Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 6/30/22	**Proposed SN:**	**Route:**	US Route 14
Revised Date:	**Existing SN:** 056-0263	**Section:**	2018-118-I
Geotechnical Engineer: GSG Consultants, Inc.		**County:**	McHenry
Structural Engineer: ABNA Engineering, Inc.		**Contract:**	P-91-029-19

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing):

According to the proposed preliminary plan drawings and information provided by ABNA, the existing 5.5 ft X12 ft concrete box culvert will be removed and replaced with a new 7 ft X 12 ft concrete box culvert. The upstream invert elevation will be 936.6 feet and the downstream invert elevation will be 936.1 feet. The preliminary plans are attached.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot):

The exploration program included advancing two (2) standard penetration test (SPT) borings at locations on either end of the proposed culvert.

The soil borings were drilled using truck-mounted Diedrich D-50 (hammer efficiency 98%) drill rig using 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to the boring termination depths of 40 feet below grade.

The borings initially noted 8 inches of asphalt. Beneath the asphalt, the borings encountered brown silty clay fill to a depth of 8.5 to 9 feet below grade (elevation of 937.5 feet). The borings then encountered gray sand fill to a depth of 10.5 feet below grade (elevation of 935.7). The borings then noted soft to medium stiff gray silty clay to a depth of 16 feet (elevation of 930.3 feet) followed by stiff to very stiff gray silty clay loam to the boring termination depths of 40 feet below grade (elevation of 906.2 feet). Boring CB-01 noted a sand seam at 13.5 feet and at 27 feet below grade and cobbles at 31 feet below grade.

The unconfined compressive strength values of the silty clay fill ranged between 0.3 tsf and 1.0 tsf. The unconfined compressive strength values of the gray silty clay ranged between 0.4 tsf and 0.8 tsf. The unconfined compressive strength values of the gray silty clay loam ranged between 0.4 tsf and 2.3 tsf. The SPT blow count 'N' values of the sand fill ranged between 6 and 13 bpf.

Groundwater was encountered in the each borings at a depths of 8.5 feet below grade (elevation of 937.7 feet) during drilling. Water was not encountered during drilling at any of the other soil boring locations. Perched water may also be present within the confined existing fill materials.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary:

Due to the presence of unsuitable low strength materials at the invert elevations of the culvert, undercuts to reach suitable soil will be required. Following undercutting to suitable native soils, the over-excavations should be backfilled to the design bearing grade with structural fill. The structural fill should be placed in accordance with the Construction Considerations section of this report. It is anticipated that 3 feet of undercut is necessary below the proposed invert elevations based on the Table 8.9-1 of the IDOT Geotechnical Manual (2020). Soil should be tested to a depth 3 feet below the bottom of the culvert as per section 8.9. The undercut values shall be field verified during construction.

Anticipated Bearing Elevation (feet)=936.6 to 936.1
Estimated Settlement at Culvert Inlet (inches) = less than 1.0 inch
Estimated Settlement at Culvert Outlet (inches) = less than 1.0 inch
Differential Settlement (inches) = less than 0.5 inch

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary:
IDOT requires that slope stability analysis be performed in areas where the cut or fill heights will exceed 15 feet in height. Based on the preliminary design plan, the maximum cut height will be less than 15 feet; therefore, no slope stability analysis was required for this report.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations:
Scour analysis is not warranted for closed bottom box culvert per All Bridge Designers memo 14.2, dated November 7, 2014. Therefore, no additional scour analysis is warranted.

The design scour elevation should be taken at the bottom of the cutoff walls. To help prevent local erosion, it is recommended to place stone riprap at the end of the culverts. This will help prevent sediments from entering and accumulating in the culvert, reduce long term maintenance, and provide protection to the streambed at the interface.

Unsuitable materials are generally replaced with aggregate when soil strength and groundwater conditions dictate. A special provision for Aggregate Subgrade Improvement or Rockfill should be included in the plans to indicate the replacement material properties and capping requirements.

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable:
As per section 7.4.5.4 "Geotechnical Evaluations and Recommendations" in the IDOT Geotechnical Manual 2020, "Box culverts and retaining walls are not typically designed for seismic loading, and as such, seismic design parameters should on not be provided in SGRs for these types of structures."

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed:
Due to the presence of unsuitable low strength materials at the invert elevations of the culvert, undercuts to reach suitable soil will be required at the proposed culvert location. Following undercutting to suitable native soils, the over-excavations should be backfilled to the design bearing grade with structural fill. The structural fill should be placed in accordance with the Construction Considerations section of this report. It is anticipated that 3 feet of undercut is necessary below the proposed invert elevations based on the Table 8.9-1 of the IDOT Geotechnical Manual (2020). Soil should be tested to a depth 3 feet below the bottom of the culvert as per section 8.9. The undercut values shall be field verified during construction.

The subgrade soils at bearing grade should be evaluated per the guidelines provided in Section 8.9 of IDOT Geotechnical Manual (2020) for suitability/workability prior to placing any portion of the proposed culvert structure. Loose granular fill soils and soft silty clay soils were noted at the invert depths of the proposed culverts. These materials may not provide sufficient subgrade stability for the proposed construction of the culvert. However, if a precast box culvert is considered, according to Section 540, IDOT SSRBC (2016) a minimum of 6-inches of porous granular material should be provided as bedding material, which will serve as a working platform for box culverts.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: Not applicable

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns:
If stage construction is used for the proposed improvement, temporary sheet piling is feasible because the existing soils strengths are less than 4.5 tsf. The Temporary Soil Retention System (TSRS) should be designed in accordance with the IDOT Bridge Design Manual, Section 3.13.1, Temporary Sheet Piling Design, Temporary Soil Retention Systems and Braced Excavations and the IDOT Design Guide. The design of the temporary earth retention system is the responsibility of the contractor. The contractor should submit the TSRS plans to the structural design team for review prior to commencing construction of the TSRS.

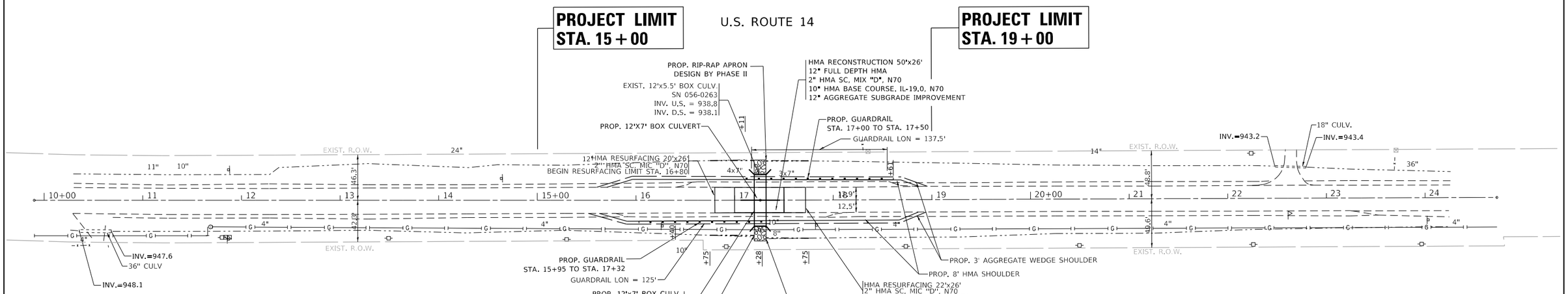
APPENDIX A

PRELIMINARY PLANS

PROJECT LIMIT STA. 15 + 00

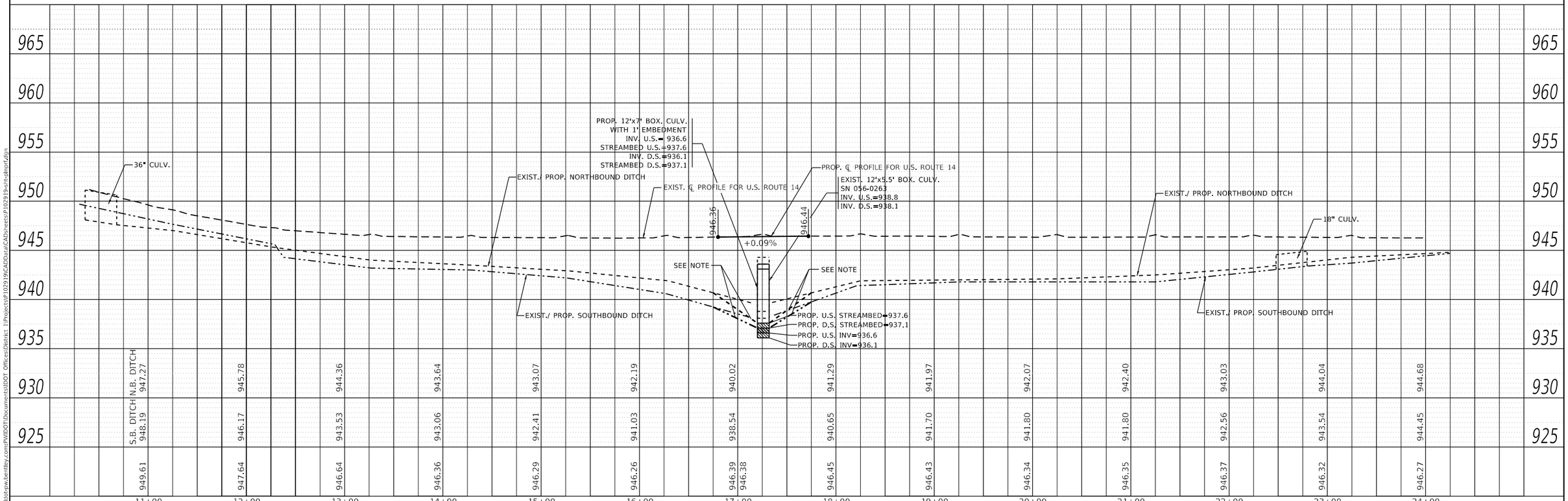
U.S. ROUTE 14

PROJECT LIMIT STA. 19 + 00



NOTE:

RE-GRADE EXISTING DITCH TO MEET THE PROPOSED STREAMBED ELEVATION AT THE PROPOSED CULVERT.



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	DRAWN -	REVISED -	
PLOT SCALE = 100.0000 ' / in.	CHECKED -	REVISED -	
PLOT DATE = 10/22/2021	DATE -	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN & PROFILE
U.S. ROUTE 14 OVER DITCH 3 MILES S/O STATE LINE

SCALE: 1"=50' | SHEET OF SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
66		McHENRY		
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

PLAN — SURVEYED, PLOTTED, ALIGNMENT CHECKED, RT. OF WAY CHECKED, CADD FILE NAME, NOTE BOOK, NO., BY, DATE

PROFILE — SURVEYED, PLOTTED, GRADES CHECKED, B.M. NOTED, STRUCTURE NOTATIONS CHKD, BY, DATE

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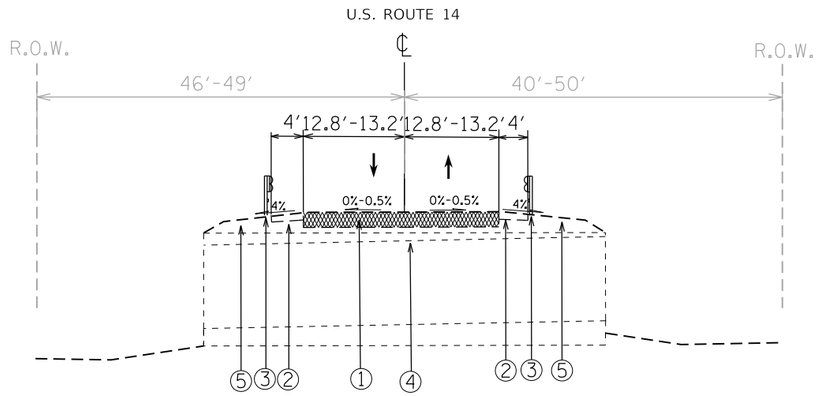
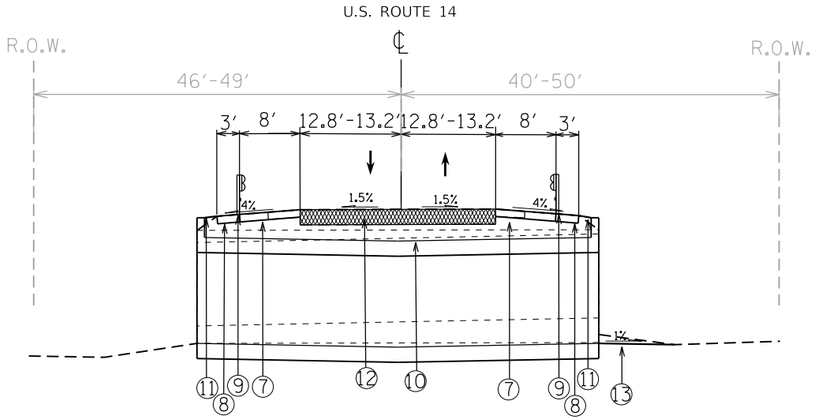


EXISTING TYPICAL SECTION

STA. 17+00 TO STA. 17+50

LEGEND

① EXISTING HMA PAVEMENT
② EXISTING HMA SHOULDER
③ EXISTING GUARDRAIL
④ EXISTING CULVERT
⑤ EXISTING TOPSOIL
⑥ PROPOSED 2'' HMA SC ,MIX ''D'', N70
⑦ PROPOSED 8' HMA SHOULDER
⑧ PROPOSED 3' AGG SHOULDER
⑨ PROPOSED GUARDRAIL
⑩ PROPOSED CULVERT
⑪ PROPOSED TOPSOIL
⑫ PROPOSED HMA FULL DEPTH PAVEMENT PATCH
⑬ PROPOSED STREAM GRADING



PROPOSED TYPICAL SECTION

STA. 17+00 TO STA. 17+50

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	DRAWN -	REVISED -	
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PLOT DATE = 10/14/2021	DATE -	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

TYPICAL SECTIONS
U.S. ROUTE 14, 3 MI. SOUTH OF STATE LINE

SCALE: | SHEET 1 OF SHEETS | STA. 15+00 | TO STA. 19+00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
66		MCHENRY	3	3
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT		

ORIGINAL SURVEY		BY	DATE
NOTE BOOK	SURVEYED		
	PLOTTED		
	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		

FINAL SURVEY		BY	DATE
NOTE BOOK	SURVEYED		
	PLOTTED		
	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		

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PLOT SCALE = 20.0000 ' / in.

PLOT DATE = 9/3/2021

Default

DESIGNED - DRAWN P102919-sht-xsht_US14.dgn

CHECKED -

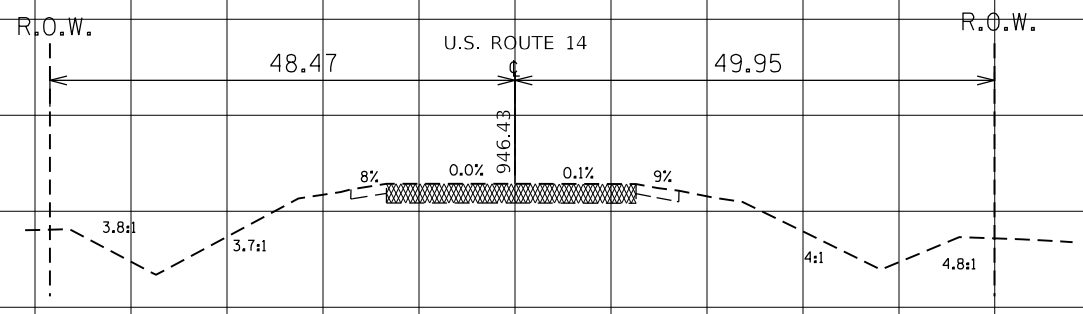
DATE -

REVISED -

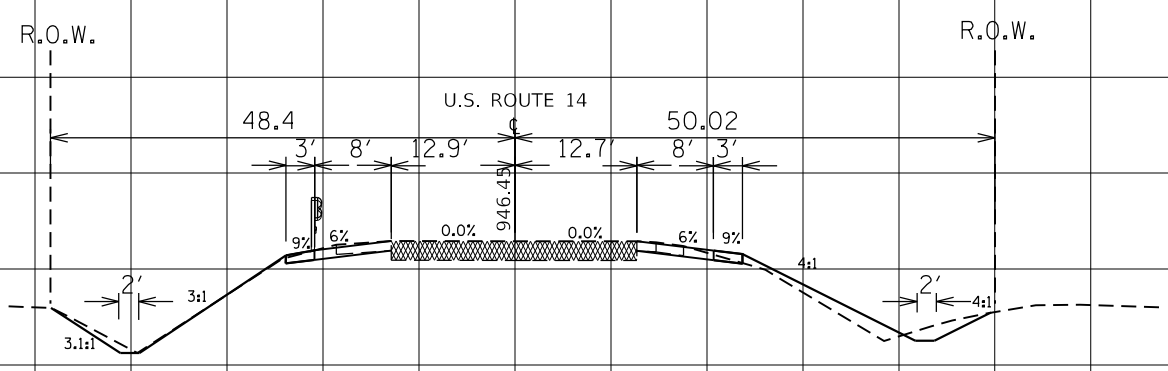
REVISED -

REVISED -

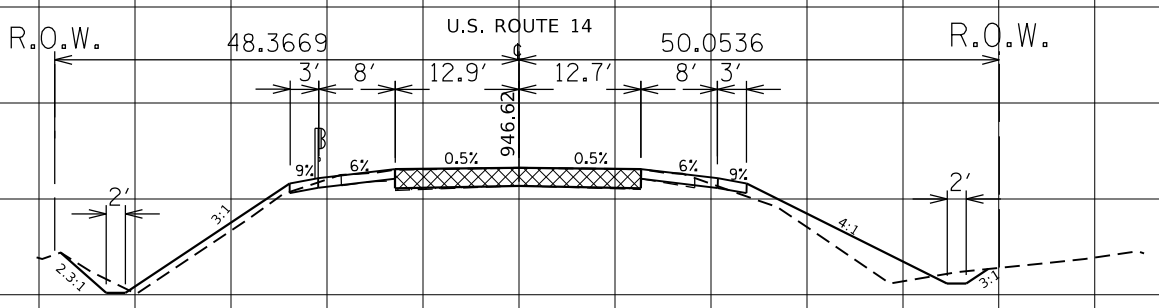
REVISED -



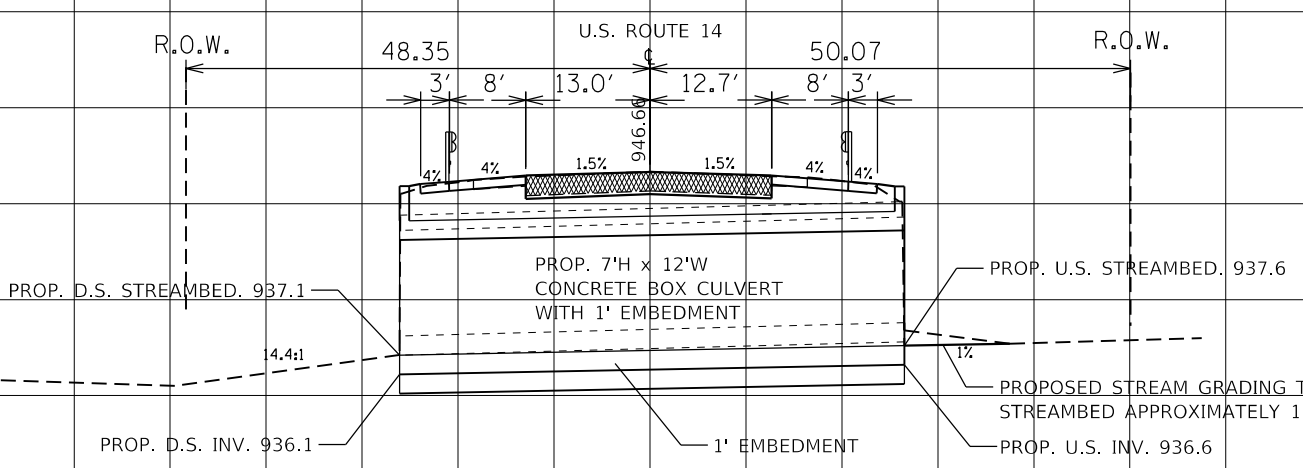
19 + 00.00



18 + 00.00



17 + 72.00



17 + 26.07

CROSS SECTIONS
ROUTE 14 OVER DITCH (3 MILES S/O STATE LINE)

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SCALE:

SHEET OF SHEETS STA. 17+26.07 TO STA.19+00.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
66	2018-118-1	McHENRY		3

ILLINOIS FED. AID PROJECT

CONTRACT NO.

APPENDIX B

SOIL BORING LOCATION PLAN

AND SUBSURFACE PROFILES

LEGEND

SOIL BORINGS

MODEL: Default
FILE NAME: T:\Illinois DOT\ABNA_2022\16\Work Order\ #16\Geotechnical\Exhibits\DGNs\IDOT Proposed Culvert Restacement -PL-01.dgn

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME = nnano	DESIGNED - ES	REVISED -
	DRAWN - NN	REVISED -
PLOT SCALE = 1200.0000 ' / ft.	CHECKED - DE	REVISED -
PLOT DATE = 6/24/2022	DATE - 06/17/2022	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

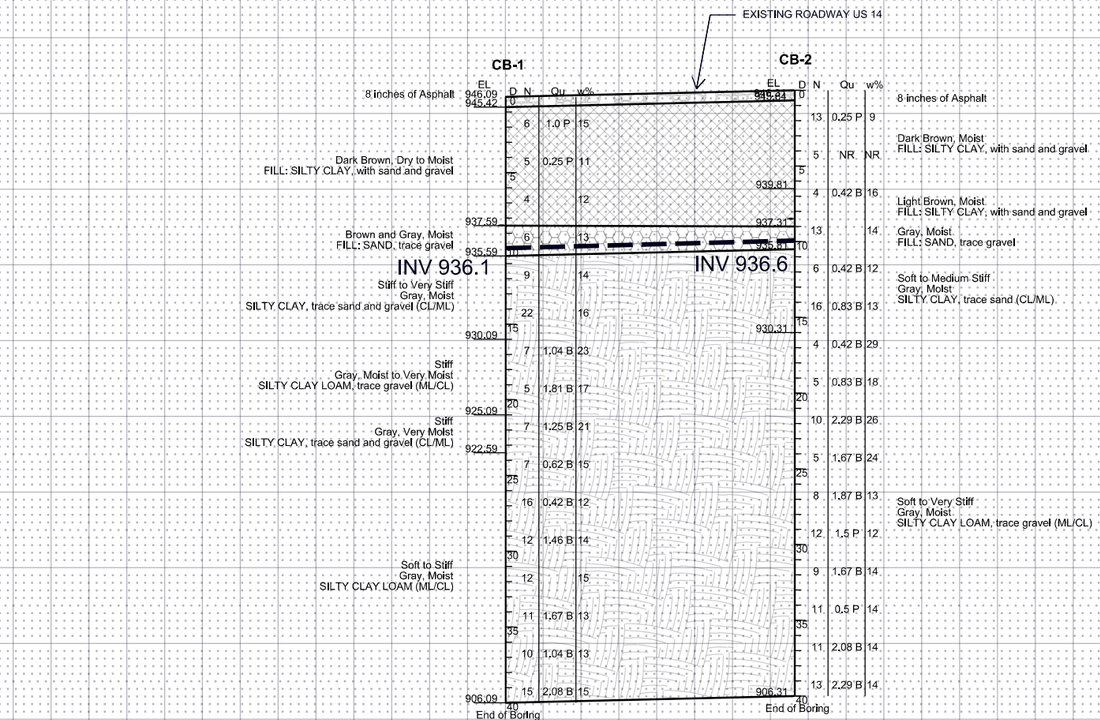
IDOT 202–016
US–14, HARVARD, ILLINOIS
CULVERT REPLACEMENT BORING LOCATION PLAN

SCALE: 1:50 | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		MCHENRY	1	2
		CONTRACT NO. PTB 202-016		
	ILLINOIS	FED. AID PROJECT		

LEGEND

PAVEMENT		FILL: SAND / GRAVEL		SANDY CLAY / LOAM	
BASE COURSE		SILTY CLAY		CLAYEY SAND / SILT	
TOPSOIL		SAND/ GRAVEL		ORGANIC SILTY CLAY	
FILL: CLAY / SILTY CLAY		SILT / SILTY LOAM		BEDROCK	



970 960 950 940 930 920 910 900 890

0.00' 25.00' 50.00' 75.00' 100.00' 125.00' 150.00' 175.00'

MODEL: Default
FILE NAME: T:\Illinois DOT\ABNA 202-016\Work Order #1\Geotechnical\Exhibits\DGNs\IDOT Proposed Culvert Realacement -Profile-01.dgn

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: 1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME = nnano	DESIGNED - ES	REVISED - _____	
	DRAWN - NN	REVISED - _____	
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PLOT DATE = 6/30/2022	DATE - 06/17/2022	REVISED - _____	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT 202–016
US–14, HARVARD, ILLINOIS
CULVERT REPLACEMENT BORING PROFILE

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. _____ | TO STA. _____

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
___	_____	MCHENRY	2	2
		CONTRACT NO. PTB 202-016		
	ILLINOIS	FED. AID PROJECT		

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation

Division of Highways
GSG Consultants Inc

SOIL BORING LOG

Date 5/31/22

ROUTE 14 **DESCRIPTION** Proposed Culvert Replacement **LOGGED BY** DD

SECTION 2018-118-I **LOCATION** , **SEC.** , **TWP.** , **RNG.** ,

Latitude , **Longitude**

COUNTY McHenry **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** Auto

DRILLING METHOD HSA **HAMMER EFF (%)** 98

STRUCT. NO.
Station

BORING NO. CB-1
Station 17+26.07
Offset
Ground Surface Elev. 946.09 ft

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

Groundwater Elev.:
First Encounter 937.6 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8 inches of Asphalt				
945.42				
Dark Brown, Dry to Moist		4		
FILL: SILTY CLAY, with sand and gravel		3	1.0	15
		3	P	
		3		
		2	0.3	11
	-5	3	P	
1 inch of concrete at 6.0 feet, low recovery		5		
		2		12
		2		
937.59 ▼				
Brown and Gray, Moist		5		
FILL: SAND, trace gravel		3		13
	-10	3		
935.59				
Soft to Medium Stiff				
Gray, Moist		4		
SILTY CLAY, trace sand and gravel (CL/ML)		5		14
Low recovery at 11.0 feet		4		
Sand seam at 13.5 feet		10		
		12		16
	-15	10		
930.09				
Stiff		2		
Gray, Moist to Very Moist		3	1.0	23
SILTY CLAY LOAM, trace gravel (CL)		4	B	
		3		
		2	1.8	17
	-20	3	B	
925.09				
Stiff		3		
Gray, Very Moist		3	1.3	21
SILTY CLAY, trace sand and gravel (CL/ML)		4	B	
922.59				
Soft to Stiff		2		
Gray, Moist		3	0.6	15
SILTY CLAY LOAM (ML/CL)	-25	4	B	
		9		
		9	0.4	12
Sand seam at 27.0 feet		7	B	
		5		
		5	1.5	14
	-30	7	B	
Cobbles at 31.0 feet		4		
		6		15
		6		
		6		
		6	1.7	13
	-35	5	B	
		3		
		5	1.0	13
		5	B	
		6		
		7	2.1	15
906.09	-40	8	B	

End of Boring

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

Illinois Department of Transportation
Division of Highways
GSG Consultants Inc

SOIL BORING LOG

Date 5/31/22

ROUTE 14 **DESCRIPTION** Proposed Culvert Replacement **LOGGED BY** DD

SECTION 2018-118-I **LOCATION** , **SEC.** , **TWP.** , **RNG.** ,

COUNTY McHenry **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 98

STRUCT. NO.
Station

BORING NO. CB-2
Station 17+26.07
Offset
Ground Surface Elev. 946.31 ft

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

Groundwater Elev.:
First Encounter 937.8 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8 inches of Asphalt				
945.64				
Dark Brown, Moist FILL: SILTY CLAY, with sand and gravel		5		
		6 7	0.3 P	9
		4		
		3 2	NR	NR
	-5			
939.81		3		
Light Brown, Moist FILL: SILTY CLAY, with sand and gravel		2 2	0.4 B	16
▼ 937.31		3		
Gray, Moist FILL: SAND, trace gravel		5 8		14
	-10			
935.81				
Soft to Medium Stiff Gray, Moist SILTY CLAY, trace sand (CL-ML)		2		
		3 3	0.4 B	12
		3		
		6 10	0.8 B	13
	-15			
930.31		2		
Soft to Very Stiff Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL)		2 2	0.4 B	29
		2		
		2 3	0.8 B	18
	-20			
Soft to Very Stiff Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL) *(continued)*		3		
		6 4	2.3 B	26
		2		
	-25	3 2	1.7 B	24
		5		
		3 5	1.9 B	13
		3		
	-30	6 6	1.5 P	12
		4		
		5 4	1.7 B	14
		3		
	-35	6 5	0.5 P	14
		4		
		5 6	2.1 B	14
		6		
906.31	-40	6 7	2.3 B	14

End of Boring

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)

APPENDIX D

LABORATORY TEST RESULTS

GSG CONSULTANTS, INC.

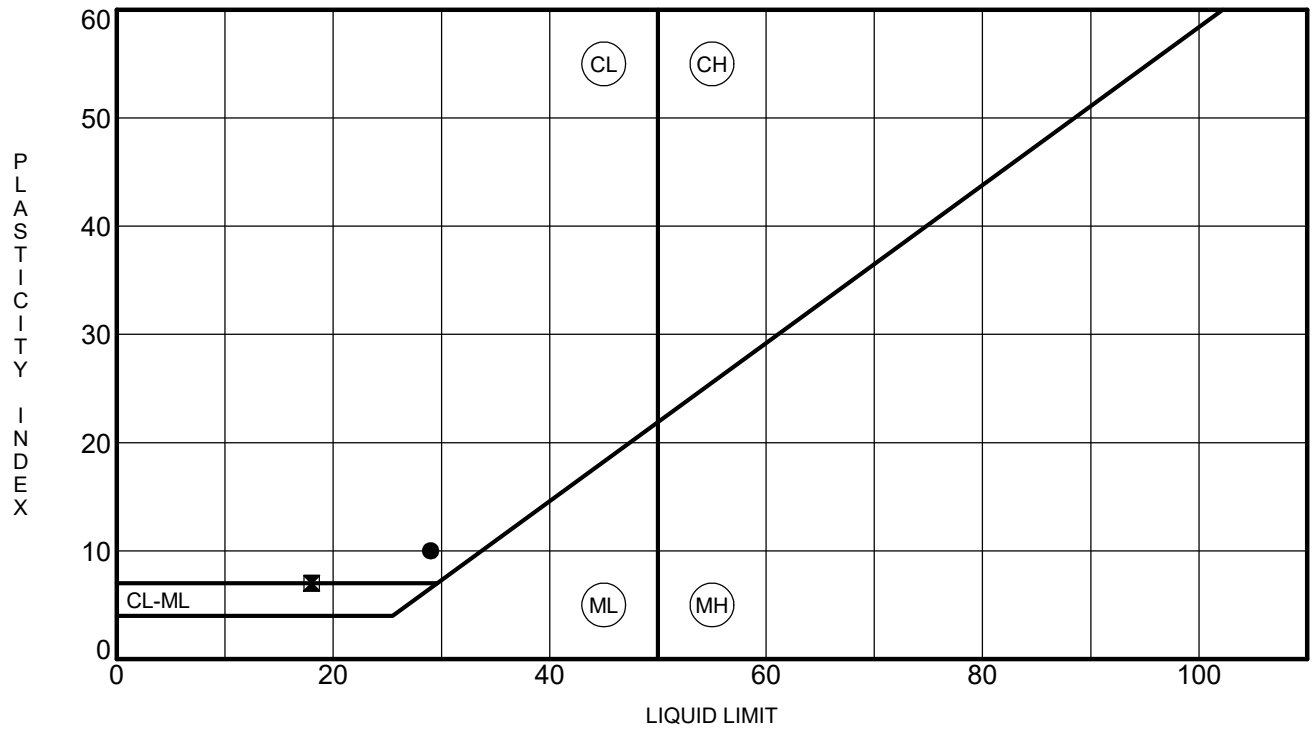
735 Remington Road
Schaumburg, IL 60173
Tel: 630.994.2600
www.gsg-consultants.com

Table D-1 – Atterberg Limits

Boring ID	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
CB-01	16-17.5	29.0	19.0	10.0	CL
CB-02	11-12.5	18.0	11.0	7.0	CL-ML

Table D-2 – Dry Unit Weight

Boring ID	Sample Depth (ft)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
CB-01	11-12.5	110.5	136.0



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**CB-1**	**16.00**	**29.0**	**19.0**	**10.0**		
⊠	**CB-2**	**11.00**	**18.0**	**11.0**	**7.0**		

GSG CONSULTANTS, INC.
735 Remington Road, Schaumburg, IL 60173
Tel: 630.994.2600, www.gsg-consultants.com

ATTERBERG LIMITS RESULTS

Route: 14

Section: US Route 14 over Drainage Ditch

County: McHenry