STRUCTURE GEOTECHNICAL REPORT

FAP-828 (IL 121) OVER LONG POINT CREEK

SECTION (108BR-1)B
EXISTING STRUCTURAL NUMBER: 018-0012
PROPOSED STRUCTURAL NUMBER: 018-0066

CUMBERLAND COUNTY, IL

Contract Number: 74323
PTB Number: 147-28 WO#7

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9/27/2011

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Bridge Number 018-0012 carrying FAP 828 (Illinois Highway 121) over Long Point Creek in Cumberland County, IL is proposed to be replaced with a two span bridge. See Figure 1 for site location.

The original structure was built in 1928 and underwent complete reconstruction in 1981. The existing bridge for Illinois Highway 121 consists of the reconstructed 33 feet wide roadway and two 44 feet 3 inch spans on closed abutments. The original superstructure was removed and replaced with 11 three feet wide deck beams. The foundations under the original abutments are spread foundations, approximately 3 feet wide by 36 feet long. The existing structure is skewed 45 degrees left. In 2008 and 2009, temporary support beams were placed under two deck beams due to delaminations found during inspection.

The proposed replacement structure will consist of a two span bridge. It will be 155’-2” long. The width will be increased to 39 feet. We understand that the existing grade profile will be raised approximately 1.5 feet. We also understand that the structure meets hydraulic requirements for anticipated flood levels. Stone riprap will be placed on both abutment slopes and across the channel.

Two borings were performed by others on December 12, 2010 to depths of approximately 27 feet and 39.5 feet below grade. The boring logs were provided by IDOT. One boring was drilled on both the north and south approaches to the bridge. Boring Number 1 (B-1) was offset 10 feet to the right of centerline, while Boring Number 2 (B-2) was drilled 7 feet to the left of centerline. Figure 3 shows the boring locations. The borings were above the stream channel level. The top 10 feet is likely fill material or native material and not influenced by alluvial processes. Per IDOT, the borings were considered adequate for the geotechnical report.

The original foundations of the existing bridge are concrete rectangular spread footings. Previous structural loads and drawings were available. Deterioration has been noted during inspections by IDOT. IDOT has decided to replace the current bridge after delamination of the structural beams was found during inspection.

The 45 º skew exceeds the limitation for integral abutments; therefore, stub abutments will be used. The proposed abutments were located so that the existing abutment footing will not interfere with the batter piles in the stub abutments.

3.1 Site Conditions

The topography surrounding the stream consists of gently rolling hills. The floodplain is approximately 600 ft wide. Within its natural channel, the width of the stream is 30 to 40 feet. The land around the bridge is undeveloped. Aerial photographs indicate that the land is wooded or used for farming. The nearest building is located above the channel bank and outside of the flood plain. No sensitive flood receptors were identified in the Hydraulic Report. Buried or overhead utilities may be present and should be identified before construction.

Long Point Creek is skewed 45 degrees left. The current and proposed replacement bridges maintain the same alignment.

There have been no reports of high water for the project location.

3.2 Subsurface Exploration

IDOT conducted a subsurface exploration program consisting of 2 borings drilled to the north and south of the existing structure abutments. Boring locations were taken at the shoulders of IL Hwy. 121. Boring Number (No.) 1 was drilled through the west shoulder just north of the bridge (Station 231+80). Boring Number (No.) 2 was drilled through the east shoulder, south of the bridge (Station 602+30). Boring No. 1 was drilled to a depth of 39.5 feet below ground surface. Boring No. 2 was drilled to 27.3 feet below ground surface. They were drilled using hollow stem augers. Samples were collected using a split spoon sampler. Blow counts were taken using an autohammer with a weight of 140 pounds. Hollow stem augers were used below the groundwater table and created disturbance in the soils, which may have weakened the soils before the standard penetration test (SPT) was conducted. Therefore, the SPT blow counts, as recorded on the logs, may not represent the actual soil density/consistency. Field unconfined compression tests (Rimac tests, pocket penetrometers) were also performed. Boring B-1 was cored from 29.5 feet to 39.5 feet below ground, using a rotary surf set diamond bit. NW conventional double coring barrel with a split inner barrel collected the rock core. Laboratory tests consisted of moisture contents, sieve analysis, and unconfined compression tests on shale samples. IDOT only provided laboratory data on the borings logs.

3.3 Subsurface Conditions

The borings were drilled through the asphalt and concrete pavement for B-1 and B-2, respectively. Surface grade for B-1 was El. 591.64 feet, while B-2 was 591.76 feet. The asphalt is approximately 13 inches thick in B-1. In B-2, the asphalt was 4.25 inches thick, while the concrete was 5.5 inches thick (See Figure 2).

Approximately 12 feet of soft to medium stiff, silty and sandy loams underlies the roadway. (Loam soils have intermediate amounts of sand, silt, and clay. The describing soil is the predominant soil in the loams.) Alluvial sandy loams, silty loams, and sands underlie the embankment soils. By using the hollow stem augers below the groundwater surface, the soils were disturbed before SPT testing commenced. This most likely gave erroneously low blow counts. Clay undrained strengths were calculated using the SHANSEP method (Ladd, 1986) to give more representative results. The sandy loams were very soft to soft. Sands were wet and very loose to loose with 5% to 7% of fines passing the #200 sieve. Shale bedrock is encountered at the bottom of both borings at approximately 25 ft. below ground surface. The split spoon penetrated 4 to 10 inches into the shale. The bedrock was found to be interbedded shale and limestone. The bedrock recovery was 88% in Run 1 and 71% in Run 2. RQD was 53 % in Run 1 and 91% in Run 2. Detailed boring logs are attached.

3.4 Groundwater

Surface water from the stream was present at El. 577.19 feet at the time of drilling. Groundwater was first encountered during drilling in B-1 at El. 577.1 feet and B-2 at El. 569.8 feet These elevations correspond to the elevation of the top of the sand layers. At the 24-hour reading, the water level rose to El. 581.6 feet (B-1) and El. 581.8 feet (B-2). Groundwater at completion was at El. 585.6 feet in B-1 and El. 584.8 feet in B-2.

4.1 Slope Stability

At the existing bridge, the slopes are approximately 14 feet above the stream elevation. The northern bank (left, looking upstream) has a grade of approximately 15°, while the southern bank (right, looking upstream) has a grade of approximately 30°.

Slope stability models were performed using Geoslope Slope/W software to evaluate the wing walls. Boring No. B-2 was used to model the subsurface conditions due to the presence of weaker soils. The drained, undrained, and seismic conditions were performed at the recorded surface water level and at the 50-year flood level. Table 1 shows the factors of safety for the critical failure planes.

Table 1: Factor of Safety for Slope Stability

	Factor of Safety	
	Left Bank	Right Bank
Drained	1.5	1.5
Undrained	1.9	1.5
Seismic	1.3	1.1

Both slopes satisfy the Factor of Safety requirement of 1.5 for fill slopes at bridge embankments for the drained and undrained cases. The seismic factor of safety is discussed in Section 4.2: Seismic Considerations.

4.2 Seismic Considerations

A review of the AASHTO LFRD Bridge Design Specifications shows peak ground acceleration (PGA) of 28.7% (0.287 g) for Cumberland County. The PGA is based on a 7% probability of exceedance in 75 years. IDOT classifies the site as Seismic Performance Zone 2. The soil site class is D. The seismic site coefficients S_{D1} and S_{DS} are 0.192 and 0.416, respectively. Based on the minimum factor of safety of 1.0, seismic slope stability is satisfactory.

Wet sands at depth were characterized as very loose to loose and potentially liquefiable. Liquefaction analysis per IDOT's Simplified Method (Youd, 2001) and Youd & Idriss 1997 methods were performed. Analyses indicated liquefaction would occur in the sands found in B-2, where settlement of up to 4.5 inches is possible (Youd & Idriss 1997).

4.3 Foundations

The proposed bridge will maintain the same skew as the existing structure. The bridge will increase to 39 feet wide and 155'-2" long. Abutments are designed to be stub abutments.

The Hydraulic Report discussed scour for the existing bridge. The 10-year flood velocity of the stream through the bridge is estimated to be 3.37 ft/s. Stone riprap is recommended for placement at both ends of the bridge abutment slopes and across the channel. A scour depth of 13.6 feet (EL. 566) at the pier is anticipated for the combined pier and contraction scour for the design 100-year storm event. Scour was estimated using reductions from the IDOT Bridge Manual to account for the soft alluvial soils and shale bedrock, which is more susceptible to scour. Scour elevations for the bridge as show in the table below.

Table 2: Design Scour Elevations

	Design Scour Elevation (ft)
North Abutment	585.23
Pier	566.00
South Abutment	585.25

4.3.1 Spread Footings

The soils beneath the structure have inadequate bearing capacity for spread footings. The bearing capacity analyses after the removal of the soil and replacement with crushed rock did not improve sufficiently to allow spread footing support for the applied load from the bridge. The load from the structure also could induce large settlements within the soft soils. Given the depth to competent bedrock, groundwater level, and the scour potential at the site, spread footings would be unfeasible.

4.3.2 Drilled Shafts

Drilled shafts could be implemented at the site, due to the shallow proximity to bedrock. The load of the structure would be carried by the end bearing or skin friction load in the bedrock in the shaft rock socket. The excavation into the shale and limestone rock to achieve an additional 10 feet below the scour depth would require "wet" construction methods be used, due to the presence of groundwater during construction. The shafts will require casing to maintain an open hole and minimize shale softening. Concrete would be tremied from the bottom of the shaft during installation. Due to the constructability issues of installing drilled shafts, driven piles would be more practical foundations.

4.3.3 Driven Piles

Driven piles prove to be the most feasible for the site. For stub abutments due to the bridge skew, H-pile or metal shell (MS) piles were considered. The piles will encounter refusal in the shale or limestone. Refusal on the shale or limestone would be sudden and could damage the integrity of the metal shell piles. With the exception of the pier, the bedrock is greater than 10 feet below the ground surface, allowing for adequate embedment of the piles. Top of rock is anticipated to be approximately 27 feet below the ground surface at the abutments (EL 564.6 feet). The top of pile cut-off is EL 586.23 for the north abutment and EL 586.25 for the south abutment, according to the TS&L (Appendix A). In the case of the center pier, the embedment will need to be deepened due to the scour predictions of 13.6 feet below ground surface. Scour was estimated using reductions to account for the soft alluvial soils and shale bedrock, which is more susceptible to scour. The bedrock will need to be pre-drilled an additional 10 feet, per IDOT requirements, to get the pile tip below the scour depth of El 566 feet. The pier pile would be set in rock and encased in concrete.

IDOT recommends using the Modified IDOT Static method to calculated pile capacity and embedment. Below are the pile design tables for H-piles at the north abutment and south abutment. It contains values for the Nominal Required Bearing (NRB) at the top of rock, two to three feet into bedrock and the maximum nominal required bearing with corresponding depth to achieve it. Factored resistance values are given for the corresponding NRB values. While downdrag, scour, and liquefaction have been evaluated, these cases do not control design and are not shown in Table 3.

Table 3: North Abutment Pile Design Table

Pile Type	Maximum Nominal Required Bearing of Pile (kips)	Pile Length at Maximum Nominal Required Bearing (ft)	Maximum Factored Resistance Available (kips)	Nominal Required Bearing of Pile (kips)		Factored Resistance Available (kips)	
				Top of Rock	2 ft into Rock	Top of Rock	2 ft into Rock
Steel HP 8 X 36	286	24.5	157	88	179	48	98
Steel HP 10 X 42	335	24.5	184	109	230	60	127
Steel HP 10 X 57	454	25	250	114	235	62	129
Steel HP 12 X 53	418	24.5	230	131	276	72	152
Steel HP 12 X 63	497	25	273	135	282	74	155
Steel HP 12 X 74	589	25.5	324	139	286	76	157
Steel HP 12 X 84	664	25.5	365	142	290	78	160
Steel HP 14 X 73	578	24.5	318	160	334	88	184
Steel HP 14 X 89	705	25	388	165	341	91	187
Steel HP 14 X 102	810	26.5	446	169	345	93	190
Steel HP 14 X 117	929	27	511	174	352	96	193

Note: Pile length is approximately 22 feet from pile cut-off to top of rock.

Table 4: South Abutment Pile Design Table

Pile Type	Maximum Nominal Required Bearing of Pile (kips)	Pile Length at Maximum Nominal Required Bearing (ft)	Maximum Factored Resistance Available (kips)	Nominal Required Bearing of Pile (kips)		Factored Resistance Available (kips)	
				Top of Rock	2 ft into Rock	Top of Rock	2 ft into Rock
Steel HP 8 X 36	286	26	157	96	184	53	101
Steel HP 10 X 42	335	25.5	184	119	240	66	132
Steel HP 10 X 57	454	26.5	250	124	245	68	135
Steel HP 12 X 53	418	26	230	143	288	79	158
Steel HP 12 X 63	497	26.5	273	147	294	81	162
Steel HP 12 X 74	589	26.5	324	151	298	83	164
Steel HP 12 X 84	664	28.5	365	154	302	85	166
Steel HP 14 X 73	578	26.5	318	174	348	96	192
Steel HP 14 X 89	705	26.5	388	180	355	99	195
Steel HP 14 X 102	810	28.5	446	183	360	101	198
Steel HP 14 X 117	929	28.5	511	189	366	104	201

Note: Pile length is approximately 22 feet from pile cut-off to top of rock.

Seismic resistance was analyzed; however, the factored resistance is higher than the resistance for the static case. Therefore, it is not controlling and is not presented in this report. Given the bridge loading, soft subsurface soils, and the bedrock conditions, HP14X73 is recommended for use for the foundations. A maximum of 5 feet spacing from center to center of the piles is needed to provide support of the foundation at the abutments.

The piles for the pier will need to be set on rock. In this situation, the H-pile will be encased in concrete. For a HP 14x73 pile, the diameter of the pre-drilled hole would be 30 inches to account for concrete encasement. The maximum nominal resistance for a HP 14X73 pile is 749 kips. Unit values for skin friction in the rock and end bearing are 5 ksf and 101 ksf, respectively. The pier foundations are extended to El 556 or approximately 23.5 feet length from the stream bed ground surface. The rock socket depth for all piles at the pier should be a minimum of 10 feet. The total factored resistance for both skin friction and end bearing is anticipated to be 500 kips for this embedment depth.

L-Pile software was used to calculate the lateral loads exerted on the piles. The table below gives the L-pile parameters used to find the lateral loads acting upon the HP14X73 pile.

Table 5: North Abutment L-Pile Parameters

IDOT Soil Type	L-Pile Model	Depth (in)	γ (pci)	C (psi)	E_{50}	Φ	K	E_r (psi)	U_c (psi)	RQD (%)	k_{rm}
Silty Loam	Soft Clay	0-144	0.069	3.47	0.02	-	-	-	-	-	-
Sandy Loam	Soft Clay	144-175.2	0.03	2.08	0.02	-	-	-	-	-	-
Sand	Sand	175.2-187.2	0.03	-	-	32	20	-	-	-	-
Sandy Loam	Soft Clay	187.2-264	0.03	4.17	0.02	-	-	-	-	-	-
Sand	Sand	264-300	0.03	-	-	32	20	-	-	-	-
Shale	Weak Rock	300-480	0.039	86.4	-	-	-	17,300	172.8	53	0.0003

Note: Top of pile at El. 591.64 feet.

Table 6: Pier L-Pile Parameters

IDOT Soil Type	L-Pile Model	Depth (in)	γ (pci)	C (psi)	E_{50}	Φ	K	E_r (psi)	U_c (psi)	RQD (%)	k_{rm}
Sandy Loam	Soft Clay	0-29.3	0.03	2.08	0.02	-	-	-	-	-	-
Sand	Sand	29.3-41.3	0.03	-	-	32	20	-	-	-	-
Sandy Loam	Soft Clay	41.3-118.1	0.03	4.17	0.02	-	-	-	-	-	-
Sand	Sand	118.1-154.1	0.03	-	-	32	20	-	-	-	-
Shale	Weak Rock	154.1-480	0.039	86.4	-	-	-	17,300	172.8	53	0.0003

Note: Top of pile at El. 579.6 feet.

Table 7: South Abutment L-Pile Parameters

IDOT Soil Type	L-Pile Model	Depth (in)	γ (pci)	C (psi)	E_{50}	Φ	K	E_r (psi)	U_c (psi)	RQD (%)	k_{rm}
Sandy Loam	Soft Clay	0 - 84	0.067	2.08	0.02	-	-	-	-	-	-
Silty Loam	Soft Clay	84-120.5 120.5-144	0.069 0.033	3.82	0.02	-	-	-	-	-	-
Sandy Loam	Soft Clay	144-174	0.03	4.17	0.02	-	-	-	-	-	-
Sand	Sand	174-204	-	-	-	32	20	-	-	-	-
Sandy Loam	Soft Clay	204-246	0.03	4.17	0.02	-	-	-	-	-	-
Silty Loam	Soft Clay	246-306	0.033	4.17	0.02	-	-	-	-	-	-
Shale	Weak Rock	300-480	0.039	86.4	-	-	-	17,300	172.8	53	0.0002

Note: Top of pile at El. 591.76 feet.

Lateral loads for both free-head and fixed-head conditions are shown in the tables below. The lateral loads were modeled using a ¼ inch and ½ inch deflection acting on the HP14X73 pile. All piles were modeled from the existing ground surface. Figures 6 through 14 show the depth vs. deflection, depth vs. bending moment, and depth vs. shear plots.

Table 8: Unfactored Lateral Capacities for HP14X73 with ¼ inch Deflection

	Free-Head			Fixed-Head			
Location	P_{Lat} (kips)	M^+_{max} (k-in)	Depth to M^+_{max} (ft)	P_{Lat} (kips)	M^+_{max} (k-in)	M^-_{max} (k-in)	Depth to M^+_{max} (ft)
North Abutment	-5.3	433	8 - 9	-11.9	358	-973	12 - 13
Pier	-13.2	474	7 - 8	-29.5	668	-1,244	13 - 14
South Abutment	-5.3	455	7 - 8	13.5	327	-1,000	13 - 14

Table 9: Unfactored Lateral Capacities for HP14X73 with ½ inch Deflection

	Free-Head			Fixed-Head			
Location	**P_{Lat} (kips)**	**M^{+}_{max} (k-in)**	**Depth to M^{+}_{max} (ft)**	**P_{Lat} (kips)**	**M^{+}_{max} (k-in)**	**M^{-}_{max} (k-in)**	**Depth to M^{+}_{max} (ft)**
North Abutment	-8.4	746	8 - 9	17.2	610	-1,613	14 - 15
Pier	-27	846	8 - 9	-50.9	1,285	-2,242	13 - 14
South Abutment	-8.4	765	8 - 9	19.0	570	-1,627	15 - 16

4.4 Settlement

The recommended foundation type for the bridge is H-piles. Elastic settlement of the piles is expected from pile foundations driven into rock and set into rock. Settlement of the bedrock is negligible. From preliminary profiles, 2 feet rip rap is to be added to the abutment embankments. We understand that the current design footprint will be approximately that of the existing bridge span. Therefore, settlement is likely to be minimal adjacent to the bridge.

4.5 Construction Considerations

Soil excavation for the abutments may be made by open cutting. The slopes should be no steeper than 1.5(H):1(V), which equates to a slope angle of ~ 34°. This complies with OSHA requirements for Soil Type C. Some minor sloughing should be anticipated. If sloping is not practical, soldier piles and lagging, sheet piles, or a trench box may be appropriate. If the excavation extends deeper than 12 feet, internal bracing should be used. Shoring should be designed by a Structural Engineer registered in the State of Illinois. It is anticipated that IL Hwy 121 will be kept open during construction. The work will be staged to maintain at least one open lane. Temporary shoring along the centerline at the abutment slopes will be needed during demolition and construction of the adjacent lane. The northbound lane will be removed and constructed first. After completion of the northbound lane, demolition and construction will move to the southbound lane. A temporary soil retention system is feasible for this project. Cuts are not anticipated to be greater than 10 feet.

There is a residential area near the bridge location. Overhead utilities are present just east of the bridge. Underground utilities should be identified before construction.

Abutment wingwalls should be designed using active earth pressures stated in the Illinois Department of Transportation Bridge Manual. The active earth pressure for soils is 40 pcf for wingwalls when utilizing stub abutments, per the IDOT Bridge Manual. The recommended design for the wingwalls is a parallel wall with stub abutments. The at-rest earth pressure is 0.5.

For frost protection, the foundations should be embedded 3 feet below ground surface.

A review of Illinois State Geological Survey map database showed no known coal mining occurred in the vicinity of the bridge. Therefore, no mine subsidence should occur under the bridge. The previous bridge condition report did not mention any subsidence at the abutments of the existing bridge.

Backfill is required to bring the roadway up to the proposed grade. From the Plan and Profile Sheet provided by IDOT, less than 2 feet of additional fill will be used to bring the roadway surface up to finished grade. Non-organic native or imported soils may be used for the backfill. All backfill and fill material should be placed and compacted following IDOT standard specifications.

This report discusses the geotechnical aspects of the proposed improvements and provides our recommendations. Because actual subsurface conditions can vary from those inferred from the borings, it is important that the geotechnical engineer of record be present on-site during foundation and earthwork construction to confirm that soil conditions match the design assumptions. Consequently, we recommend that URS be retained to document earthwork and foundation construction. We also recommend that we review plans and specifications related to our work to verify that our recommendations have been properly interpreted.

This report is based on our understanding of the project as described and was prepared to provide recommendations for a two-span bridge. Major changes in either loads or geometry could affect our findings and should be considered to invalidate the conclusions and recommendations until we have reviewed the changes and, if necessary, modified our finding accordingly.

The boring logs depict subsurface conditions for the specific locations and dates. The recommendations and observations presented in the report assume that significant variations do not occur. Non-uniform conditions, however, often cannot be determined by the procedures described. Such conditions may necessitate additional expenditures to obtain a properly constructed project. We recommend that a contingency fund be budgeted to accommodate such possible expenditures.

The boring logs were produced by a party other than the geotechnical engineer. We have assumed that the data provided was accurate. All calculations and recommendations were based on this data. URS is not responsible should actual field conditions differ from than reported on the boring logs.

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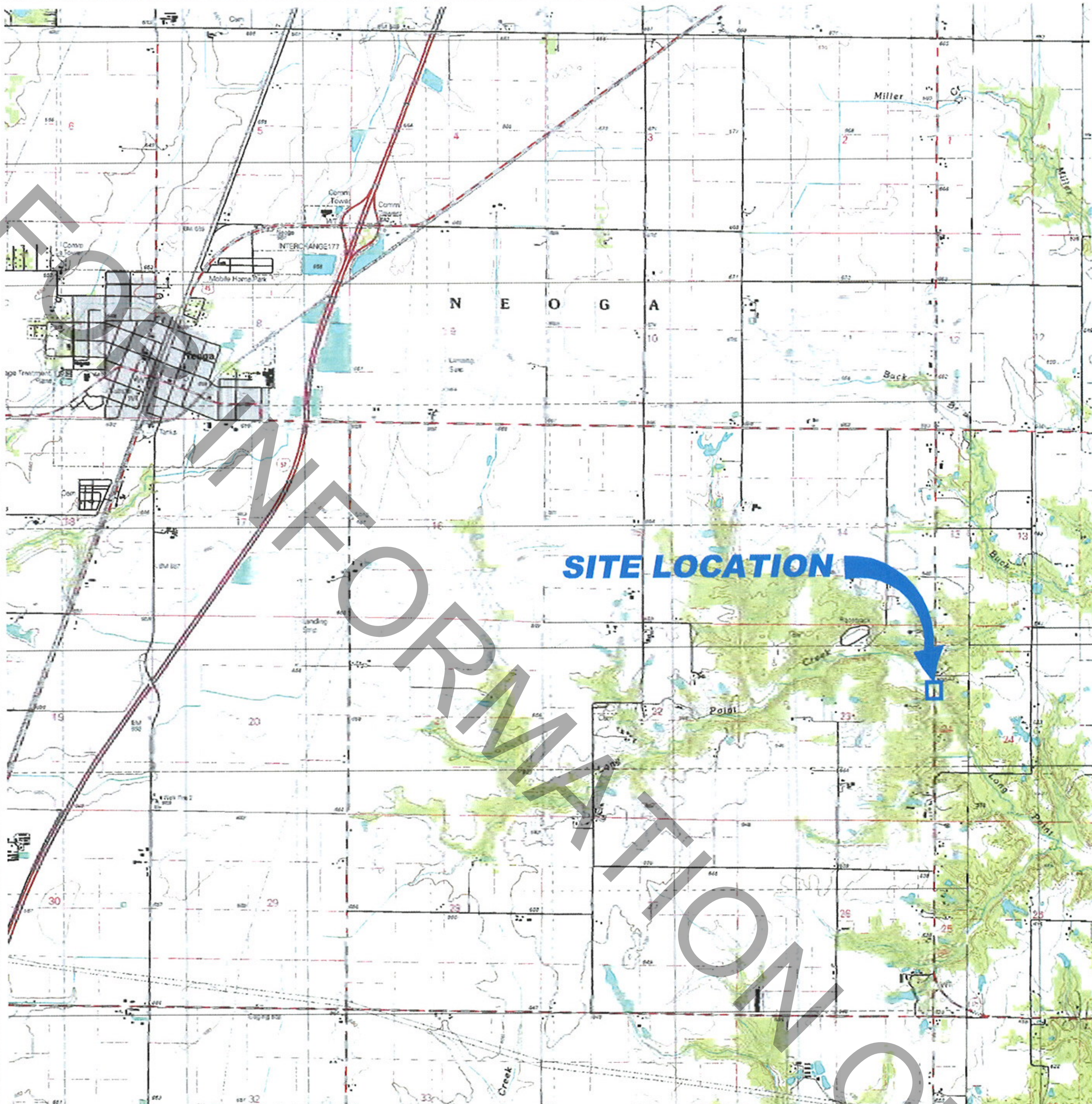
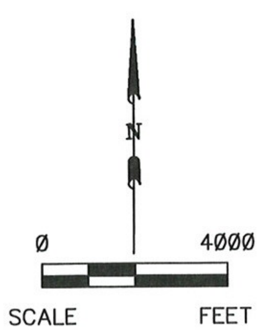


SOURCE: MAP TAKEN FROM ELECTRONIC USGS DIGITAL RASTER GRAPHIC 7.5 MINUTE TOPOGRAPHIC MAP OF JOHNSTOWN, ILLINOIS. REVISED 1998 AND NEOGA, ILLINOIS. REVISED 1998..



QUADRANGLE LOCATION

IDOT ILLINOIS HWY 121 BRIDGE ROUTE FAP 828 (IL 121), SECTION (108BR-1)B CUMBERLAND COUNTY, ILLINOIS	PROJECT NO. 36432847

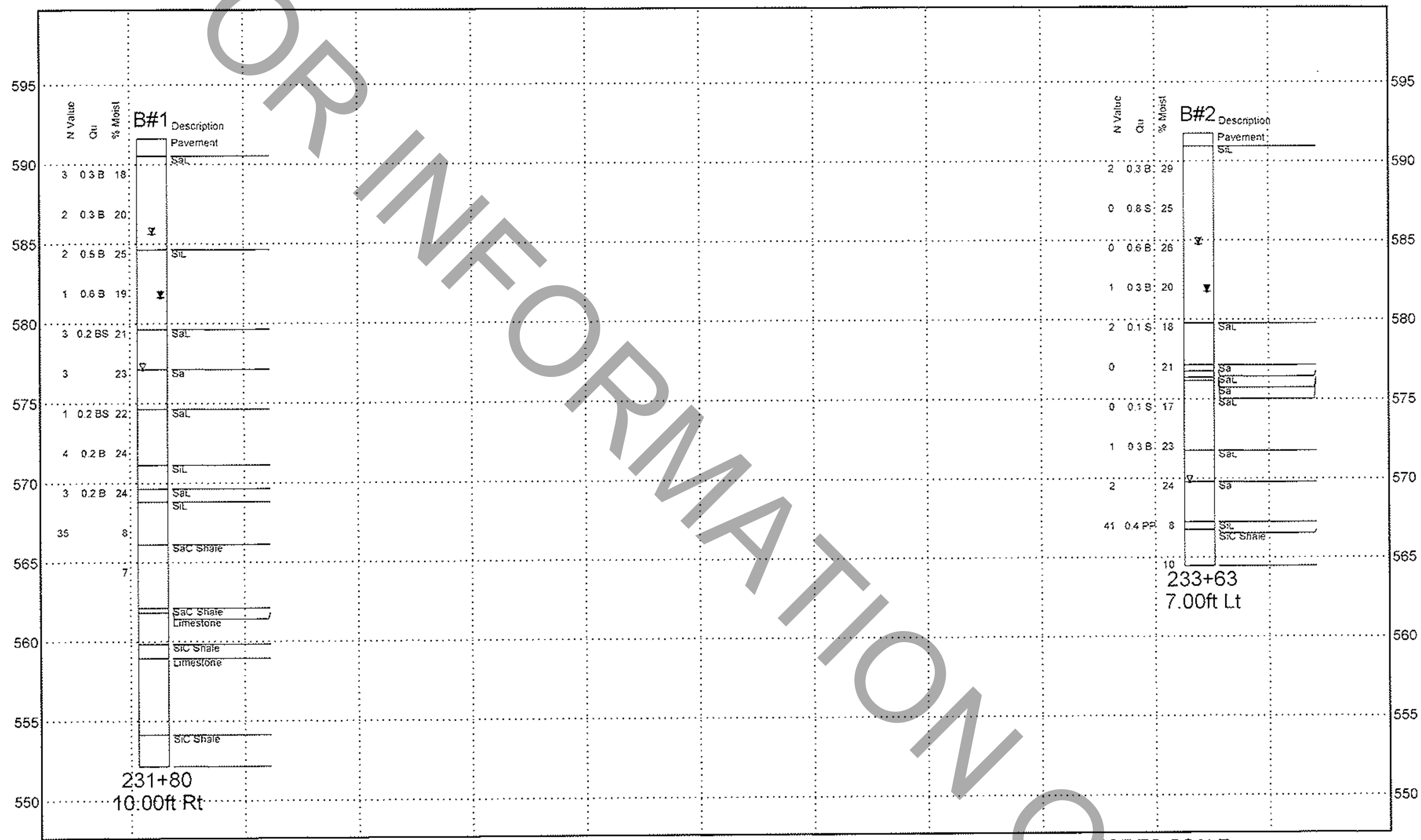
URS

DRN. BY: djd April 2011 DSGN. BY: djd CHKD. BY: sav	Site Location Map	FIG. NO. 1

File: P:\GEOTECHNICAL\DECATUR MISC\PTB 147-28\IL 121\FIGURES\FIG-1 SITE LOCATION MAP.DWG Last edited: APR. 12, 11 @ 5:25 p.m. by: david_deguire

File: P:\GEOTECHNICAL\DECATUR_MISC\PTB_147-28\IL_121\FIGURES\FIG-2_SUBSURFACE_PROFILE.DWG Last edited: APR. 12, 11 @ 5:24 p.m. by: david_deguire

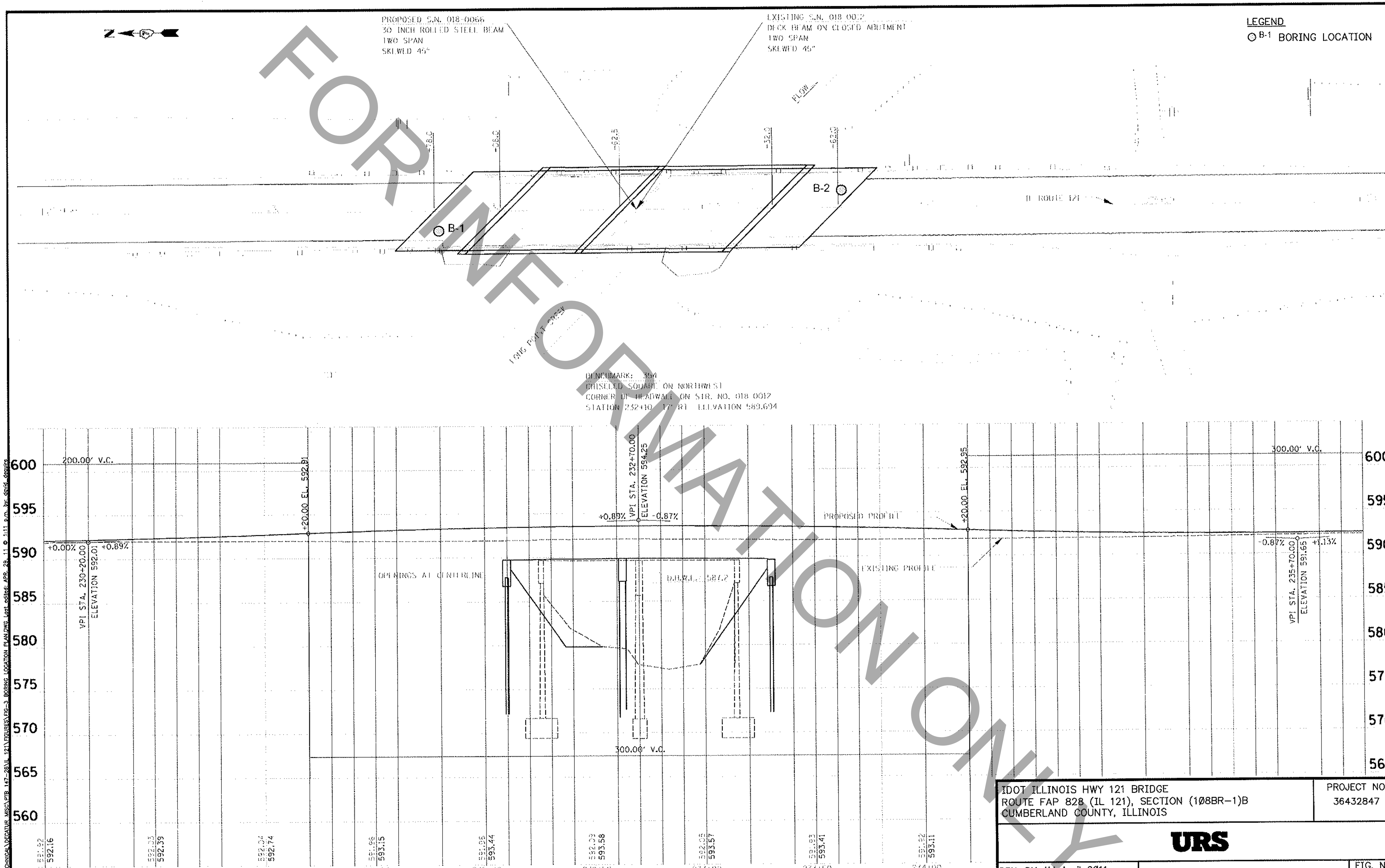
Structure Number 018-0012 Long Point Creek
Located in the NE 1/4 - Sec 23, NW 1/4 - Sec 24 of Section , Township 10 N, Range 7 E of the 3 P.M.



NOT TO SCALE

IDOT ILLINOIS HWY 121 BRIDGE ROUTE FAP 828 (IL 121), SECTION (108BR-1)B CUMBERLAND COUNTY, ILLINOIS	PROJECT NO. 36432847
URS	
DRN. BY: djd April 2011 DSGN. BY: djd CHKD. BY: sav	Subsurface Profile — FIG. NO. 2

SOURCE:
ILLINOIS DEPARTMENT OF TRANSPORTATION, BRIDGE CONDITION REPORT



SOURCE:
ILLINOIS DEPARTMENT OF TRANSPORTATION, PLAN AND PROFILE SHEET, STRUCTURE Ø18-ØØ12.

IDOT ILLINOIS HWY 121 BRIDGE ROUTE FAP 828 (IL 121), SECTION (1Ø8BR-1)B CUMBERLAND COUNTY, ILLINOIS	PROJECT NO. 36432847
URS	
DRN. BY: djd April 2Ø11 DSGN. BY: djd CHKD. BY: sav	Boring Location Plan — FIG. NO. 3

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 12/12/10

ROUTE FAP 828 (IL 121) **DESCRIPTION** Long Point Creek **LOGGED BY** E. Sandschafer

SECTION (108BR-1)B **LOCATION** NE 1/4 - Sec 23, NW 1/4 - Sec 24, **SEC.**, **TWP.** 10 N, **RNG.** 7 E, 3 **PM**

COUNTY Cumberland **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 018-0012
Station 232+70

BORING NO. 1
Station 231+80
Offset 10.00ft Rt
Ground Surface Elev. 591.64 ft

Surface Water Elev. 577.19 ft
Stream Bed Elev. 576.99 ft

Groundwater Elev.:
First Encounter 577.1 ft
Upon Completion 585.6 ft
After 24 **Hrs.** 581.6 ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
13" asphalt pavement.	590.54				
Soft, damp, brown to gray, SANDY LOAM.			0		
			1	0.3	18
			2	B	
		-5	0		
			1	0.3	20
			1	B	
	584.64				
Soft to medium, damp, gray, SILTY LOAM.			0		
			1	0.5	25
			1	B	
		-10	0		
			0	0.6	19
w/ trace Sand.			1	B	
	579.64				
Very soft, very damp, gray, SANDY LOAM.			1		
			1	0.2	21
			2	BS	
	577.14				
Very loose, wet, brown, fine grained, SAND. *5% passing #200 sieve.*		-15	1		
			1		23
			2		
	574.64				
Very soft, wet, gray, SANDY LOAM.			1		
			1	0.2	22
			0	BS	
		-20	1		

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	571.14		2	0.2	24
Very soft, wet, gray, SILTY LOAM.			2	B	
	569.64				
Gray, SANDY LOAM.			0		
	568.84		2	0.2	24
Very soft, wet, gray, SILTY LOAM.			1	B	
		-25	0		
	566.14		1		8
Very dense, very moist, gray, SANDY CLAY SHALE.			34		
			50/3"		
			50/2"		7
			50/2"		
	562.14				
Borehole continued with rock coring.		-30			
		-35			
		-40			

Latitude W 88 deg 22.706 min, Longitude N 39 deg 17.839 min, Map Datum WGS 84

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, from 137 (Rev. 8-99)

Figure 4

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 12/12/10

ROUTE FAP 828 (IL 121) DESCRIPTION Long Point Creek LOGGED BY E. Sandschafer

SECTION (108BR-1)B LOCATION NE 1/4 - Sec 23, NW 1/4 - Sec 24, SEC. , TWP. 10 N, RNG. 7 E, 3 PM

COUNTY Cumberland CORING METHOD Rotary, surf set diamond bit

STRUCT. NO. 018-0012
Station 232+70

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner

BORING NO. 1
Station 231+80
Offset 10.00ft Rt
Ground Surface Elev. 591.64 ft

Core Diameter 2.06 in
Top of Rock Elev. 566.14 ft
Begin Core Elev. 562.14 ft

Description	Elev.	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Soft, gray, SANDY CLAY SHALE.	~~562.14~~ 561.84	-30	B1C1	88	53	1.5	
Gray, slight to moderately weathered, Est LIMESTONE, scratches w/ moderate pressure.	559.84						
Gray, moderately weathered, SILTY CLAY SHALE.	558.94						
Gray, slightly weathered, Est LIMESTONE, scratches w/ hard pressure. *Rockcore B1C1 from 32.9' to 33.4' depth, Qu = 1214 tsf.*							
		-35	B1C2	71	91	1.4	
	554.14						
Bluish gray, moderately weathered, SILTY CLAY SHALE. *Rockcore B1C2 from 38.0' to 38.5' depth, Qu = 7.1 tsf.*	552.14						
Extent of exploration. Benchmark: BM 354 chiseled square on NW corner of existing bridge headwall, Sta 232+10, 17' Rt, Elevation = 589.69'.		-40					
		-45					

Color pictures of the cores Available on request
Cores will be stored for examination until 10/12/2015
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Figure 4

Field Rock Core Log a.xls

Field Rock Core Log

Date: 10-12-10

Structure # : 018-0012 Boring # : B1 N ABUT

Rock Core # : C1

Depth: 29.5

Depth (ft)	Description	Joints
1	GREY SANDY CLAY SHALE SOFT; SPLIT VERTICALLY	0.30 OJ
	GREY LIMESTONE LIKE ROCK; MODERATE WEATHERING	0.55 OJ, 0.65 OJ, 0.75 OJ
	Scratches w/ moderate pressure	1.20 OJ
2	SLIGHT to moderate weathering	1.80 OJ
(31.8')	GREY SILTY CLAY SHALE	2.27 OJ, 2.58 OJ, 2.65 OJ
3	MODERATE WEATHERING	3.15 OJ
(32.7)	GREY LIMESTONE LIKE ROCK	3.35 OJ
4	SLIGHT WEATHERING	3.95, 4.23, 4.40
5		

CORE TO TEST (3.35 – 3.95)

RQD

0.43
0.53
0.49
0.37
0.83
2.65

Depth: 34.5

Core Time: 7:26 (1.5 min/ft)

Recovery: 88%

RQD: 53%

Rock Core # : C2

Depth: 34.5

Depth (ft)	Description	Joints
1	GREY LIMESTONE LIKE ROCK; HARD TO SCRATCH; SLIGHT WEATHERING	0.45 OJ, 0.51 OJ
2		
3	severe weathering	2.65 OJ, 2.70 OJ, 2.89 OJ, 2.91 OJ, 2.97 CJ
(37.5')	BLUISH GREY SILTY CLAY SHALE w/ MOD WEATHERING	3.29 OJ, 3.45 OJ, 3.47
4		4.0
	split vertically	4.40 OJ, 4.55
5		

CORE TO TEST (3.47 – 4.0)

RQD

0.45
2.14
0.97
3.56

Depth: 39.5

Core Time: 7:11 (1.4 min/ft)

Recovery: 71%

RQD: 91%

Logged By: Eric Sandschafer

Figure 4

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/13/10

ROUTE FAP 828 (IL 121) **DESCRIPTION** Long Point Creek **LOGGED BY** E. Sandschafer

SECTION (108BR-1)B **LOCATION** NE 1/4 - Sec 23, NW 1/4 - Sec 24, **SEC.** , **TWP.** 10 N, **RNG.** 7 E, 3 **PM**

COUNTY Cumberland **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 018-0012
Station 232+70

BORING NO. 2
Station 233+63
Offset 7.00ft Lt
Ground Surface Elev. 591.76 ft

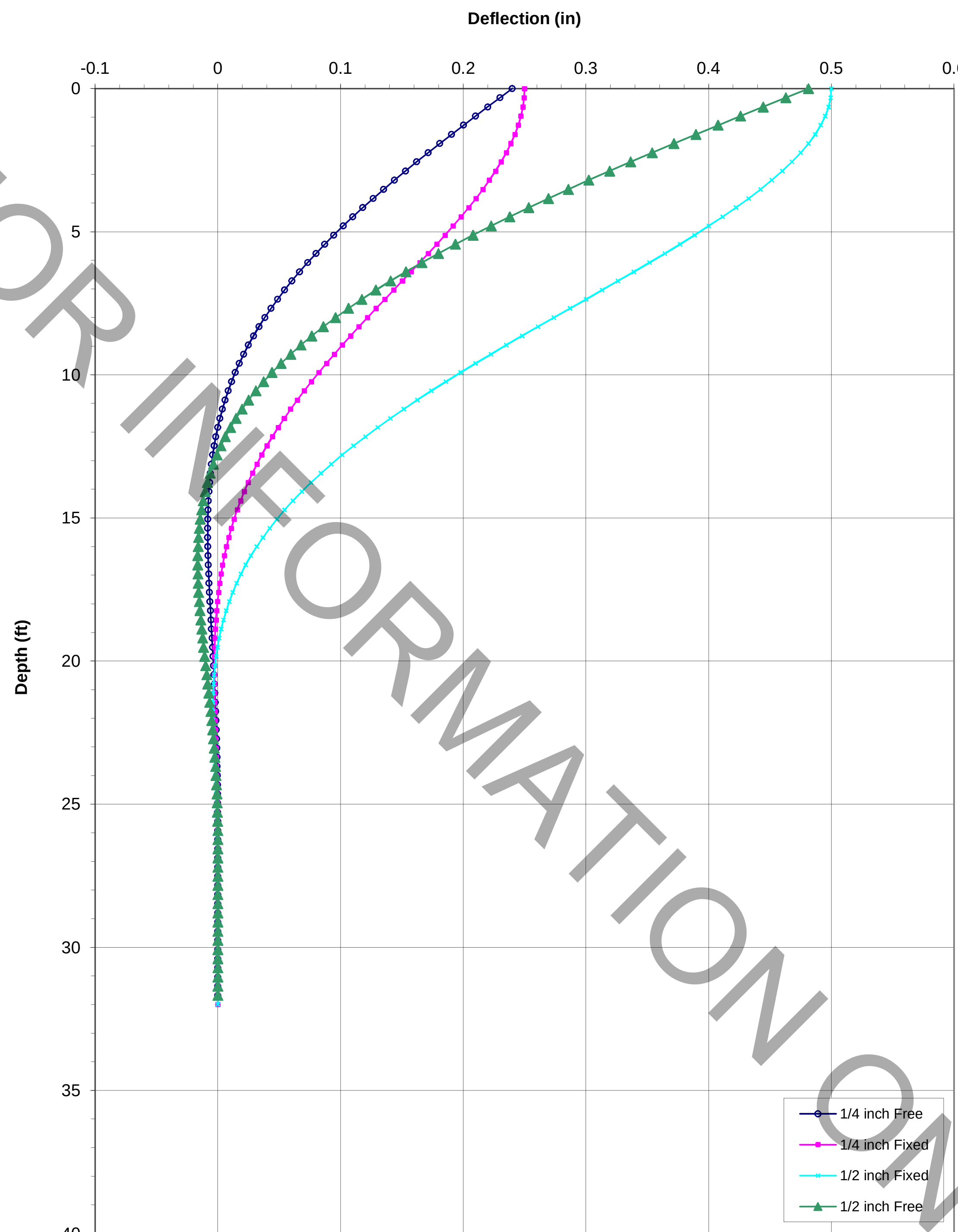
Surface Water Elev. 577.19 ft
Stream Bed Elev. 576.99 ft

Groundwater Elev.:
First Encounter 569.8 ft
Upon Completion 584.8 ft
After 24 **Hrs.** 581.8 ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 1/4" asphalt on 5 1/2" concrete pavement.	590.96				
Soft to medium, damp, gray/reddish brown/brown, SILTY LOAM.			2		
			1	0.3	29
			1	B	
		-5	1		
			0	0.8	25
			0	S	
			1		
			0	0.6	26
			0	B	
		-10	0		
			0	0.3	20
			1	B	
	579.76				
Very soft, damp, brown, SANDY LOAM.			0		
			1	0.1	18
			1	S	
	577.16				
Gray, fine grained, SAND. 7% *passing #200 sieve.*	576.76	-15	1		
Gray, SANDY LOAM.	576.36		0		21
Gray, fine grained, SAND.	576.16		0		
Very soft, wet, brown, SANDY LOAM.			1		
			0	0.1	17
			0	S	
	571.76	-20	1		
Soft, damp, gray, SANDY LOAM w/ trace Silt.			1	0.3	23
			0	B	
	569.76				
Very loose, wet, gray, fine grained, SAND. *7% passing #200 sieve.*			1		
			1		24
			1		
	567.26				
Gray, SILTY LOAM.	566.76	-25	10		
Very dense, moist, gray, SILTY CLAY SHALE.			41	0.4	8
			50/4"	PP	
	564.46		50/2"		10
Extent of exploration.			50/1"		
			50/1"		
Benchmark: BM 354 chiseled square on NW corner of existing bridge headwall, Sta 232+10, 17' Rt, Elevation = 589.69'.		-30			
		-35			
		-40			

Latitude W 88 deg 22.701 min. Longitude N 39 deg 17.808 min. Map Datum WGS 84

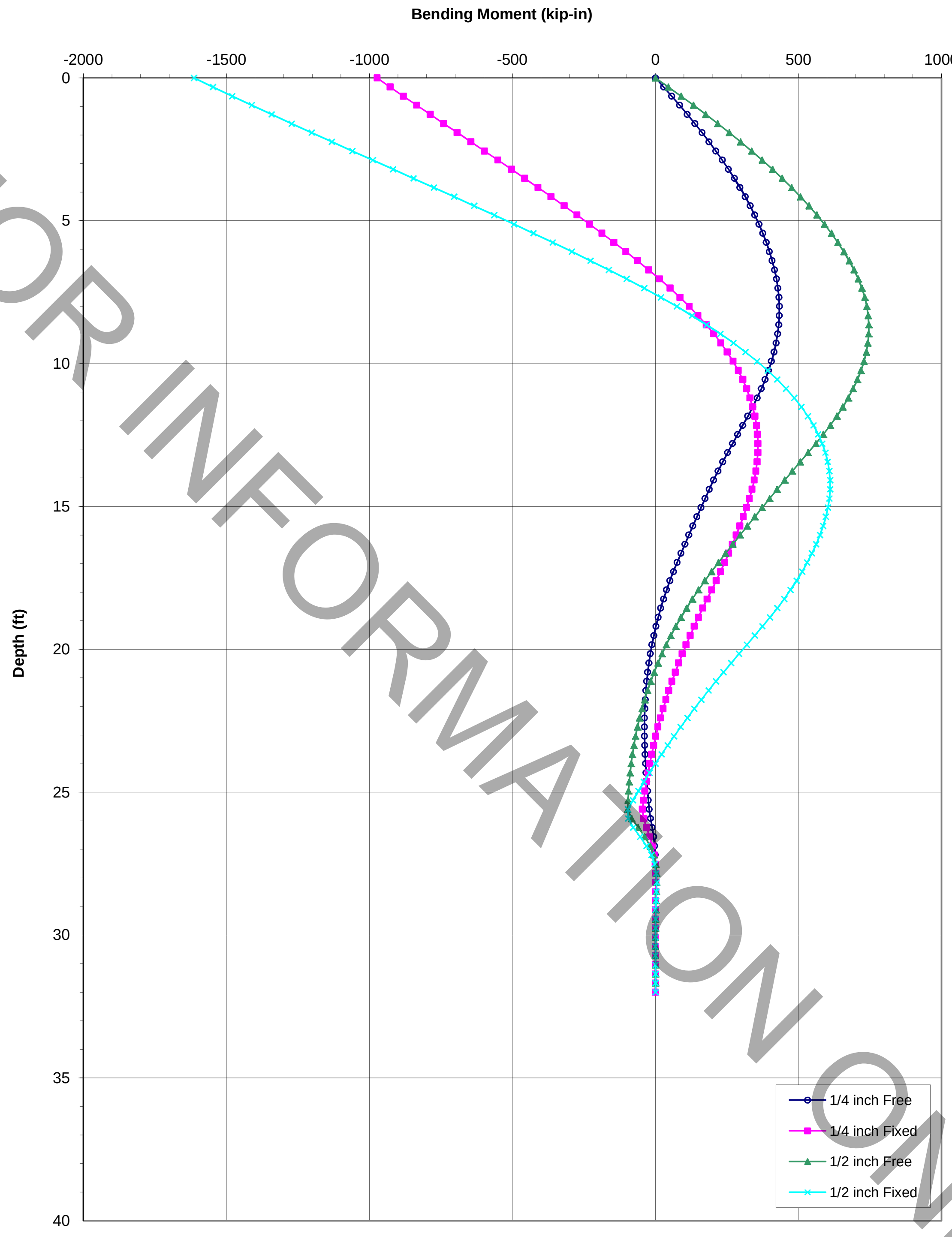
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



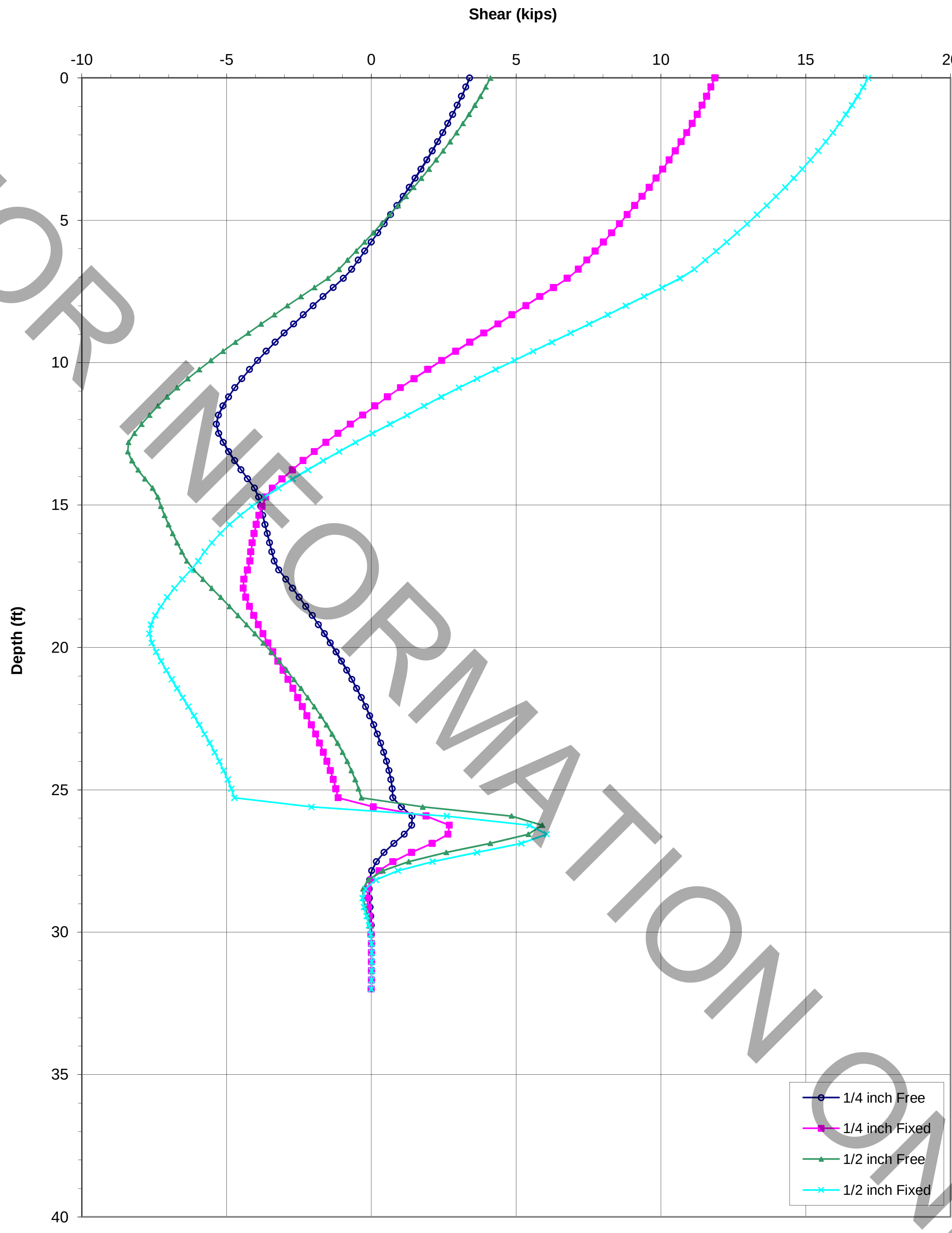
IDOT Illinois Hwy 121 Bridge Cumberland County, IL	PROJECT NO. 36432847

URS

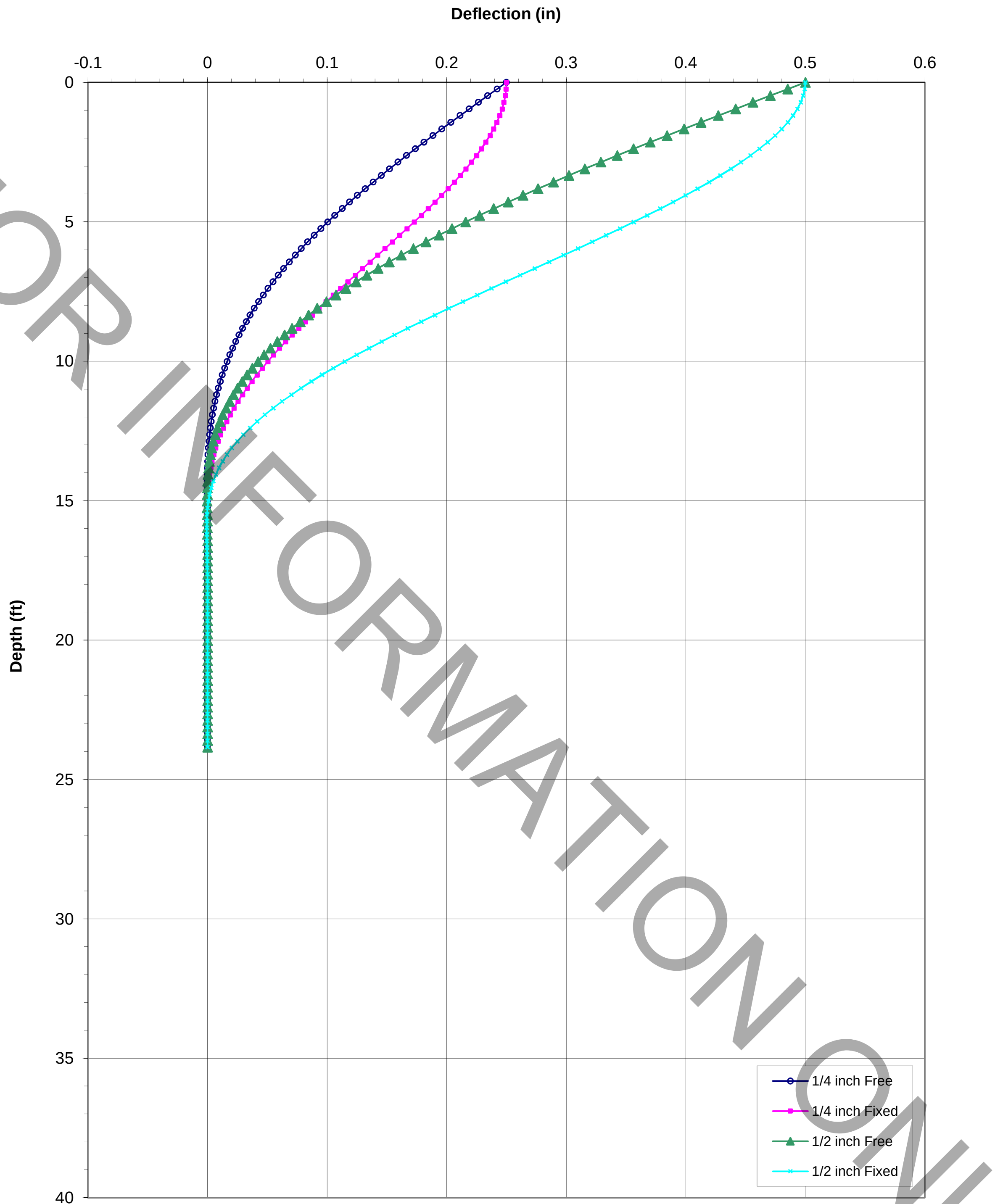
DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Deflection North Abutment HP 14X73	FIG. NO. 6



IDOT Illinois Hwy 121 Bridge Cumberland County, IL			PROJECT NO. 36432847
URS			
DRN. BY:	SAV	Depth vs. Bending Moment North Abutment HP 14X73	FIG. NO. 7
DSGN. BY:	SAV		
CHKD. BY:	EJG		



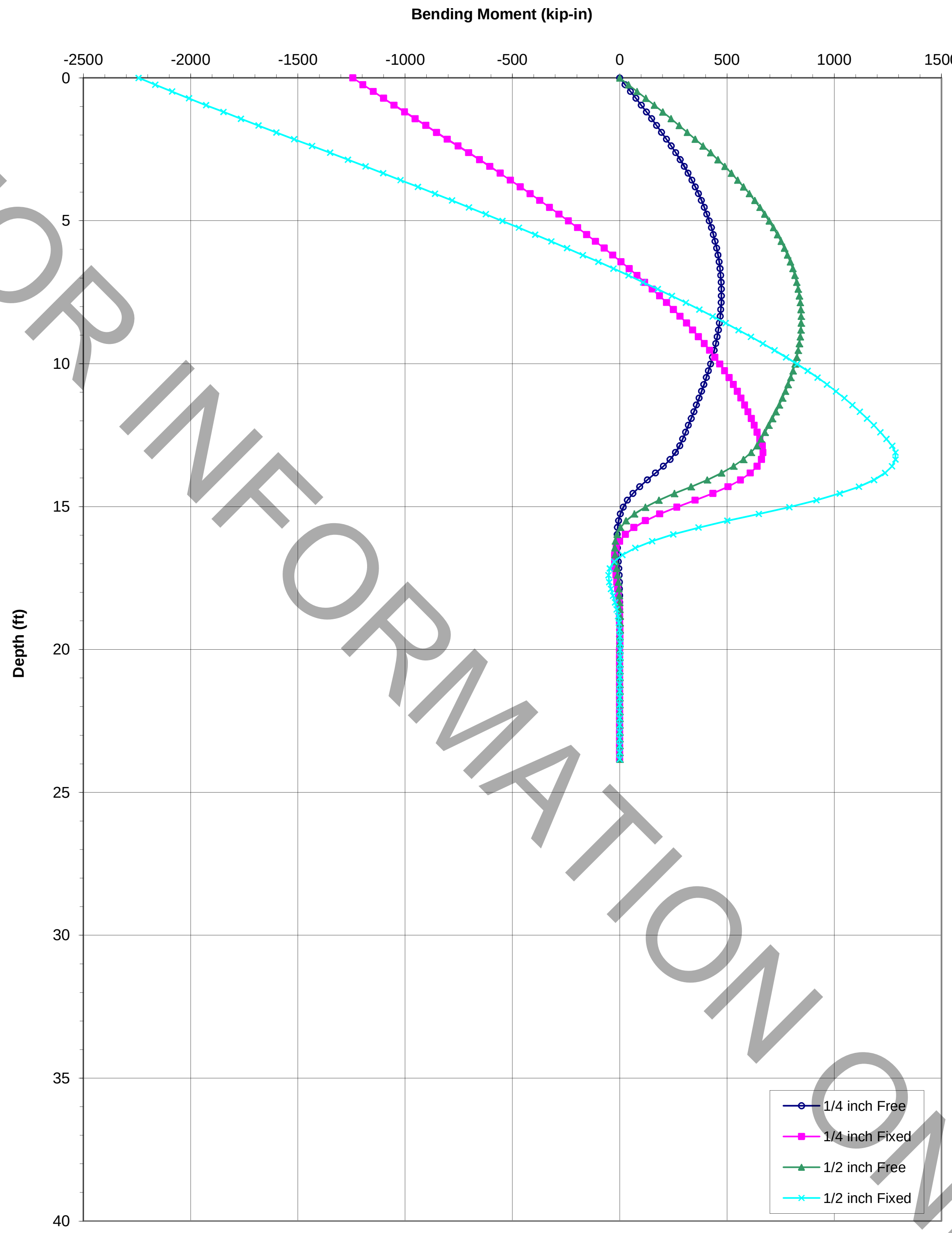
IDOT Illinois Hwy 121 Bridge Cumberland County, IL		PROJECT NO. 36432847
URS		
DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Shear North Abutment HP 14X73	FIG. NO. 8



IDOT Illinois Hwy 121 Bridge Cumberland County, IL	PROJECT NO. 36432847

URS

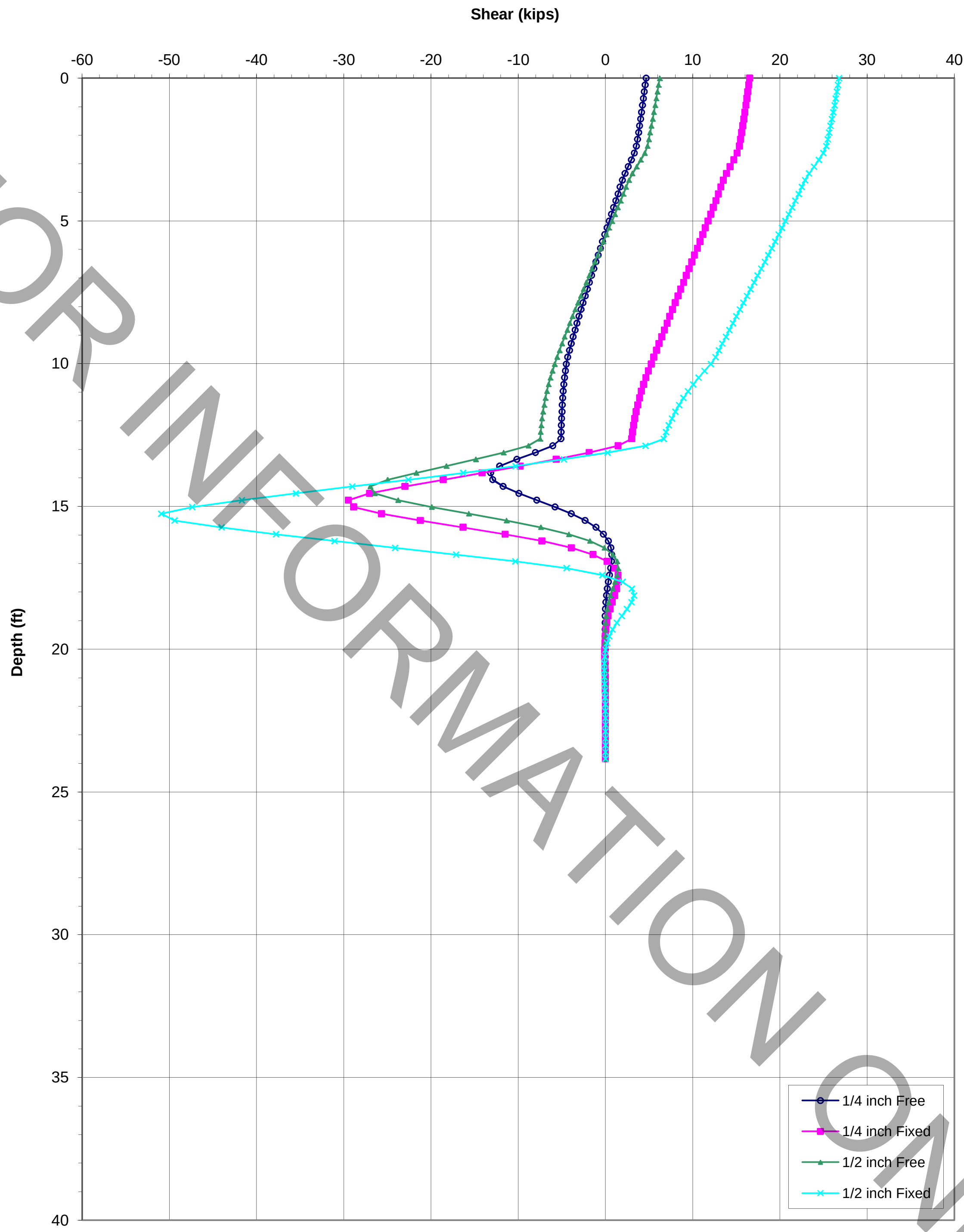
DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Deflection Pier HP 14X73	FIG. NO. 9



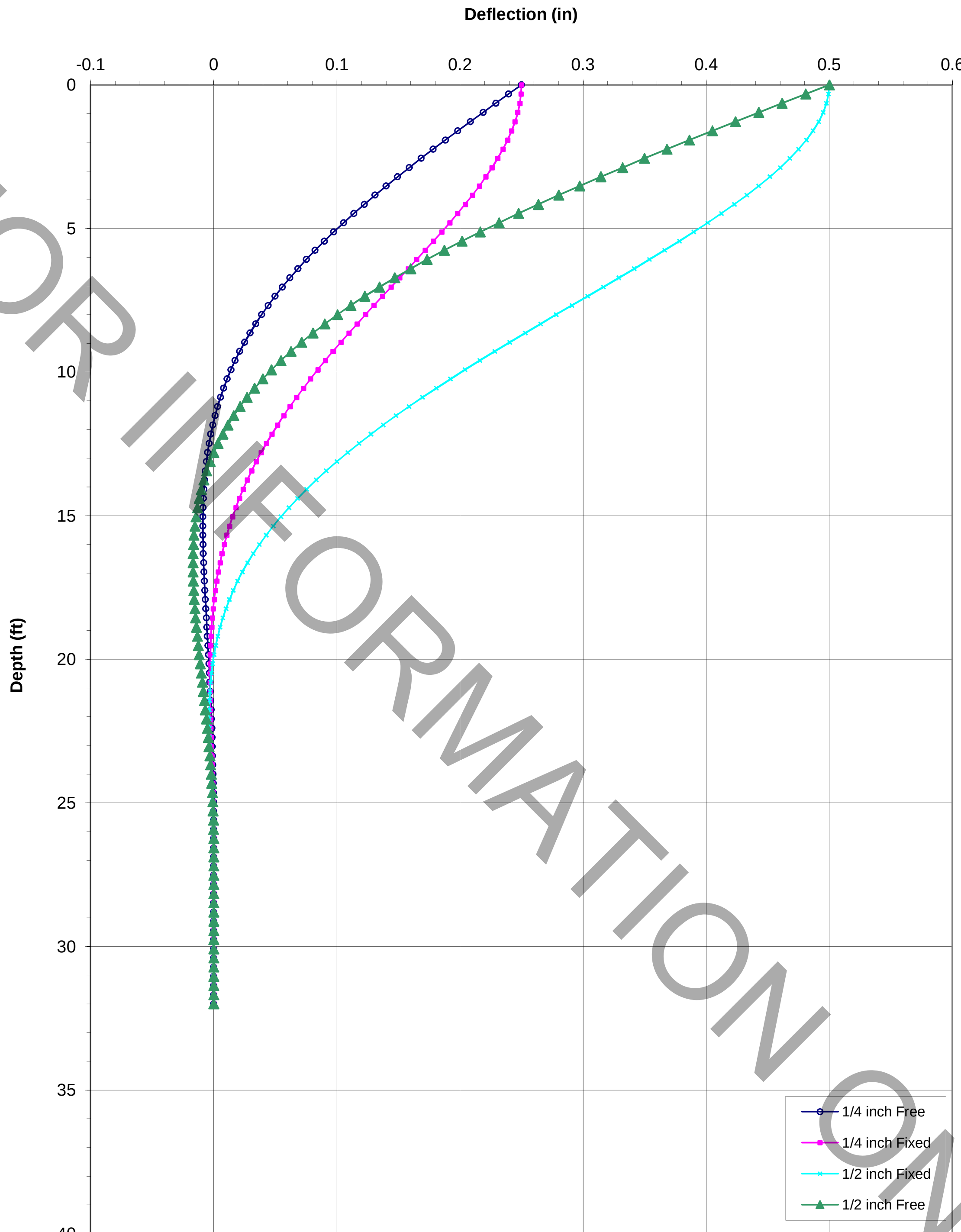
IDOT Illinois Hwy 121 Bridge Cumberland County, IL	PROJECT NO. 36432847

URS

DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Bending Moment Pier HP 14X73	FIG. NO. 10



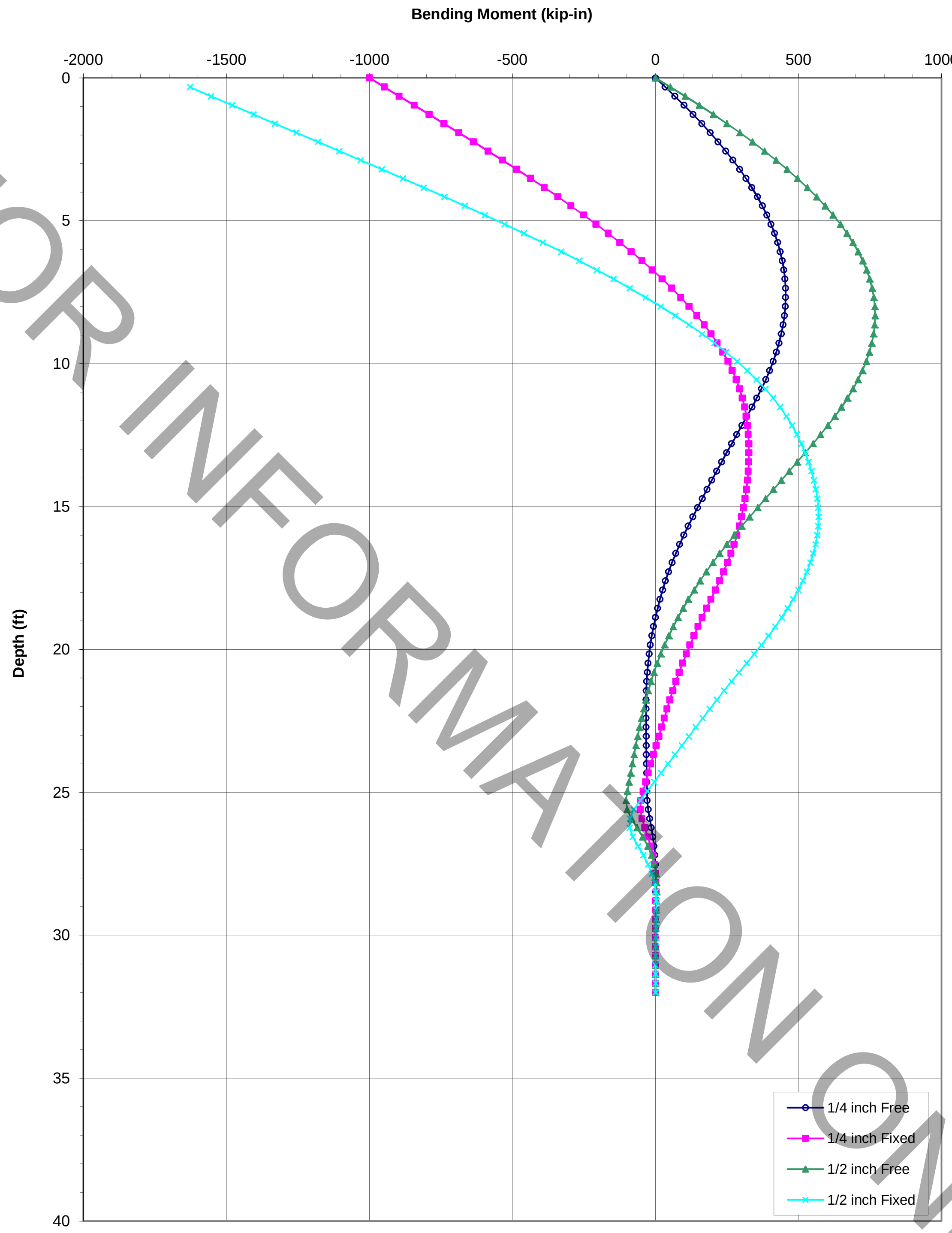
IDOT Illinois Hwy 121 Bridge Cumberland County, IL			PROJECT NO. 36432847
URS			
DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Shear Pier HP 14X73		FIG. NO. 11



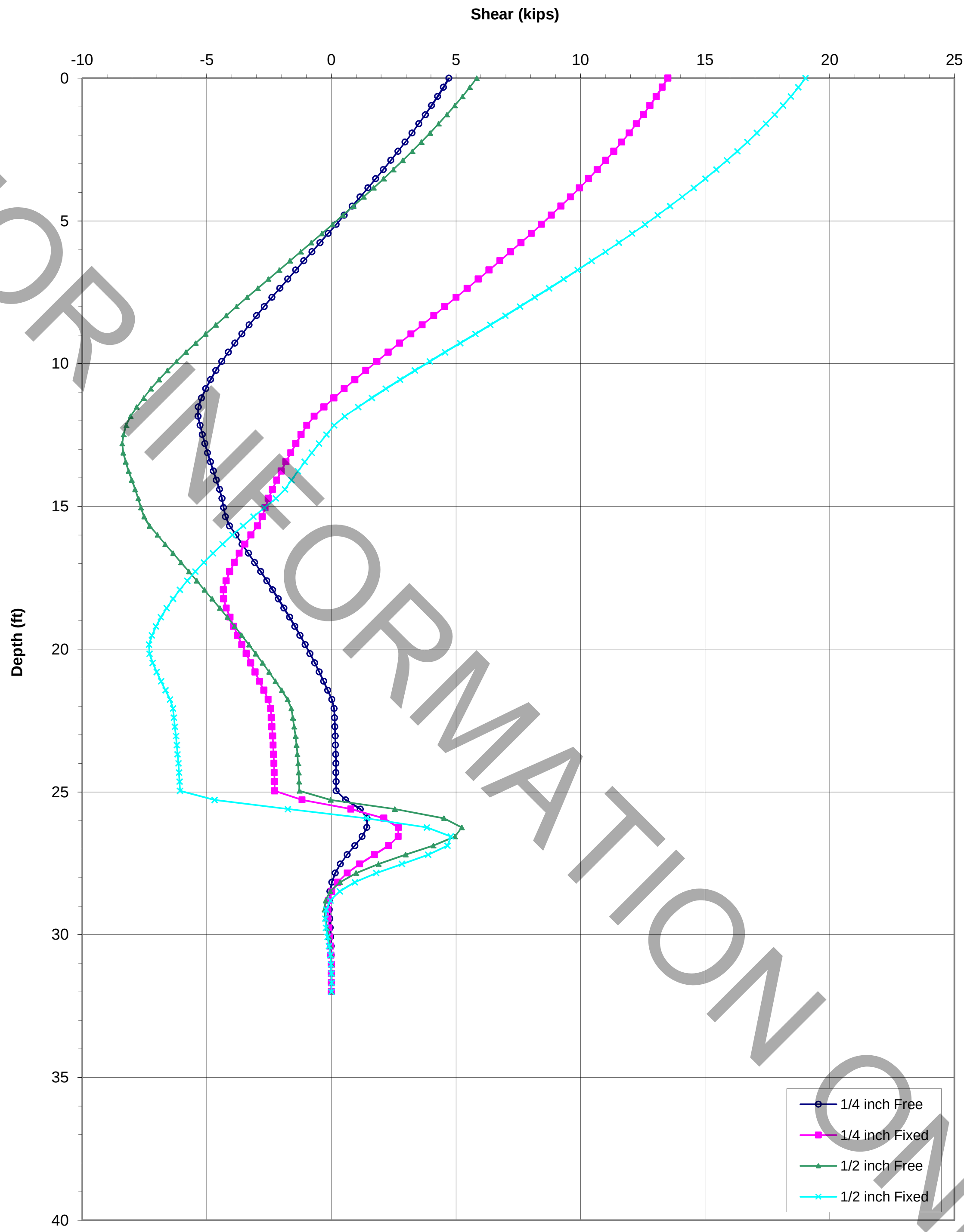
IDOT Illinois Hwy 121 Bridge Cumberland County, IL	PROJECT NO. 36432847

URS

DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Deflection South Abutment HP 14X73	FIG. NO. 12



IDOT Illinois Hwy 121 Bridge Cumberland County, IL		PROJECT NO. 36432847
URS		
DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Bending Moment South Abutment HP 14X73	FIG. NO. 13



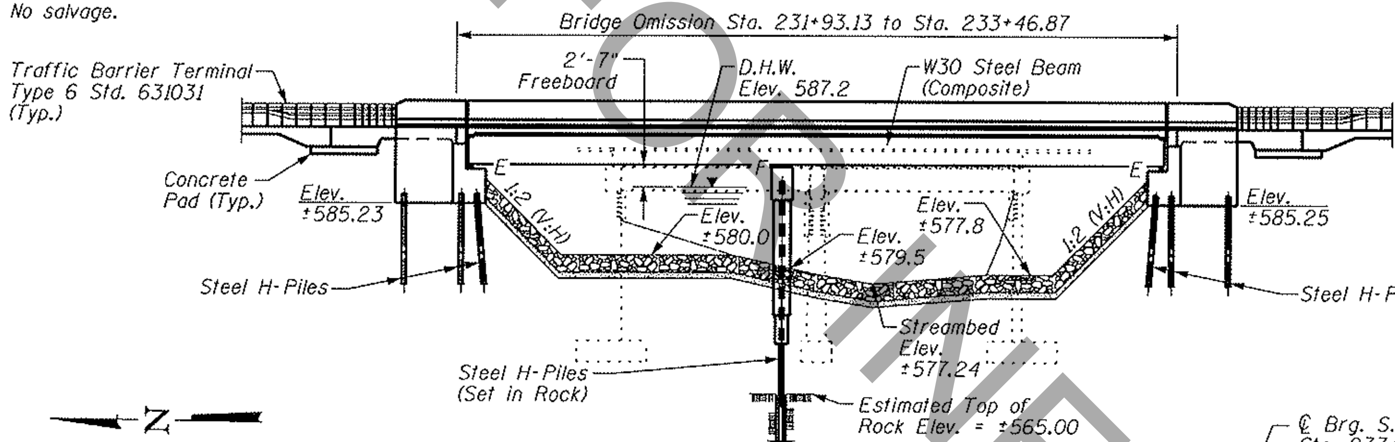
IDOT Illinois Hwy 121 Bridge Cumberland County, IL	PROJECT NO. 36432847
URS	

DRN. BY: SAV DSGN. BY: SAV CHKD. BY: EJG	Depth vs. Shear South Abutment HP 14X73	FIG. NO. 14

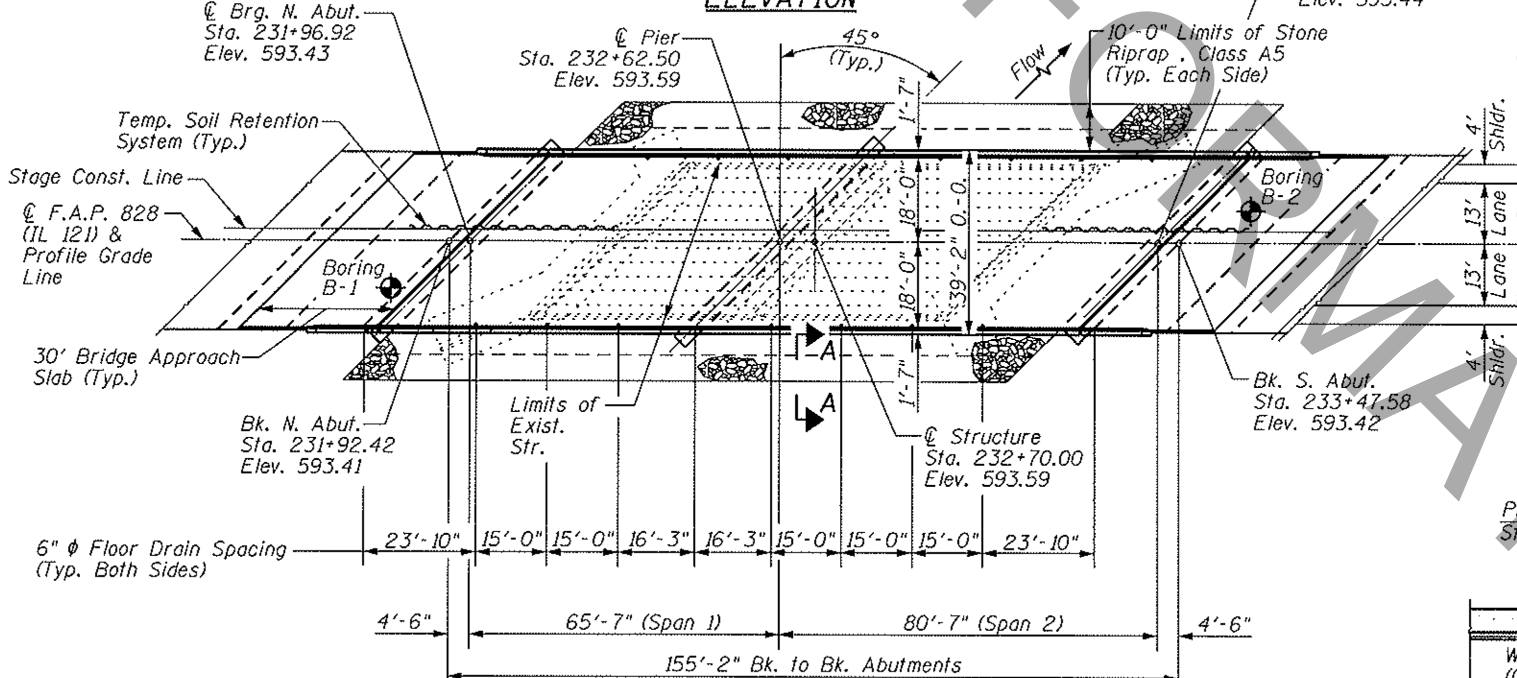
Bench Mark: Chiseled square on N.W. corner of headwall on Structure No. 018-0012. Sta. 232+10, 17' Rt. Elevation 589.69.

Existing Structure: S.N. 018-0012 originally built in 1928 as Rte. 131, Section 108-B at Station 232+70. The structure consisted of two 44'-3" spans on closed abutments skewed at 45 degrees with a 22'-0" width. Structure consists of RC closed abutments and RC solid pier setting on spread footings. In 1981 the structure underwent reconstruction and was replaced with 11 three ft wide deck beams, providing a width of 33'-0" and a length of 88'-3" back to back abutments. In 2008 & 2009 temporary support beams were placed under beam 6 in the north span and beam 4 in both spans due to delamination noted in prior inspections. Existing structure is to be removed and replaced utilizing stage construction.

No salvage.



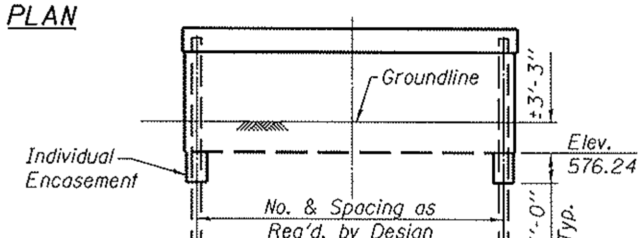
ELEVATION



PLAN

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	N. Abut.	Pier	S. Abut.
	585.23	569.52	585.25



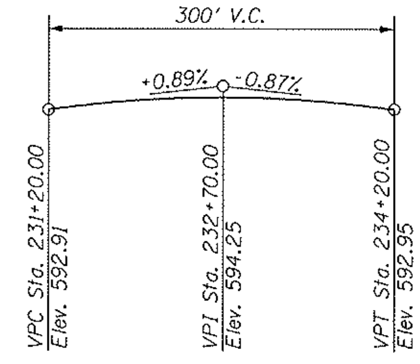
PIER SKETCH

WATERWAY INFORMATION

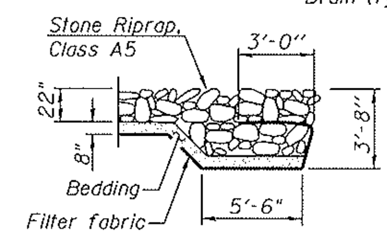
Drainage Area = 8.58 Sq. Mi. Existing Low Grade Elev. 591.92 @ Sta. 230+00
Proposed Low Grade Elev. 592.01 @ Sta. 229+20

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	1860	349	552	586.2	1.3	1.0	587.5	587.2
Design	50	3010	403	637	587.2	2.0	1.6	589.2	588.8
Base	100	3520	427	675	587.6	3.2	1.7	590.8	589.3
Overtopping									
Max. Calc.	500	4790	482	764	588.5	3.3	2.1	591.8	590.6

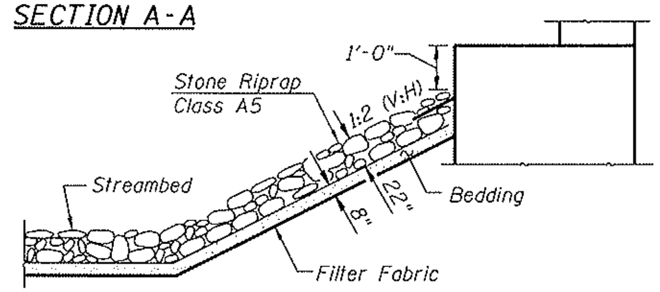
10 Yr. Velocity = 5.33 fps (Existing) and 3.37 fps (Proposed)



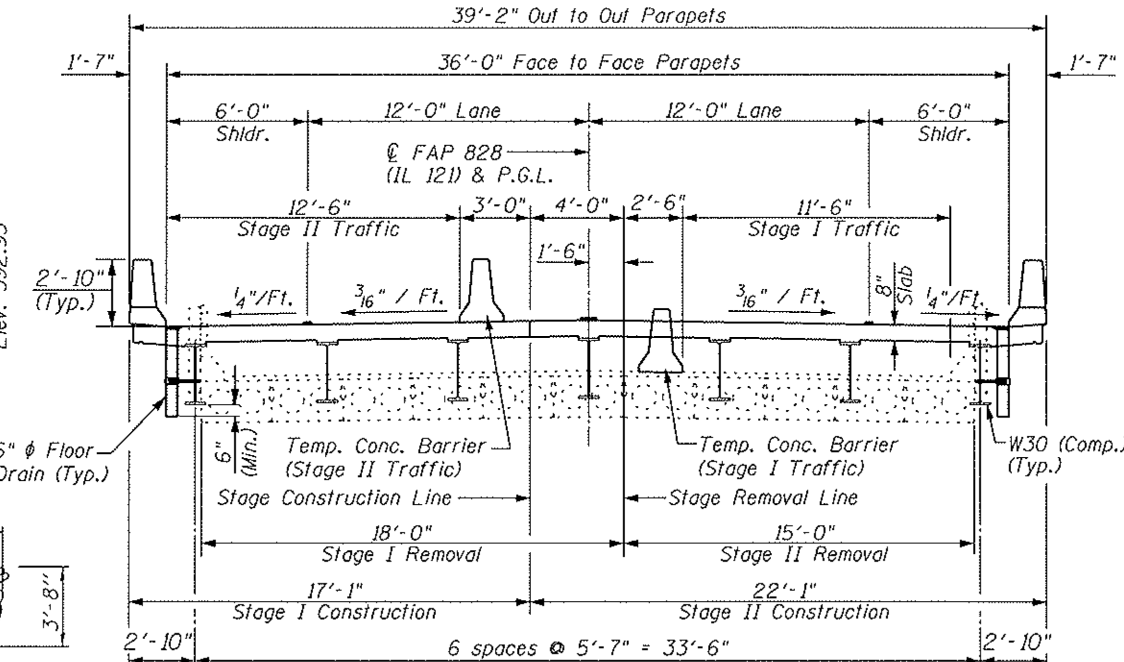
PROFILE GRADE
(Along ℄ Roadway)



SECTION A-A



STONE RIPRAP DETAIL



CROSS SECTION
(Looking South)

HIGHWAY CLASSIFICATION

F.A.P. Rte. 828 - IL 121
Functional Class: Rural Minor Arterial
ADT: 2800 (2009), 3789 (2032)
Directional Split: 50:50
ADTT: 11.6%
DHV: 455 (2032)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic

DESIGN SPECIFICATIONS

2010 AASHTO LRFD Bridge Design Specifications

LOADING HL 93

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

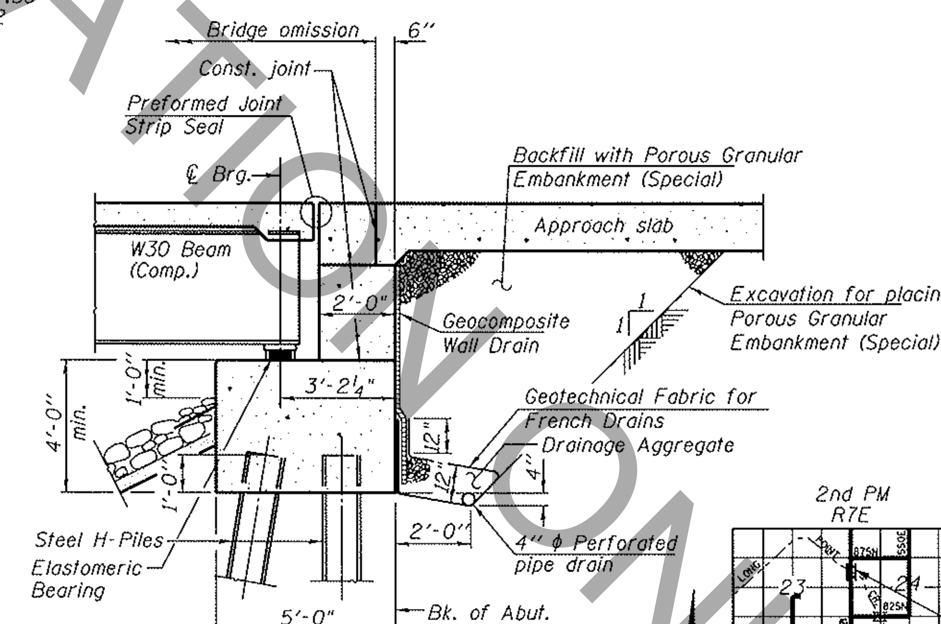
DESIGN STRESSES

FIELD UNITS

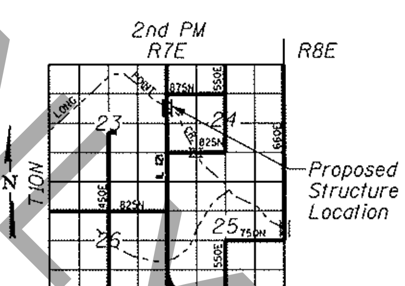
f'_c = 3,500 psi
f_y = 60,000 psi (reinforcement)
f_y = 50,000 psi (Structural Steel AASHTO M270 Grade 50)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.280g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.644g
Soil Site Class = E



SECTION THRU PILE SUPPORTED STUB ABUTMENT
(Horiz. dim. @ Rt. L's)



LOCATION SKETCH

GENERAL PLAN
IL 121 OVER LONG POINT CREEK
SECTION (108BR-1)B
CUMBERLAND COUNTY
STATION 232+70
STRUCTURE NO. 018-0066

FILE NAME = S:\36432847\structures\TSL.dgn	USER NAME = Brian K. Nicholson	DESIGNED - MJP	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	GENERAL PLAN STRUCTURE NO. 018-0066
		CHECKED - KWB	REVISED -		
	PLOT SCALE = 48	DRAWN - BKN	REVISED -		
	PLOT DATE = May 2, 2011	CHECKED - KWB	REVISED -		SHEET NO. 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
828	(108BR-1)B	CUMBERLAND		
		CONTRACT NO. 74323		
	ILLINOIS FED. AID PROJECT			