

STRUCTURE GEOTECHNICAL REPORT

Proposed S.N. 015-2025

Existing S.N. 015-0013

IL Rte 16 over Little Wabash River
2 Miles West of Mattoon
FAP Route 325
Section (8B)B-1
Coles County

PTB 173 - Item 027
IDOT Job No. D-97-056-14
Contract No. 74652

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Date Prepared: 07/26/2016
Date Revised: 09/20/2016

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Exhibits: 1) Location Map
2) Type Size & Location Plan
3) Boring Locations
4) Subsurface Data Profile
5) Boring Logs
6) Slope Stability Output

Project Description and Proposed Structure Information

This project consists of the construction of a new culvert and the removal of the existing bridge over the Little Wabash River at station 110+09.60 to address deterioration of the existing structure and satisfy hydraulic design requirements. The structure will carry one lane of traffic in each direction. The proposed structure is a 9' span x 8' rise triple barrel reinforced concrete box culvert, 47'-8¾" out-to-out of headwalls measured along the culvert centerline with 10 degrees ahead right skew. The proposed structure design will follow the LRFD Design Specifications. Complete removal of the existing structure will be required for construction. This work will be completed using stage construction.

The stage construction requires soil retention for excavation during removal of the existing structure and construction of the proposed structure. The maximum fill height is approximately 2'-11" above the top of the proposed culvert. The structure will have 15'-3" horizontal cantilever wingwalls at the northeast and southwest corners, and 16'-0" horizontal cantilever wingwalls with 2'-0" cantilever sheet pile extensions at the northwest and southeast corners. Each wingwall will retain a 1:2 (V:H) embankment slope. The project site falls within Section 20, Range 7E, Township 12N, in the 3rd Principal Meridian about 2 miles west of Mattoon. A *Location Map* is presented in Exhibit 1.

See *Type Size & Location Plan* attached in Exhibit 2 for further information about the proposed structure.

Existing Information

Existing SN 015-0013 was originally constructed in 1925 as a single span reinforced concrete deck girder bridge. In 1975, the superstructure was replaced with precast concrete deck beams. The bridge has an overall length of 32'-10¼" and is supported on closed abutments, which were widened to accommodate the wider roadway. The bridge has an out-to-out width of 45' and is not skewed. The closed abutments are supported on concrete spread footings with the original portions of the footings supported by untreated timber piles. Existing IL Rte. 16 was built on a horizontally tangent alignment with a crest vertical curve profile. The roadway currently provides one lane of traffic in each direction. Stationing along the roadway increases from east to west.

Site Investigation, Subsurface Exploration and Generalized Subsurface Conditions

The site is located in a rural area approximately 2 miles west of Mattoon. The river flows from north to south. There are flat fields on both sides of the bridge. There are no utilities supported by the structure. There are aerial electric lines on the south side of the structure, running parallel to the roadway.

The boring data was provided by IDOT District 7 personnel. Two borings drilled in April of 2016 are associated with the proposed culvert location. Boring 1 (NW) was drilled at station 110+36, approximately 30 ft north of the centerline and was terminated at a depth of 31 ft below ground surface. Boring 2 (SE) was drilled at station 109+69 approximately 37 ft south of the centerline and was terminated at a depth of 31 ft below ground surface. *Boring Locations* relative to the culvert location are shown in Exhibit 3.

At each boring location, a standard penetration test (SPT) was conducted every 2.5 ft according to AASHTO T 206 using a Hollow Stem Auger and Split Spoon. While drilling boring 1 (NW), groundwater was not encountered during drilling or upon completion. 96 hours after completion of drilling, groundwater was encountered at an elevation of 707.1. While drilling boring 2 (SE), groundwater was encountered at an elevation of 694.1. Upon completion of drilling, groundwater was encountered at an elevation of 703.9. 96 hours after completion of drilling, groundwater was encountered at an elevation of 707.4. Starting at the ground surface, both borings depict stiff to very stiff gray and brown clay, very soft silty loam, and very stiff gray clay loam till, with unconfined compressive strengths ranging from 0.16 to 4.33 tsf, blow count values ranging from 2 to 20 blows per ft, and moisture contents ranging from 11% to 27%. Further description of the soil layers can be found in the *Subsurface Data Profile* in Exhibit 4 and the *Boring Logs* attached in Exhibit 5.

Geotechnical Evaluations

Settlement: No significant changes in profile are proposed at the culvert locations. There will be an increase in pressure between the locations of the existing abutments due to the weight of the proposed culvert and fill. It is proposed to remove the top layers of unsuitable material and replace with Rock Fill, reducing the effects of settlement. Our preliminary calculations show there is no significant settlement in underlying very stiff clay layers.

Slope Stability: Stability analyses were performed for the maximum wing wall height of 15'-2", measured from the top of the backfill to the bottom of the footing. The analyses resulted in a factor of safety of 3.36, which is well above the minimum of 1.5 for fill areas and 1.7 for cut slopes described in the IDOT Geotechnical Manual (2015). Therefore, no stability problems are expected.

Mining Activity: A review of the Illinois State Geological Survey (ISGS) "Coal Mines in Illinois Viewer" for Coles County indicates that no mining activity has been present at the project location. The nearest underground coal mine is located 2.7 miles northeast of the bridge location.

Liquefaction: Liquefaction calculations indicate no liquefiable soils at this structure location.

Box Culvert Evaluations and Design Recommendations

Culvert Barrel: Since debris and drift is minimal at this site, a box culvert structure is appropriate.

Due to the need for cast in place wingwalls, the relatively small size of the project, and the potential stage construction complications due to skew, the precast culvert option is not recommended.

With the large foundation area and proposed soil improvement at the culvert base, the bearing capacity at the base of the foundation was found to be more than adequate for resistance of estimated bearing pressures.

Wingwalls: There are several feasible options for selection of wingwalls. The wall type selection should be performed considering, but not limited to, soil conditions, length, and economy.

Per IDOT Culvert Manual Figure 3.1.5-2, based on the 10° skew, 1:2 (V:H) slope behind the wingwall, and estimated H_L of 12'-1 1/2", the wingwall length chart shows lengths of 15'-3" and 18'-0" with angles of 50° and 40° respectively.

Horizontal cantilever wingwalls are the most appropriate option at this location. Where wingwall lengths in excess of 16'-0" are required, combination horizontal cantilever with a cantilever sheet pile extension is recommended. Driven soldier pile wall extensions are also feasible. However, driven soldier piles are not anticipated to be a cost-effective alternative. The recommended at-rest earth pressure as an equivalent fluid pressure on the horizontal cantilever wingwalls according to the proposed design is 60 pcf. The recommended active earth pressure as an equivalent fluid pressure on the cantilever sheet pile extensions according to the proposed design is 70 pcf.

Vertical cantilever T-type walls are feasible at this location. The recommended active earth pressure as an equivalent fluid pressure on the cantilever wingwalls according to the proposed design is 60 pcf. Factored bearing resistance available is 5.5 ksf. A coefficient of friction for sliding of 0.5 is recommended.

Gabion baskets appear to be feasible and can be constructed easily and quickly with traditional labor equipment. This wall can be labor intensive and expensive if a nearby stone source is not available. Factored bearing resistance available is 5.5 ksf. The recommended coefficient of friction for sliding of 0.5 and an at-rest earth pressure as an equivalent fluid pressure is 60 pcf.

Construction Considerations

Cofferdams: In order to maintain a dry construction area, dewatering techniques may be necessary. Based on an Estimated Water Surface Elevation (EWSE) of 704.4, a Type 1 cofferdam may be required if other methods cannot be utilized to keep the working area dry. Stream diversion could be utilized in order to facilitate construction of the box culvert.

Stage Construction: In order to maintain traffic flow, stage construction shall be utilized. To retain fill at the edge of the bridge deck during stage construction, it is recommended that Temporary Sheet Piling be used to retain Stage I fill. If this method is not adequate, it may be necessary to provide a temporary Geotextile Retaining Wall per IDOT Bridge Manual Fig. 3.13.2-1. It is recommended that the chosen system be included in the design plans.

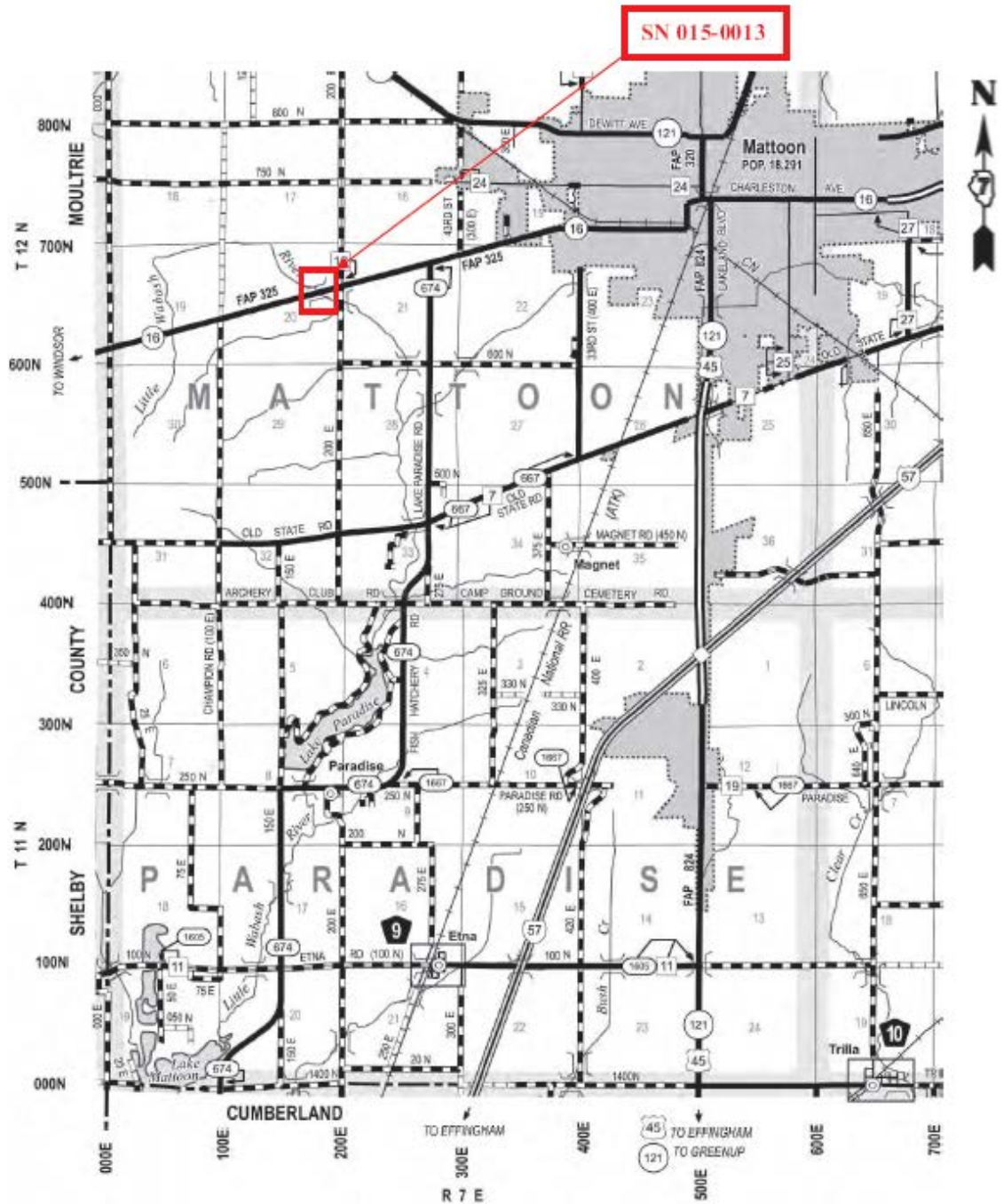
Excavation: Temporary excavation slopes for construction shall be determined in the field based on the soil conditions encountered and OSHA requirements.

Backfill: Backfill on the sides of the culvert should be done within a 1:1 slope using Granular Culvert Backfill. All other backfill may be composed of soil materials excavated from the project site placed and compacted according to the Standard Specifications.

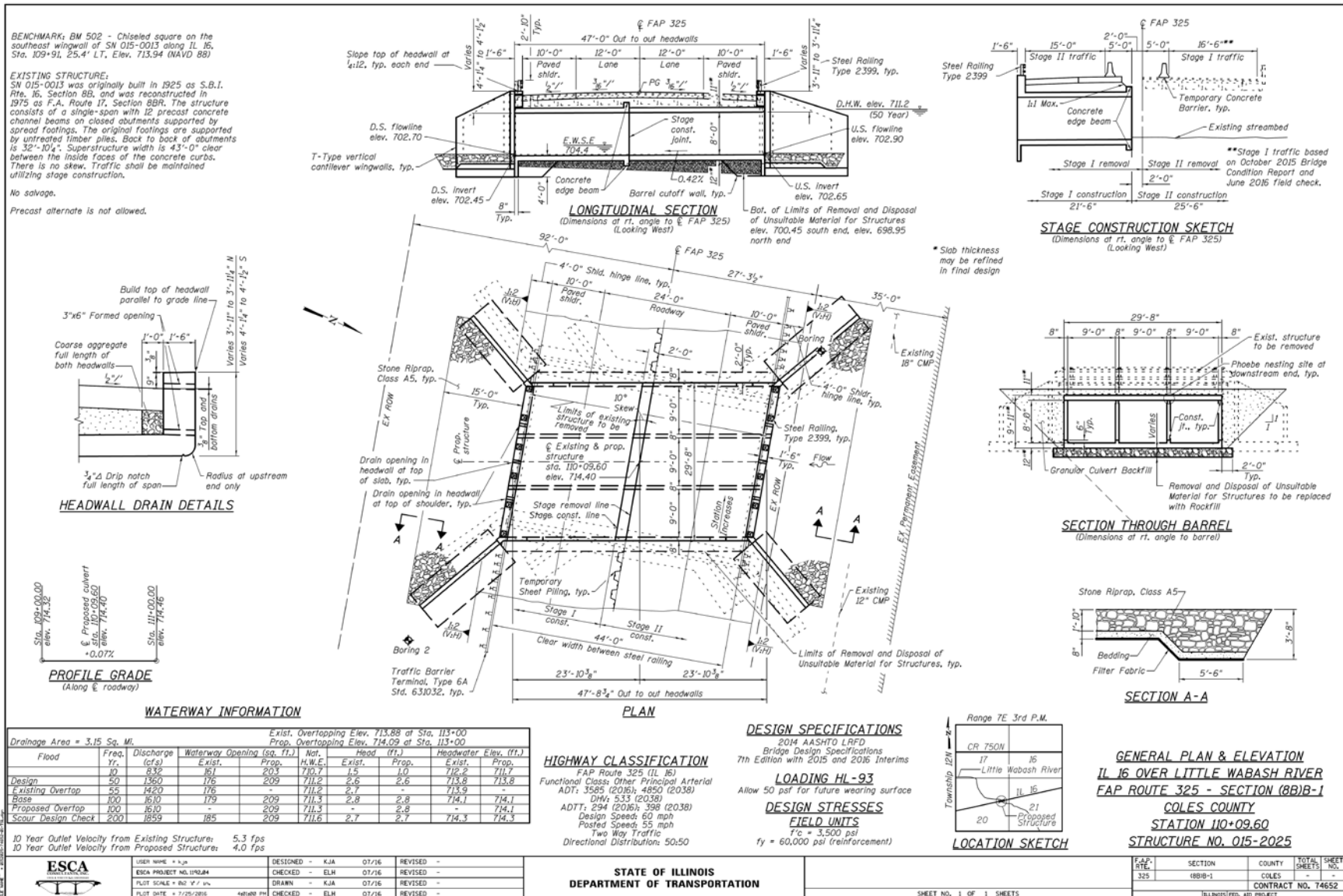
Ground Improvement: The weak silty loam layer beneath the bottom of the culvert shall be removed down to an elevation varying linearly from 700.45 at the south end to 698.00 at the north end and replaced with Rock Fill. The pay limits shall extend 2 feet outside the limits of the barrel.

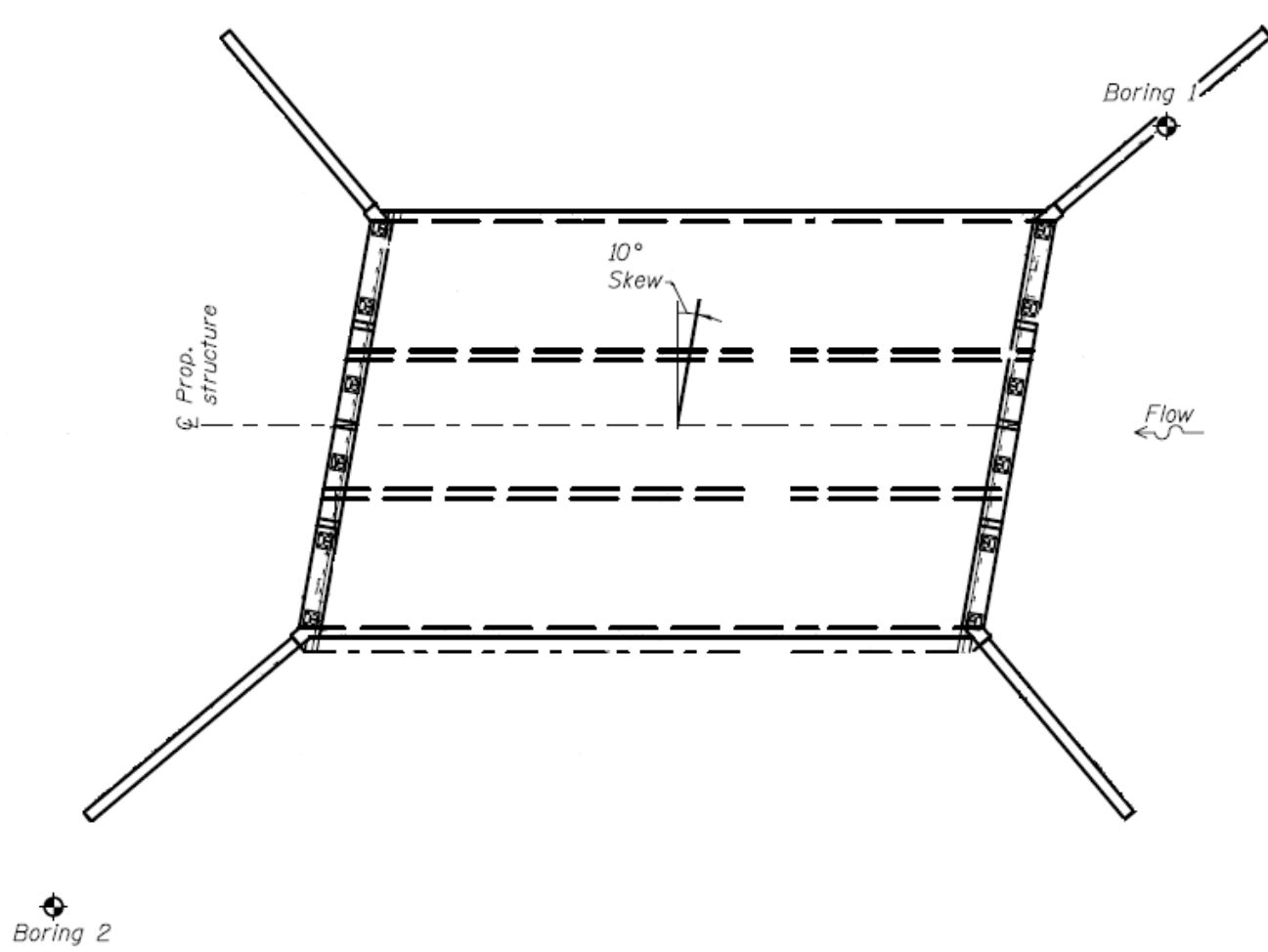
Limitations

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

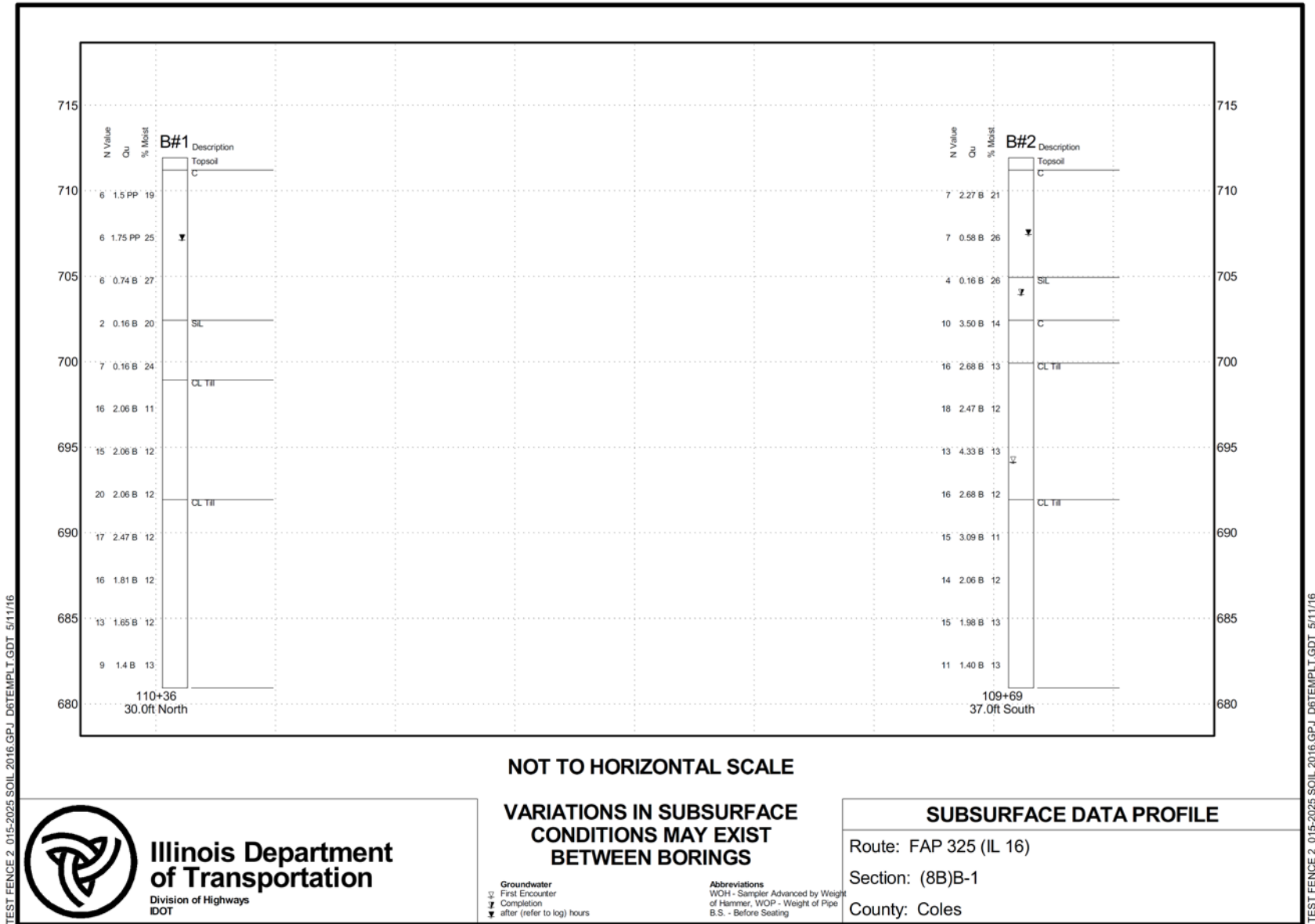


Location Map
SN 015-0013
Coles County
FAP 325 (IL 16)
Over Little Wabash River





Structure Number 015-2025 Little Wabash River
Located in the NE 1/4 of Section 20, Township 12 N, Range 7 E of the 3 P.M.





Illinois Department of Transportation

To: Tim Hemmen Attn: David Macklin
From: Terry Stephenson By: David Miller
Subject: Foundation Boring Logs*
Date: May 11, 2016

* Route: FAP 325 (IL 16)
 Section: (8B)B-1
 Structure No.: Proposed 015-2025 (Existing 015-0013)
 County: Coles
 Contract: 74652
 Job No.: D-97-011-14
 Location: Little Wabash River (2 mi W of Mattoon)

Attached is one (1) copy of the foundation boring logs and fence diagram for the above captioned section.

If you have any questions, or require any additional information, please contact David Miller, District Geotechnical Engineer, at (217) 342-8233.

Terry J. Stephenson
District Materials Engineer

DM

Attachments



Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Page 1 of 1

Date 4/26/16

ROUTE FAP 325 (IL 16) DESCRIPTION Little Wabash River LOGGED BY E. Sandschafer
SECTION (8B)B-1 LOCATION NE 1/4, SEC. 20, TWP. 12 N, RNG. 7 E, 3 PM
COUNTY Coles DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO.	Station	D E P T H S	B L O W S	U C S Qu	M O I S T	Surface Water Elev.	Stream Bed Elev.	Groundwater Elev.:	D E P T H	B L O W S	U C S Qu	M O I S T
		(ft)	/6"	(tsf)	(%)	ft	ft	ft	(ft)	/6"	(tsf)	(%)
015-2025	110+09.6					705.75	704.03					
1 (NW)	110+36											
	Offset 30.0ft North											
	Ground Surface Elev. 711.94 ft											
	8" topsoil.	711.24						Very stiff, damp, gray, CLAY LOAM TILL.	10	2.06	12	
	Stiff, damp, dark brown, CLAY.								10	B		
			3							5		
			3	1.5	19					7	2.47	12
			3	PP						10	B	
	Gray mottled brown.		3							5		
			3	1.75	25					7	1.81	12
			3	PP						9	B	
	Gray marbled brown.		2							5		
			3	0.74	27					6	1.65	12
			3	B						7	B	
		702.44										
	Very soft, damp, brown marbled gray, SILTY LOAM w/ small Gravel.		0							3		
			1	0.16	20					4	1.4	13
			1	B						5	B	
			2									
		698.94	3	0.16	24							
	Very stiff, damp, gray, CLAY LOAM TILL.		4	B								
			5									
			7	2.06	11							
			9	B								
			6									
			6	2.06	12							
			9	B								
		691.94	6									

File Name S:\NEW GEOTECHNICAL\GINTID\AT\PROJECTS\COLES CO (01510015-2025 SOIL 2016.GPJ Data Template 06 TEMP.LT.GDT Date Printed 5/11/16
Latitude W 88 deg 26 min 17.335 sec Longitude N 39 deg 28 min 12.691 sec Datum Job Number

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)



Illinois Department
of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Page 1 of 1

Date 4/26/16

ROUTE FAP 325 (IL 16) DESCRIPTION Little Wabash River LOGGED BY E. Sandschafer

SECTION (8B)B-1 LOCATION NE 1/4, SEC. 20, TWP. 12 N, RNG. 7 E, 3 PM

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

STRUCT. NO.	Station	D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	Surface Water Elev.		D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	
						ft	ft					
015-2025	110+09.6					705.75						
						704.03						
2 (SE)	109+69											
	<u>37.0ft South</u>											
	711.94					694.1						
						703.9						
						707.4						
8" topsoil.						Very stiff to stiff, damp, gray, CLAY LOAM TILL.						
	711.24							7	2.68	12		
Very stiff to medium, damp, gray/brown, CLAY.												
			3					9	B			
			3	2.27	21			3				
			4	B				6	3.09	11		
								9	B			
▼												
			3	0.58	26			5				
			4	B				6	2.06	12		
								8	B			
	704.94		0					4				
Very soft, very damp, brown, SILTY LOAM.												
			2	0.16	26			7	1.98	13		
			2	B				8	B			
	702.44		2									
Very stiff, damp, brown mottled gray, CLAY.												
			4	3.50	14			3				
			6	B				5	1.40	13		
								6	B			
						690.94	Extent of exploration.					
	699.94		4				Benchmark: BM 502A Chiseled square on top of NE wingwall of existing structure = 713.97', Sta 109+91, 26' Rt. Provided by Program Development.					
Very stiff, damp, gray, CLAY LOAM TILL.												
			6	2.68	13							
			10	B								
			6									
			8	2.47	12							
			10	B								
			4				<i>(Existing SN 015-0013)</i>					
1/2" Sand lense at 17.8'. ↙												
			6	4.33	13		<i>(Stationing runs from East to West)</i>					
			7	B								
			5									
	691.94											

File Name: S:\NEW GEOTECHNICAL\DATA\PROJ\CTS\COLES CO (01510 15-2025 SOIL 2016).GPJ Data Template 06 TEMPLATE.DOT Date Printed 5/11/16
Latitude W 88 deg 28 min 15.961 sec Longitude N 39 deg 28 min 12.485 sec Datum Job Number

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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