 1/4, **SEC.** 26, **TWP.** 28N, **RNG.** 4E, 3rd **PM**, **Latitude** 40.872836, **Longitude** -88.721898

COUNTY Livingston **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 053-0065
Station 852+21.83

BORING NO. 02 (E. Abut.)
Station 853+25
Offset 18.0 ft Rt.
Ground Surface Elev. 647.86 ft

Surface Water Elev. 629.64 ft
Stream Bed Elev. 628.40 ft

Groundwater Elev.:
First Encounter 632.9 ft ▼
Upon Completion 632.9 ft ▽
After ___ **Hrs.** ___ ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Augered Shoulder Stone, Black Silty Clay Loam Fill	645.36				
Very Stiff Black Silty Clay Loam Fill with Construction Debris and 10" of CA6 @ 3 ft.			12 / 12 / 6	2.5 P	8
		-5	3 / 4 / 6	2.5 P	21
			4 / 3 / 3	2.0 P	22
	635.86	-10	1 / 4 / 6	2.5 P	27
Stiff Black & Gray Silty Clay Loam / Sandy Loam with Sand & Gravel Layers	633.36		2 / 1 / 3	1.0 P	18
Hard Brown Silty Clay Loam / Silty Loam Till with Large Gravel Pieces	630.36	-15 ▼▽	6 / 11 / 15	4.0 P	15
Dense Gray Limestone identified by chip recovery (Large Boulder or Actual Rock?)		-20	100/1"		
Dense Gray Limestone identified by chip recovery (Large Boulder or Actual Rock?) *(continued)*	626.36		100/1"		5
Dense Gray Silty Shale with Probable Thin Limestone Beds / Fingers in top 3 ft. and scattered throughout entire sample depth. Modified Standard Penetration Test used from 22.5 ft. to end of boring. Results are on a separate log sheet.					5
		-25			6
					7
		-30			5
	613.86				7
End of Boring		-35			
		-40			

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

Illinois Department of Transportation

Modified SPT Log

Route: IL 116 Structure No.: 053-0065 (Exist.) (Prop.) Date: 1/25/18 Page: 1 of 1

Section: 112-BR-2 Description: IL 116 over Rooks Creek, 2.68 miles West of I-55

County: Livingston Logged by: Larry Myers Sampler Tube Length: 24 in.

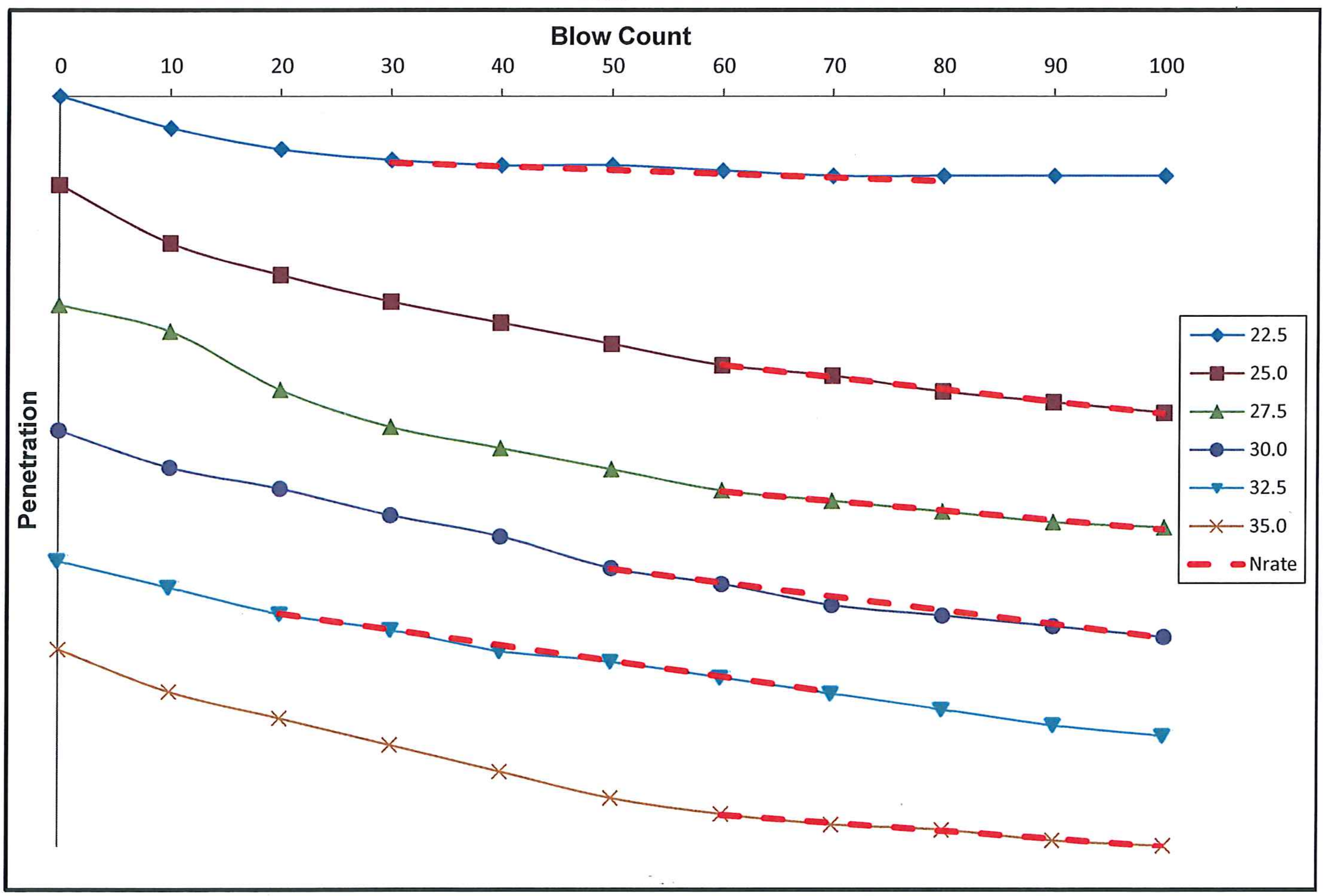
Boring No.: 2 Station: 851+92 Offset: 18' Lt. Latitude: Longitude:

Drill Rig: CME - 75 Hammer Type: Auto Hammer Efficiency (%): 93 Surface Elevation: 647.86

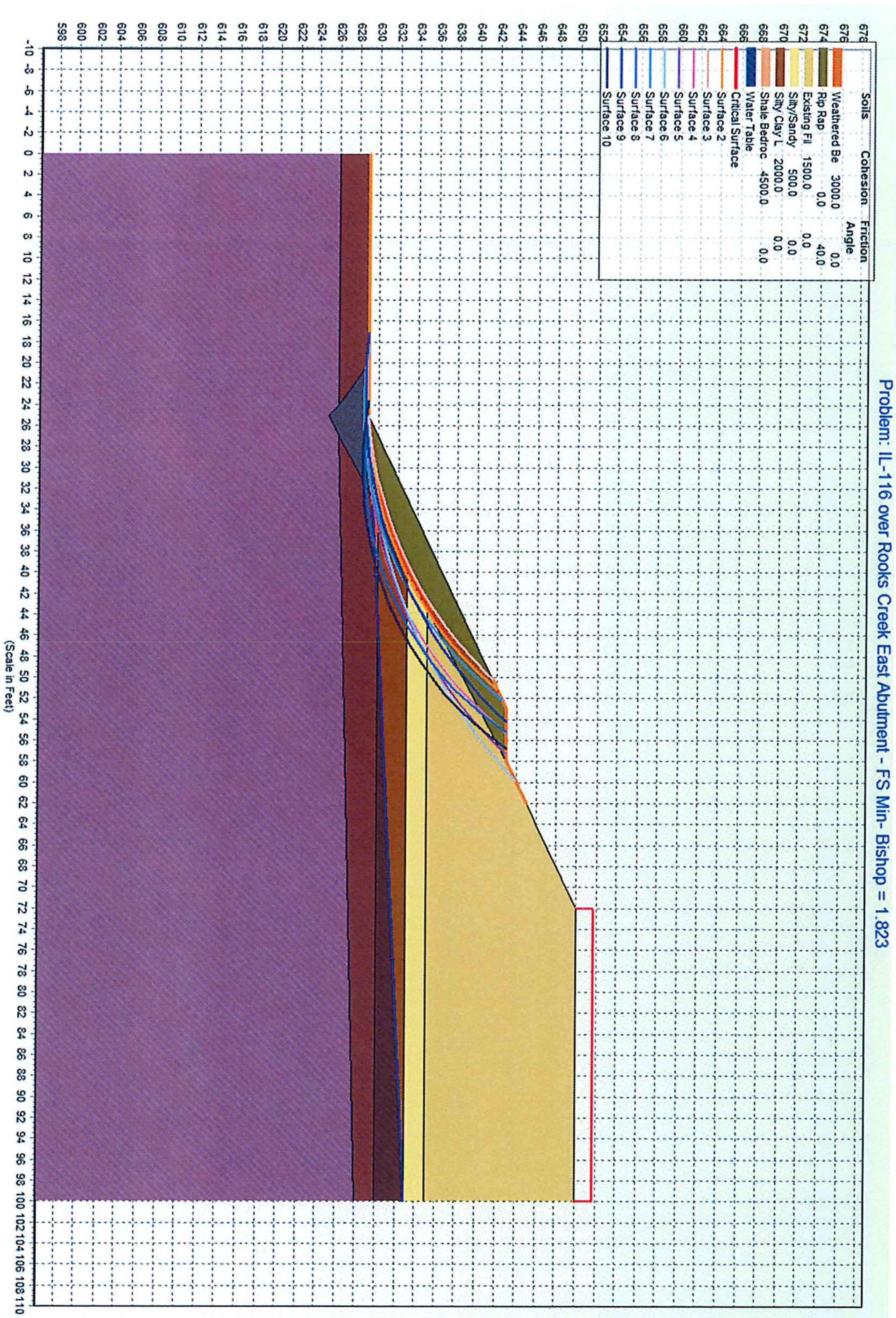
Borehole Diameter. (in.) 2.5 to 4.5 Split-barrel Sampler Description: 1.5-in. I.D. w/o Liner

Measured Rod Length (ft)	Blows where exposed rod length is measured (blows)											$N_{rate,90}$	q_u	Young's Modulus
Test Elevation	0	10	20	30	40	50	60	70	80	90	100	(bpf)	(ksf)	(ksi)
22.50	2.36	2.3	2.26	***2.24***	***2.23***	***2.23***	***2.22***	2.21	***2.21***	2.21	2.21	1775	170	177.11
25.00	2.32	2.21	2.15	2.1	2.06	2.02	***1.98***	***1.96***	***1.93***	***1.91***	***1.89***	540.3	51.9	13.18
27.50	2.33	2.28	2.17	2.1	2.06	2.02	***1.98***	***1.96***	***1.94***	***1.92***	***1.91***	690.4	66.3	18.27
30.00	2.38	2.31	2.27	2.22	2.18	***2.12***	***2.09***	2.05	***2.03***	***2.01***	***1.99***	477.8	45.9	11.25
32.50	2.35	2.3	***2.25***	***2.22***	2.18	***2.16***	***2.13***	***2.1***	2.07	2.04	2.02	419.2	40.2	9.54
35.00	2.38	2.3	2.25	2.2	2.15	2.1	***2.07***	***2.05***	***2.04***	***2.02***	***2.01***	828.4	79.5	23.46

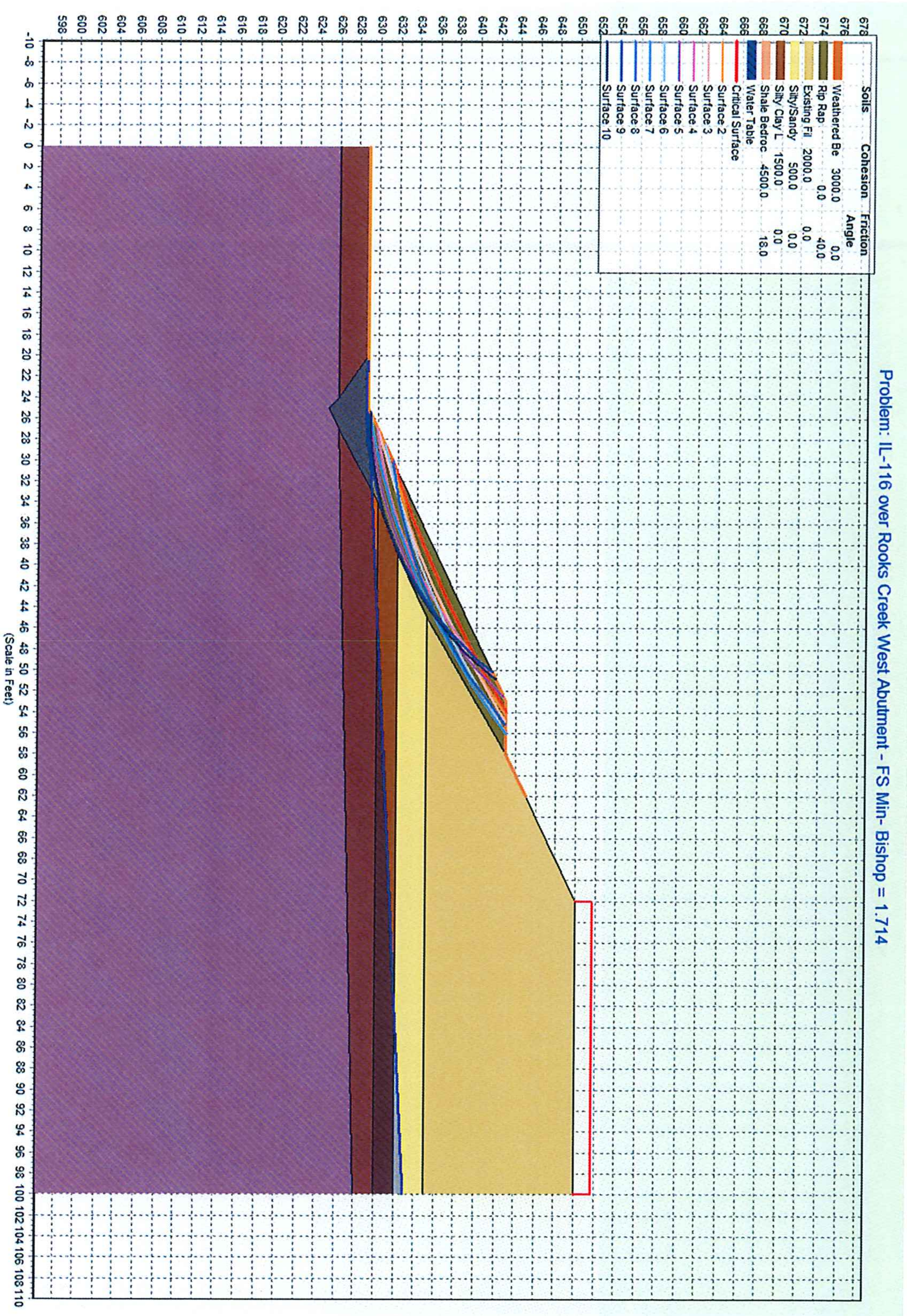
Note: "***Values***" indicates data used to calculate $N_{rate,90}$.



East Abutment Undrained



West Abutment Undrained



INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

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

Modified 1/7/2014

STRUCTURE NUMBER===================== 053-0192
STRUCTURE TYPE ========================= MULTI-SPAN
STRUCTURE SKEW========================= 24 DEGREES
TOTAL STRUCTURE LENGTH================= 190.33 FT
LONGEST END SPAN LENGTH =============== 71.67 FT

ABUTMENT #1 DATA

ABUTMENT NAME ========================= East
ABUTMENT REFERENCE BORING============= B-2
BOTTOM OF ABUTMENT ELEVATION========== 643 FT
ESTIMATED NUMBER OF PILES AT ABUT.======= 6

ABUTMENT #2 DATA

ABUTMENT NAME ========================= West
ABUTMENT REFERENCE BORING============= B-1
BOTTOM OF ABUTMENT ELEVATION========== 643 FT
ESTIMATED NUMBER OF PILES AT ABUT.======= 6

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
639.00	4.00		18	2.9
636.50	2.50		10	2.4
634.00	2.50		6	2.0

9.00 FT = TOTAL DEPTH ENTERED

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #2

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
639.00	4.00		12	2.6
636.00	3.00		8	2.3
634.00	2.00		8	2.3
631.50	2.50		8	2.3

11.50 FT = TOTAL DEPTH ENTERED

ENTER 10 FT OF SOIL DATA

WEIGHTED AVERAGE Qu FOR ABUTMENT #1======= 2.52 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #1
= 1/(1.45-[0.3*2.52])=================== 1.44

ENTER 10 FT OF SOIL DATA

WEIGHTED AVERAGE Qu FOR ABUTMENT #2======= 2.37 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #2
= 1/(1.45-[0.3*2.37])=================== 1.35

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.44*6*0+1.35*6*190.33]/[1.44*6+1.35*6]========= 92.16 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.35*6*0+1.44*6*190.33]/[1.35*6+1.44*6]========= 98.17 FT

EFFECTIVE EXPANSION LENGTH (EEL) CALCULATION

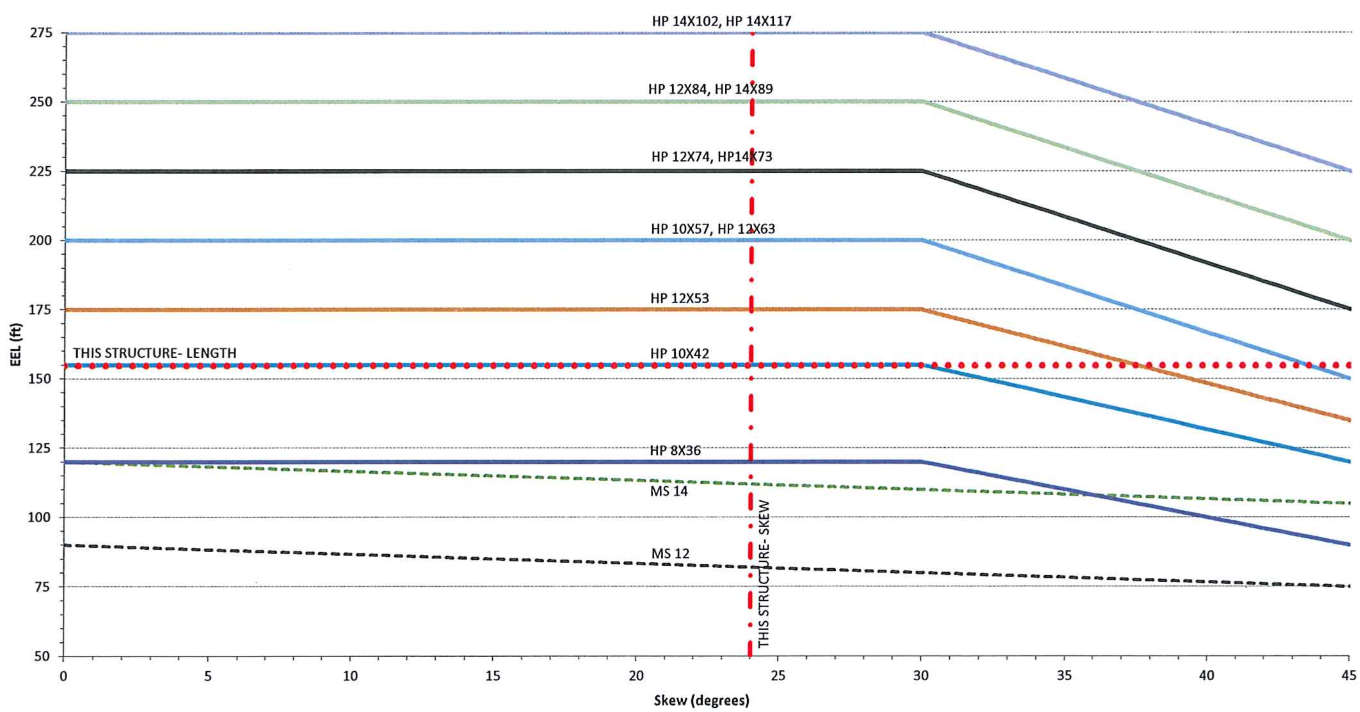
CONTROLLING ABUTMENT=== ABUT. #2 West
CONTROLLING EXPANSION LENGTH (DISTANCE TO CENTROID OF STIFFNESS FROM CONTROLLING ABUTMENT) ========================== 98.17 FT
WEIGHTED AVE. Qu FOR CONTROLLING ABUTMENT == 2.37 TSF
Qu CORRECTION FACTOR ============================== 2.37/1.5 ==================================== 1.58
EFFECTIVE EXPANSION LENGTH (EEL) ===================== EEL = 98.17*1.58 ================================ 154.80 FT

FEASIBLE PILE TYPES PER CHART IN ABD MEMO 12.3 BASED ON SKEW AND EEL OR MODIFIED EEL:

PILE SIZES AT OR ABOVE THE LENGTH LINE AT THE INTERSECTION WITH THE SKEW LINE ARE ALLOWED FOR USE WITH THIS INTEGRAL ABUTMENT STRUCTURE

AVAILABLE PILE SIZES:

HP 10X42, HP 12X53, HP 10X57, HP 12X63, HP 12X74, HP 14X73, HP 12X84, HP 14X89, HP 14X102, HP 14X117



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE============================== West Abutment
REFERENCE BORING =========================== B-1
LRFD or ASD or SEISMIC ========================= LRFD
PILE CUTOFF ELEV. ============================ 645.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 643.00 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 ================ kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)============ ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE =========

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**418** KIPS	**230** KIPS	**25** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
639.00	4.00	3.50	12		27.2		82.3	39.7		***45.8***	46	0	0	25	6
636.00	3.00	4.00	8		22.6	55.1	102.1	33.0	6.0	***78.5***	78	0	0	43	9
634.00	2.00	3.80	8		14.5	52.4	116.6	21.1	5.7	***99.6***	100	0	0	55	11
631.50	2.50	3.80	8		18.1	52.4	***96.1***	26.4	5.7	121.8	96	0	0	53	14
629.00	2.50	1.00	4		7.0	13.8	***116.9***	10.3	1.5	133.6	117	0	0	64	16
626.00	3.00	2.00	12		13.9	27.6	257.5	20.3	3.0	***167.7***	168	0	0	92	19
625.00	1.00		84	Hard Till	6.2	154.3	263.7	9.0	16.9	***176.8***	177	0	0	97	20
624.00	1.00		84	Hard Till	6.2	154.3	238.0	9.0	16.9	***182.3***	182	0	0	100	21
623.00	1.00			Shale	49.4	122.5	287.4	72.3	13.4	***254.5***	255	0	0	140	22
622.00	1.00			Shale	49.4	122.5	336.8	72.3	13.4	***326.8***	327	0	0	180	23
621.00	1.00			Shale	49.4	122.5	***386.2***	72.3	13.4	399.0	386	0	0	212	24
620.00	1.00			Shale	49.4	122.5	***435.6***	72.3	13.4	471.3	~~436~~	~~0~~	~~0~~	~~240~~	~~25~~
619.00	1.00			Shale	49.4	122.5	***485.1***	72.3	13.4	543.5	~~485~~	~~0~~	~~0~~	~~267~~	~~26~~
618.00	1.00			Shale	49.4	122.5	***534.5***	72.3	13.4	615.8	~~534~~	~~0~~	~~0~~	~~294~~	~~27~~
617.00	1.00			Shale	49.4	122.5	***583.9***	72.3	13.4	688.0	~~584~~	~~0~~	~~0~~	~~321~~	~~28~~
616.00	1.00			Shale	49.4	122.5	***633.3***	72.3	13.4	760.3	~~633~~	~~0~~	~~0~~	~~348~~	~~29~~
615.00	1.00			Shale	49.4	122.5	***682.7***	72.3	13.4	832.5	~~683~~	~~0~~	~~0~~	~~375~~	~~30~~
614.00	1.00			Shale	49.4	122.5	***732.1***	72.3	13.4	904.8	~~732~~	~~0~~	~~0~~	~~403~~	~~31~~
613.00	1.00			Shale	49.4	122.5	***781.5***	72.3	13.4	977.0	~~782~~	~~0~~	~~0~~	~~430~~	~~32~~
612.00	1.00			Shale	49.4	122.5	***831.0***	72.3	13.4	1049.3	~~831~~	~~0~~	~~0~~	~~457~~	~~33~~
611.00	1.00			Shale		122.5			13.4						

Pile Design Table for West Abutment utilizing Boring #B-1

Pile	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	38	21	6
	66	36	9
	78	43	14
	93	51	16
	140	77	19
	147	81	20
	152	84	21
	335	184	25
Steel HP 10 X 57			
	40	22	6
	67	37	9
	80	44	14
	96	53	16
	145	80	19
	153	84	20
	157	86	21
	454	250	28
Steel HP 12 X 53			
	46	25	6
	78	43	9
	96	53	14
	117	64	16
	168	92	19
	177	97	20
	182	100	21
	418	230	25
Steel HP 12 X 63			
	47	26	6
	81	44	9
	97	53	14
	118	65	16
	173	95	19
	182	100	20
	187	103	21
	497	273	27
Steel HP 12 X 74			
	49	27	6
	82	45	9
	98	54	14
	120	66	16
	177	98	19
	187	103	20
	191	105	21
	589	324	28
Steel HP 12 X 84			
	50	28	6
	84	46	9
	100	55	14
	122	67	16
	181	100	19
	191	105	20
	194	107	21
	664	365	30
Steel HP 14 X 73			
	56	31	6
	95	52	9
	117	64	14
	144	79	16
	205	113	19
	216	119	20
	222	122	21
	578	318	26
Steel HP 14 X 89			
	58	32	6
	98	54	9
	118	65	14
	146	81	16
	211	116	19
	222	122	20
	227	125	21
	705	388	28
Steel HP 14 X 102			
	60	33	6
	100	55	9
	120	66	14
	148	82	16
	216	119	19
	227	125	20
	231	127	21
	810	445	30
Steel HP 14 X 117			
	62	34	6
	102	56	9
	121	67	14
	150	83	16
	223	122	19
	234	129	20
	237	130	21
	929	511	32

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE=============================== East Abutment
REFERENCE BORING ========================== B-2
LRFD or ASD or SEISMIC ======================== LRFD
PILE CUTOFF ELEV. ========================== 645.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 643.00 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 ================ kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ========

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== KIPS

PILE TYPE AND SIZE =========== Steel HP 12 X 53

Plugged Pile Perimeter==================== 3.967 FT. Unplugged Pile Perimeter=========== 5.800 FT.
Plugged Pile End Bearing Area============== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**418** KIPS	**230** KIPS	**24** FT.

BOT. OF LAYER ELEV. (FT.)	*LAYER THICK. (FT.)*	*UNCONF. COMPR. STRENGTH (TSF.)*	*S.P.T. N VALUE (BLOWS)*	*GRANULAR OR ROCK LAYER DESCRIPTION*	*NOMINAL PLUGGED SIDE RESIST. (KIPS)*	*NOMINAL PLUGGED END BRG. RESIST. (KIPS)*	*NOMINAL PLUGGED TOTAL RESIST. (KIPS)*	*NOMINAL UNPLUG'D SIDE RESIST. (KIPS)*	*NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)*	*NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)*	*NOMINAL REQ'D BEARING (KIPS)*	*FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)*	*FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)*	*FACTORED RESISTANCE AVAILABLE (KIPS)*	*ESTIMATED PILE LENGTH (FT.)*
639.00	4.00	2.50	18		21.4		55.8	31.2		***35.0***	35	0	0	19	6
636.50	2.50	2.50	10		13.4	34.5	62.3	19.5	3.8	***53.8***	54	0	0	30	9
634.00	2.50	2.00	6		11.5	27.6	80.7	16.9	3.0	***71.4***	71	0	0	39	11
631.50	2.50	2.50	10		13.4	34.5	***73.4***	19.5	3.8	88.7	73	0	0	40	14
629.00	2.50	1.00	4		7.0	13.8	121.8	10.3	1.5	***103.5***	104	0	0	57	16
626.50	2.50	4.00	26		18.8	55.1	208.0	27.5	6.0	***138.4***	138	0	0	76	19
625.50	1.00			Shale	49.4	122.5	257.4	72.3	13.4	***210.6***	211	0	0	116	19.5
624.50	1.00			Shale	49.4	122.5	306.8	72.3	13.4	***282.9***	283	0	0	156	20.5
623.50	1.00			Shale	49.4	122.5	356.2	72.3	13.4	***355.1***	355	0	0	195	21.5
622.50	1.00			Shale	49.4	122.5	***405.6***	72.3	13.4	427.4	406	0	0	223	22.5
621.50	1.00			Shale	49.4	122.5	***455.0***	72.3	13.4	499.6	~~455~~	~~*0*~~	~~*0*~~	~~*250*~~	~~23.5~~
620.50	1.00			Shale	49.4	122.5	***504.4***	72.3	13.4	571.9	~~504~~	~~*0*~~	~~*0*~~	~~*277*~~	~~24.5~~
619.50	1.00			Shale	49.4	122.5	***553.9***	72.3	13.4	644.1	~~554~~	~~*0*~~	~~*0*~~	~~*305*~~	~~25.5~~
618.50	1.00			Shale	49.4	122.5	***603.3***	72.3	13.4	716.4	~~603~~	~~*0*~~	~~*0*~~	~~*332*~~	~~26.5~~
617.50	1.00			Shale	49.4	122.5	***652.7***	72.3	13.4	788.6	~~653~~	~~*0*~~	~~*0*~~	~~*359*~~	~~27.5~~
616.50	1.00			Shale	49.4	122.5	***702.1***	72.3	13.4	860.9	~~702~~	~~*0*~~	~~*0*~~	~~*386*~~	~~28.5~~
615.50	1.00			Shale	49.4	122.5	***751.5***	72.3	13.4	933.1	~~752~~	~~*0*~~	~~*0*~~	~~*413*~~	~~29.5~~
614.50	1.00			Shale	49.4	122.5	***800.9***	72.3	13.4	1005.4	~~801~~	~~*0*~~	~~*0*~~	~~*441*~~	~~30.5~~
613.50	1.00			Shale	49.4	122.5	***850.3***	72.3	13.4	1077.7	~~850~~	~~*0*~~	~~*0*~~	~~*468*~~	~~31.5~~
612.50	1.00			Shale	49.4	122.5	***899.8***	72.3	13.4	1149.9	~~900~~	~~*0*~~	~~*0*~~	~~*495*~~	~~32.5~~
611.50	1.00			Shale		122.5			13.4						

Pile Design Table for East Abutment utilizing Boring #B-2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
29	16	6
45	25	9
59	33	14
86	48	16
115	63	19
335	184	24
Steel HP 10 X 57		
30	17	6
46	25	9
61	33	14
89	49	16
120	66	19
454	250	26
Steel HP 12 X 53		
35	19	6
54	30	9
71	39	11
73	40	14
104	57	16
138	76	19
418	230	24
Steel HP 12 X 63		
36	20	6
55	30	9
73	40	11
74	41	14
106	58	16
143	78	19
497	273	25
Steel HP 12 X 74		
37	20	6
56	31	9
74	41	11
75	41	14
108	59	16
146	80	19
589	324	27
Steel HP 12 X 84		
38	21	6
57	31	9
75	41	11
76	42	14
109	60	16
149	82	19
664	365	28
Steel HP 14 X 73		
43	24	6
65	36	9
87	48	11
90	49	14
126	69	16
169	93	19
578	318	25
Steel HP 14 X 89		
44	24	6
67	37	9
88	49	11
91	50	14
128	71	16
174	96	19
705	388	27
Steel HP 14 X 102		
45	25	6
68	37	9
90	49	11
92	51	14
130	72	16
178	98	19
810	445	28
Steel HP 14 X 117		
47	26	6
69	38	9
91	50	11
93	51	14
133	73	16
183	101	19
929	511	30

Project Name: IL Rte 116 over Rooks Creek
Location: Livingston County, Illinois
Existing Structure: 053-0065
Proposed Structure: 053-0065
MPS Project Number: ME17126

West Abutment Estimated Maximum Pile Elevations (Boring B-1, 2018)

Pile Type and Size	Estimated Pile Refusal Elevation (ft.)
HP 10 x 42	620.0
HP 10 x 57	617.0
HP 12 x 53	620.0
HP 12 x 63	618.0
HP 12 x 74	617.0
HP 12 x 84	615.0
HP 14 x 73	619.0
HP 14 x 89	617.0
HP 14 x 102	615.0
HP 14 x 117	613.0

East Abutment Estimated Maximum Pile Elevations (Boring B-2, 2018)

Pile Type and Size	Estimated Pile Refusal Elevation (ft.)
HP 10 x 42	621.5
HP 10 x 57	619.5
HP 12 x 53	621.5
HP 12 x 63	620.5
HP 12 x 74	618.5
HP 12 x 84	617.5
HP 14 x 73	620.5
HP 14 x 89	618.5
HP 14 x 102	617.5
HP 14 x 117	615.5