SCI ENGINEERING, INC.
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Structure Geotechnical Report

CULVERT REPLACEMENT
IL 78 OVER WALNUT CREEK
F.A. 22 (S.B.I. 78)
SECTION (128B)BR
STARK COUNTY, ILLINOIS
EXISTING STRUCTURE NO: 088-0012
PROPOSED STRUCTURE NO: 088-2503

August 2018

ILLINOIS DEPARTMENT OF TRANSPORTATION
Owner

Prepared for:
OATES ASSOCIATES, INC.
Mr. Jeffrey Rensing, P.E., S.E.
100 Lanter Court, Suite 1
Collinsville, Illinois 62234
(618) 622-3040

SCI No. 2009-3210.52

11/30/19
LICENSED PROFESSIONAL ENGINEER
THOMAS JOSEPH CASEY
062-061853
STATE OF ILLINOIS

SCI ENGINEERING, INC.
EARTH • SCIENCE • SOLUTIONS
GEOTECHNICAL
ENVIRONMENTAL
NATURAL RESOURCES
CULTURAL RESOURCES
CONSTRUCTION SERVICES

August 8, 2018

Mr. Jeff Rensing, P.E., S.E.
Oates Associates, Inc.
100 Lanter Court, Suite 1
Collinsville, Illinois 62234

RE: Structure Geotechnical Report
Culvert Replacement
IL 78 over Walnut Creek
F.A. 22 (S.B.I. 78)
SECTION (128B)BR
Stark County, Illinois
Existing Structure No. 088-0012
Proposed Structure No. 088-2503
PTB 153-042 WO#4
SCI No. 2009-3210.52

Dear Mr. Rensing:

Enclosed is our S*tructure Geotechnical Report (SGR)* dated August 2018. The report should be read in its entirety, and our recommendations applied to the design and construction of the proposed culvert. Please call if you have any questions.

Respectfully,

SCI ENGINEERING, INC.

Bronson L. Bowling, P.E.
Staff Engineer

Thomas J. Casey, P.E.
Chief Geotechnical Engineer

BLB/TJC/tlw

Enclosure

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Structure Geotechnical Report

CULVERT REPLACEMENT
IL 78 OVER WALNUT CREEK
F.A. 22 (S.B.I. 78)
SECTION (128B)BR
STARK COUNTY, ILLINOIS
EXISTING STRUCTURE NO: 088-0012
PROPOSED STRUCTURE NO: 088-2503

1.0 PROJECT DESCRIPTION

The geotechnical study summarized in this report was performed for the proposed replacement of the culvert that carries Illinois 78 over Walnut Creek in Stark County, Illinois. The location of the site is shown on the *Vicinity and Topographic Map*, Figure 1. The purpose of our study was to explore the subsurface conditions and develop design and construction recommendations for the culvert replacement.

The existing structure (SN 088-0012) is an approximate 47-foot-long and 33-foot-wide, bridge supported on shallow foundations. This existing structure is a pre-cast, pre-stressed concrete deck beam. The existing structure will be replaced by a triple cast-in-place box culvert, with cells measuring 12 feet by 10 feet according to a preliminary TS&L dated November 2, 2017, by Oates Associates, Inc. (Oates). The preliminary TS&L is included as Appendix C. The new structure will have an approximate 47.75-foot span, as measured along the roadway alignment, with an out-to-out headwall width of 65 feet. Due to the 35-degree skew, each culvert will have a length of approximately 79.3 feet. Based on the provided TS&L, the culvert will be supported on a mat foundation with a bearing elevation of approximately 651.2 feet.

2.0 SUBSURFACE CONDITIONS

A total of two structure borings, designated B-1 and B-2, were drilled at each approach lane as shown on the *Aerial Photograph*, Figure 2. The borings were advanced to a depth of 50 feet. No rock coring was included in the current scope. A summary of the pertinent boring information is presented in Table 2.1. Detailed information regarding the nature and thickness of the soils and rock encountered, and the results of the field sampling and laboratory testing are shown on the Boring Logs in Appendix A, and on IDOT form BD508 A in Appendix B. The boring locations are shown on the *Site Plan*, Figure 3.

The boring locations were selected by SCI Engineering Inc (SCI) with input from District 4 of the Illinois Department of Transportation, (IDOT) and staked in the field by SCI using a GPS with sub-meter accuracy. The station, offset, and ground surface elevations were interpreted based on the preliminary

TS&L. The field exploration was performed in general accordance with the procedures outlined in the *2015 IDOT Geotechnical Manual*. A geologist from SCI was with the drill rig to supervise drilling, log the borings, and perform field unconfined compressive strength tests.

A Mobile B-57 drill rig with hollow-stem augers was used to advance the borings. SPTs were performed with a split-spoon sampler at 2½-foot intervals to a depth of 30 feet, and then at 5-foot intervals to the boring termination depths. Unconfined compressive strengths of cohesive samples were measured with a Rimac testing apparatus. A pocket penetrometer was used to estimate the compressive strength if the sample was not conducive to Rimac testing.

The SCI borings were drilled to a depth of 50 feet. Auger refusal was not encountered in the borings. Auger refusal is a designation applied to any material that cannot be further penetrated by the power auger without extraordinary effort and is indicative of a very hard or very dense material, usually boulders or bedrock. A cross section of select subsurface information is shown on the *Subsurface Profile*, Figure 4.

Table 2.1 – Summary of Borings

Boring	Total Depth (feet)	Ground Surface Elevation (feet)	Shale		Boring Location		
			Depth (feet)	Elevation (feet)	Station (feet)	Offset (feet)	Offset Direction
B-1	50.0	665.6	N/A	N/A	252+63	6	LT
B-2	50.0	665.6	47.5	618.1	253+79	6	RT

2.1 Structure Borings

Surficial materials consisting of asphalt and concrete pavements were encountered to depths of 18 to 20 inches. The fill underlying the pavement, consisted of fine to course sand and gravel (A-1) with crushed asphalt to depths of 2 to 4 feet at B-1 and B-2, respectively. Below the course-grained fill, additional fill consisting of low plastic silty clay (A-6) and clay (A-7) was encountered to depths of 9 feet and 15 feet, at B-1 and B-2, respectively. SPT N-values within the existing fill ranged from 4 to 7 blows per foot (bpf). As an exception, in the near surface gravel fill, 50 blows over 5 inches was encountered in B-2. Moisture contents within the fill ranged from 1 to 38 percent with an average of 27. Below the fill, interbedded layers of low plastic sandy and silty clay (A-4 and A-6), high plastic clay (A-7), and clayey shale were encountered to the depth of termination of 50 feet. The consistency of the natural cohesive materials ranged from soft to very stiff with SPT N-values ranging from 2 to 17 bpf with an average of 10 bpf. The moisture contents of the native soils ranged from 12 to 40 percent with an average of 23 percent.

Due to the drilling method of mud rotary, an accurate groundwater level was not observed. For our foundation analysis, we assumed groundwater to be at the invert elevation of Walnut Creek of 651.5. It should be noted that the groundwater level is subject to seasonal and climatic variations, the water level in the creek, and other factors; and may be present at different depths in the future. Further information regarding groundwater depths and elevations can be found on the boring logs in Appendix A.

2.2 Mining Activity

According to the *Directory of Coal Mines in Illinois – Stark County*, dated January 2017, the subject site was not undermined. The listed disclaimer indicates locations of some features on the mine map may be offset by 500 or more feet due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors. However, the subject site is more than 2.7 miles away from the closest mining area shown on the map.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Seismic Considerations

According to the *2017 IDOT Culvert Manual*, as well as article 3.10.1 of the *2017 AASHTO LRFD Bridge Design Specification* (8th Edition), culverts are considered buried structures and they are not designed for seismic effects.

3.2 Approach Fill Settlement

Settlement analyses were not performed for the approach fill soils since no grade changes are anticipated. Additionally, an unloading will occur along the northern section of the planned culvert due to grade changes.

3.3 Bridge Approach Slabs

The bridge approach slabs should be designed to bear on newly placed low plastic structural fill. In evaluating the bearing resistance of the slabs, we recommend using a modulus of subgrade reaction of 150 pounds per square inch per inch of deflection (pci).

3.4 Scour

No scour information was available at the time of this report. However, it appears that scour at the upstream and downstream ends of the culvert will be reduced by using stone dumped riprap. When information is available, SCI should be provided with the scour data to determine if scour will be a problem with the proposed foundations.

3.5 Box Culvert Recommendations

The foundation supporting the proposed culvert must provide sufficient support to resist dead and live loads. Based on the encountered subsurface conditions, and the assumed loads, we recommend a reinforced mat foundation be used to support the culvert for this project.

Based on information provided by Oates personnel, the elevation of the bottom of the existing footings is estimated to be 647.4. The thickness of the existing footings is currently unknown. Where existing foundations are present within 24 inches below the planned bearing elevation and at least 2 feet laterally beyond the extent of the new culverts, we recommend that the existing foundation components be removed.

Regardless of the removal of the existing foundations, a uniform bearing material must be constructed to bridge the existing footings left in place, the potentially soft zone between the existing footings and the new culvert footprint. To provide a uniform bearing, the existing foundation elevation should be exposed under the entire footprint of the culvert and backfilled with crushed rock. To perform the over excavation, we anticipate that 3 to 4 feet of soil will be removed below the planned bearing elevation of the culvert. The horizontal limits of excavation for the culvert should be at least 2 feet, beyond the footprint of the box culvert. Three-inch stone may be used from the base of the overexcavation to within 18 inches of the bearing grade of the culvert, approximately El 651.3. The remaining 18 inches should be backfilled with 1-inch clean crushed rock. Due to a slight risk of migration of soil fines into the clean rock, a synthetic filter fabric, such as Mirafi 140N or equivalent, should be placed between the soil face of the excavation and any crushed rock. If the recommendations here are followed, we anticipate that total settlements will be less than 1 inch after construction.

3.6 Wing Walls

Below-grade walls required at this site may include the culvert side walls and the wing walls designed to accommodate surface grade changes around the culvert and paved areas. Below-grade walls should be designed to withstand lateral earth pressures caused by the weight of the backfill, including slopes behind the walls; and the traffic surcharge.

According to the preliminary TS&L, the wing walls will range in length from approximately 12 to 23 feet in total length. The northwest and southeast wing walls are shown with 1V:2H slopes above the top of the wall and below the toe of the wall. At this location, there are many wing wall type options available. The feasible walls considered include L-type, T-type, Horizontal Cantilever, and Soldier Pile walls. Due to the proposed height, sheet piling was not considered. The L-Type and T-type walls both require a large excavation footprint, and this feature was undesirable. Soldier Pile cantilever systems were anticipated to be significantly more expensive than Horizontal Cantilever options with sheet pile extensions. As a large excavation footprint and cost were considered, the design team eliminated L-type, T-type and Soldier Pile wall systems as an option for use at the wing walls. If these options become necessary, SCI should be contacted to provide additional recommendations.

According to the 2017 Culvert Manual, the maximum length of a horizontal cantilever wingwall is 16 feet. However, a combination of horizontal cantilever wingwalls and sheet pile extensions was considered to be the most economically feasible option for this project. For the northeast and southwest walls, which extend beyond the maximum length of 16 feet, permanent sheet pile wing extensions will be used. The horizontal cantilever type wing walls are structurally connected to the box at the end of the barrel. The foundation soils are not relied upon for lateral and vertical support. According to Section 3.11.4 of the *2012 IDOT Bridge Manual*, the Permanent Sheet Pile design requires a minimum of Grade 50 steel and shall follow the AASHTO LRFD Specifications.

We recommend the equivalent fluid unit weights presented in Table 3.1 below for lateral earth pressures, in pounds per cubic foot (pcf), be used in the design of below-grade walls. Values for two conditions are provided: the first is that drainage is provided behind the wall to prevent buildup of hydrostatic pressure, and the second is the submerged condition, where water is allowed to build up behind the wall. The passive earth pressure provided is anticipated to correspond to the submerged condition at the bottom of the creek. Expansive soils should not be used to backfill the wall excavations. Values for granular material should only be used if the granular backfill extends upwards and outwards the full height of the wall at a slope of 45 degrees or flatter from its base. In this case, exterior granular backfill should be capped with approximately 2 feet of cohesive soil to reduce the potential for surface water infiltration into the granular backfill. With clean granular backfill, filter fabric, such as Mirafi 140N, should be placed along the interface between the soil and granular backfill to reduce the potential for infiltration of the soil into the granular material.

Table 3.1 - Recommended Lateral Earth Pressures

Backfill Type	Equivalent Fluid Unit Weights				
	Drained Condition		Submerged Condition		
	At-Rest Earth Pressures (pcf)	Active Earth Pressures (pcf)	At-Rest Earth Pressures (pcf)	Active Earth Pressures (pcf)	Passive Earth Pressures (pcf)
Cohesive Soil	70	50	100	90	285
Granular Material (1-inch minus)	60	40	95	85	N/a
Free-Draining Granular Material (1-inch clean)	50	30	90	80	N/a

At-rest earth pressures should be used for restrained or fixed-headed walls that are restricted from rotation, such as culvert walls which are part of the cell. Active earth pressures should be used for free-headed walls where the base remains fixed and deflection at the top of the wall of approximately 1 inch for each 10 feet of wall height is allowed, such as a wing-wall.

The above values are applicable when the surface of the backfill behind the wall is horizontal. Upward sloped or loaded backfill will result in increased values (as exists at the NW and SE wing walls). In addition to lateral earth pressures, below-grade walls should be designed to resist any surcharge loads, including shallow building foundations and traffic. These surface loads can be modeled as uniform lateral loads, equivalent to one-half of the surface load, acting at the halfway point on the wall. For soil surcharge loads, we recommend using a unit weight of 120 pcf in this calculation.

3.7 Site Preparations

We understand that while excavating the existing culvert, excessively disturbed, wet or soft materials may be present. Per table 8.9-1 of the 2015 Geotechnical Manual, the working platform and box culvert subgrade may require improvements. We anticipate that the recommended treatment, as previously discussed, will be suitable to establish an adequate working platform as required by the 2017 IDOT Culvert Manual. Scour protection should be considered to retain the crushed rock material underlying the culvert to an elevation of at least 647.4. Typically, suitable retention can be accomplished with the installation of rip rap or a below grade head wall at the inlet. We anticipate that similar protections will be required at the downstream outlet. Recommendations regarding soft soils and providing an adequate working platform may be further defined with Dynamic Cone Penetrometer (DCP) testing of the bearing material during construction. Soft material, being less than 4 to 5 blows with a 10.1 pound hammer per 2 inches on the Kessler DCP, corresponds to the soil having an insufficient bearing capacity. (Per Table 3 Tabulated Correlation of blows per 2" penetration versus CBR and PSF – DCP-K100 Manual)

3.7.1 Culvert Wall and Wing-Wall Backfill

Backfill for the culvert and wing-walls may consist of 1-inch minus crushed limestone. We advise performing field density tests on at least every other lift to monitor compaction. As an alternate, we suggest using 1-inch clean crushed limestone to provide improved drainage and to reduce lateral pressures on the culvert walls. Due to a slight risk of migration of soil fines into the clean rock, a synthetic filter fabric, such as Mirafi 140N or equivalent, should be placed between the soil face of the excavation and any crushed rock, if used. If clean rock is used, it may be placed in 2-foot-thick lifts and tamped or tracked to achieve adequate densification. Clean rock backfill should be capped with cohesive soil to reduce the potential for surface water infiltration.

Backfill placed next to culvert walls should be compacted with hand operated equipment and not large self-propelled or machine operated equipment, which could result in potential overcompaction and higher lateral pressures. Compaction should be reduced within approximately 1 foot of the walls, and the walls should be observed periodically for signs of movement. If movement is detected, it may be necessary to change backfill procedures.

3.8 Temporary Construction Works

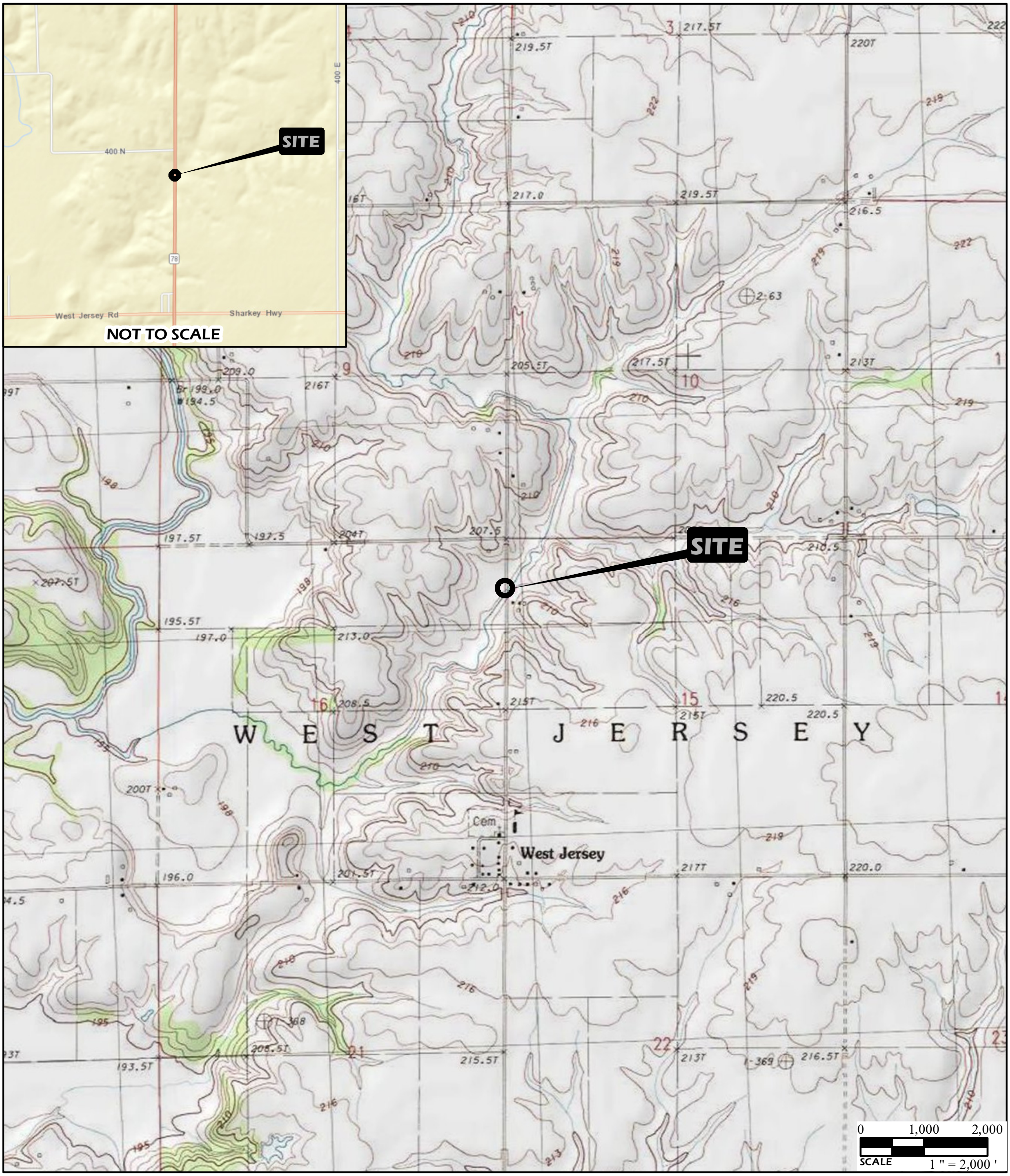
Based on information provided by Oates, SCI anticipates that staged construction will be used to construct the culvert while also maintaining traffic during construction. Temporary construction works will be required at the transition zone between the stage 1 traffic pattern and the stage 1 construction area and will be embedded parallel to the existing bridge. The top of shoring is located at approximate elevation 665.6 and will have a maximum retained height of 19 feet to facilitate the lane reconstruction and culvert installation. The shoring splitting the north and south drive lanes and perpendicular to the north and south approaches is estimated to be 15 feet long. It appears that temporary sheet piling will not be a feasible option according to the Bridge Manual Design Guide 3.13.1 - Temporary Sheet Piling Design (2009). As such, a Temporary Soil Retention System designed and installed by the contractor will be required.

4.0 CONSTRUCTION CONSIDERATIONS

The construction activities should be performed in accordance with the current *IDOT Standard Specifications for Road and Bridge Construction* and any pertinent Special Provisions or policies. Cofferdams and underwater structure excavation protection are not anticipated for construction.

5.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of our client and IDOT District 4. They are specific only to the project described and are based on subsurface information obtained at two boring locations within the proposed culvert improvement areas, 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. SCI should be contacted if conditions encountered during construction are not consistent with those described.



PROJECT NAME		
IL 78 OVER WALNUT CREEK STARK COUNTY, ILLINOIS		
VICINITY AND TOPOGRAPHIC MAP		
DRAWN BY RCV CHECKED BY BLB	DATE 08/2018	JOB NUMBER 2009-3210.52

GENERAL NOTES/LEGEND

USGS TOPOGRAPHIC MAP
LAFAYETTE, ILLINOIS QUADRANGLE
DATED 1983
1.5M CONTOURS

STREET MAP
HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_STREET_MAP

N W E S

FIGURE
1

PROJECT NAME

IL 78 OVER WALNUT CREEK
STARK COUNTY, ILLINOIS

AERIAL PHOTOGRAPH

DRAWN BY	RCV	DATE	JOB NUMBER
CHECKED BY	BLB	08/2018	2009-3210.52

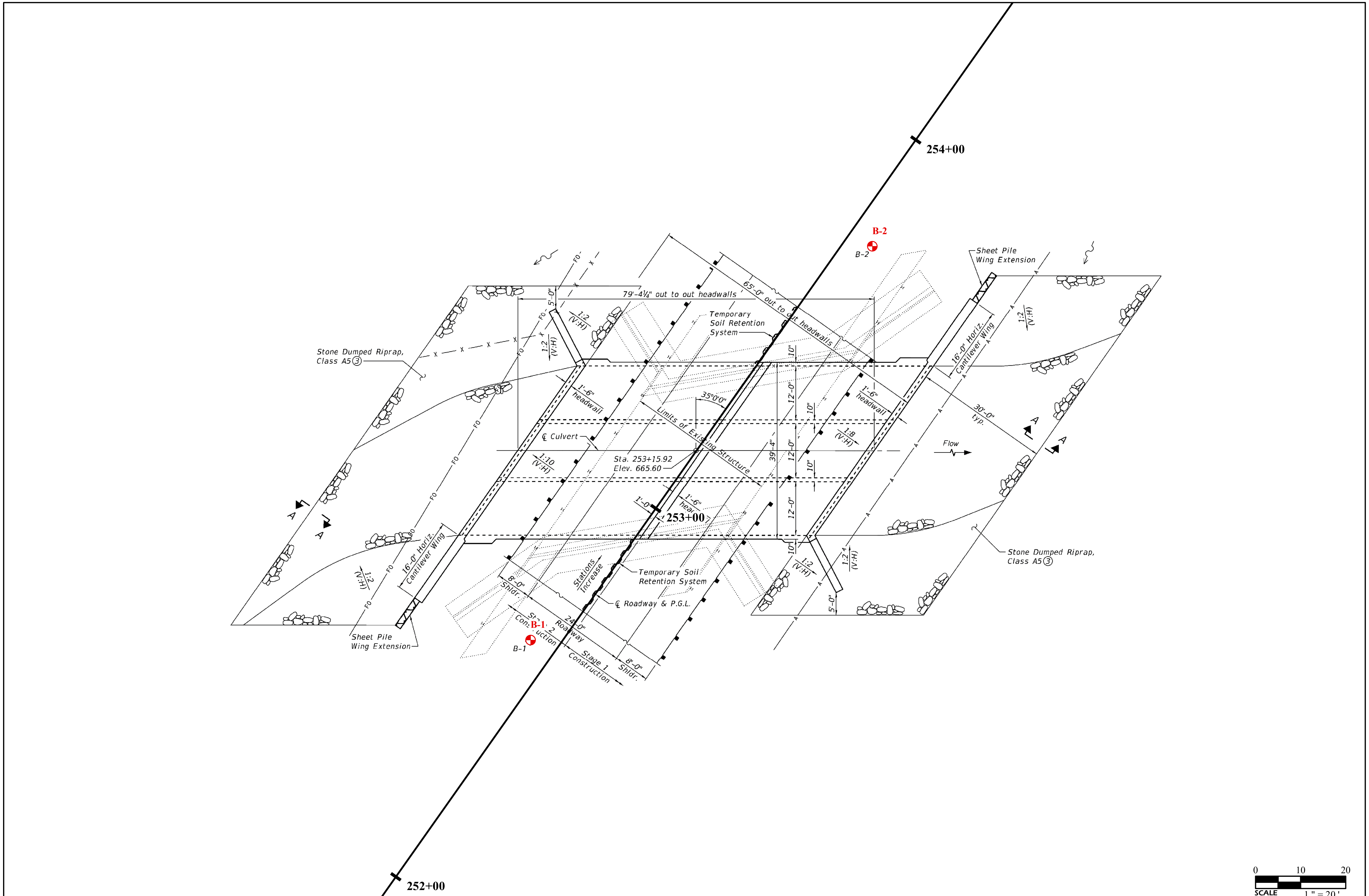
GENERAL NOTES/LEGEND

INDICATES APPROXIMATE SOIL BORING LOCATIONS.

AERIAL PHOTOGRAPH OBTAINED FROM ARCGIS ONLINE, WORLD IMAGERY.

N
W E
S

FIGURE
2



GENERAL NOTES/LEGEND

INDICATES APPROXIMATE SOIL BORING LOCATION.

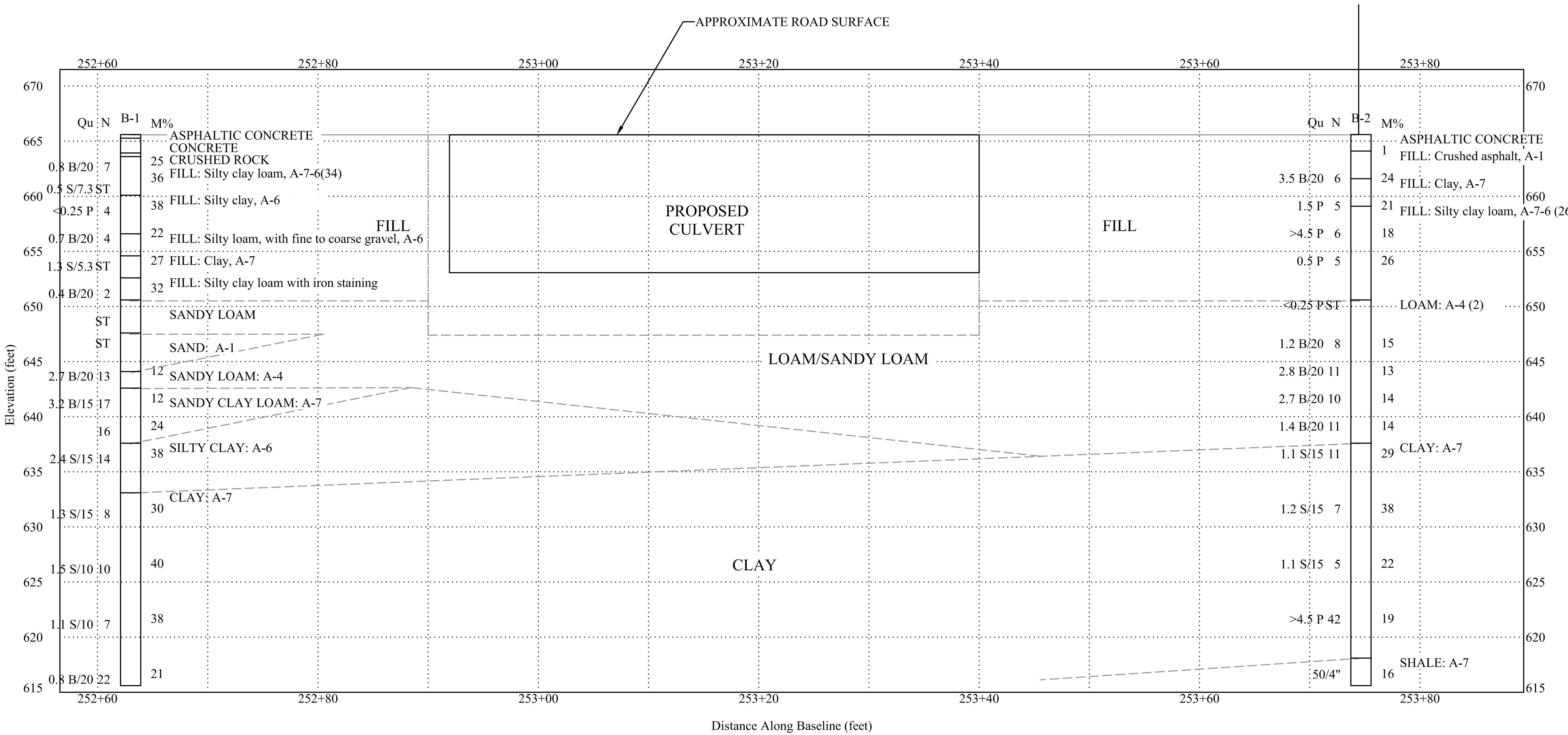
PLAN DATED 7/30/2018 BY OATES ASSOCIATES. DIMENSIONS AND LOCATIONS ARE APPROXIMATE; ACTUAL MAY VARY. DRAWING SHALL NOT BE USED OUTSIDE THE CONTEXT OF THE REPORT FOR WHICH IT WAS GENERATED.

PROJECT NAME

IL 78 OVER WALNUT CREEK
STARK COUNTY, ILLINOIS

SITE PLAN

JOB NUMBER	2009-3210.52
DATE	08/2018
DRAWN BY	RCV
CHECKED BY	BLB
FIGURE	3



General Notes/Legend

VARIATIONS IN SUBSURFACE CONDITIONS MAY AND LIKELY EXIST BETWEEN BORINGS. DASHED HORIZONS ARE INTERPRETED AND ARE SHOWN FOR ILLUSTRATION ONLY.

PROJECT NAME

IL 78 OVER WALNUT CREEK
STARK COUNTY, ILLINOIS

SUBSURFACE PROFILE

SCALE	1" = 10' V 1" = 10' H
JOB NUMBER	2009-3210.52
DATE	08/2018
DRAWN BY	RCV
CHECKED BY	BLB
FIGURE	4

APPENDIX A

SCI Engineering, Inc.
650 Pierce Boulevard
O'Fallon, Illinois 62269

SOIL BORING LOG

Date 11/07/17

ROUTE FAP 22 (SBI 78) **DESCRIPTION** SN088-0012 Replacement **LOGGED BY** SCI

SECTION (128B)BR **LOCATION** Northing Easting

COUNTY Stark **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 088-0012
Station 249+92 to 256+38

BORING NO. B-1
Station 252+63
Offset 6 ft Lt
Ground Surface Elev. 665.6 ft

Surface Water Elev. N/A 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 (%)
4 inches ASPHALTIC CONCRETE	665.3				
16 inches CONCRETE	663.9				
4 inches CRUSHED ROCK	663.6				
FILL: Dark gray, silty clay loam, medium stiff, A-7-6(34)			2 3 4	0.8 B/20	25
Dry Unit Weight: 79.1 pcf	660.1	-5	ST	0.5 S/7.3	36
FILL: Dark brown, silty clay, soft, A-6			1 2 2	<0.25 P	38
	656.6		2	0.7 B/20	22
FILL: Brownish-gray, silty loam, with fine to coarse gravel, soft, A-6		-10	2 2		
Began mud rotary at 10 feet.	654.6				
FILL: Dark brownish-gray, clay, medium stiff, A-7 *Dry Unit Weight: 96.7 pcf*	652.6		ST	1.3 S/5.3	27
FILL: Brown and gray, silty clay loam, soft, with iron stiaining	650.6	-15	1 1 1	0.4 B/20	32
SANDY LOAM: Brown and gray, soft, with fine to coarse sand and gravel *Unable to perform Unconfined Compressive Strength test due to low sample recovery.*	647.6		ST		24
SAND: Greenish-gray, fine to coarse, with fine to coarse chert gravel, A-1 *Unable to perform Unconfined Compressive Strength Test. Sample non-cohesive.*		-20	ST		16

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: Greenish-gray, fine to coarse, with fine to coarse chert gravel, A-1 *(continued)*	644.1				
SANDY LOAM: Brownish-gray, fine to coarse, with fine to coarse gravel, medium stiff, A-4	642.6		4 5 8	2.7 B/20	12
SANDY CLAY LOAM: Gray, stiff, A-7		-25	5 7 10	3.2 B/15	12
Trace coarse gravel	637.6		12 7 9		24
SILTY CLAY: Dark gray, stiff, A-6 With shaley clay layers		-30	5 7 7	2.4 S/15	38
	633.1				
CLAY: Grayish-brown, with green, stiff, slickensided, A-7		-35	2 4 4	1.3 S/15	30
		-40	3 5 5	1.5 S/10	40

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SECTION (128B)BR **LOCATION** Northing Easting

COUNTY Stark **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 088-0012
Station 249+92 to 256+38

BORING NO. B-1
Station 252+63
Offset 6 ft Lt
Ground Surface Elev. 665.6 ft

Surface Water Elev. N/A ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter - ft
Upon Completion - ft
After Hrs. - ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY: Grayish-brown, with green, stiff, slickensided, A-7 *(continued)*					
		-45	2 3 4	1.1 S/10	38
Becomes gray and green	615.6	-50	5 10 12	0.8 B/20	21
Boring terminated at 50.0 ft. Boring grouted to ft.					
		-55			
		-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

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SOIL BORING LOG

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SECTION (128B)BR **LOCATION** Northing Easting

COUNTY Stark **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 088-0012
Station 249+92 to 256+38

BORING NO. B-2
Station 253+79
Offset 6 ft Rt
Ground Surface Elev. 665.6 ft

Surface Water Elev. N/A ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter - ft
Upon Completion - ft
After Hrs. - ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
18 inches ASPHALTIC CONCRETE	664.1		50/5"		1
FILL: Crushed asphalt, fine to coarse sand and gravel, A-1	661.6				
FILL: Greenish-gray, clay, stiff, A-7		-5	2 2 4	3.5 B/20	24
FILL: Dark brown, silty clay loam, medium stiff, A-7-6 (26)	659.1		1 2 3	1.5 P	21
Split spoon samples from 6-7.5 feet and 8.5 to 10 feet were combined to determine liquid limit and plasticity index. Becomes greeenish-gray		-10	2 2 4	>4.5 P	18
Becomes soft			1 2 3	0.5 P	26
Shelby tube pushed from 13 to 15 feet. No sample recovered.	650.6	-15			
LOAM: Gray, medium stiff, with fine to coarse chert gravel, A-4 (2) *Unable to perform unconfined compressive strength test due to low sample recovery.*			ST	<0.25 P	16
		-20	2 3 5	1.2 B/20	15

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
LOAM: Gray, medium stiff, with fine to coarse chert gravel, A-4 (2) *(continued)*					
Trace fine gravel			3 5 6	2.8 B/20	13
Gravel becomes fine to coarse		-25	3 4 6	2.7 B/20	14
			3 5 6	1.4 B/20	14
CLAY: Gray, trace fine sand seams, medium stiff, with shaley layering A-7	637.6	-30	3 4 7	1.1 S/15	29
		-35	2 3 4	1.2 S/15	38
Becomes dark gray, trace organics	625.6	-40	2 2 3	1.1 S/15	22

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

SCI Engineering, Inc.
650 Pierce Boulevard
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SECTION (128B)BR **LOCATION** Northing Easting

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STRUCT. NO. 088-0012
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BORING NO. B-2
Station 253+79
Offset 6 ft Rt
Ground Surface Elev. 665.6 ft

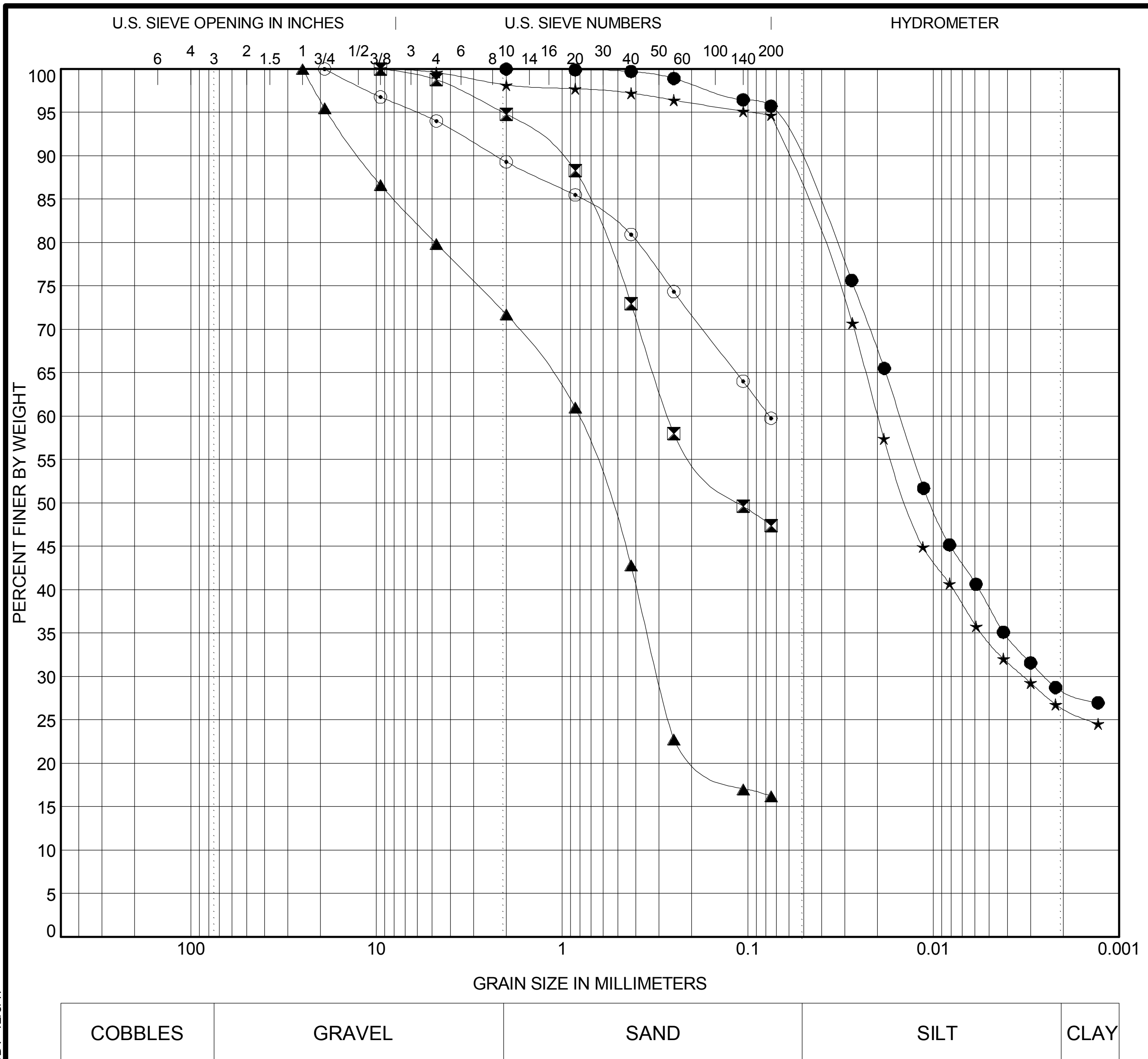
Surface Water Elev. N/A ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter - ft
Upon Completion - ft
After Hrs. - ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY: Dark gray, trace fine sand seams, medium stiff, with shaley layering, trace organics A-7 *(Continued)*					
			9 10 32	>4.5 P	19
		-45			
With fine to coarse gravel layer					
	618.1				
SHALE: Gray, trace coarse gravel, A-7 *Sample recovered was not in tact, so moisture content may not be representative due to drilling mud.*			50/4"		16
	615.6	-50			
Boring terminated at 50.0 ft.					
Boring grouted to 50 ft.					
		-55			
		-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

APPENDIX B



Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● B-1	3.5	A-7-6 (34) SILTY CLAY LOAM	56	25	31		
⧗ B-1	16.0						
▲ B-1	18.0	SAND					
★ B-2	8.0	A-7-6 (26) SILTY CLAY LOAM	45	20	25		
⊙ B-2	15.0	A-4 (2)	23	15	8		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	3.5	2	0.015	0.003		0.0	4.3	67.3	28.4
⧗ B-1	16.0	9.5	0.268			5.2	47.4	47.4	
▲ B-1	18.0	25	0.819	0.303		28.3	55.5	16.2	
★ B-2	8.0	9.5	0.02	0.003		1.8	3.5	68.3	26.4
⊙ B-2	15.0	19	0.076			10.7	29.5	59.8	

SCI Engineering, Inc.
650 Pierce Blvd.
O'Fallon, Illinois
Telephone: 618-624-6969
Fax: 618-624-7099

GRAIN SIZE DISTRIBUTION - IDH

Project: IL 78 over Walnut Creek

Location: 1 mile north of West Jersey (253+15)

SCI Project No.: 2009-3210.52

GRAIN SIZE IDOT-IDH AUTO 2009-3210.52 IL 78 OVER WALNUT CREEK.GPJ IL DOT.GDT 12/5/17

BD 508A

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
SOIL TEST DATA

ROUTE FAP 22 (SBI 78)
SECTION (128B)BR
COUNTY Stark
LOCATION 1 mile north of West Jersey (253+15)

BORING NO.		B-1	B-1	B-1	B-1
STATION		252+63	252+63	252+63	252+63
OFFSET		6 ft Lt	6 ft Lt	6 ft Lt	6 ft Lt
DEPTH	ft	3.5 - 5.5	11.0 - 13.0	16.0 - 18.0	18.0 - 19.8
AASHTO CLASSIFICATION		A-7-6(34)			
GRADATION PASSING - 1"	%	100		100	100.0
3/4"	%	100		100	95.5
1/2"	%	100		100	90.2
NO. 4	%	100		98.8	79.9
NO. 10	%	100.0		94.8	71.7
NO. 40	%	99.7		73.0	42.8
NO. 100	%	97.5		53.0	19.3
NO. 200	%	95.7		47.4	16.2
SAND (AASHTO T-88)	%	4.3		52.6	83.8
SILT (AASHTO T-88)	%	67.3			
CLAY (AASHTO T-88)	%	28.4			
LIQUID LIMIT (AASHTO T-89)	%	56	61		
PLASTICITY INDEX (AASHTO T-90)	%	31	40		
STD. DRY DENSITY pcf (AASHTO T-99)	pcf				
OPTIMUM MOISTURE (AASHTO T-99)	%				
SUBGRADE SUPPORT RATING		POOR			
INSITU MOISTURE					

BD 508A

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
SOIL TEST DATA

ROUTE	FAP 22 (SBI 78)
SECTION	(128B)BR
COUNTY	Stark
LOCATION	1 mile north of West Jersey (253+15)

BORING NO.		B-2	B-2		
STATION		253+79	253+79		
OFFSET		6 ft Rt	6 ft Rt		
DEPTH	ft	8.0	15.0 - 17.0		
AASHTO CLASSIFICATION		A-7-6(26)	A-4(2)		
GRADATION PASSING - 1"	%	100	100		
3/4"	%	100	100.0		
1/2"	%	100	98.1		
NO. 4	%	99.6	94.0		
NO. 10	%	98.2	89.3		
NO. 40	%	97.2	80.9		
NO. 100	%	95.7	68.2		
NO. 200	%	94.7	59.8		
SAND (AASHTO T-88)	%	5.3	40.2		
SILT (AASHTO T-88)	%	68.3			
CLAY (AASHTO T-88)	%	26.4			
LIQUID LIMIT (AASHTO T-89)	%	45	23		
PLASTICITY INDEX (AASHTO T-90)	%	25	8		
STD. DRY DENSITY pcf (AASHTO T-99)	pcf				
OPTIMUM MOISTURE (AASHTO T-99)	%				
SUBGRADE SUPPORT RATING		POOR			
INSITU MOISTURE					

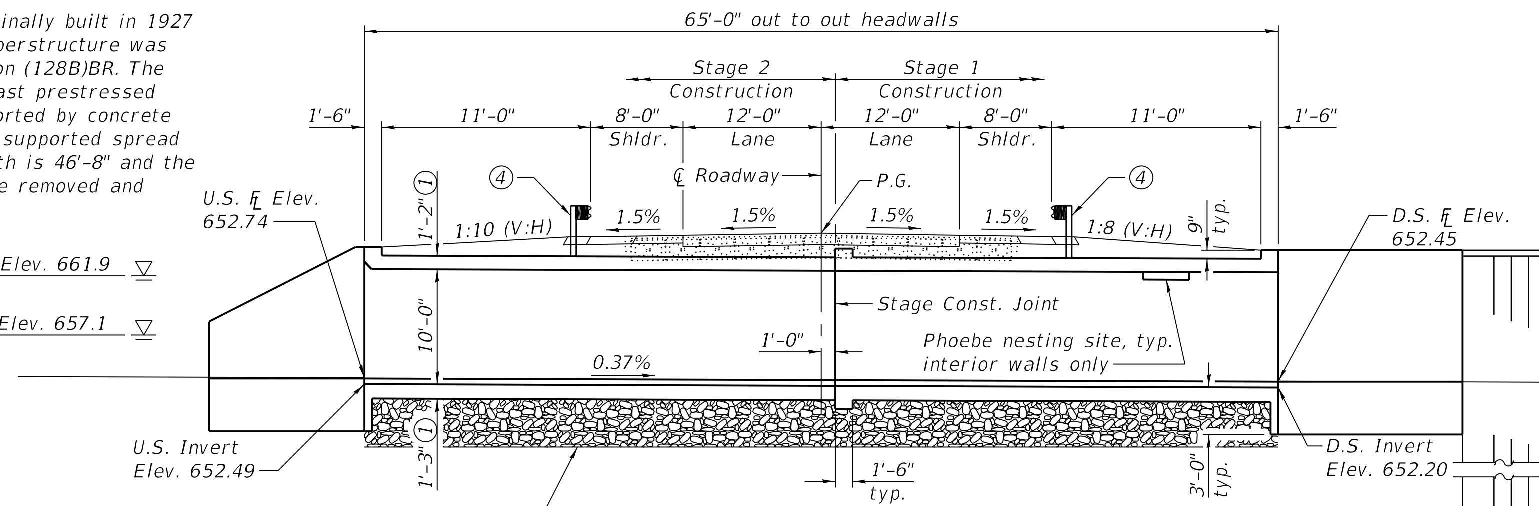
APPENDIX C

Benchmark: TBM-5 Chiseled square on top of southeast wingwall, Sta. 253+26.64, 17.33' LT., Elev. 663.37.

Existing Structure: S.N. 088-0012 was originally built in 1927 as S.B.I. Route 78, Section 128B. The superstructure was replaced in 1984 as F.A. Route 22, Section (128B)BR. The structure consists of a single span precast prestressed concrete deck beam superstructure supported by concrete closed abutments founded on timber pile supported spread footings. The back to back abutment length is 46'-8" and the out to out width is 33'-0". Structure to be removed and replaced.

Traffic Control: One lane of traffic will be maintained utilizing stage construction.

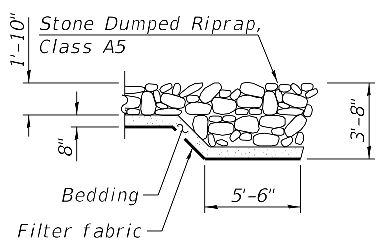
Salvage: None



LONGITUDINAL SECTION

(Dimensions are at right angles to ℄ Roadway)
(Looking South)

Remove and replace unsuitable material to bottom of existing footing, Elev. ±647.4, below proposed culvert.



SECTION A-A

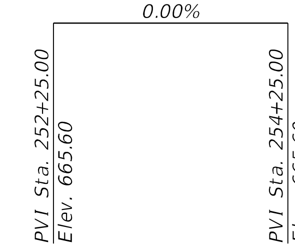
WATERWAY INFORMATION

Drainage Area = 9.72 sq. mi.	Existing Overtopping Elev. = 665.4 @ Sta. 253+00 Proposed Overtopping Elev. = 665.4 @ Sta. 253+00

Flood	Freq. Yr.	Q C.F.S.	Opening Ft² Exist.	Opening Ft² Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	1,540	187.9	202.4	661.0	1.1	0.7	662.1	661.7
Design	50	2,440	214.7	234.8	661.9	3.5	2.0	665.4	663.9
Base	100	2,860	223.6	245.6	662.2	3.4	2.7	665.6	664.9
Scour Design Check	200	3,254	232.3	256.4	662.5	3.4	3.1	665.9	665.6
Overtopping Existing	75	2,650	220.6		662.1	3.5		665.6	
Overtopping Proposed	160	3,096		252.8	662.4		2.9		665.3
Max. Calc.	500	3,850	244.3	270.8	662.9	3.3	2.9	666.2	665.8

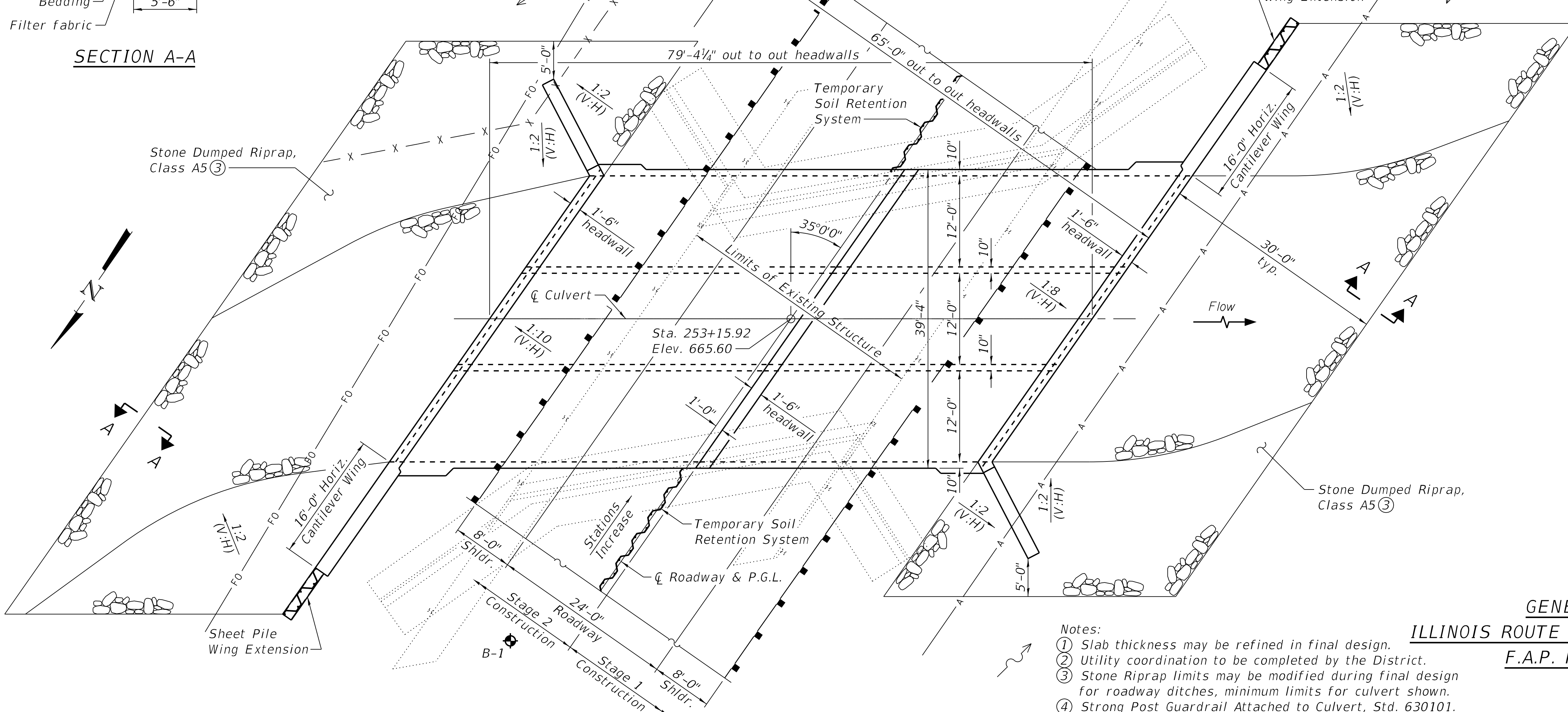
PRELIMINARY PLANS

SUBJECT TO REVISIONS



PROFILE GRADE

(Along ℄ Roadway)



PLAN

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition

DESIGN STRESSES

FIELD UNITS

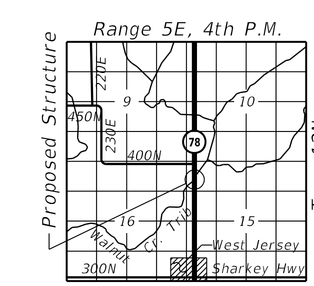
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

HIGHWAY CLASSIFICATION

F.A.P. Rte. 22 - IL Rte. 78
Functional Class: Minor Arterial (Rural)
ADT: 2,450 (2016); 2,990 (2036)
ADTT: 240 (2016); 293 (2036)
DHV: 299
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

LOADING HL-93

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



LOCATION SKETCH

Notes:
① Slab thickness may be refined in final design.
② Utility coordination to be completed by the District.
③ Stone Riprap limits may be modified during final design for roadway ditches, minimum limits for culvert shown.
④ Strong Post Guardrail Attached to Culvert, Std. 630101.
⑤ Precast alternate is not allowed.
⑥ Staging to be verified during development of final plans based on most recent load rating inspection.

GENERAL PLAN & ELEVATION
ILLINOIS ROUTE 78 OVER WALNUT CREEK TRIBUTARY
F.A.P. RTE. 22 - SEC. (128B)BR-2
STARK COUNTY
STATION 253+15.92
STRUCTURE NO. 088-2503

FILE NAME: H:\Pr\29048\WO 4 SN088-0012 IL 78 over Walnut Creek Trib Phase 1\Structural\TSL\Microstation\0882503-68897-001-General Plan & Elevation.dgn

OATES ASSOCIATES
www.oatesassociates.com
ILLINOIS DESIGN FIRM LICENSE NO.: 184.001115

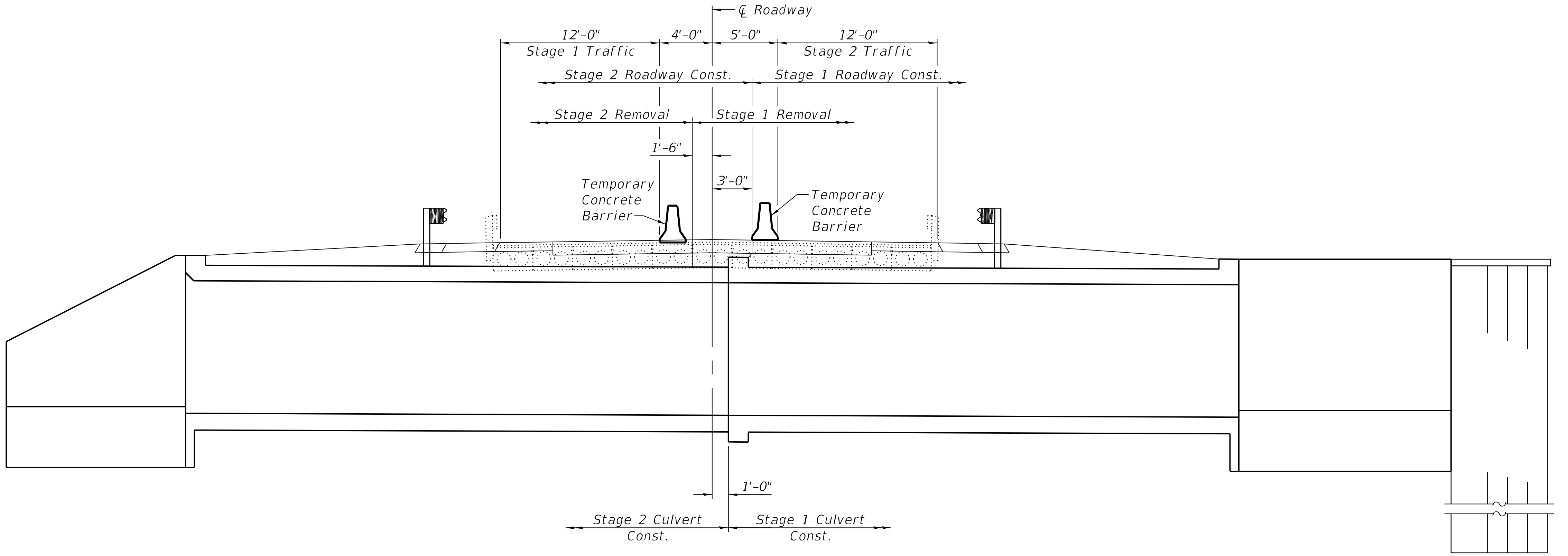
USER NAME =	DESIGNED - SJN	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
	CHECKED - JAD	REVISED -	
PLOT SCALE =	DRAWN - SJN	REVISED -	
PLOT DATE = 7/30/2018	CHECKED - JAD	REVISED -	

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
22	(128B)BR-2	STARK		

CONTRACT NO. 68897

ILLINOIS FED. AID PROJECT

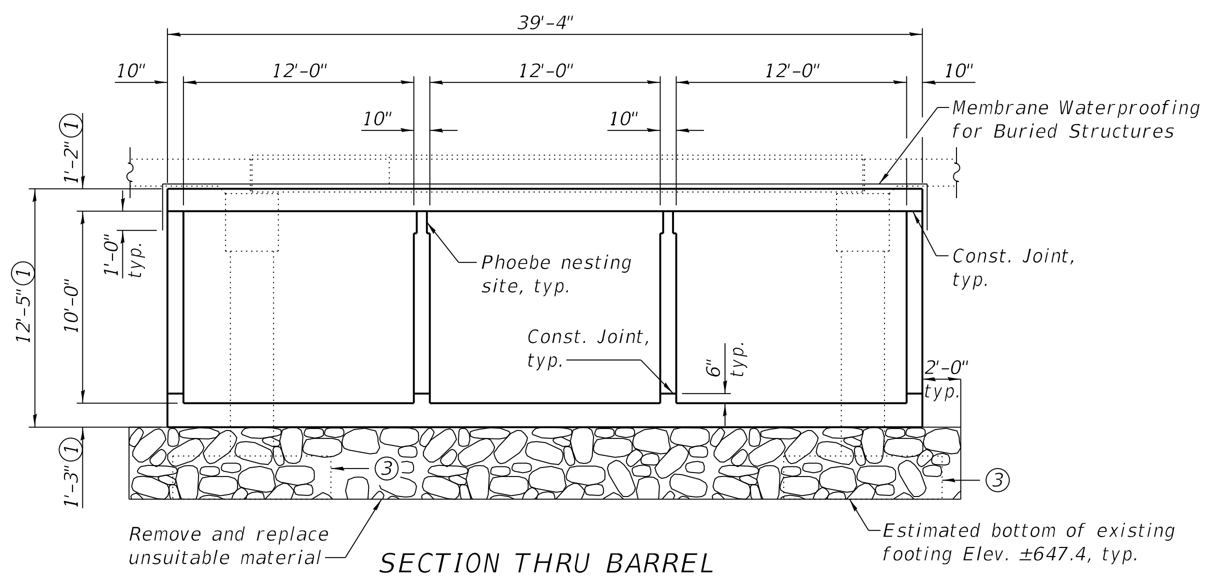


STAGE CONSTRUCTION DETAILS ②

(Looking South)

PRELIMINARY PLANS

SUBJECT TO REVISIONS



SECTION THRU BARREL

Notes:

① Slab thickness may be refined in final design.

② For dimensions not shown, see Longitudinal Section on sheet 1 of 2.

③ Existing concrete shall be completely removed to 2 feet beyond the horizontal limits of the proposed structure.

DETAILS
ILLINOIS ROUTE 78 OVER WALNUT CREEK TRIBUTARY
F.A.P. RTE. 22 - SEC. (128B)BR-2
STARK COUNTY
STATION 253+15.92
STRUCTURE NO. 088-2503

FILE NAME: H:\P\29048\WO 4 SN088-0012 IL 78 over Walnut Creek Trib Phase 1\Structural\TSL\Microstation\0882503-68897-002-Details.dgn

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PLOT SCALE =	DRAWN - SJN	REVISED -	
PLOT DATE = 7/30/2018	CHECKED - JAD	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
22	(128B)BR-2	STARK		
CONTRACT NO. 68897				
ILLINOIS FED. AID PROJECT				

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

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